PEARSON EDEXCEL A-LEVEL BIOLOGY A · 9BN0

BIOLOGY



EXAM QUESTION PACK

TOPIC 2: GENES AND HEALTH

SCORE	PERCENTAGE
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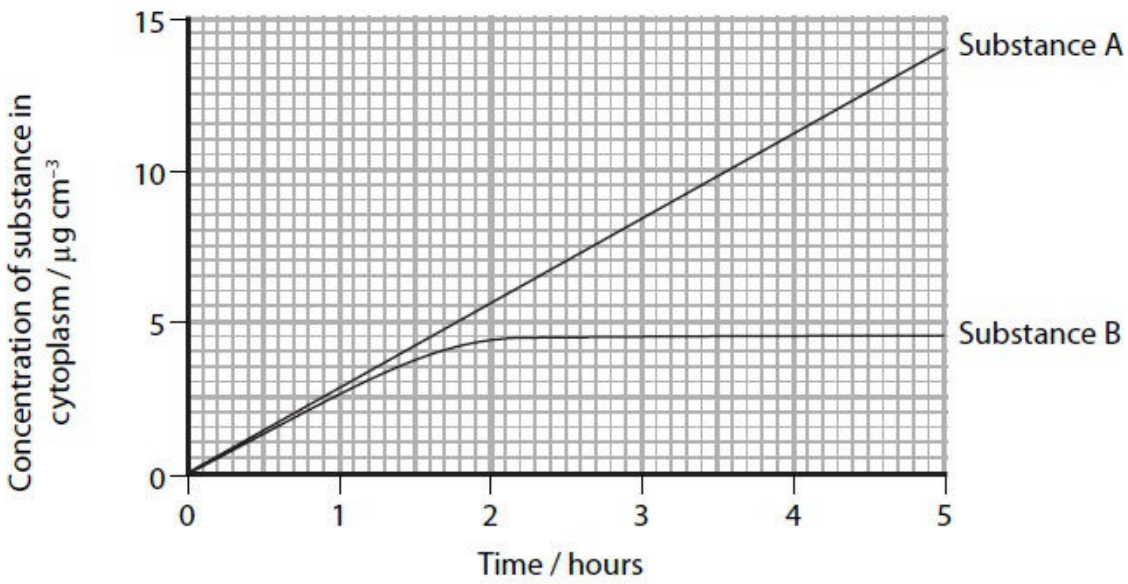
Q1.

Amoeba is a single-celled aquatic organism. Substances in the water can enter the cell by a variety of mechanisms.

An experiment was carried out to compare the uptake into *Amoeba* of substance A and substance B.

Some of these organisms were placed in a solution containing equal concentrations of both substances and kept at 25 ºC. The concentration of substances A and B, in the cytoplasm of these organisms, was measured every 30 minutes over a period of 5 hours.

The results of this experiment are shown in the graph below.



(a) Using the information in the graph, compare the uptake of substance A with the uptake of substance B during this period of 5 hours.

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*(b) Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.

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(c) Substance A enters the cells by active transport. Give **two** differences between active transport and diffusion.

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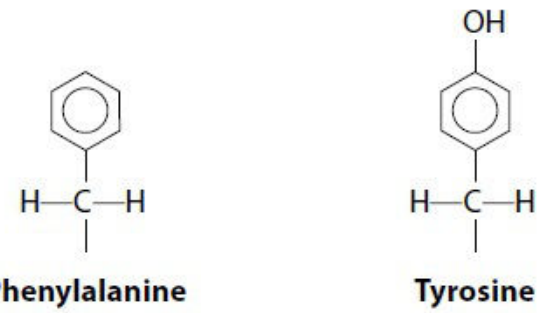
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(Total for question = 9 marks)

Q2.

Phenylketonuria is a recessive genetic disorder characterised by a lack of the enzyme phenylalanine hydroxylase. When there is an excess of phenylalanine in the diet, this enzyme converts the amino acid phenylalanine into the amino acid tyrosine.

(a) The diagram below shows the structure of the R group of phenylalanine and tyrosine.



Phenylalanine **Tyrosine**

(i) In the space below draw a diagram to show the structure of the amino acid phenylalanine.

(3)

(ii) The enzyme phenylalanine hydroxylase converts its substrate, phenylalanine, into the product, tyrosine. Using the information shown in the diagram and your knowledge of the mechanism of action of enzymes, suggest how this reaction takes place.

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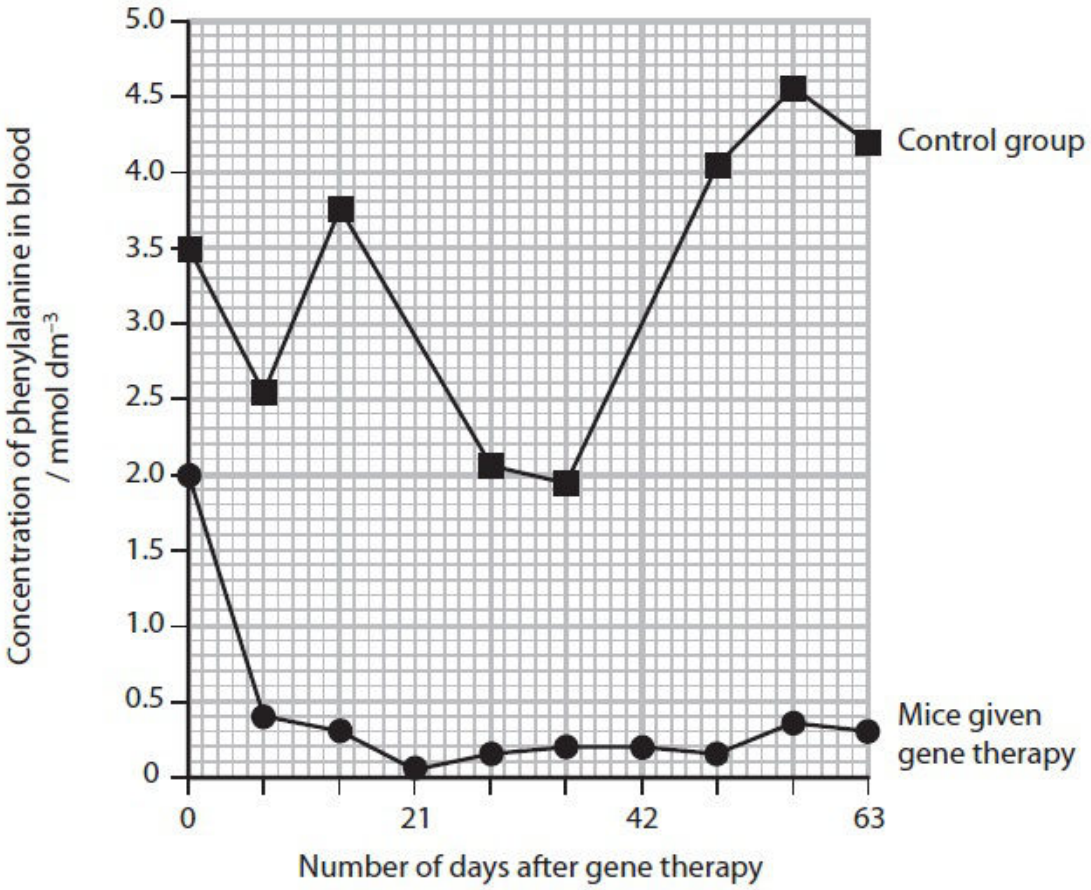
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(b) A number of investigations have been carried out into the use of somatic gene therapy to treat mice that have phenylketonuria.
The graph below shows the results of one such investigation.



(i) Use the graph to describe the effect that gene therapy has on the phenylalanine concentration in the blood of these mice.

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(ii) Describe how somatic gene therapy may have been carried out to treat phenylketonuria in these mice.

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(iii) Suggest what treatment the control group of mice may have been given in this investigation.

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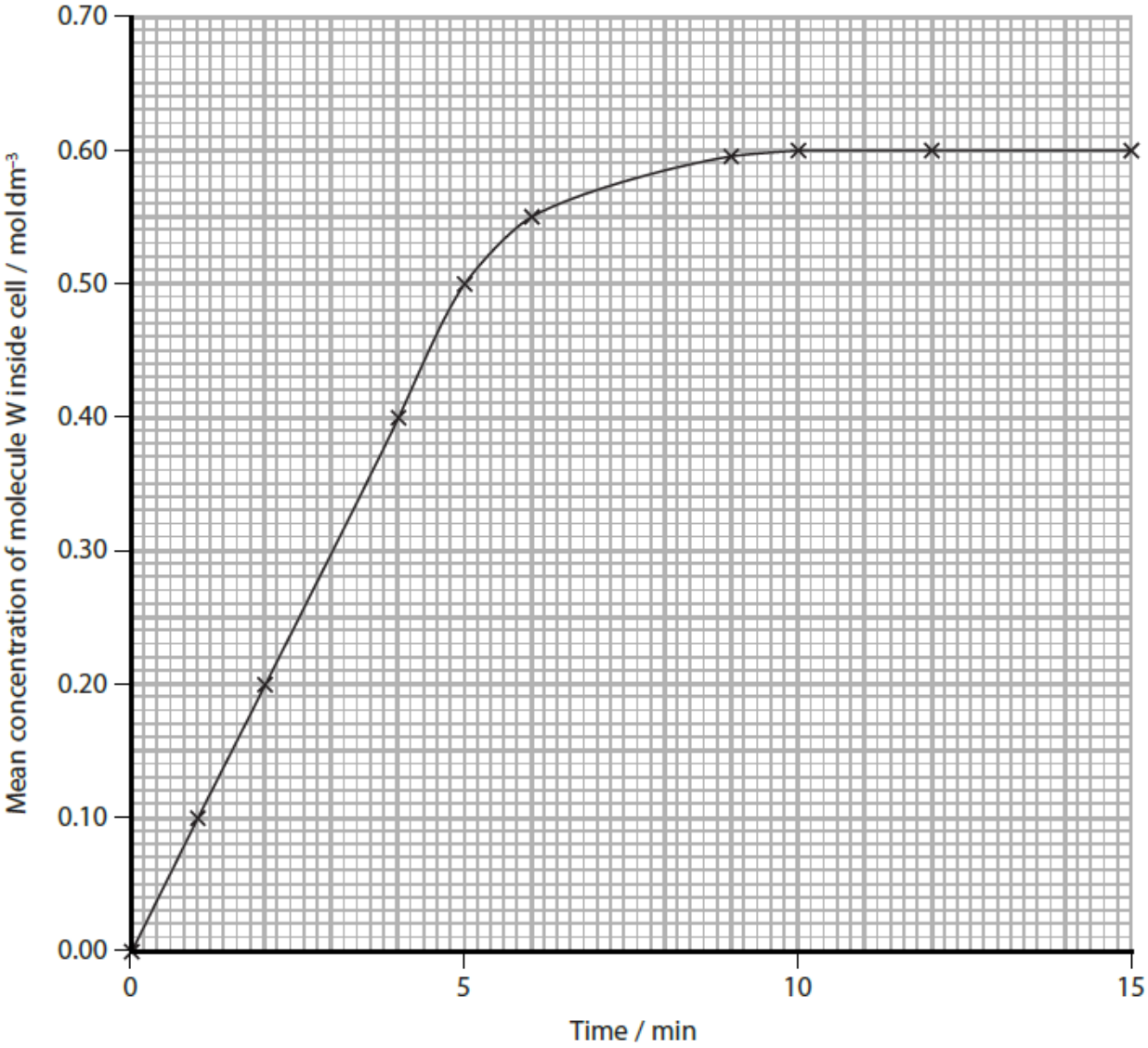
(Total for question = 13 marks)

Q3.

A student investigated the movement of molecules into red blood cells. He placed red blood cells into a solution of molecule W.

He then measured the concentration of W inside the cells over a period of 15 minutes.

The graph below shows the results of this investigation.



(i) Using the information in the graph, describe the uptake of molecule W into the red blood cells during the 15 minutes of this investigation.

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(ii) From his results, the student concluded that molecule W was taken up by diffusion.

Using the information in the graph, give an explanation for his conclusion.

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(Total for question = 5 marks)

Q4.

* Haemoglobin is a protein found in red blood cells that helps transport oxygen in the blood.

In sickle cell anaemia, the presence of the allele (**a**) in place of the normal allele (**A**) results in a change of one amino acid in the haemoglobin molecule.

This mutation changes the properties of haemoglobin and can result in red blood cells becoming less flexible and blocking small blood vessels.

The frequency of the recessive allele (**a**) is much higher in populations in West Africa than in populations in Northern Europe.

People in West Africa have a much higher risk of being infected with malaria parasites and developing severe anaemia than people in Northern Europe.

People who are heterozygous for sickle cell anaemia have sufficient amounts of normal haemoglobin to prevent severe anaemia.

One theory suggests that the malaria parasite (*Plasmodium sp*.) causes red blood cells with any modified haemoglobin to rupture. This occurs before the parasite can reproduce.

In West Africa, the average life expectancies of people with genotypes **AA**, **Aa** or **aa** are different.

(i) Using the information above, give an explanation for the difference in life expectancy of people who do not have the recessive allele.

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(ii) Using the information above, give an explanation for the difference in life expectancy of people in West Africa who have the genotype **Aa**.

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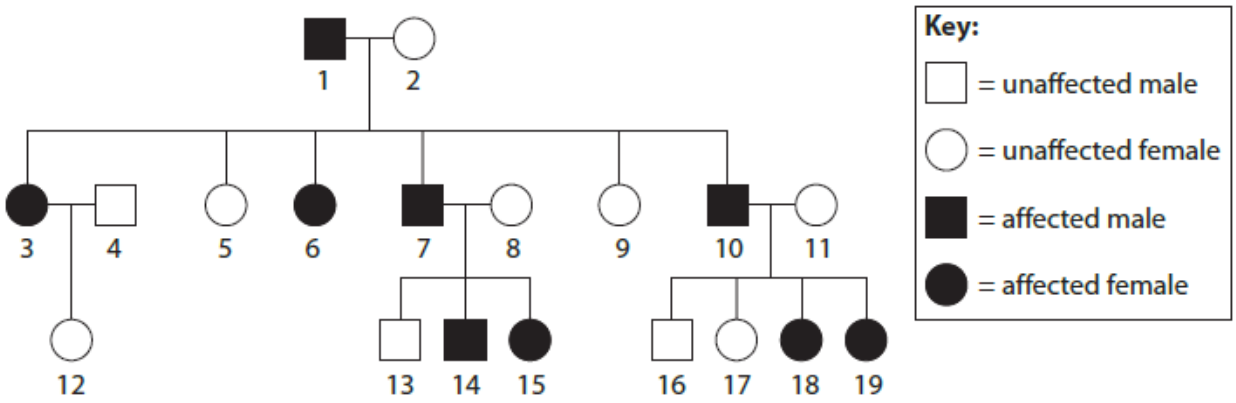
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Q5.

Moyamoya is a **rare** disorder caused by a dominant allele. This disorder progressively damages the arteries supplying the brain.

Inherited factors may contribute to the development of moyamoya.

The pedigree diagram below shows a family affected by moyamoya.



(i) Explain how the information in the pedigree diagram suggests that this disorder is due to a dominant allele.

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(ii) Using a genetic diagram, find the probability that the next child born to parents 3 and 4 would be affected by moyamoya.

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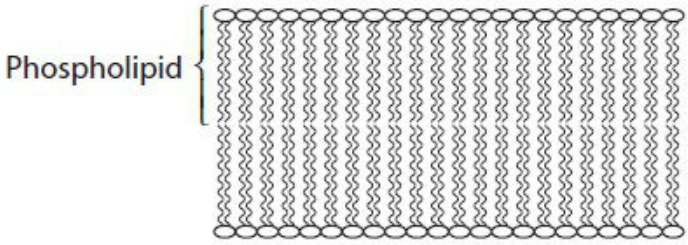
Probability .....

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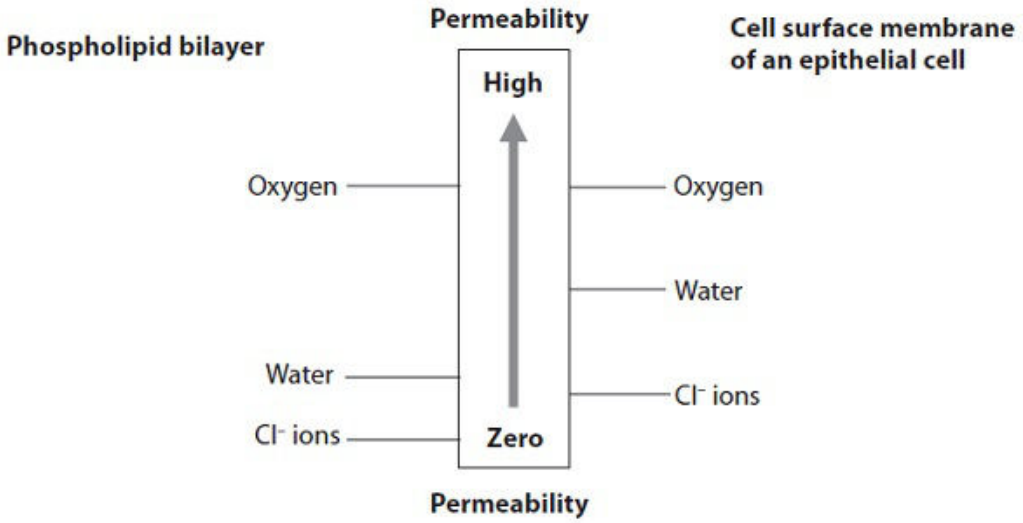
Q6.

Artificial membranes have a variety of medical applications.

It is possible to make an artificial membrane consisting of a phospholipid bilayer only, as shown in the diagram below.



The diagram below represents the relative permeability to oxygen, water and chloride ions (Cl^-) of a phospholipid bilayer and a cell surface membrane of an epithelial cell of the trachea.



Using the information in the diagram and your knowledge of membrane structure, suggest an explanation for each of the following.

(a) The permeability to oxygen is the same for a phospholipid bilayer and a cell surface membrane.

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(b) The permeability to chloride ions (Cl^-) is different in the two membranes.

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(c) The rates of osmosis will be different in the two membranes.

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(Total for question = 7 marks)

Q7.

The questions below refer to some important biological molecules.
Place a cross ☒ in the most appropriate box that describes the structure or role of these biological molecules.

(a) Disaccharides can be split by

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☒ **A** hydrolysis of glycosidic bonds

☒ **B** condensation of glycosidic bonds

☒ **C** hydrolysis of ester bonds

☒ **D** condensation of ester bonds

(b) Amylose is an example of a

(1)

☒ **A** monosaccharide

☒ **B** disaccharide

☒ **C** polysaccharide

☒ **D** trisaccharide

(c) The role of starch is to

(1)

☒ **A** be a source of energy to plants

☒ **B** store energy in all living organisms

☒ **C** store energy in plants

☒ **D** store energy in animals

(d) Proteins are polymers of amino acids joined by peptide bonds formed between the

(1)

☒ **A** R groups

☒ **B** R group and the amino group

☒ **C** R group and the carboxyl group

☒ **D** carboxyl group and the amino group

(e) The three-dimensional structure of a protein is held together by

(1)

☒ **A** peptide, hydrogen and ionic bonds

☒ **B** hydrogen, ester and ionic bonds

☒ **C** disulphide bridges and ester bonds

☒ **D** disulphide bridges, hydrogen and ionic bonds

(f) DNA consists of mononucleotides joined together by bonds between

(1)

☒ **A** two pentose sugars

☒ **B** one ribose sugar and one phosphate group

☒ **C** one deoxyribose sugar and one phosphate group

☒ **D** two phosphate groups

(g) Water is described as a dipolar molecule because it has a

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☒ **A** positively charged hydrogen end and a negatively charged oxygen end

☒ **B** positively charged hydrogen end and a positively charged oxygen end

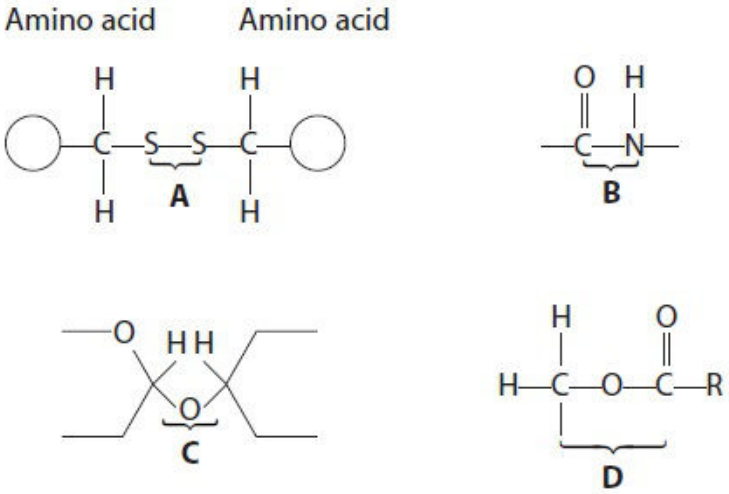
☒ **C** negatively charged hydrogen end and a negatively charged oxygen end

☒ **D** negatively charged hydrogen end and a positively charged oxygen end

(Total for question = 7 marks)

Q8.

(a) The diagrams below show four different bonds, A, B, C, and D, found in biological molecules.



Place a cross ☒ in the box to complete each of the following statements.

(i) The bond which occurs in a triglyceride molecule is

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) The bond which may occur in the tertiary, but not the primary, structure of a protein is

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(iii) The peptide bond is

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(iv) The ester bond is

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☒ **A**

☒ **B**

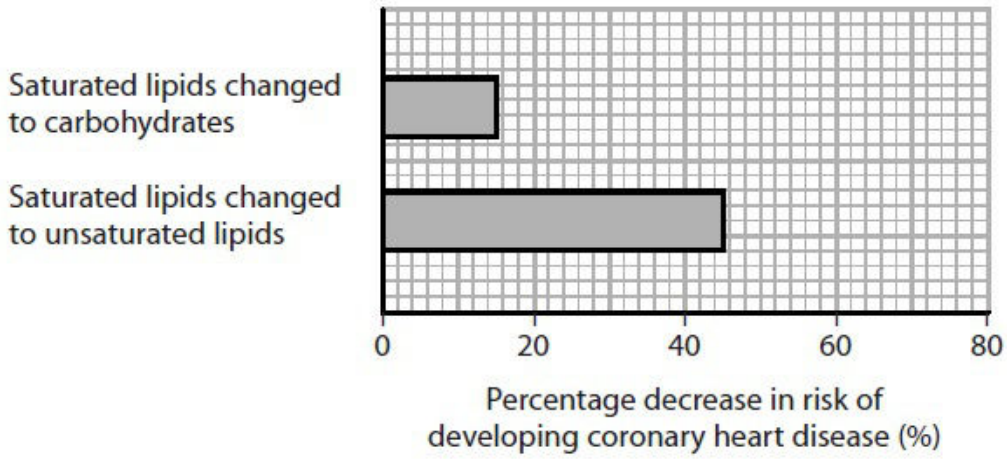
☒ **C**

☒ **D**

(b) Adult volunteers took part in an investigation to find out the effect of dietary changes on their risk of developing coronary heart disease.

In this investigation, 5% of the volunteers' energy intake was changed from one food source to another. The volunteers' total energy intake remained constant.

The graph below shows the results of this investigation.



(i) Suggest why it was necessary to ensure that their total energy intake remained constant.

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(ii) Using the information in the graph and your own knowledge, suggest an explanation for the results of this investigation.

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(Total for question = 9 marks)

Q9.

There are many venomous (poisonous) snakes in the world. Many of the venoms from these snakes affect the blood clotting process.

*(a) Describe the blood clotting process.

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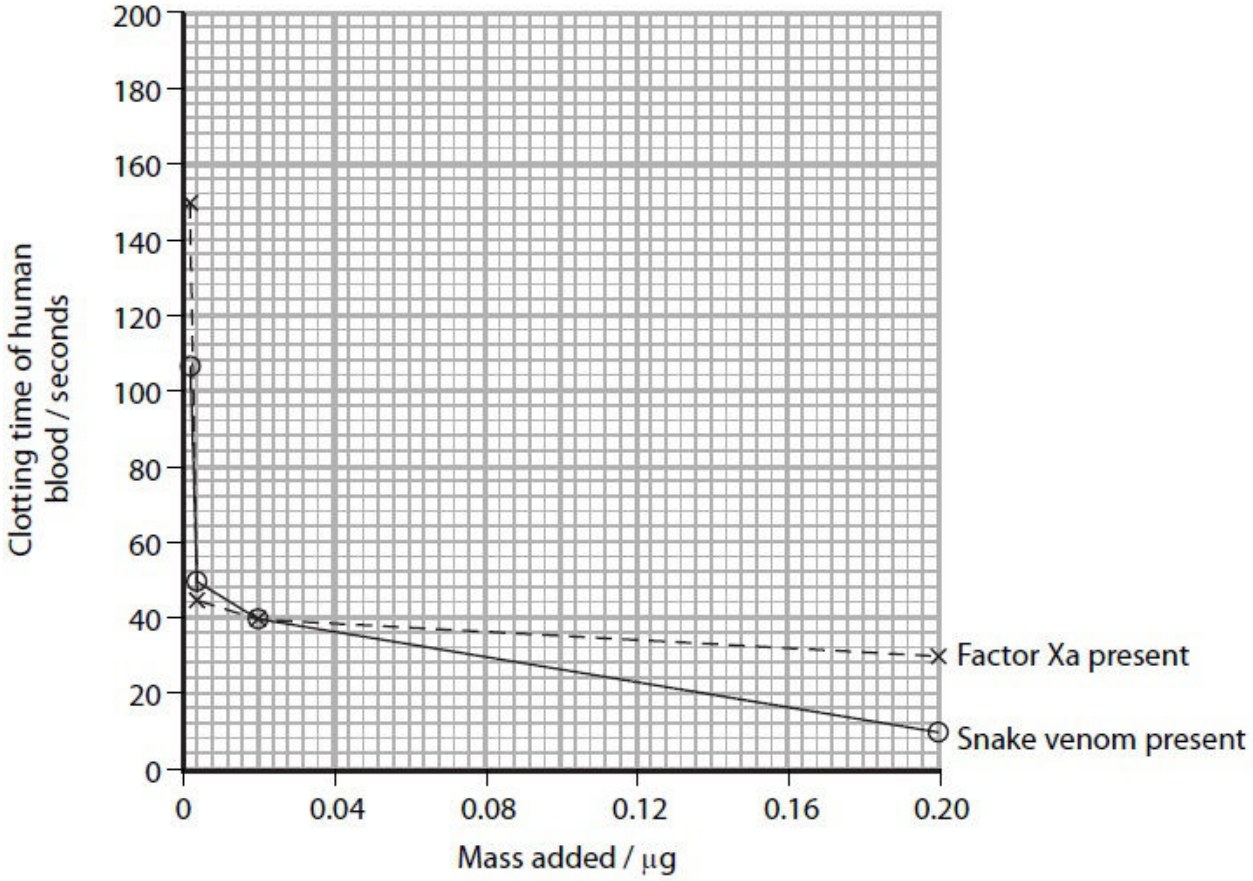
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(b) Factor Xa is a clotting factor present in human blood.

An experiment was carried out to investigate the time taken for human blood to clot in the presence of different masses of Factor Xa. The experiment was repeated using snake venom in place of Factor Xa.

The graph below shows the results of these experiments.



(i) Using the information in the graph, describe the effect of the snake venom on the clotting time of human blood.

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(ii) Suggest why the clotting time of the human blood with snake venom added was compared with the clotting time in the presence of Factor Xa.

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(c) The component of the snake venom that affects blood clotting is an enzyme.

(i) Describe the structure of an enzyme.

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(ii) Suggest how the enzyme in the snake venom could be involved in the blood clotting process.

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(Total for question = 13 marks)

Q10. (a) Read through the following passage on the blood clotting process, then write on the dotted lines the most appropriate word or words to complete the passage.

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The blood clotting process starts when cell fragments called ..... release molecules of ..... . These molecules are ..... which catalyse the conversion of ..... into ..... , in the presence of calcium ions. As a result, fibrinogen is converted into fibrin and blood cells are trapped to form the clot.

(b) Fibrinogen and fibrin are both proteins.

A protein consists of a chain of amino acids joined together by bonds.

(i) In the space below, draw a diagram to show the structure of an amino acid.

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(ii) Name the covalent bond that joins the amino acids into a chain.

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(iii) Suggest **two** differences between fibrinogen and fibrin.

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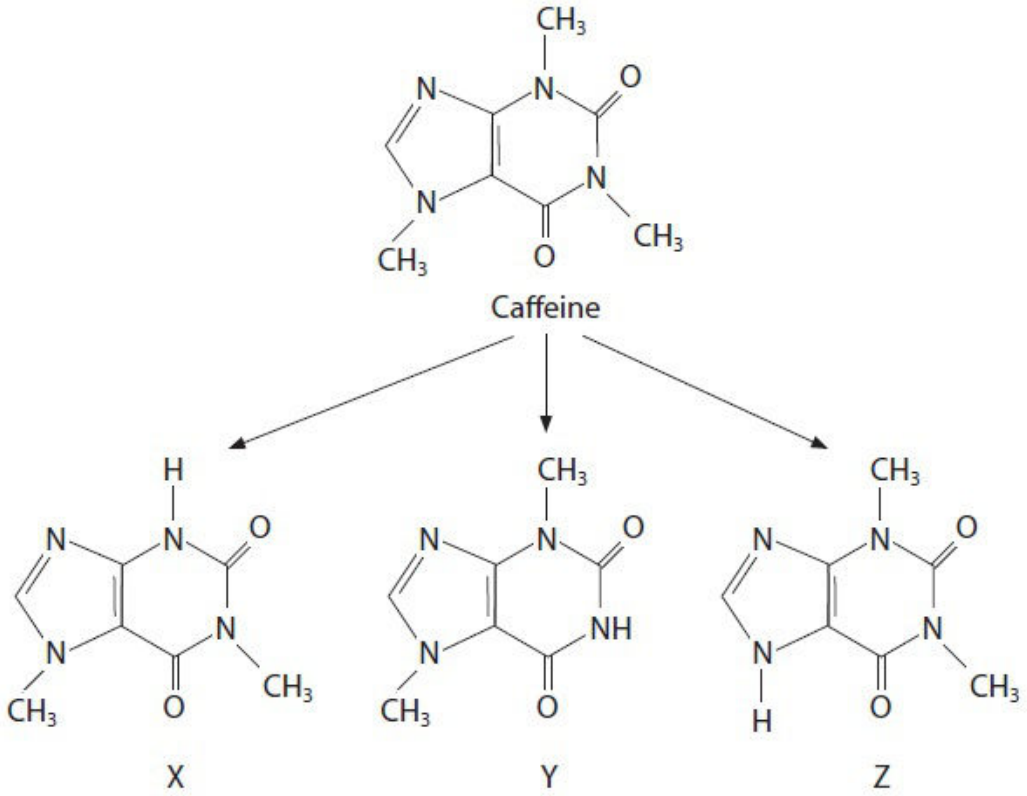
(Total for Question = 11 marks)

Q11.

Caffeine is a drug frequently consumed in a number of drinks such as coffee, cola, hot chocolate and tea.

Caffeine is broken down in the liver by a group of enzymes called cytochrome P450 oxidase.

(a) The diagram below shows the structure of caffeine and its three breakdown products, X, Y and Z.



(i) Using the information in the diagram, give **two** reasons why caffeine is **not** an amino acid.

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(ii) Using the information in the diagram, state **two** differences between the breakdown products.

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(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

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(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
coffee	200 cm^3	135
cola	1 can	80
hot chocolate	200 cm^3	10
tea	1 cup	50

The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

Conclusion 1

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Conclusion 2

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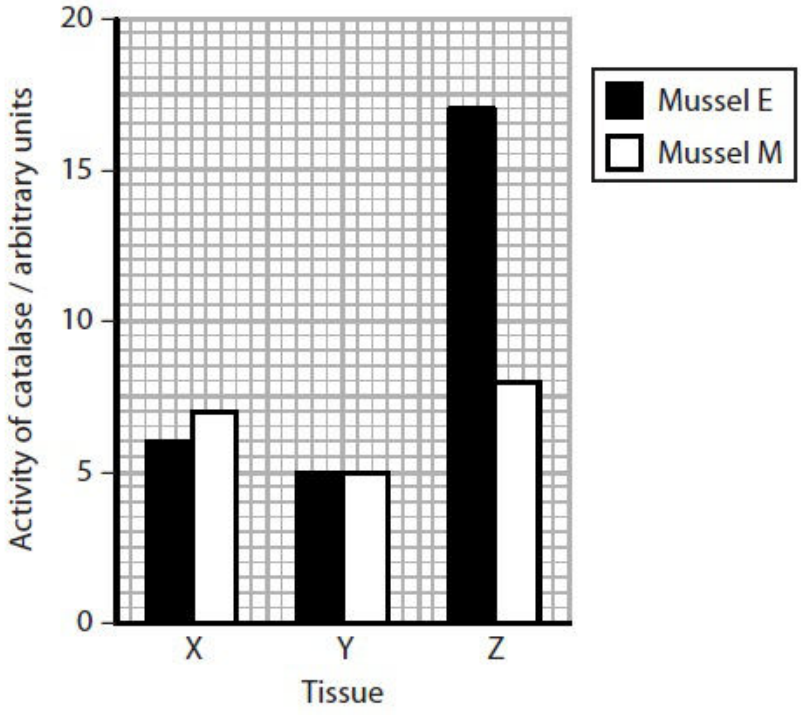
Q12.

Catalase is an enzyme present in many tissues of most living organisms. Its role is to break hydrogen peroxide down into oxygen and water. Hydrogen peroxide is produced by cells and is very harmful if it is not broken down.

(a) A study compared the activity of catalase in the tissues of freshwater mussels. Mussels from two different rivers: mussel E from the river Eo and mussel M from the river Masma were studied.

The catalase activity was measured in three tissues, X, Y and Z, taken from each type of mussel.

The graph below shows the results of this study.



(i) Use the information in the graph to state the conclusions that can be made about the activity of catalase in the tissues of
mussel E.

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(ii) Using the information in the graph, compare the activity of catalase in mussel E and mussel M.

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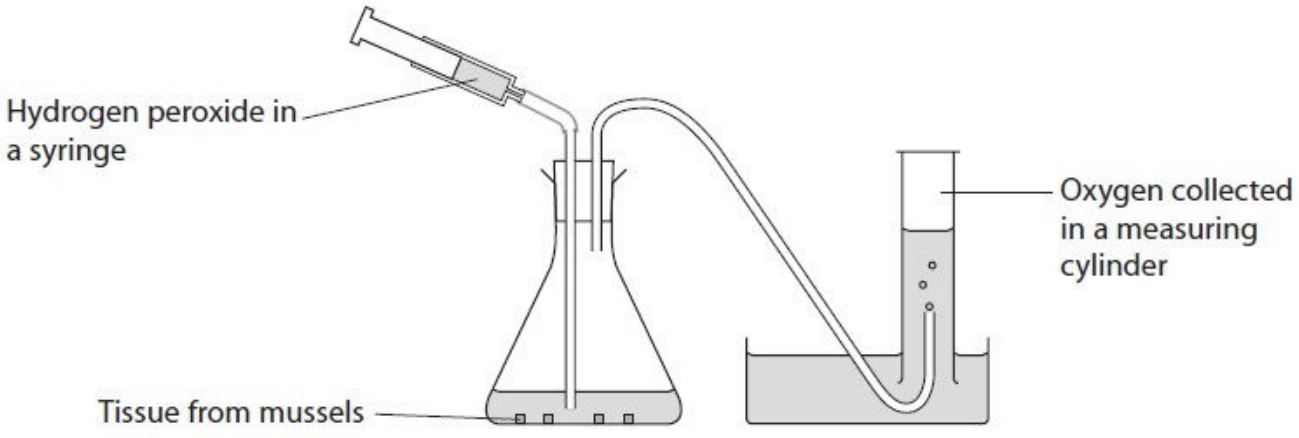
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(b) Catalase activity in tissue from mussels can be studied using the apparatus shown below.

Tissue from mussels is placed in the flask and hydrogen peroxide is added using the syringe. The oxygen produced from the breakdown of hydrogen peroxide is collected in the measuring cylinder.



Describe how this apparatus could be used to compare the catalase activity in two different types of mussel.

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(Total for question = 9 marks)

Q13.

Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

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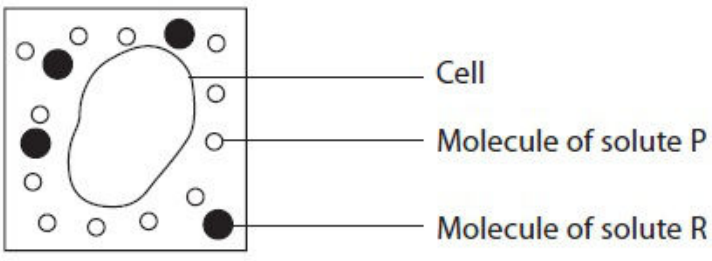
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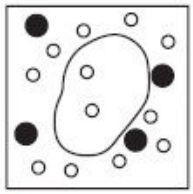
(b) Cells were placed in a solution containing two different solutes, solute P and solute R.

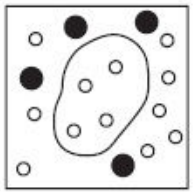
The diagram below represents the concentration of the two solutes outside one of the cells, when this cell was placed in the solution.

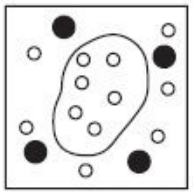


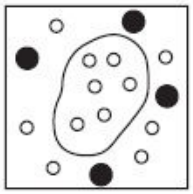
The cells were left in the solution for 50 minutes.

The diagrams below represent the concentrations of the two solutes, inside and outside the cell after 10, 20, 30 and 40 minutes in the solution.


After 10 minutes


After 20 minutes


After 30 minutes


After 40 minutes

(i) Using the information in the diagrams, describe the changes that have taken place in the concentrations of solute P and solute R, in the 40 minute period.

Suggest an explanation for these changes.

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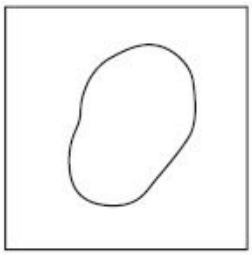
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(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

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(Total for question = 9 marks)

Q14. The fluid mosaic model has been developed from the knowledge of the structure and properties of cell membranes. It can explain how molecules can enter and leave a cell.

(a) Describe the structure of a cell membrane. (You may use a labelled diagram to support your answer).

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(b) Suggest **two** properties of molecules that enable them to enter a cell by diffusion.

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(c) Facilitated diffusion and active transport are two ways in which molecules are transported across cell membranes.

Describe **one** similarity and **one** difference between facilitated diffusion and active transport.

(i) Similarity

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(ii) Difference

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(Total for Question = 9 marks)

Q15. The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

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(b) The table below describes four methods by which molecules or ions can move through the cell membrane.

Description of method	Method by which molecules or ions can move through the cell membrane			
	A	B	C	D
The direction of movement is from a higher concentration to a lower concentration of the molecule	✓	×	✓	✓
ATP required	×	✓	×	×
Membrane proteins involved	✓ or ×	✓	✓	×
A molecule or ion transported by this method	water	sodium ions	glucose	oxygen

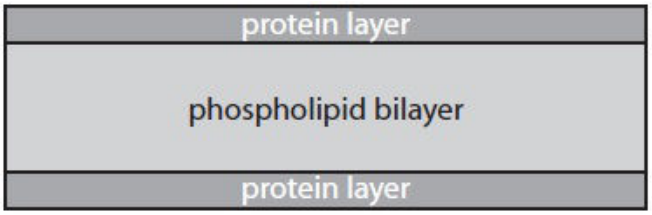
Identify the method of movement by placing a cross ☒ in the correct box in the table below.

(3)

Method of movement	A	B	C	D
Active transport	☐	☐	☐	☐
Facilitated diffusion	☐	☐	☐	☐
Osmosis	☐	☐	☐	☐

(c) The fluid mosaic model explains our current knowledge of the structure and properties of cell membranes. This model was developed from the Davson-Danielli model.

The diagram below shows the Davson-Danielli model of membrane structure.



(i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

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(ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

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(Total for Question = 10 marks)

Q16.

There is evidence for a causal relationship between blood cholesterol levels and cardiovascular disease (CVD).

(a) Explain the meaning of the term **causal relationship**.

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Lipoproteins are composed of phospholipids, cholesterol and proteins.

(i) Proteins are made up of amino acids.

Describe how amino acids join together to form the three-dimensional structure of a protein.

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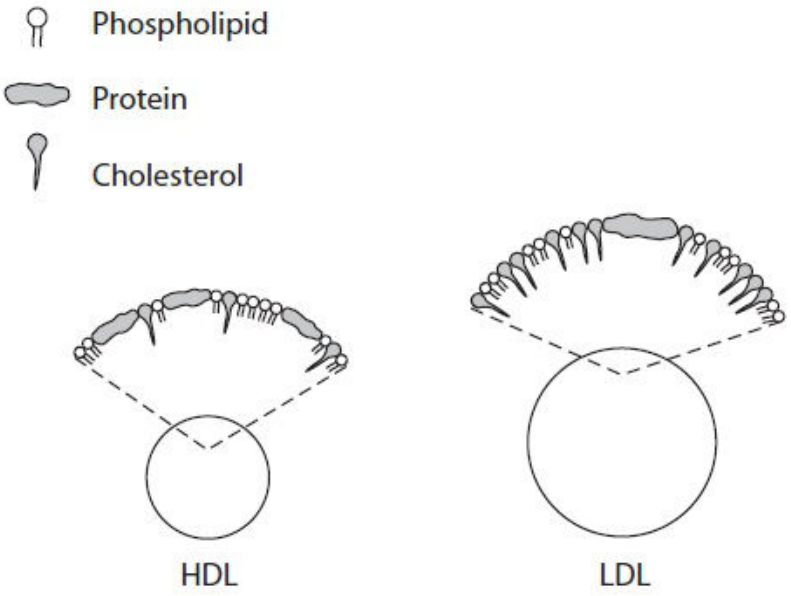
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(ii) The diagrams below show part of the structure of the surface of high-density lipoprotein (HDL) and low-density lipoprotein (LDL).



Using the information in the diagram, describe the differences between the structure of HDL and the structure of LDL.

(2)

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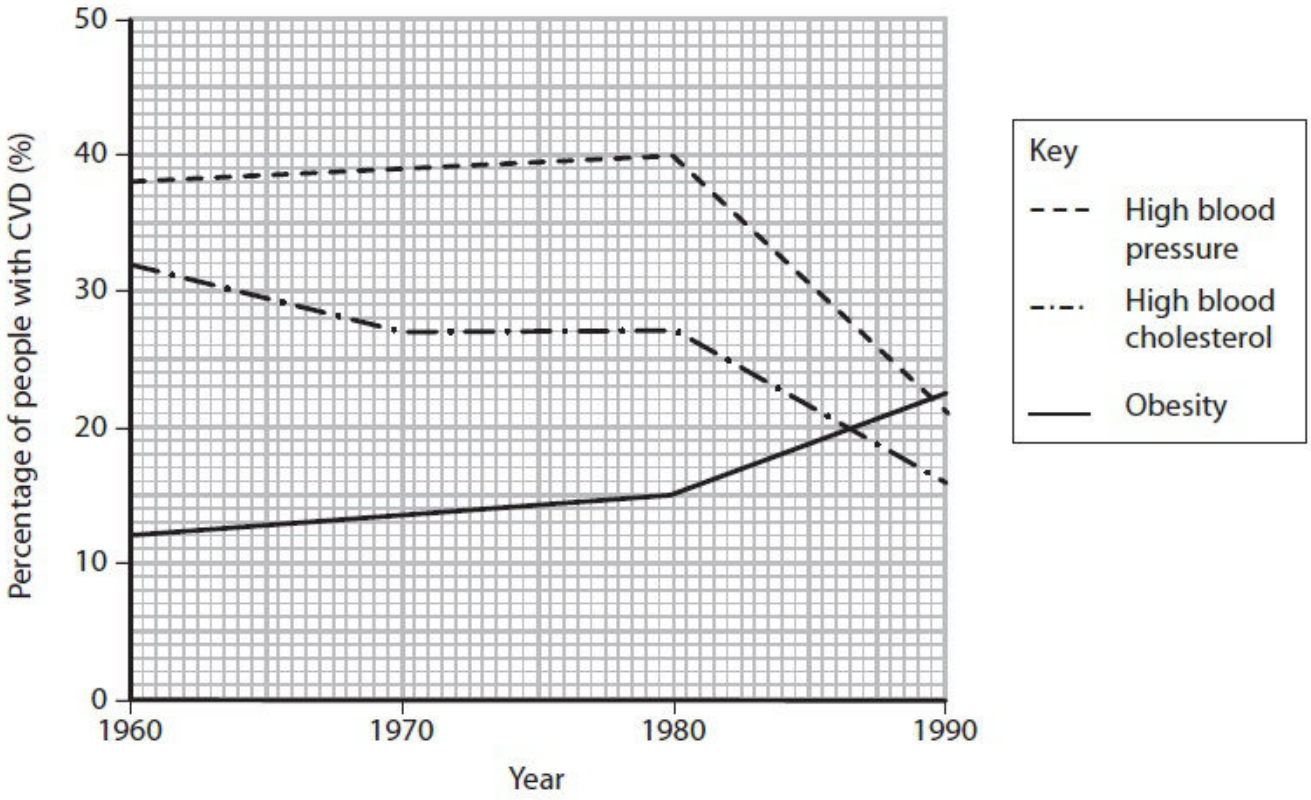
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(c) Obesity and high blood pressure are also factors that increase the risk of CVD.

The graph below shows the percentage of people with CVD who have high blood pressure or have high blood cholesterol or are obese for the period 1960 to 1990.



(i) Using the information in the graph, describe the overall changes that have occurred in these risk factors during this period.

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(ii) Suggest **two** reasons for the overall change in high blood cholesterol as a risk factor.

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(ii) State **two** factors, other than obesity, high blood pressure and high blood cholesterol, that increase the risk of CVD.

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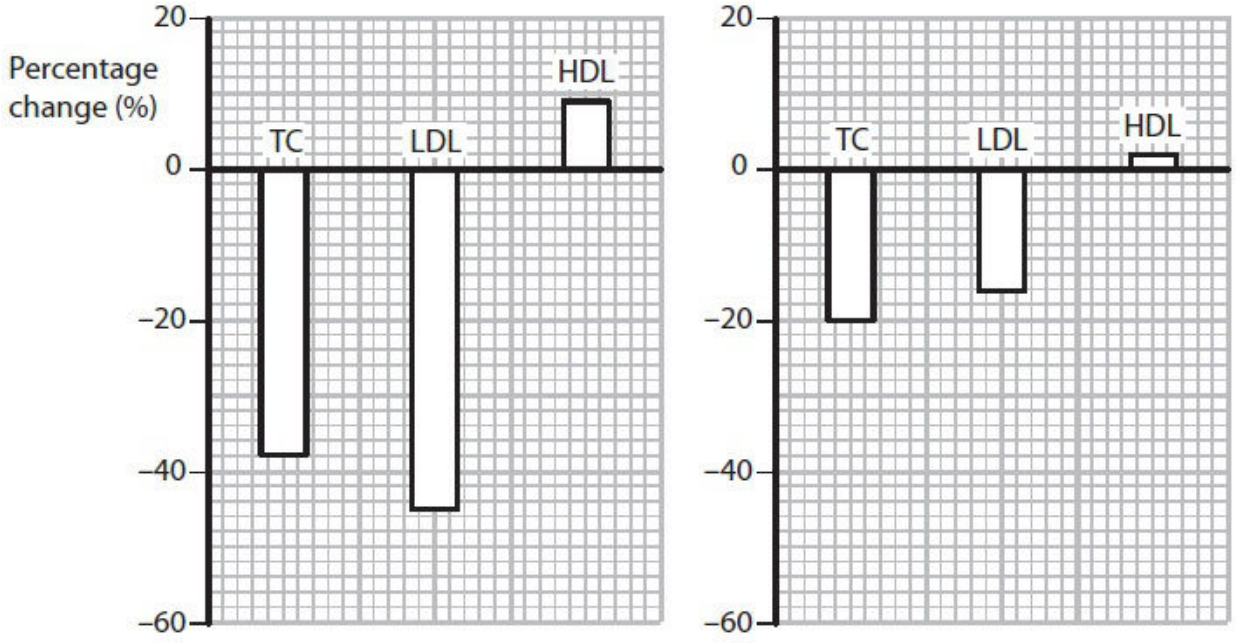
(Total for question = 13 marks)

Q17.

High blood cholesterol levels are associated with an increased risk of developing cardiovascular disease (CVD). There are cholesterol-reducing drugs available to lower this risk.

(a) Two groups of patients were treated with a different type of cholesterol-reducing drug, Drug A or Drug B.

The graphs below show the percentage changes of total cholesterol (TC), lowdensity lipoproteins (LDL) and high-density lipoproteins (HDL) in the blood of these patients, after treatment.



Patients treated with Drug A

Patients treated with Drug B

(i) Compare the effects of Drug A and Drug B on the percentage changes in total cholesterol (TC), LDL and HDL in the blood of these two groups of patients.

(3)

(ii) The enzyme HMG-CoA reductase catalyses the synthesis of cholesterol. When this enzyme is active, there are fewer LDL receptors on liver cells. These receptors are needed to remove LDL from the blood.

Statins are a group of cholesterol-reducing drugs that act by inhibiting this enzyme. Suggest which of the two drugs, Drug A or Drug B, is more likely to be a statin. Give reasons for your answer.

(3)

(b) State **two** risks of treatments using statins.

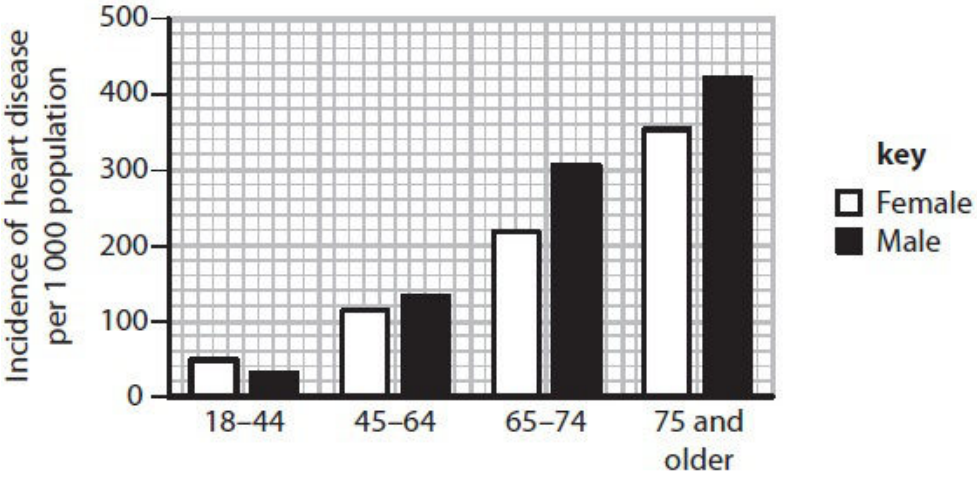
(2)

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(c) Age and gender are two other factors that may influence the development of heart disease in an individual.

The graph below shows the results of a survey in America, on the incidence of heart disease in adults aged 18 and older.



(i) Using the information in the graph, describe how the incidence of heart disease is affected by age and gender.

(3)

(ii) Calculate the increased risk that a man who is 75 or older has of developing heart disease, compared to a man aged between 18 and 44 years old.

(2)

Answer

(Total for question = 13 marks)

Q18.

The polynucleotides, DNA and RNA, are involved in the process of protein synthesis.

The diagram below shows the sequence of bases in part of a messenger RNA molecule that codes for the amino acids in a polypeptide chain.

A - U - G - G - C - C - U - C - G - A - U - A - A - C - G - G - C - C - A - C - C - A - C - C

(i) State the maximum number of amino acids in the polypeptide chain produced from this part of the messenger RNA molecule.

(1)

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(ii) State the number of different tRNA molecules that would be used to produce the polypeptide chain from this part of the messenger RNA molecule.

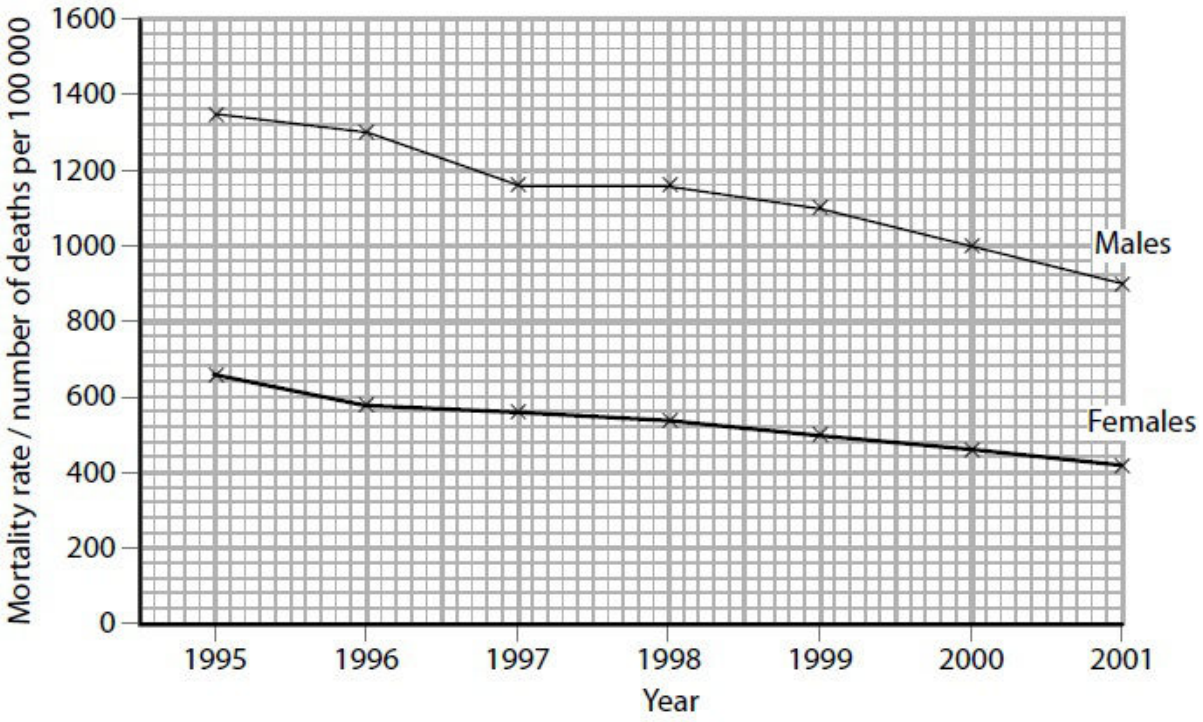
(1)

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(Total for question = 2 marks)

Q19.

The graph below shows the mortality rate (number of deaths per 100 000) from coronary heart disease in people aged between 65 and 74 in Scotland between 1995 and 2001.



(a) Compare the mortality rate from coronary heart disease in males with that of females, between 1995 and 2001.

(3)

(b) The graph shows a change in the number of deaths from coronary heart disease between 1995 and 2001. Suggest **three** reasons for this change.

(3)

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(c) One cause of coronary heart disease is atherosclerosis. Describe how atherosclerosis develops.

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(Total for question = 10 marks)

Q20.

Cardiovascular disease (CVD) is responsible for many deaths.

*(a) One cause of CVD is atherosclerosis. Describe how atherosclerosis develops.

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(b) A number of factors have been identified that increase the risk of CVD. One of these factors is genetic.

The genotype of some individuals causes them to be more at risk of developing CVD. One gene that influences this risk is the *KIF6* gene. Carriers of the 719 Arg allele of this gene are more at risk of CVD.

(i) Explain the meaning of the term **genotype**.

(1)

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(ii) Explain the meaning of the term **allele**.

(1)

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(c) Give **two** factors, other than genetic factors, that increase the risk of developing CVD.

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(d) Trials have shown that plant statin therapy is more effective in 719 Arg carriers than in non-carriers of this allele.

Describe the risks of using plant statins to treat CVD.

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(Total for question = 9 marks)

Q21. Cystic fibrosis is a genetic disease caused by mutations in the CFTR gene. This disease can be classified according to the effect of the different gene mutations on the CFTR protein.

The table below shows the classification of cystic fibrosis.

Class	Effect on the CFTR protein
I	CFTR protein is not synthesised.
II	CFTR protein is mis-folded and is not found in the correct location.
III	CFTR protein is mis-folded and is found in the correct location, but does not function properly.
IV	CFTR protein has a faulty opening.
V	CFTR protein is synthesised in smaller quantities than normal.
VI	CFTR protein breaks down quickly after it is synthesised.

(a) For class I cystic fibrosis, suggest how a mutation in the CFTR gene could result in no CFTR protein being synthesised.

(2)

(b) Class II cystic fibrosis results from the CFTR protein being located in the wrong place.

Describe the correct location for the CFTR protein.

(2)

(c) The mutation causing class III cystic fibrosis results in a change in the primary structure of the CFTR protein.

Explain why this would result in the CFTR protein being mis-folded.

(2)

(d) For class IV cystic fibrosis, explain why a faulty opening of the CFTR protein would affect the functioning of this protein.

(2)

(e) For a person with class V cystic fibrosis, describe the effect of having smaller quantities of CFTR protein.

(2)

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(f) For class VI cystic fibrosis, suggest how the CFTR protein is broken down.

(2)

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(Total for Question = 12 marks)

Q22. Cystic fibrosis is a genetic disorder caused by mutations in the CFTR gene. One aim of somatic gene therapy is to overcome the effects of defective genes.

(a) (i) Describe the difference between somatic gene therapy and germ line gene therapy.

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*(ii) Suggest how somatic gene therapy could enable cells lining the lungs to function normally in people with cystic fibrosis.

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(b) Rhythmical tapping of the chest wall during physiotherapy can relieve the symptoms of cystic fibrosis in the lungs.

Suggest an explanation for this.

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(Total for Question = 8 marks)

Q23.

Cystic fibrosis is a genetic disease that can affect many body systems, including the respiratory system.

*(a) Explain how a gene mutation causes a build up of mucus in the respiratory system of a person with cystic fibrosis.

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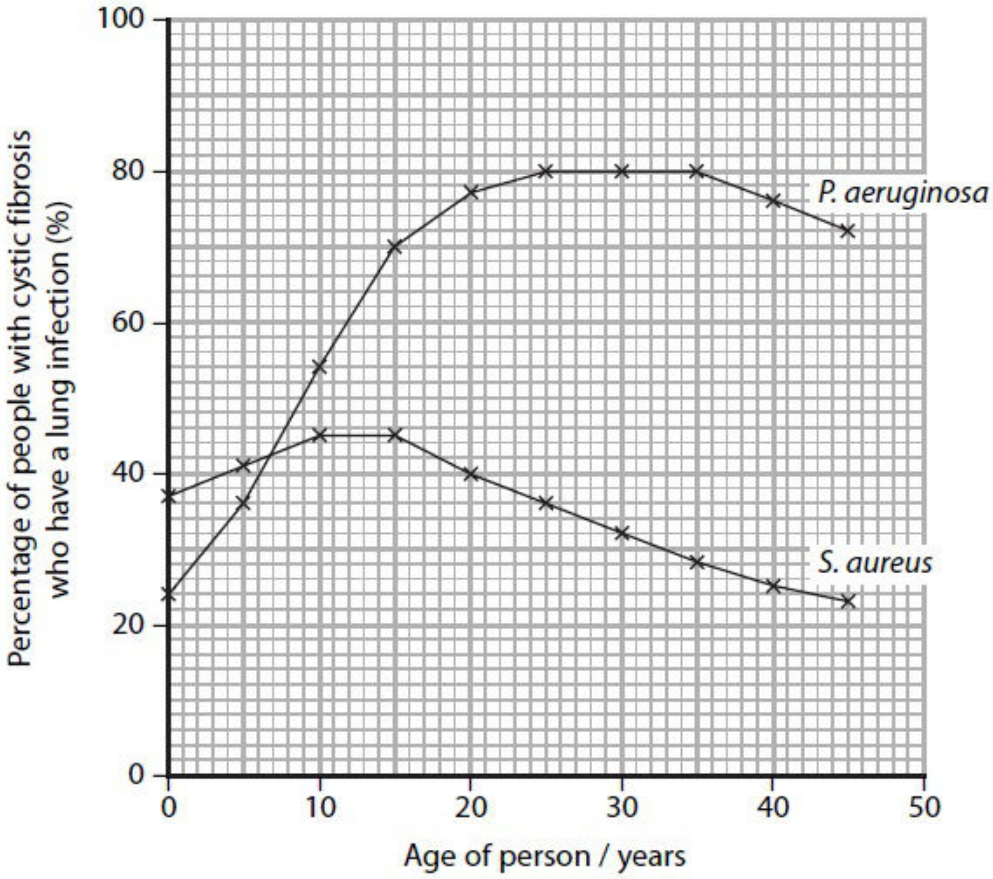
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(b) Lung infections can be caused by bacteria such as *P. aeruginosa* and *S. aureus*. People with cystic fibrosis may develop these lung infections.

The graph below shows the relationship between the percentage of people with cystic fibrosis who have a lung infection and the age of the person.



(i) Suggest why people with cystic fibrosis are more likely to suffer from these lung infections than people without cystic fibrosis.

(2)

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(ii) Using the information in the graph, describe the relationship between the age of a person and the incidence of a lung infection due to *P. aeruginosa*.

(3)

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(iii) Using the information in the graph, give **two** differences between the percentages of people with infections due to *P. aeruginosa* and infections due to *S. aureus*.

(2)

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(Total for question = 12 marks)

Q24.

Cystic fibrosis is a genetic disease that can affect many body systems, including the digestive system. In a carrier of this disorder, preimplantation genetic diagnosis can be used to detect the presence of an allele for cystic fibrosis.

*(a) Explain how cystic fibrosis affects the digestive system.

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(b) Explain how **preimplantation** genetic diagnosis is performed to detect cystic fibrosis.

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(c) Discuss either **one** ethical issue or **one** social issue relating to the use of preimplantation genetic diagnosis.

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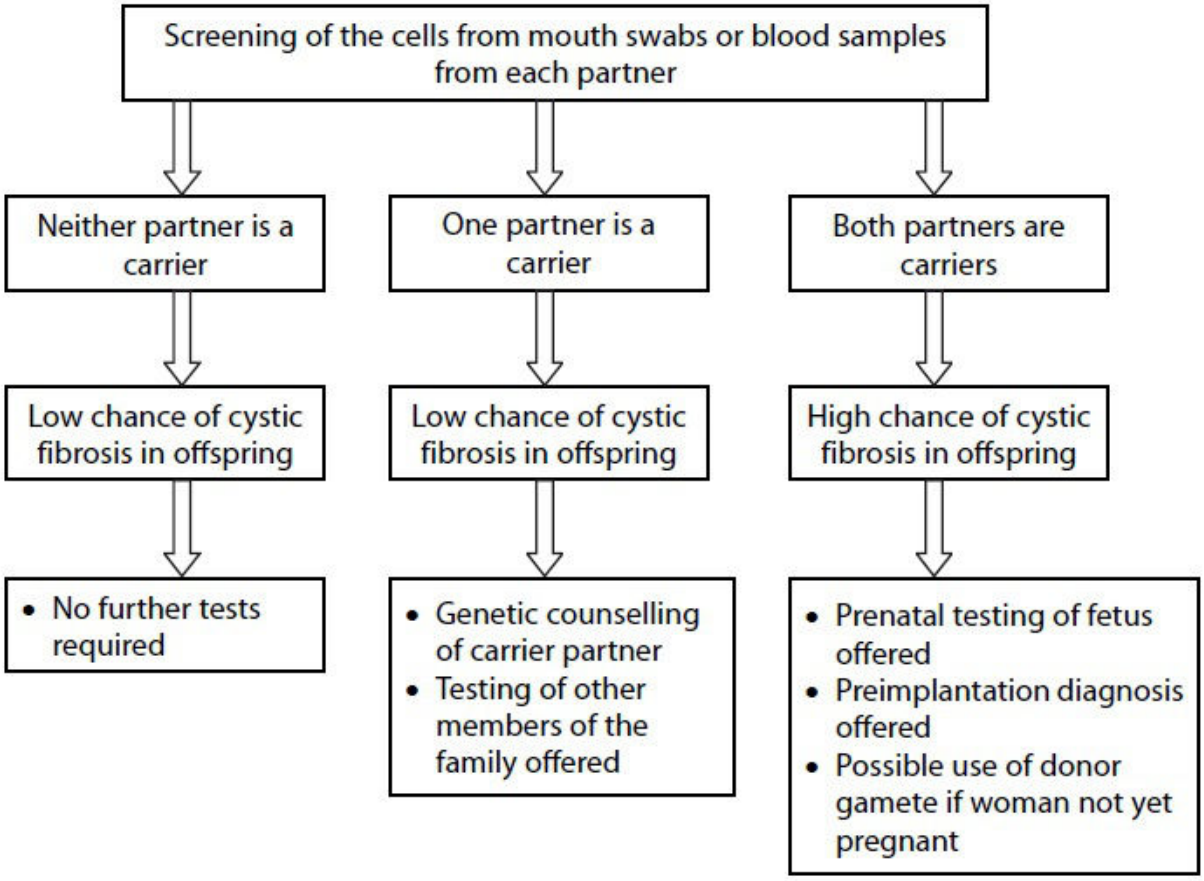
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(Total for question = 9 marks)

Q25.

Cystic fibrosis is a life-threatening condition that can affect many different parts of the body. It is a recessive genetic trait. Genetic screening can be used to test for the presence of recessive alleles. A person found to possess a recessive allele is called a carrier.

The diagram below illustrates a risk analysis following the screening for recessive alleles of a couple, who are planning a pregnancy.



(a) Suggest why cells from mouth swabs or blood samples are used rather than gametes.

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(b) Explain why it is necessary to test for several different recessive alleles in the screening for cystic fibrosis.

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(c) In the risk analysis shown, if neither partner is a carrier then it is considered that the chance of having a child with cystic fibrosis is low. Explain why the probability of having a child with cystic fibrosis is low and **not** zero.

(2)

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(d) In the risk analysis shown, if one of the partners is found to be a carrier then screening for cystic fibrosis may be offered to other family members. Explain why this screening is offered to other family members.

(2)

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(e) Using your knowledge of monohybrid crosses, calculate the probability of having a child with cystic fibrosis if both partners are found to be carriers. Draw a genetic diagram to explain how you calculated this probability.

(5)

Answer .....

(Total for question = 13 marks)

Q26.

Cystic fibrosis can be detected using prenatal genetic testing.

(i) Describe how **one** named method of **prenatal** genetic testing can be carried

out.

(3)

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(ii) Explain **either** one ethical issue **or** one social issue relating to the use of prenatal genetic testing.

(2)

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Q27.

The molecules DNA and RNA are involved in protein synthesis.

* Explain how the sequence of bases in DNA determines the primary structure of a protein.

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(Total for question = 4 marks)

Q28.

Active transport and facilitated diffusion are two ways in which some molecules can move through cell membranes.

State **one** difference and **one** similarity between active transport and facilitated diffusion.

(2)

Difference

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Similarity

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(Total for question = 2 marks)

Q29.

The polynucleotides, DNA and RNA, are involved in the process of protein synthesis.

State **three** differences between the structure of DNA and the structure of RNA.

(3)

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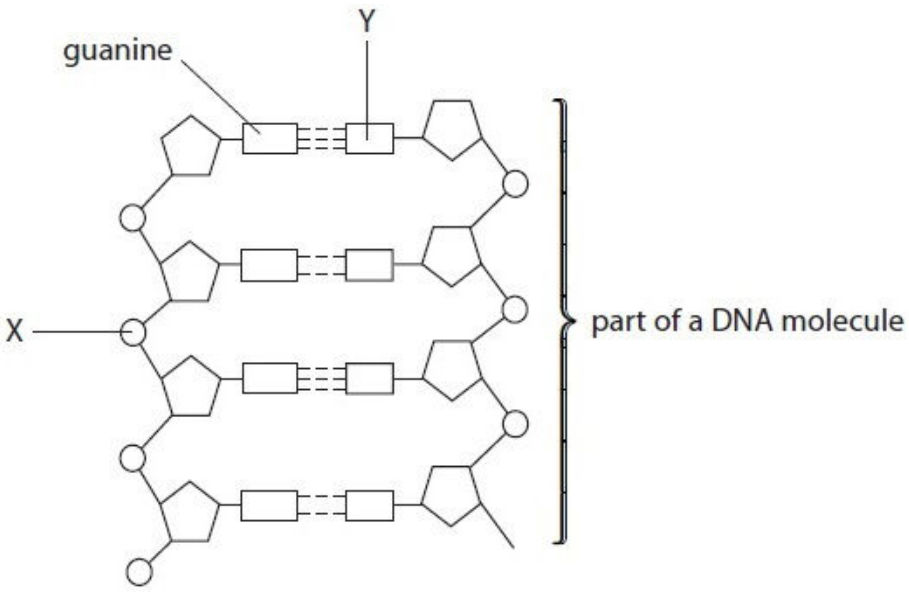
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(Total for question = 3 marks)

Q30. (a) The diagram below shows part of a DNA molecule.



(i) Place a cross ☒ in the box next to the molecule represented by the letter X

(1)

☒ **A** Deoxyribose

☒ **B** Phosphate

☒ **C** Ribose

☒ **D** Uracil

(ii) Place a cross ☒ in the box next to the molecule represented by the letter Y

(1)

☒ **A** Adenine

☒ **B** Cytosine

☒ **C** Thymine

☒ **D** Uracil

(iii) Place a cross ☒ in the box next to the name of the bonds holding the two strands of DNA together.

(1)

☒ **A** Ester bonds

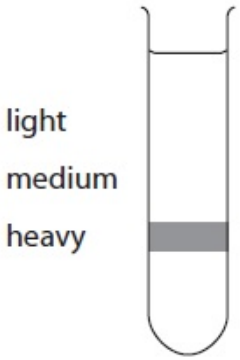
☒ **B** Glycosidic bonds

☒ **C** Hydrogen bonds

☒ **D** Peptide bonds

(b) A culture of bacteria had its DNA labelled with the heavy isotope of nitrogen (^{15}N).

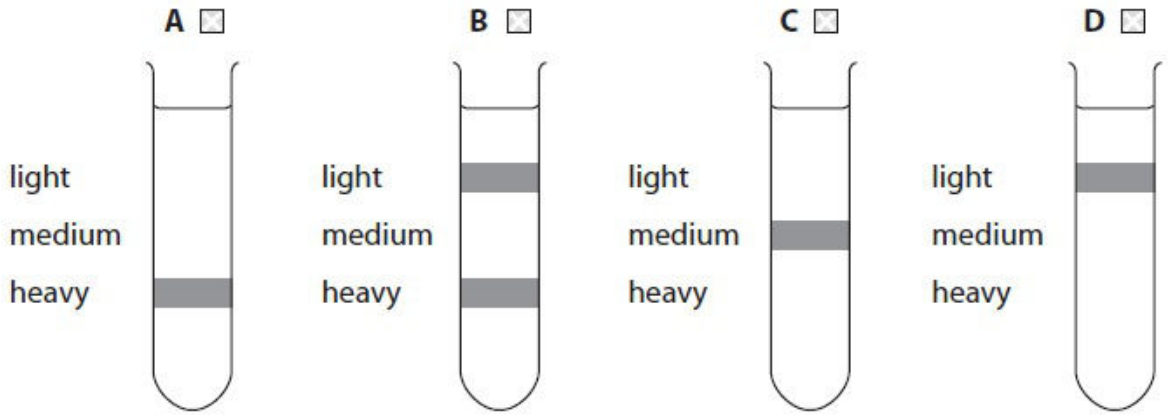
The diagram below shows the position of the DNA band in the centrifuge tube when the DNA was labelled with the heavy isotope of nitrogen, ^{15}N.



The bacterial culture was then allowed to reproduce using nucleotides containing the normal isotope of nitrogen (^{14}N).

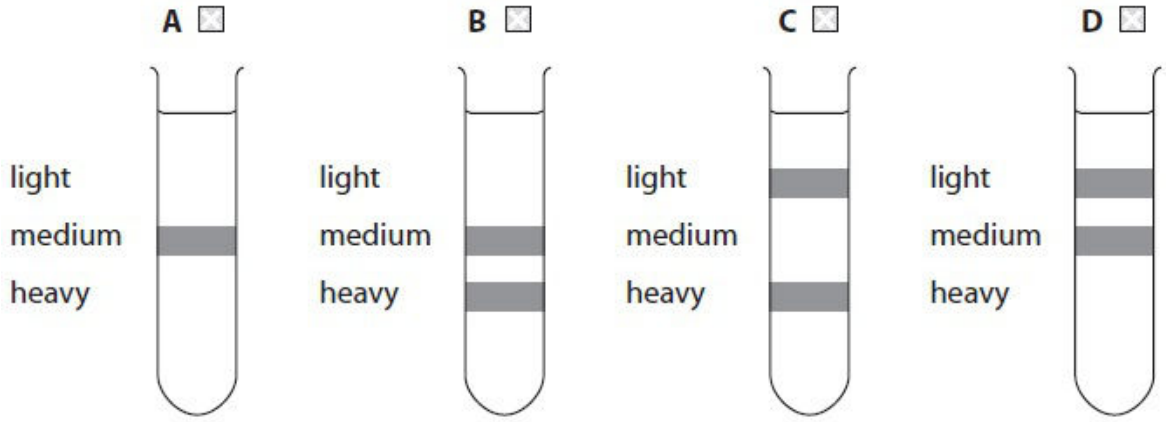
(i) Place a cross ☒ in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided once.

(1)



(ii) Place a cross ☒ in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided twice.

(1)



(c) Name the place in a eukaryotic cell where messenger RNA will be synthesised.

(1)

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(d) Achondroplasia is an inherited condition that results in restricted growth in humans. This condition is caused by a dominant allele (A).

Fetuses which are homozygous for the allele for achondroplasia are rarely born alive.

Two parents who both have achondroplasia would like to have children. They are concerned about the risk of their child inheriting two dominant alleles and dying before birth.

(i) Describe **one** advantage and **one** disadvantage to these parents of genetic screening of their fetus.

(2)

Advantage:

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Disadvantage:

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(ii) In the space below, draw a suitable genetic diagram to show the probability of a child from

these parents growing up without achondroplasia.

(4)

probability .....

(Total for Question = 12 marks)

Q31.

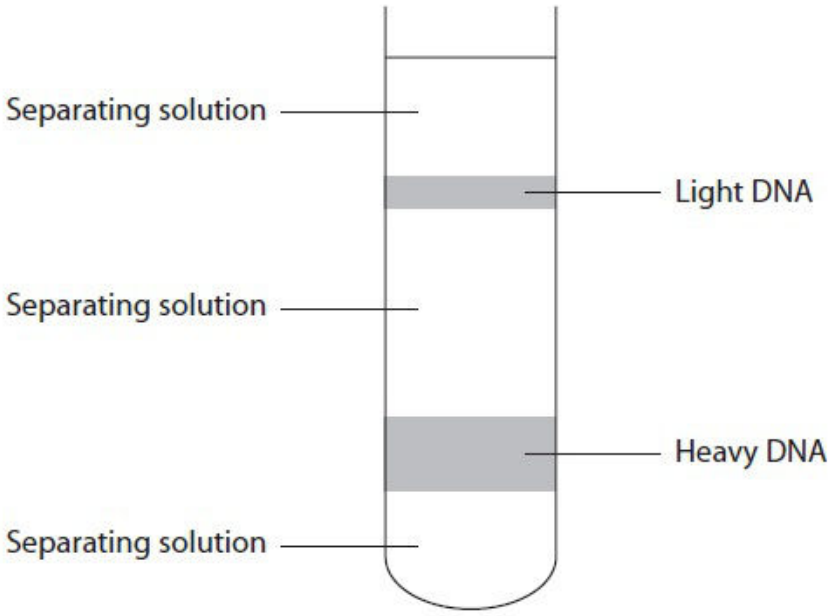
In the late 1950s, Meselson and Stahl performed some important experiments. These experiments provided evidence to support the idea that new DNA was synthesised by semi-conservative replication.

(a) Name an enzyme involved in DNA replication.

(1)

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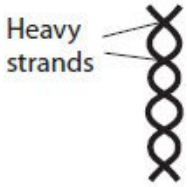
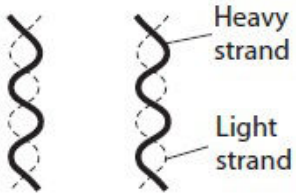
(b) Meselson and Stahl's experiments involved growing bacteria in culture media containing either heavy nitrogen (^{15}N) or light nitrogen (^{14}N). The DNA was then extracted from the bacteria. The DNA was analysed as shown in the diagram below.



The table below summarises the three stages of Meselson and Stahl's experiment and their results.

Complete the table by drawing, in the appropriate boxes, diagrams of the DNA molecules and mark the position and size of the DNA bands in the tubes.

(6)

Experimental stage	Diagram to show the strands in the DNA molecules of the bacteria	Position and size of DNA bands in the tube of separating solution
Stage 1 Bacteria grown for several generations in culture medium containing heavy nitrogen		
Stage 2 The bacteria from the end of stage 1 were grown for another generation in culture medium containing light nitrogen		
Stage 3 The bacteria from the end of stage 2 were grown for one more generation in culture medium containing light nitrogen		

(Total for question = 7 marks)

Q32. DNA is a very important molecule in living organisms as it carries the genetic code. Before a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

(a) Explain the nature of the genetic code.

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*(b) Describe the process of DNA replication.

(5)

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(Total for Question = 7 marks)

Q33.

The diagram below shows the sequence of bases in a short length of mRNA.

A	U	G	G	C	C	U	C	G	A	U	A	A	C	G	G	C	C	A	C	C	A	U	C

(a) (i) Place a cross ☒ in the box next to the letter that shows the DNA sequence which is complementary to the **first four** of these bases.

(1)

☒ **A** | T | A | C | C |

☒ **B** | T | U | C | C |

☒ **C** | U | A | C | C |

☒ **D** | U | T | C | C |

(ii) State the maximum number of amino acids coded for by this length of mRNA.

(1)

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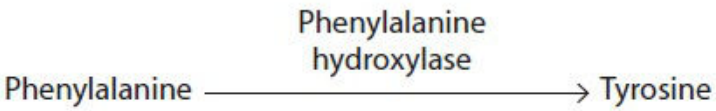
(b) Name the process by which mRNA is formed in the nucleus.

(1)

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(c) Phenylalanine is an amino acid found in many proteins in the human diet.

In most people it is converted to the amino acid tyrosine by an enzyme, as shown in the diagram below.



Phenylketonuria is the result of a gene mutation.

People with phenylketonuria cannot convert phenylalanine to tyrosine.

Explain why people with this gene mutation cannot convert phenylalanine to tyrosine.

(4)

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(d) Explain why a gene mutation involving the replacement of one base with another has less effect than the loss of a base.

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(Total for question = 9 marks)

Q34.

The photograph below shows a cleft iris, a rare condition in humans. Cleft iris may be due to the inheritance of recessive alleles.



Magnification ×1

(i) In the space below, draw a genetic diagram to show the genotypes and phenotypes of a man with cleft iris and a woman who is heterozygous for this condition, and all their possible children.

(4)

(ii) State the probability that the first child of these parents will have a cleft iris.

(1)

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Q35.

Ascorbic acid (vitamin C) is named from the Latin word for scurvy, *scorbutus.*

Scurvy is caused by vitamin C deficiency and used to be a serious concern for sailors. These sailors had no access to fresh fruit and vegetables during long sea voyages.

Sauerkraut (fermented cabbage) contains vitamin C. Ships stored sauerkraut because it does not decompose easily.

Vitamin C is water soluble and is found in cabbage cells. These cells also contain an enzyme, ascorbic acid oxidase, that can oxidise vitamin C.

(a) (i) Suggest why the vitamin C content is reduced by boiling cabbage in water.

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(ii) Suggest why less vitamin C is lost when the cabbage is added to boiling water rather than cold water before being boiled for 5 minutes.

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(b) Suggest why sauerkraut was more useful than cabbage on a long sea voyage.

(1)

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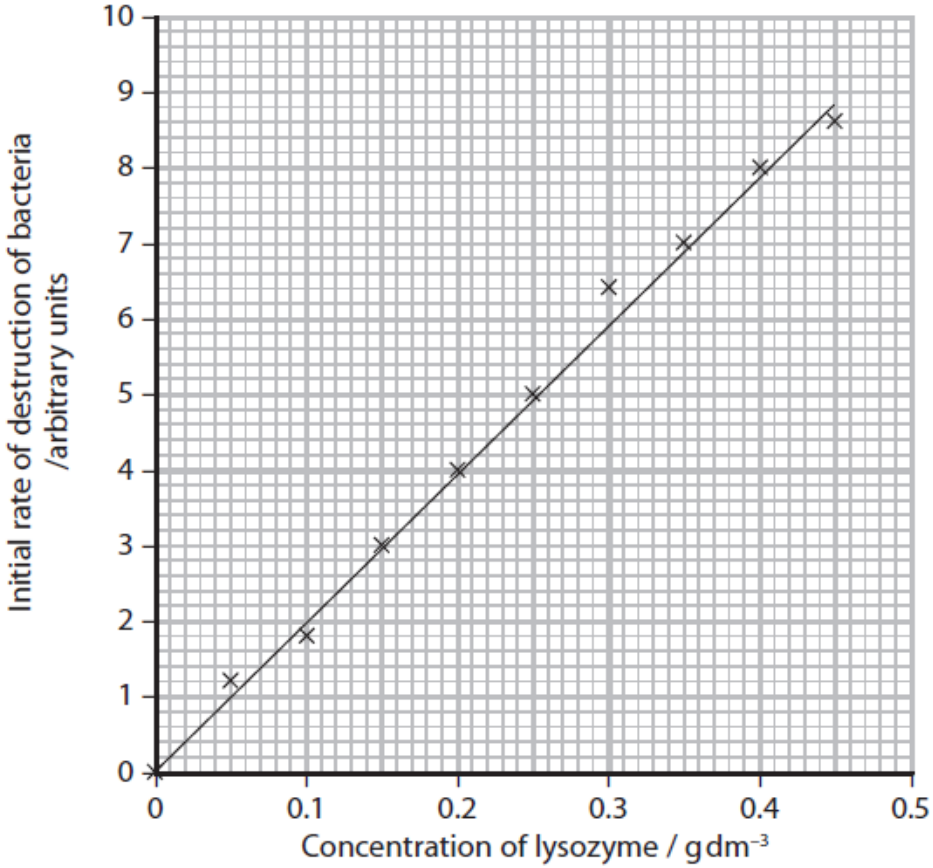
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(Total for question = 4 marks)

Q36.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

The graph below shows the effect of increasing the concentration of lysozyme on the initial rate of destruction of bacteria.



(i) Using the information in the graph, explain the effect of the concentration of lysozyme on the initial rate of destruction of bacteria.

(3)

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(ii) Suggest why some of the data points in the graph do not fit on a straight line.

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Q37.

The cell vacuoles of beetroot (*Beta vulgaris*) contain the red pigment betalain.

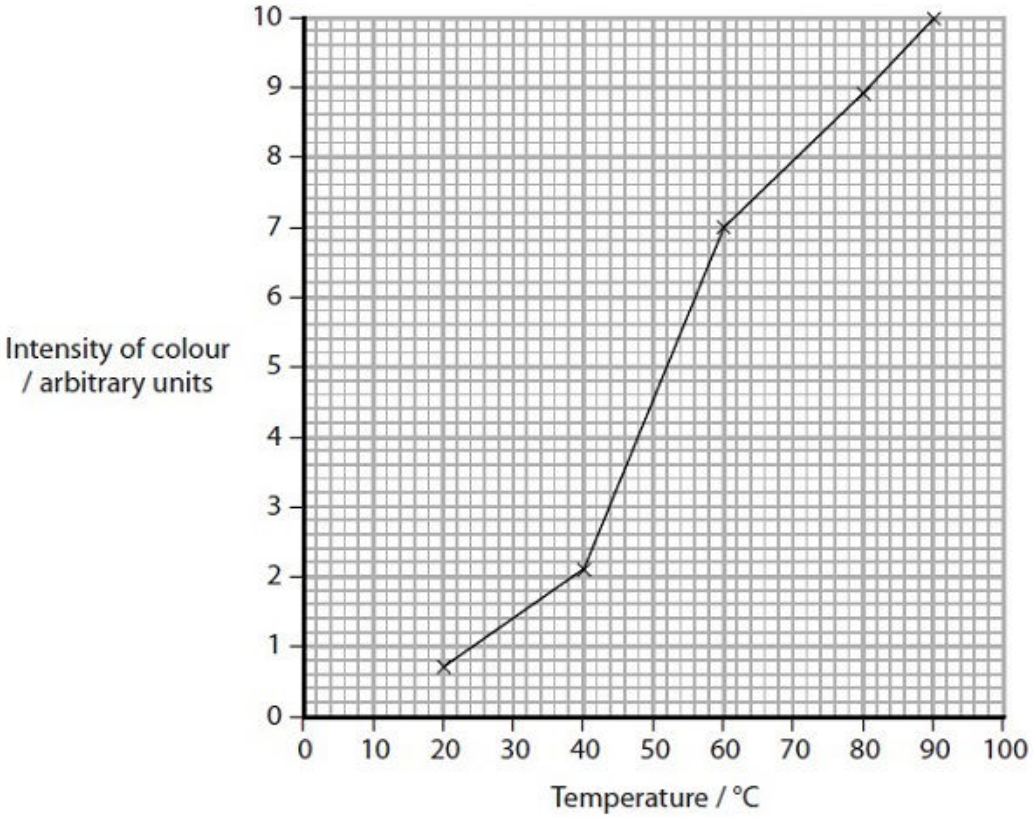
A student investigated the effect of temperature on the permeability of beetroot cell membranes.

In this investigation, five pieces of beetroot were used. One piece of beetroot was left in 10 cm^3 of distilled water for
20 minutes at 20 °C.

After 20 minutes, the piece of beetroot was removed and the intensity of the colour of the water was measured using a colorimeter.

This was repeated with the other pieces of beetroot using water temperatures of 40 °C, 60 °C, 80 °C and 90 °C.

(a) The student's results are shown in the graph below.



(i) Using the information in the graph, describe the effect of temperature on the permeability of the cell membranes.

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(ii) Using the information in the graph and your knowledge of membrane structure, explain the effect of temperature on the cell membranes.

(3)

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*(b) Using all the information given in the question, describe how this investigation could be carried out to provide valid and reliable results.

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(Total for question = 10 marks)

Q38.

The mammalian lung is adapted for efficient gas exchange.

Describe how the following feature assists in producing an efficient gaseous exchange system.

The lungs are composed of many alveoli. Each alveolus has a wall 0.1 µm thick.

(2)

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(Total for question = 2 marks)

Q39.

The mammalian lung is adapted for efficient gas exchange.

Describe how the following feature assists in producing an efficient gaseous exchange system.

The lungs are composed of many alveoli. The alveoli are ventilated.

(2)

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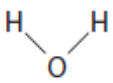
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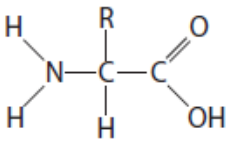
(Total for question = 2 marks)

Q40.

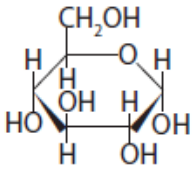
The diagram below shows four molecules, P, Q, R and S, found in living organisms.



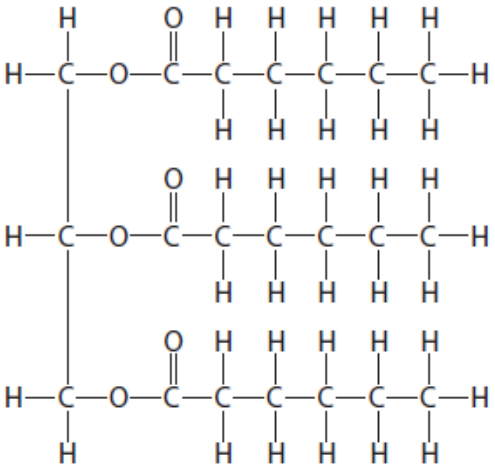
P



Q



R



S

Name one element found in all molecules of **Q** that would not be found in carbohydrates.

(1)

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Q41.

Enzymes are biological catalysts that change the activation energy of chemical reactions.

(a) Explain the meaning of the terms **biological catalyst** and **activation energy**.

(4)

Biological catalyst

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Activation energy

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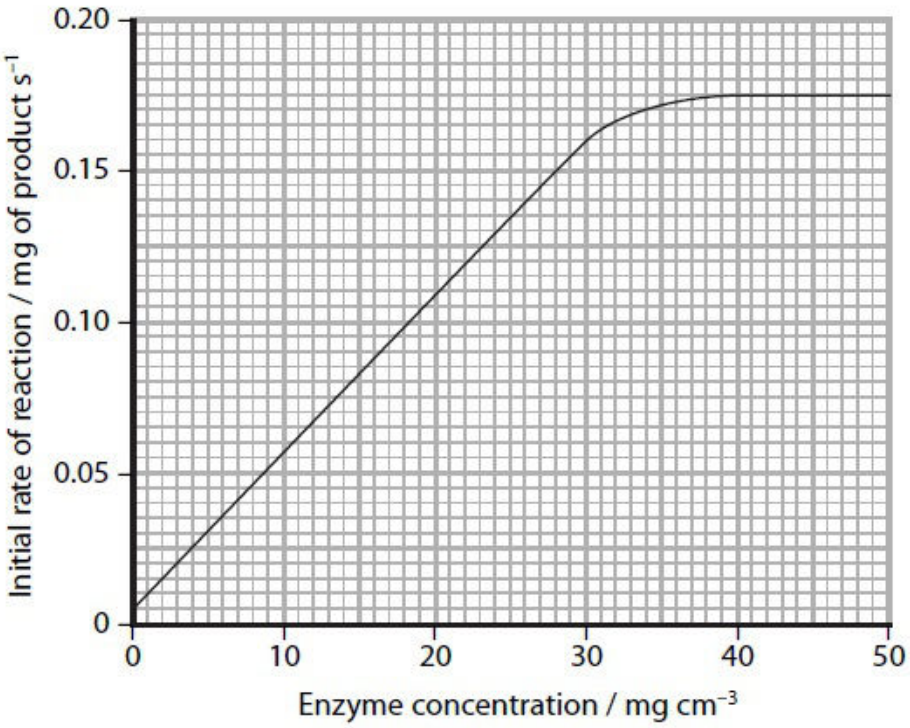
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(b) The graph below shows the results of an investigation into the effect of enzyme

concentration on the initial rate of this reaction.



Explain why it is necessary to measure the **initial rate** of reaction when investigating the effect of enzyme concentration on the rate of reaction.

(2)

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(c) In this investigation, the substrate concentration was a factor that was kept constant. Suggest **two** other factors that should be kept constant. For each factor, state how it can be kept constant.

(4)

Factor 1

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How the factor can be kept constant

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Factor 2

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How the factor can be kept constant

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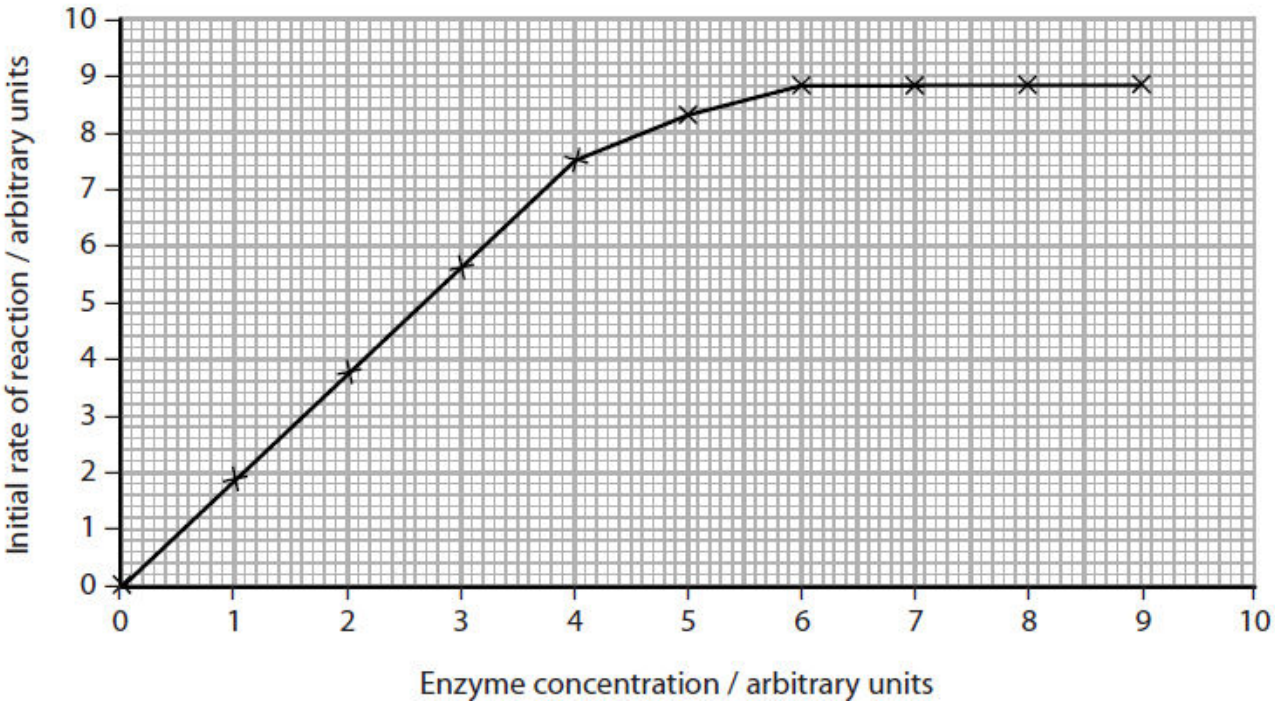
(Total for question = 10 marks)

Q42. Enzymes are biological catalysts made of protein.

(a) Proteins are chains of amino acids. In the space below draw the structure of **one** amino acid.

(3)

(b) The graph below shows the effect of changing the enzyme concentration on the initial rate of a reaction.



(i) Explain the effect of changing enzyme concentration on the initial rate of reaction.

(3)

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(ii) Describe an experiment that could be carried out to investigate the effect of enzyme concentration on the initial rate of reaction.

(4)

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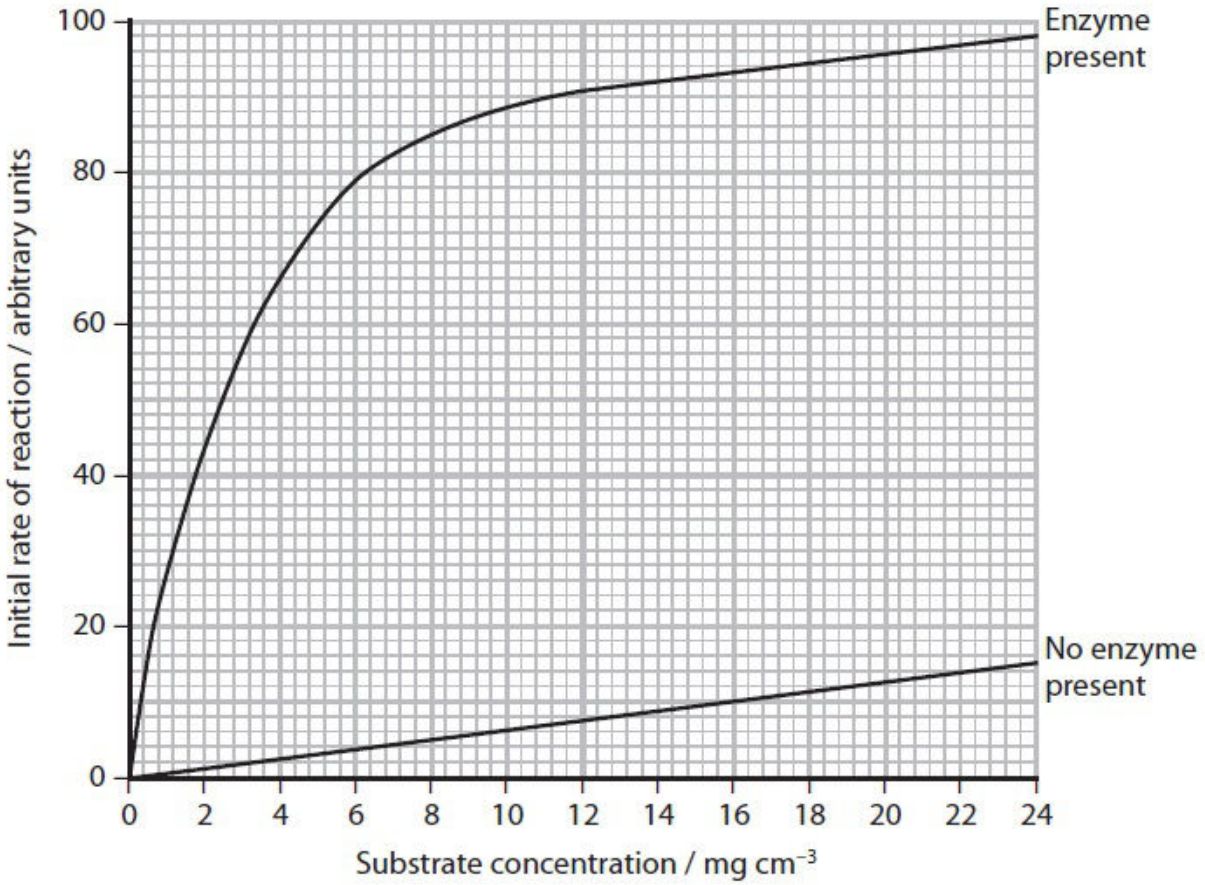
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(Total for Question = 10 marks)

Q43.

Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

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(b) Lipases are enzymes that are involved in the breakdown of lipids, such as triglycerides.

(i) Name the bond broken by lipases.

(1)

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(ii) Name **two** products formed from the breakdown of triglycerides by lipases.

(2)

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(iii) Suggest what effect the breakdown of triglycerides could have on the pH of a reaction mixture.

(1)

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*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)

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(Total for question = 11 marks)

Q44.

Describe **three** differences between the processes of replication and transcription of DNA.

(3)

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2 .....

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3 .....

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Q45.

Cystic fibrosis is an inherited condition.

Read through the following passage about cystic fibrosis then write on the dotted lines the most appropriate word or words to complete the sentences.

(4)

Cystic fibrosis is a disorder caused by one of a number of gene mutations.

The symptoms of the disorder are seen only in an individual who is

..... for the recessive allele. The gene codes for

a ..... protein called CFTR. This protein is responsible for the

movement of ..... ions across the cell membranes. Cystic fibrosis

impairs the functions of the gaseous exchange, digestive and .....

systems in the body.

Q46.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

Temperature affects the activity of lysozyme.

Suggest why increasing the temperature above 45 °C causes a decrease in the activity of lysozyme.

(2)

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Q47.

The photograph below shows a cleft iris, a rare condition in humans. Cleft iris may be due to the inheritance of recessive alleles.



Magnification ×1

Explain the meaning of the term **recessive allele**.

(3)

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Q48.

Cystic fibrosis is an inherited condition.

Explain why people with cystic fibrosis can have breathing difficulties.

(4)

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Q1.

(a)

Results Plus: Examiner Tip

Read values very carefully from the graph and ensure that they are stated accurately in the answer.

(a) Using the information in the graph, compare the uptake of substance A with the uptake of substance B during this period of 5 hours.

(3)

Until about 1 hour in to the experement both ~~sub~~ substance A and B were being taken up at an equal rate. Then Substance B stoped being taken up by the Amoeba as quickly as it had been and it began to level out, even though A kept being taken up at the same rate.

Results Plus: Examiner Comments

This would have been a good response if the candidate had followed the advice given above and would have scored all 3 marks. However, they only got 1 mark. The rate of uptake of substance A and B are the same up to 30 minutes not 1 hour, so the mark was lost for not reading the graph carefully enough. Mark point 4 could have been awarded at the end of the response if the candidate had stated the time at which the uptake of substance B had levelled out.

(b)

Results Plus: Examiner Tip

When a question asks for a description and an explanation of results, especially if it is also assessing QWC, then the explanation needs to be clearly linked to the description. It is best to link the sentences together with a 'because' in between, so that there is the first description and then the explanation, followed by the next description and the corresponding explanation.

*(b) **Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.**

(4)

Substance B starts to diffuse, as it goes down a concentration gradient, so the concentration in the cytoplasm increases, the diffusion starts to slow down because equilibrium is nearly reached and then at just over 2 hours, equilibrium is reached so diffusion stops.

Results Plus: Examiner Comments

This is a particularly clear answer that scored full marks.

Q2.

A relatively high number of blank spaces was seen in this question, showing that some candidates has failed to finish. For those centres who had not previously taught SNAB, the topic of this question is new to this specification. Some candidates however, clearly had a very good knowledge and understanding of enzyme action and gene therapy as some extremely good answers were seen. As in Question 3, many candidates did not appreciate the detail to which molecular structure needs to be learnt. Incorrect reference to 'healthy' genes or alleles was commonly seen in (b)(ii). Although we decided not to be too strict about the use of the terms gene and allele (as it is an AS paper and the examiners wanted to keep the mark scheme fairly open), it was still decided to draw the line with the reference to 'healthy'. Some candidates suggested that 'the faulty gene had to be removed from the mice'. There was some confusion describing how the normal gene was introduced into the mice − we had 'viruses in plasmids' and 'liposomes in viruses', to name a few methods! Part (b)(iii) was another example of How Science Works causing some candidates problems. Surprisingly few correct answers were seen.

Q3.

(i)

This is another question that gained the full spread of marks. Most candidates appreciated that uptake increase during the first five minutes but often failed to identify that it was at a constant rate, so missing the mark, however, most then described the decreased rate after five minutes and so gained the mark. Most candidates recognised that no further uptake took place after 10

minutes, although there was lots of confusion between uptake, rate of uptake and concentration in some responses.

A significant number of candidates successfully manipulated data from the graph. However, there was a significant number who misread the graph and identified the change in rate at 4 or 6 minutes (rather than 5) and/or that uptake stopped at 9 minutes (rather than 10).

(ii)

Many candidates gained the marks for recognising that uptake stops because equilibrium is reached so there is no longer any concentration gradient. A few excellent responses included details about why it could not be active transport. A significant number of candidates just described the process of diffusion, without actually answering the question. They did not apply their knowledge to the actual data to analyse and conclude that diffusion must be the process.

Q4.

(i)

Whereas many candidates picked up on the idea that AA is more likely to contract malaria or that they are less likely to have severe anaemia, they did not compare life expectancy to another genotype (even though life expectancy was mentioned) so only gained one of the two marks available. Rarely did candidates realise that the AA genotype could be compared to the 2 different genotypes, Aa and aa. Many were confused over referring to genotypes or individual alleles.

For this question, as well as part (ii), candidates often thought that rapturing of blood cells either leads to the severe anaemia or that it was a disadvantageous thing to happen. The link between rupturing red blood cells and the resistance to malaria was not understood by a significant number of candidates.

Other candidates thought that the genotypes affect the likelihood of being infected by the malarial parasite, rather than the development/ severity of the disease once infected.

(ii)

See comments for part (i) for some of the confusion and misconceptions.

Many candidates gained a mark for recognising that they are "less likely to get anaemia".

Candidates who gained 2 marks usually recognised that they are less likely to suffer from malaria because the parasite couldn't reproduce.

Q5.

(i)

This was probably the most challenging question on the paper with the majority of candidates scoring 0 or 1 mark out of the three available. Few candidates tackled the information with a logical approach to try and explain evidence for it being a dominant allele.

Many candidates focussed upon the fact that they assumed that there were no carriers in the family, because no one was labelled as a carrier, which led them to incorrect and irrelevant explanations. For example, many stated it must be dominant if 50% of the children inherit the disorder ignoring that the children of a homozygous recessive parent and a carrier for a recessive disorder, also have 50% probability of inheriting the disorder.

Surprisingly, few candidates failed to appreciate and accurately state that it is frequently inherited throughout the family despite being a rare disorder (so that it is unlikely that unrelated parents would also be carriers of the affected allele).

Many only referred to the 1st generation with 4 out 6 children affected (or often 4 out of 9 children – implying that the partners 4, 8 and 11 were siblings of the rest of the children of 1 and 2.)

The most common mark awarded was for identifying that parent 1 is heterozygous, and occasionally giving valid explanations to support this.

(ii)

This was well answered by the vast majority of candidates. Some however, failed to identify and display the parental gametes correctly (e.g. M M and M m). A few misinterpreted the offspring genotypes and subsequently gave the wrong probability (e.g. MM, Mm, Mn, mm as 25%). Some gave the answer of 50% even when this did not match the outcomes of the Punnett square they drew – so did not get the credit.

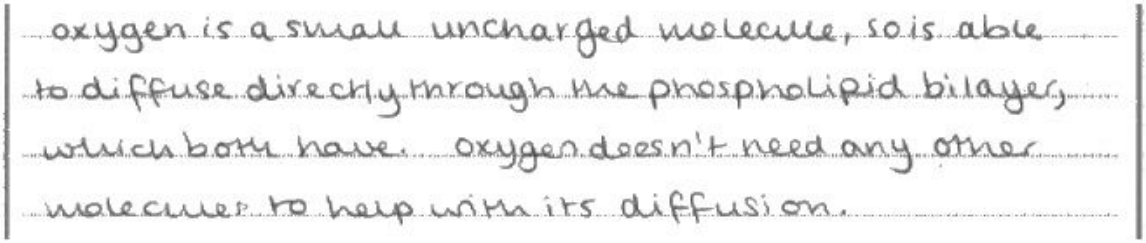
Q6.

Question (a)

Those candidates that realised oxygen is a small molecule usually went on to correctly refer to diffusion. Other responses, however, were along the lines of all cells need oxygen for respiration and stating that as a reason for high permeability.

Some candidates lost marks by contradicting themselves as regards diffusion/facilitated diffusion, small but charged/polar etc.

This response gained both marks available.


oxygen is a small uncharged molecule, so is able to diffuse directly through the phospholipid bilayer, which both have. oxygen doesn't need any other molecules to help with its diffusion.

Results Plus: Examiner Comments

This gained credit for recognising that oxygen can diffuse across the bilayer and that it can do this because it is small and uncharged.

This response gains one of the two available marks.



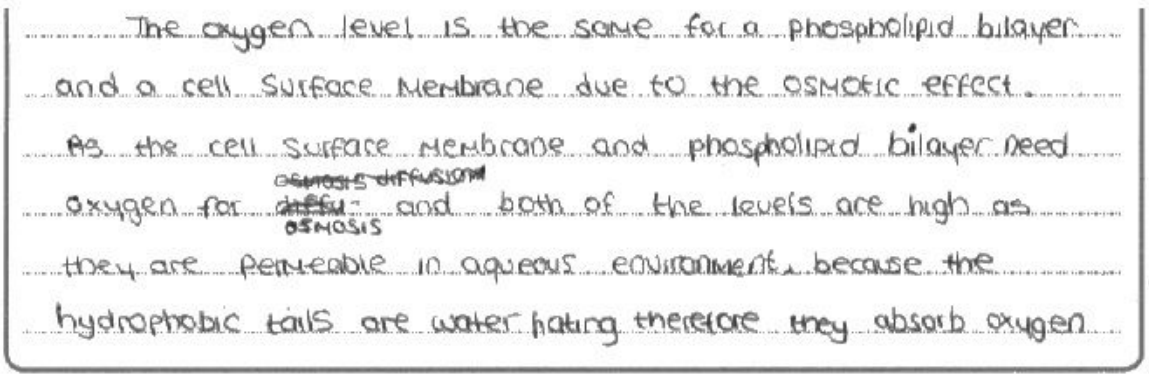
Results Plus: Examiner Comments

This response makes one clear point about the ability of oxygen to diffuse through the membranes.

Results Plus: Examiner Tip

If a question is worth two marks and has asked for an explanation, make sure your answer is not just a partial answer by checking you have at least two clear statements and in this case explain why oxygen is able to diffuse.

This response gained no credit.



Results Plus: Examiner Comments

This response is typical of those which relate permeability to need rather than the structure of the membranes. It has also confused osmosis and diffusion.

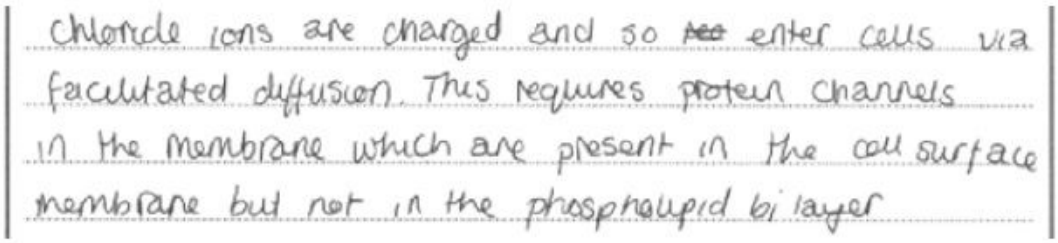
Question (b)

This question was attempted well with the majority of candidates being able to discuss the idea that carrier proteins were needed to move chloride ions across a membrane and some linked this to facilitated transport or active transport. Some candidates accurately described the CFTR channel proteins and their involvement because of the context of the question.

A lot of answers mentioned chloride ions being charged, but also, quite a few said that they are big/polar.

Some candidates unfortunately believed that the question was referring to the process by which mucous viscosity is controlled and discussed electrical gradients and the 'need to transport chloride' rather than explaining the difference in permeability.

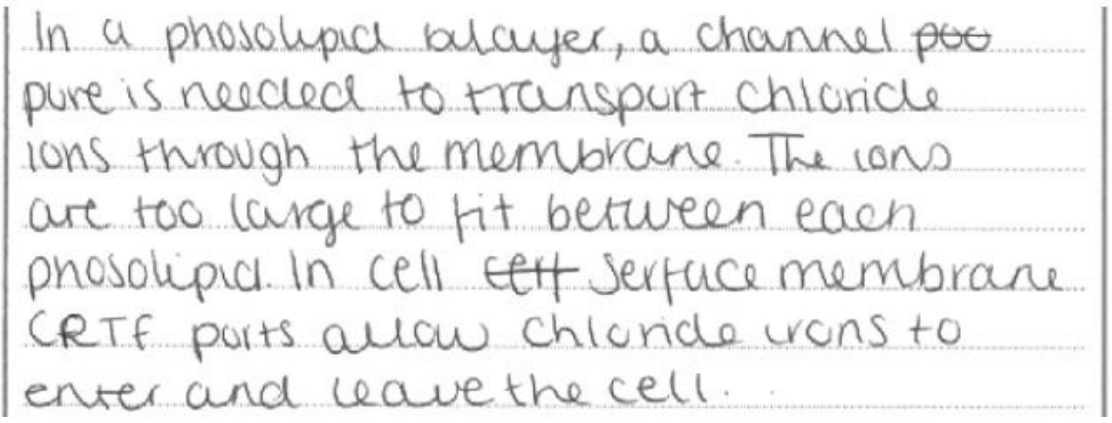
This response gains all three marks available.


Chloride ions are charged and so ~~neo~~ enter cells via facilitated diffusion. This requires protein channels in the membrane which are present in the cell surface membrane but not in the phospholipid bi layer

Results Plus: Examiner Comments

Marks were awarded for:
chloride ions are charged
facilitated diffusion
protein channels in the cell surface membrane and not the phospholipid bilayer.

This response gained 0 marks.


In a phosolipid bilayer, a channel ~~poo~~ pore is needed to transport chloride ions through the membrane. The ions are too large to fit between each phosolipid. In cell ~~cell~~ serface membrane CRTF ports allow chloride ions to enter and leave the cell.

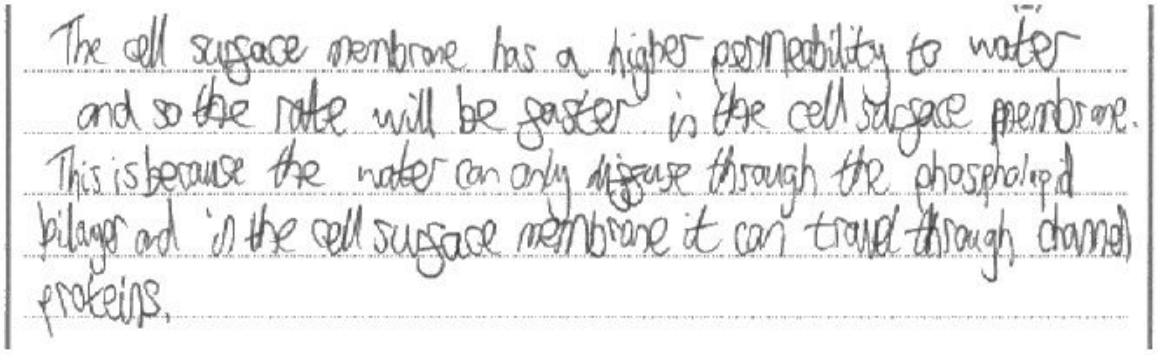
Results Plus: Examiner Comments

Channel pore is not sufficient for channel protein and CRTF ports (rather than CFTR) does not get credit unless stated that it is a channel protein. It is the charge rather than the size of the chloride ions that prevents them diffusing across a phospholipid bilayer.
AS level Biology does require some precision and clarity over the way knowledge is expressed to gain credit.

Question (c)

Relatively few candidates scored well on this question. Many responses focussed on the formation of concentration gradients due to the movement of chloride ions across the respective membranes. Rarely did they concentrate on the actual ability for water to move through (e.g. by means of channel proteins) and incomplete references to the cell membrane being more permeable to water. A significant number of candidates believed that the reason for the different rates is that one membrane was thicker than the other. Others explained that the phospholipid bilayer is impermeable to water, or that osmosis is the movement of the chloride ions.

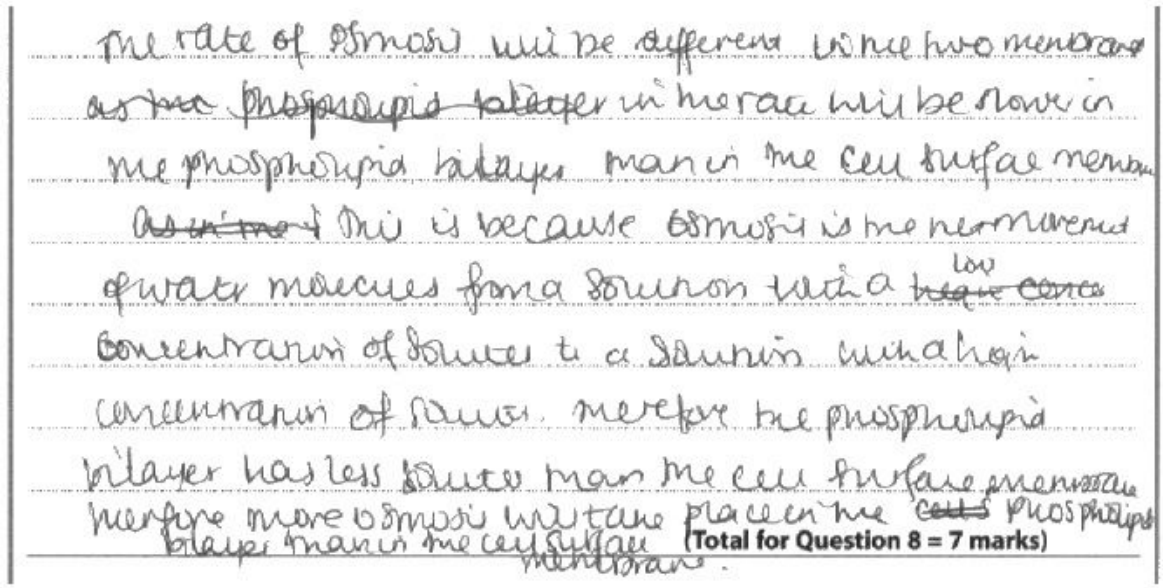
This response gained both marks available.



Results Plus: Examiner Comments

Marks were gained for:
cell surface membrane has higher permeability to water;
water can diffuse through phospholipid bilayer;
can travel through channel proteins in the cell surface membrane.

This response scored 0 marks.



Results Plus: Examiner Comments

This response is typical of the many responses that ignored the differences in permeability to water between the membranes and focused on a concentration gradient.

Results Plus: Examiner Comments

Look carefully at the labelling and information on the graphs/diagrams provided.

Q7. No Examiner's Report available for this question

Q8. No Examiner's Report available for this question

Q9.

(a)

5 There are many venomous (poisonous) snakes in the world. Many of the venoms from these snakes affect the blood clotting process.

*(a) Describe the blood clotting process.

(4)

The blood clotting process takes place when damage is done to an artery wall. Thromboplastin is released which catalyses the conversion of prothrombin (protein) into thrombin (an enzyme). Thrombin then catalyses the conversion of fibrinogen (protein) into fibrin (long fibres). These longer fibrin fibres then create a mesh which collects blood cells and platelets so forming a clot.

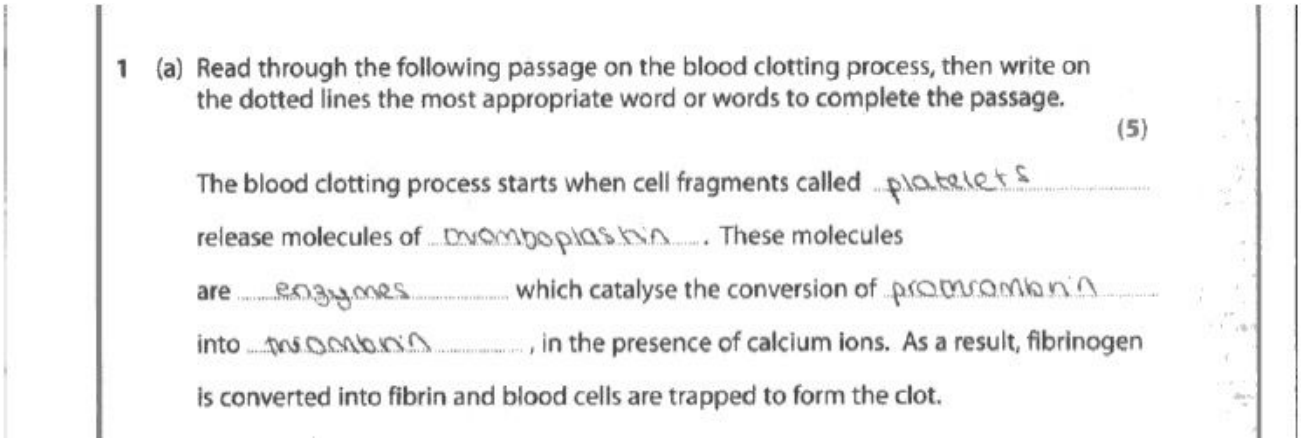
Results Plus: Examiner Comments

This answer illustrates the excellent quality of some of the responses that we read on the blood clotting process. It is also included to illustrate how QWC assessment is performed. The steps are clearly in the correct order. There is an error in the spelling of thromboplastin on the second line, so this mark could not be awarded. However, as the candidate went on to make at least 4 more points that were on our mark scheme, full marks could still be awarded. This also reiterates what

we have said previously: the candidate should try and write more statements than there are marks for a question of this type.

Q10. ***Question (a)***

Many candidates scored well in this question and clearly knew the steps involved in blood clotting. Unfortunately marks were sometimes lost by spelling errors that meant the words were not unambiguous. One of the more common errors was to confuse white blood cells and platelets. Candidates who were unfamiliar with the blood clotting process were usually able to get a mark for the word "enzyme" as being the catalyst. It was disappointing to see fibrin and fibrinogen given as answers since these were already referred to in the text.



1 (a) Read through the following passage on the blood clotting process, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

The blood clotting process starts when cell fragments called platelets

release molecules of thromboplastin. These molecules

are enzymes which catalyse the conversion of prothrombin

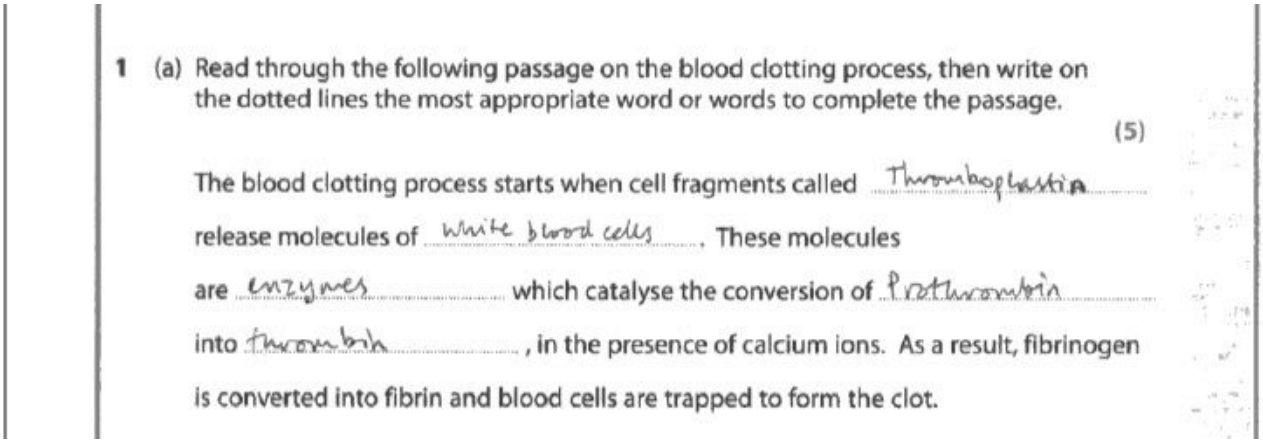
into thrombin, in the presence of calcium ions. As a result, fibrinogen

is converted into fibrin and blood cells are trapped to form the clot.

Results Plus: Examiner Comments

This response gains all five marks available.

This is an example of a response that gained three of the five marks available.



1 (a) Read through the following passage on the blood clotting process, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

The blood clotting process starts when cell fragments called Thromboplastin

release molecules of white blood cells. These molecules

are enzymes which catalyse the conversion of Prothrombin

into thrombin, in the presence of calcium ions. As a result, fibrinogen

is converted into fibrin and blood cells are trapped to form the clot.

Results Plus: Examiner Comments

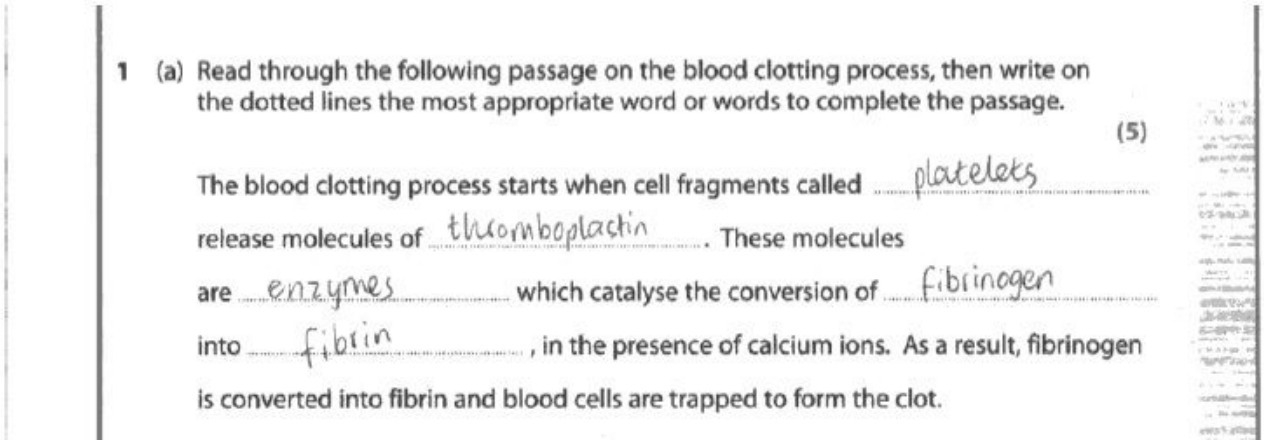
The candidate clearly knows many of the terms involved in the blood clotting process. However,

they have made mistakes with the first two responses.

Results Plus: Examiner Tip

For fill in the blanks questions make sure you read back over your response in the context of the whole passage to make sure it makes sense.

This response gained three of the five marks available.



1 (a) Read through the following passage on the blood clotting process, then write on the dotted lines the most appropriate word or words to complete the passage. (5)

The blood clotting process starts when cell fragments called platelets release molecules of thromboplastin. These molecules are enzymes which catalyse the conversion of fibrinogen into fibrin, in the presence of calcium ions. As a result, fibrinogen is converted into fibrin and blood cells are trapped to form the clot.

Results Plus: Examiner Comments

The first three answers are correct, but this candidate made the common mistake of including fibrinogen and fibrin as the last responses, despite those molecules being used in the sentence immediately afterwards.

Results Plus: Examiner Tip

Read through the complete passage to help guide what will be the most appropriate words to use. The passage is unlikely to repeat itself so it is best not to repeat words as they are unlikely to be the most appropriate to use.

Question (b)(i)

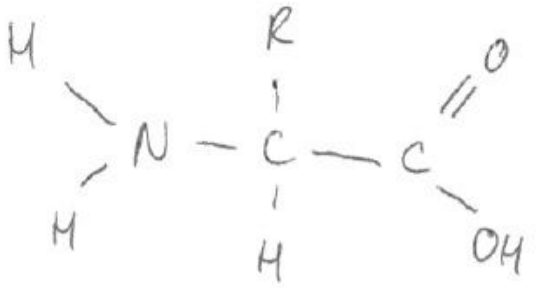
Over 50% of candidates gained all three marks for the structure of an amino acid. The most common errors were to miss the hydrogen attached to the central carbon, or make bonding errors for the carboxyl or amino group. Some candidates named the groups instead of drawing the structure as requested. Several candidates tried to draw nucleotides and a few attempted a modified monosaccharide.

(b) Fibrinogen and fibrin are both proteins.

A protein consists of a chain of amino acids joined together by bonds.

(i) In the space below, draw a diagram to show the structure of an amino acid.

(3)



Results Plus: Examiner Comments

This example gained all three marks available.

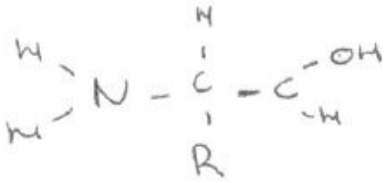
This response scored two of the three marks available.

(b) Fibrinogen and fibrin are both proteins.

A protein consists of a chain of amino acids joined together by bonds.

(i) In the space below, draw a diagram to show the structure of an amino acid.

(3)



Results Plus: Examiner Comments

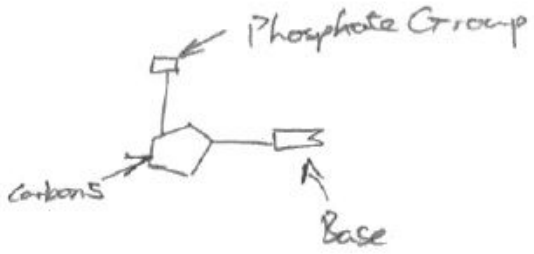
This is a typical example of a candidate who lost a mark for an error in the carboxyl group.

• (b) Fibrinogen and fibrin are both proteins.

A protein consists of a chain of amino acids joined together by bonds.

(i) In the space below, draw a diagram to show the structure of an amino acid.

(3)



Results Plus: Examiner Comments

This is an example of the many responses seen where the candidate drew a nucleotide rather than an amino acid. This is also a model rather than a structural diagram of the molecule.

Results Plus: Examiner Tip

When asked to draw the structure of a molecule, make sure you show the relevant atoms and bonds, particularly for functional groups.

Question (b)(ii)

Few problems with this question as over 80% of candidates recognised that amino acids are joined with a peptide bond. The most common error was naming a glycosidic bond instead.

(ii) Name the covalent bond that joins the amino acids into a chain.

(1)

Peptide

Results Plus: Examiner Comments

This is an example of the correct response.

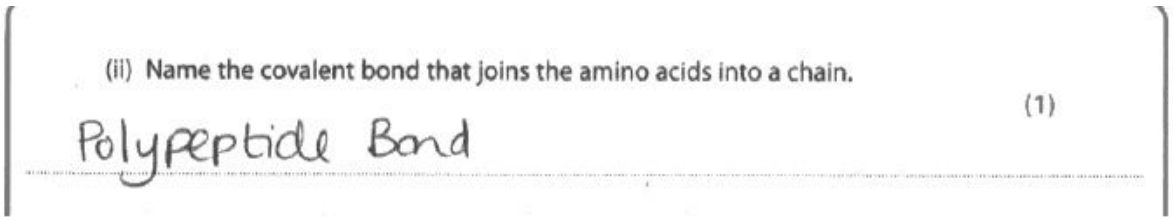
(ii) Name the covalent bond that joins the amino acids into a chain.

(1)

hydrogen bond

Results Plus: Examiner Comments

This is an example of an incorrect bond type. There are hydrogen bonds in a protein, but they are not covalent bonds and are not the principle bonds joining the amino acids together into a chain.


(ii) Name the covalent bond that joins the amino acids into a chain. (1)

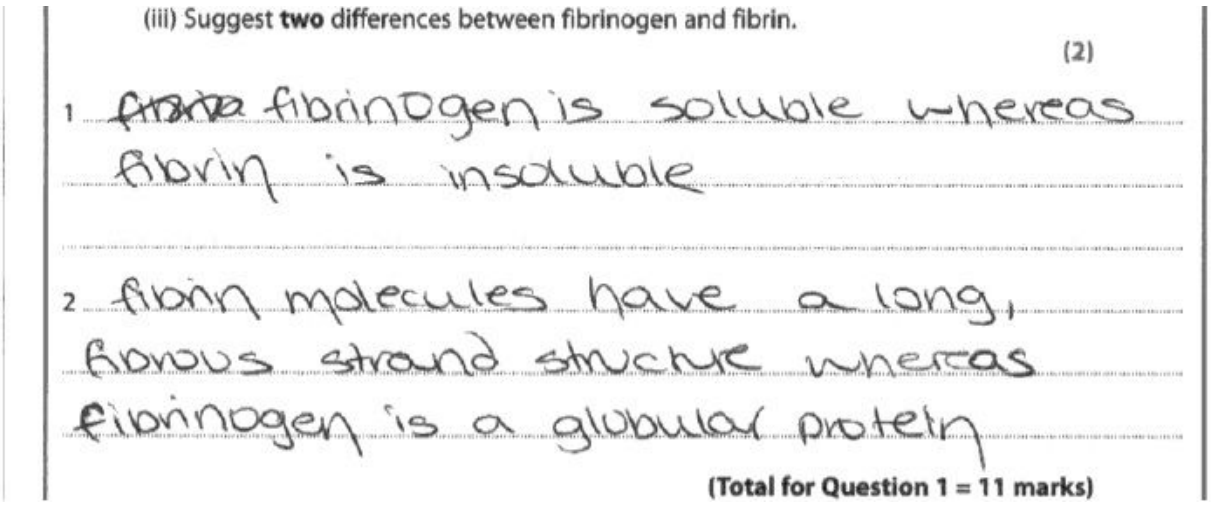
Polypeptide Bond

Results Plus: Examiner Comments

This response did not gain the mark as polypeptide is not the name of the bond but the molecule that is produced.

Question (b)(iii)

Many candidates gained one mark for recognising the different solubilities of the proteins. Better responses also recognised that the proteins were either globular or fibrous, or were different sizes. Several candidates got the two molecules the wrong way round and many did not make comparative comments by only referring to just one of the proteins. Many candidates gave low level descriptions of functions e.g. fibrin traps red blood cells, fibrinogen is an enzyme.


(iii) Suggest **two** differences between fibrinogen and fibrin. (2)

1 ~~fibrin~~ fibrinogen is soluble whereas fibrin is insoluble

2 fibrin molecules have a long, fibrous strand structure whereas fibrinogen is a globular protein

(Total for Question 1 = 11 marks)

Results Plus: Examiner Comments

This is an example of a response that gained both available marks.

This response scored no marks.

(iii) Suggest **two** differences between fibrinogen and fibrin.

(2)

1 fibrin are long strands

2 fibrin needs to be ~~ete~~ catalysed

Results Plus: Examiner Comments

Fibrin and fibrinogen. If they had stated that fibrin was long and fibrinogen was much shorter they would have gained a mark. Similarly if they had said that fibrinogen is a globular protein in comparison to this first statement they would have been given the mark even though it lacks some precision.

Results Plus: Examiner Tip

When asked for a difference between two things make sure you mention both in your response for a clear comparison.

Q11.

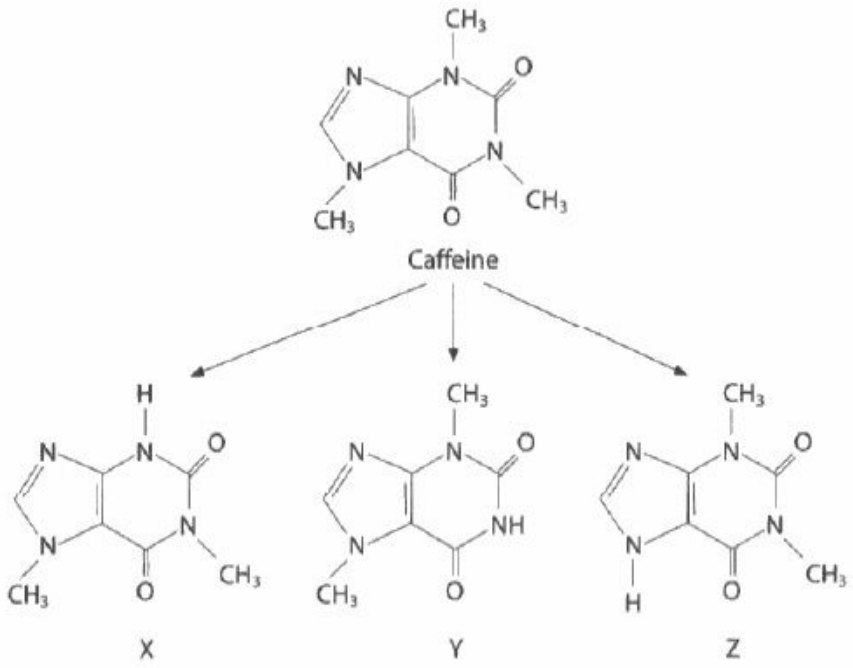
(a) (i) The majority of candidates could correctly name groups found within amino acids that were not present in caffeine - particularly amine and carboxylic acid groups. A few candidates had drawn an amino acid on the paper so that they could compare it visually with caffeine - a useful strategy for some.

This response scored both available marks.

6 Caffeine is a drug frequently consumed in a number of drinks such as coffee, cola, hot chocolate and tea.

Caffeine is broken down in the liver by a group of enzymes called cytochrome P450 oxidase.

(a) The diagram below shows the structure of caffeine and its three breakdown products, X, Y and Z.



(i) Using the information in the diagram, give **two** reasons why caffeine is **not** an amino acid.

(2)

1 It doesn't have a COOH group.

2 It doesn't have an NH_2 group.

Results Plus: Examiner Comments

This candidate has correctly identified two key groups found in amino acids but not caffeine.

Results Plus: Examiner Tip

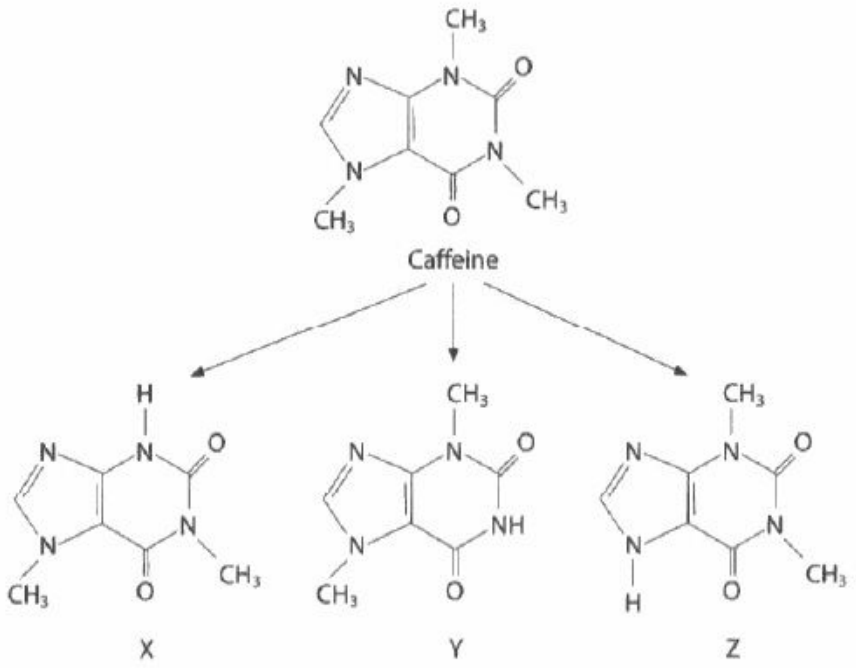
Many candidates named the groups rather than include the formula - either is acceptable in this context.

This response scored one of the two available marks.

6 Caffeine is a drug frequently consumed in a number of drinks such as coffee, cola, hot chocolate and tea.

Caffeine is broken down in the liver by a group of enzymes called cytochrome P450 oxidase.

(a) The diagram below shows the structure of caffeine and its three breakdown products, X, Y and Z.



(i) Using the information in the diagram, give **two** reasons why caffeine is **not** an amino acid.

(2)

1 It doesn't have an amino acid group

2 There are no peptide bonds.

Results Plus: Examiner Comments

The lack of amino group is correct. However, mentioning peptide bonds was a common error.

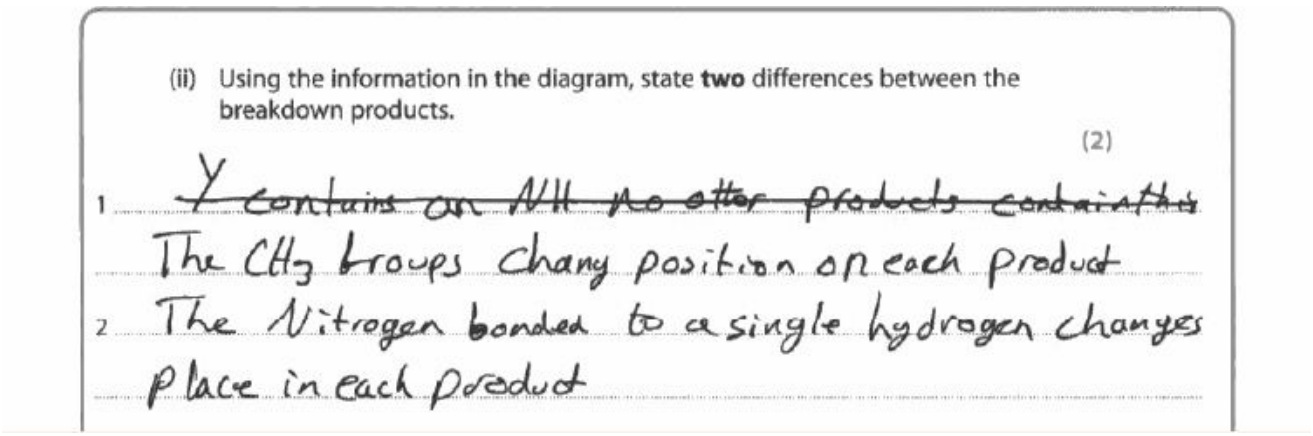
Results Plus: Examiner Tip

A single amino acid does not contain a peptide bond - they are only formed when amino acids are bonded together.

(a) (ii) Many candidates wrote clear answers correctly identifying that CH3 and H were bonded in different positions in the three molecules. A few excellent responses identified that the products were isomerically different.

However, many candidates did not express themselves very clearly in this question and answers sometimes had to be read very carefully to decipher their meaning. In a few cases candidates failed to count atoms correctly.

This response scores both marks available.



(ii) Using the information in the diagram, state **two** differences between the breakdown products.

(2)

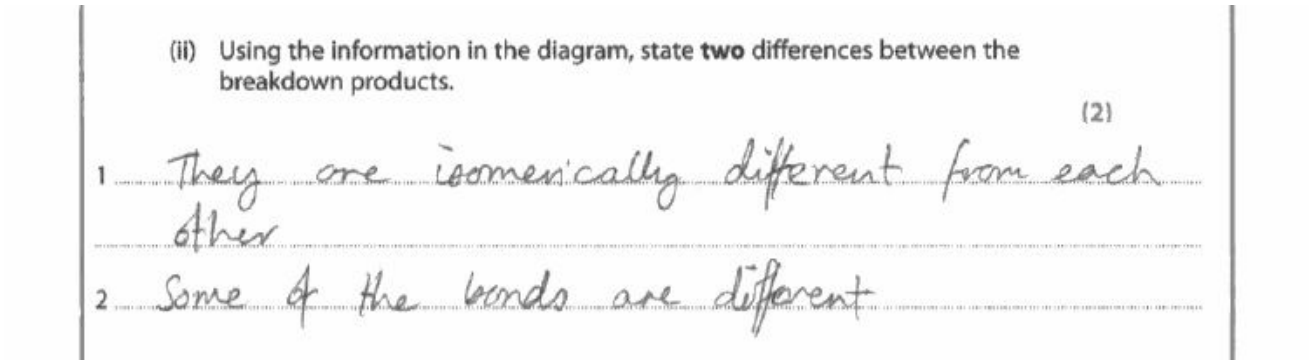
1 ~~Y contains an NH no other products contain this~~
The CH_3 troups chany position on each product

2 The Nitrogen bonded to a single hydrogen changes place in each product

Results Plus: Examiner Comments

Two clear differences have been correctly identified.

This response scores one mark.



(ii) Using the information in the diagram, state **two** differences between the breakdown products.

(2)

1 They are isomerically different from each other

2 Some of the bonds are different

Results Plus: Examiner Comments

It is an excellent point to recognise that the products are isomerically different, but the second point made is not specific enough for credit.

This response scored one mark.

(ii) Suggest why there are changes to the available energy (ATP) in the heart muscle cells following the loss of blood flow.

(2)

ATP energy is carried in the blood. After the loss of the flow of blood, the supply of ATP is cut off.

Results Plus: Examiner Comments

The first difference is correctly identified, but this candidate, along with several others, could not count the number of Nitrogen atoms correctly.

(a) (iii) Most candidates managed to score at least 1 mark in this question by stating that an enzyme is specific to its substrate.

Fewer candidates correctly referred to the difference in shape/structure of the products only stating that they were 'different products'. Many candidates also just referred to 'more than one enzyme' needed only (as stated in the question) and did not deduce that P450 consists of at least three enzymes/active sites.

Some candidates explained that more enzymes would be needed to speed up reactions to break down caffeine faster.

This response scores all three marks available.

(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

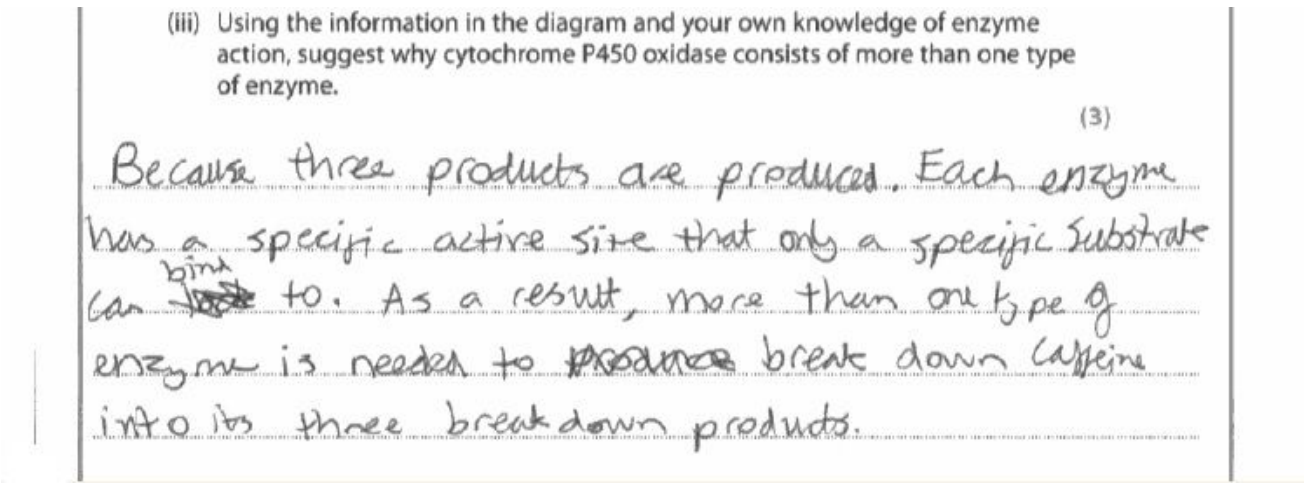
(3)

As enzyme have highly specific active sites where only one substrate can fit and form the right bonds - ~~as~~ as these are three products with different chemical structures - it must mean that cytochrome P450 must have 3 enzymes types to break caffeine in such a way.

Results Plus: Examiner Comments

This candidate recognises that enzymes are specific, the products have different structures and therefore there must be 3 enzyme types to produce the three different products.

This response scored one mark.



(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

(3)

Because three products are produced. Each enzyme has a specific active site that only a specific substrate can bind to. As a result, more than one type of enzyme is needed to ~~produce~~ break down caffeine into its three breakdown products.

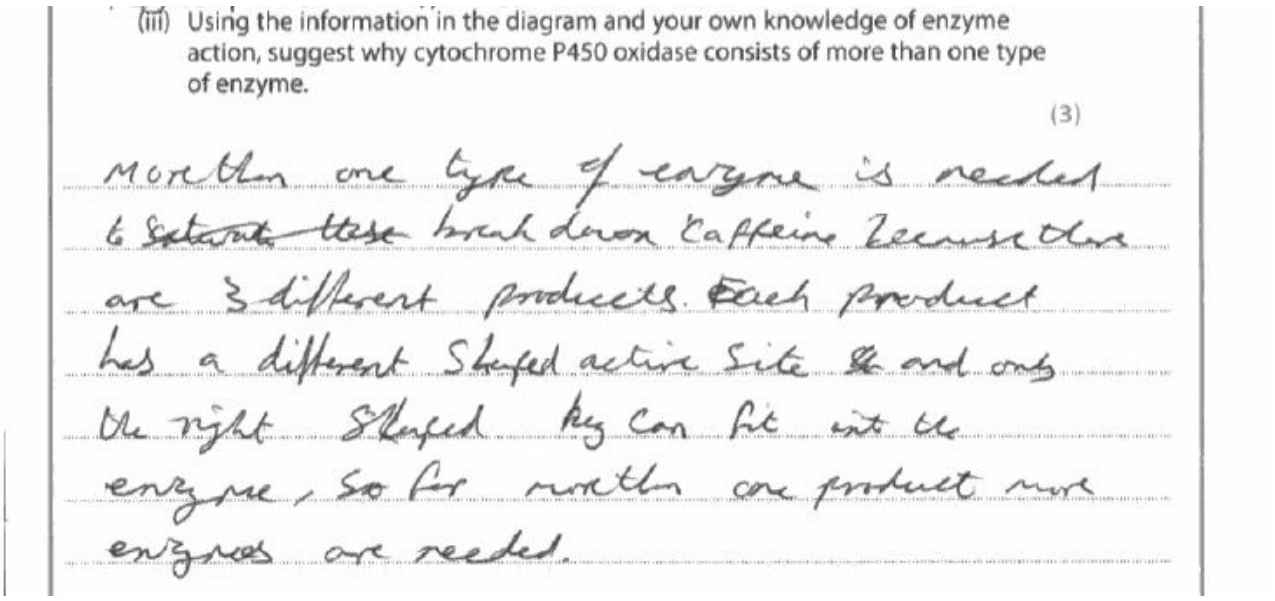
Results Plus: Examiner Comments

This is a typical example of one of the most common answers for this question. The candidate recognises that enzymes are specific, but they do not state what is different about the products and state that more than one type of enzyme is needed (as stated in the question stem).

Results Plus: Examiner Tip

Remember, you are not likely to score marks for repeating information from the question stem.

This response scores no marks.



(iii) Using the information in the diagram and your own knowledge of enzyme action, suggest why cytochrome P450 oxidase consists of more than one type of enzyme.

(3)

More than one type of enzyme is needed to ~~extent~~ these breakdown caffeine because there are 3 different products. Each product has a different Shaped active site & and only the right Shaped key can fit into the enzyme, so for more than one product more enzymes are needed.

Results Plus: Examiner Comments

Several candidates confuse the enzyme and substrate/ product and, as in this example, they state that the active site is part of the product and not the enzyme.

Results Plus: Examiner Tip

Remember the substrate fits into the active site of the enzyme.

(b) There were some very clearly expressed answers, but also some candidates did not refer to validity, despite this being asked for specifically in the question. They stated that a particular conclusion was 'true', 'false', 'correct' or 'incorrect'.

The lack of volume control was the most commonly expressed reason given, but it was pleasing to see some references to the number of drinks tested or not being able to calculate the concentration in all the drinks.

Some candidates correctly referred to the fact that coffee and hot chocolate did have different concentrations, but they did not always pair this up with a correct statement about validity.

When giving reasons for their answers some candidates included references to a lack of repeats. Many did not understand the difference between 'content' and 'concentration' and did not appreciate that without a stated volume it is impossible to calculate a concentration.

This response scores all three marks available.

(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
coffee	200 cm^3	135
cola	1 can	80
hot chocolate	200 cm^3	10
tea	1 cup	50

The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

(3)

Conclusion 1 This is not very valid as ~~he~~ he has ~~not~~ different volumes of drink, ~~you can~~ I can is an inaccurate measurement and could be ~~a~~ any thing it could be much less then 200cm^3

Conclusion 2 This is also invalid as it does not state how much coffee was used and you cannot compare to the others as there are inaccurate measurements and there is no control and it doesn't tell you if he repeated the test to make it reliable.

(Total for Question 6 = 10 marks)

Results Plus: Examiner Comments

The candidate makes comments on the validity of each conclusion and explains their reasons for doubting the validity.

This response scores two of the three marks available.

(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
coffee	200 cm^3	135
cola	1 can	80
hot chocolate	200 cm^3	10
tea	1 cup	50

The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

(3)

Conclusion 1 This conclusion is valid because the caffeine contents are all different depending on what type of drink is.

Conclusion 2 This conclusion is not valid because different ~~concentrations~~ volumes of drinks were used so therefore this experiment does not show valid data.

Results Plus: Examiner Comments

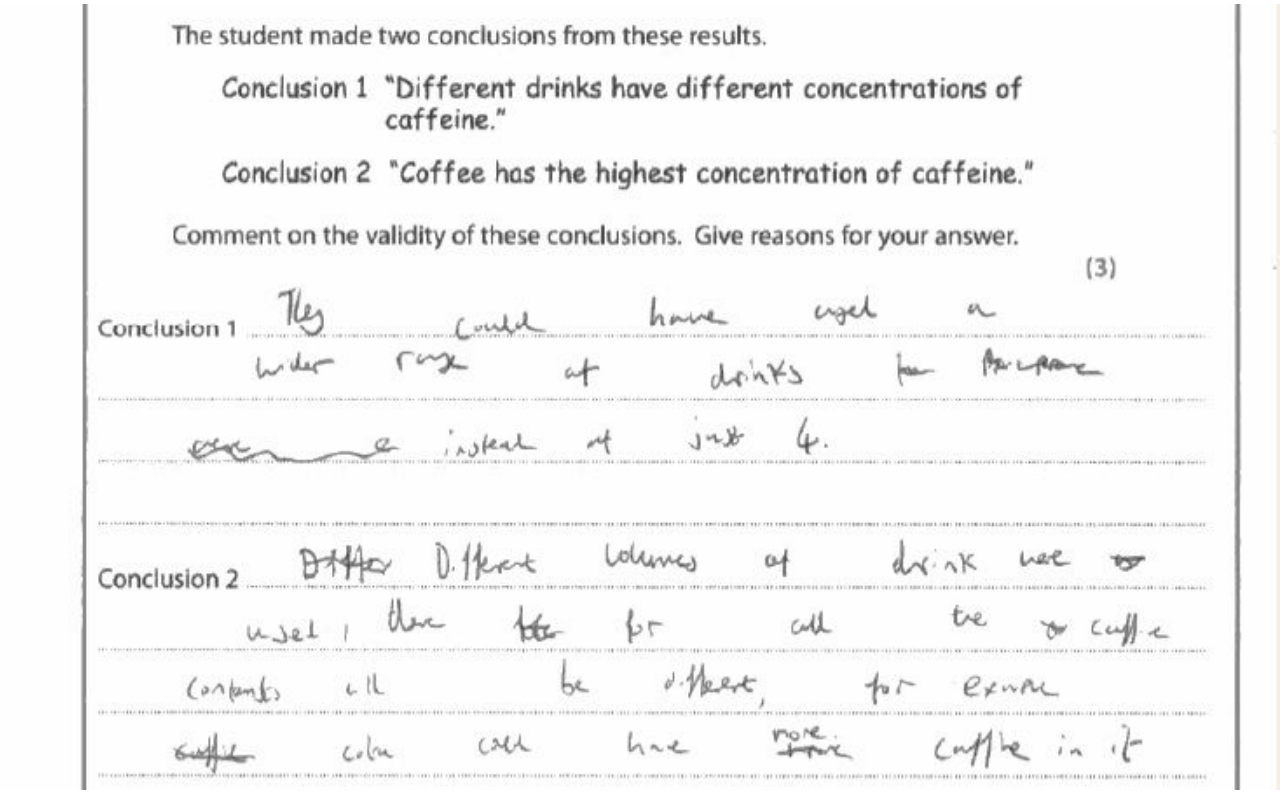
The candidate makes a correct comment on the validity of the second conclusion and explains their reasons for doubting the validity. However, they have confused concentration and content for the first conclusion.

This response scores two of the three available marks.

(b) A student decided to investigate the concentration of caffeine in four drinks: coffee, cola, hot chocolate and tea.

The student's results are shown in the table below.

Drink	Volume of drink	Caffeine content / mg
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The student made two conclusions from these results.

Conclusion 1 "Different drinks have different concentrations of caffeine."

Conclusion 2 "Coffee has the highest concentration of caffeine."

Comment on the validity of these conclusions. Give reasons for your answer.

(3)

Conclusion 1 They could have used a wider range of drinks for example instead of just 4.

Conclusion 2 Different Different volumes of drink was used, there for for all the coffee contents will be different, for example coffee cola will have more coffee in it

Results Plus: Examiner Comments

Two correct comments have been made - one for each conclusion. However, the candidate has not answered the question fully as they have not commented directly on the validity.

Results Plus: Examiner Tip

Read the question carefully and make sure you respond to the instructions given.

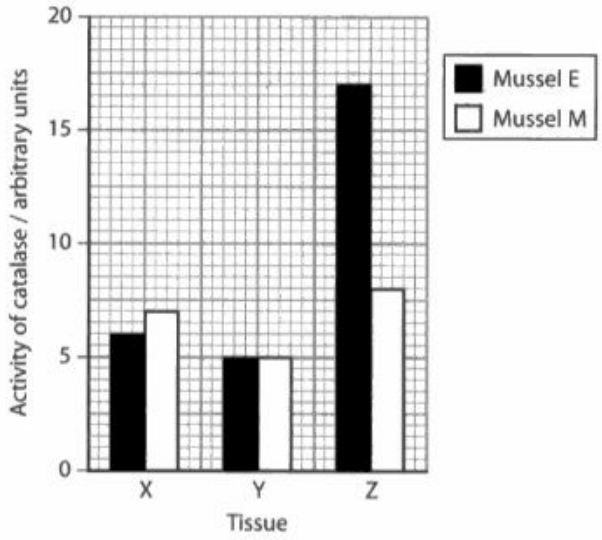
Q12.

(a) (i) Most candidates who answered the question gained marks for recognising that tissue Z has the highest activity, and tissue Y has the lowest activity. Fewer candidates stated that X and Y had similar levels, and some even stated that they had the same levels of activity. There were a few pleasing answers that correctly made the general statement that different tissues have different levels of catalase activity. It was also pleasing to see a good number of candidates scoring a mark for making a correct manipulation of the figures, usually stating the difference in activity between tissue Z and tissue Y, although some candidates failed to read the scale correctly.

It was disappointing to see a significant number of candidates completely misread this question and compare activity in mussels E and M instead of describing the activity of catalase in the tissues of mussel E.

This response scores all four marks available.

The graph below shows the results of this study.



(i) Use the information in the graph to state the conclusions that can be made about the activity of catalase in the tissues of mussel E.

(3)

The activity of catalase varies in all the tissues of mussel E; it is lowest in Y (at 5 arbitrary units) and highest in Z (at 17 units), with X being only slightly higher than Y (at 6 units). It has the most effect on Z - over three times more catalase activity is shown than in Y.

Results Plus: Examiner Comments

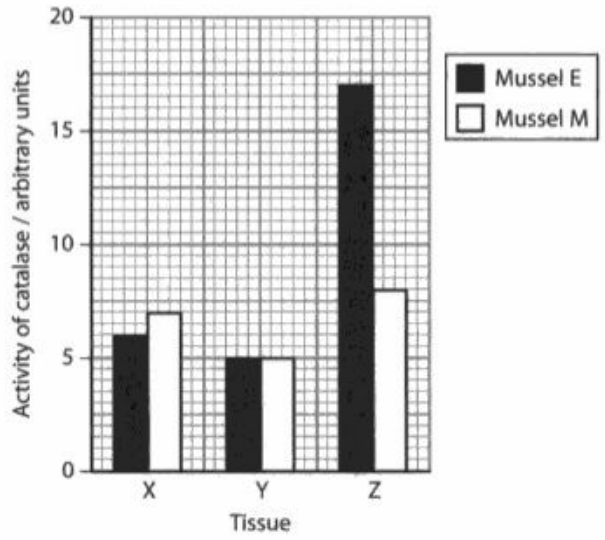
This candidate has made the general statement that catalase activity varies in all tissues, and that Z is highest and Y is lowest (and close to X).

Results Plus: Examiner Tip

This response would not get the manipulation of figures mark because recognising that Z has over three times more activity than Y is too vague. Make sure you bring a calculator into the exam and use it. The increase in activity is 3.4 times, which is over three times (but so are many other numbers e.g. 5).

This response failed to score any marks.

The graph below shows the results of this study.



(i) Use the information in the graph to state the conclusions that can be made about the activity of catalase in the tissues of mussel E.

(3)

Catalase is used more in tissue X by Mussel M than mussel E and, in tissue Y, mussel E and M use catalase equally to break down hydrogen peroxide. Finally, in tissue Z, mussel E has a much higher activity of catalase than mussel M as it is almost double of it. So mussel E primary

Results Plus: Examiner Comments

This response is typical of the many candidates who did not answer the question asked but chose to compare mussel E with mussel M instead. They also lack clarity in some of their statements. For example 'almost double' is not clear enough for a manipulation of figures mark, and 'mussel E primary activity is in the Z tissue' is not clear enough to be interpreted as stating that tissue Z had the highest activity of catalase in mussel E.

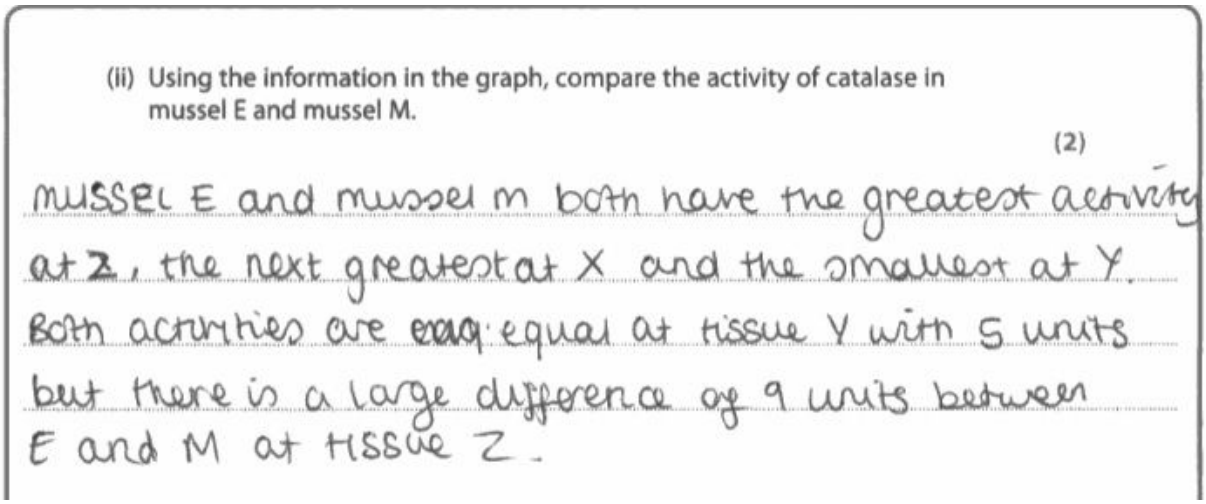
Results Plus: Examiner Tip

Read the whole question carefully, in this case you would have spotted that this answer corresponds to the question asked in ii.

(a) (ii) Most candidates managed to identify at least one clear statement directly comparing the activity of mussel E and mussel M in a particular tissue (often all three). Many candidates also gained the manipulation of figures mark for stating the difference between the mussels in tissue X or for tissue Z.

It was pleasing to see some candidates recognising that mussel E has more overall activity. Very few candidates recognised that the order of activity was the same in both mussels.

This response gained both available marks.



(ii) Using the information in the graph, compare the activity of catalase in mussel E and mussel M.

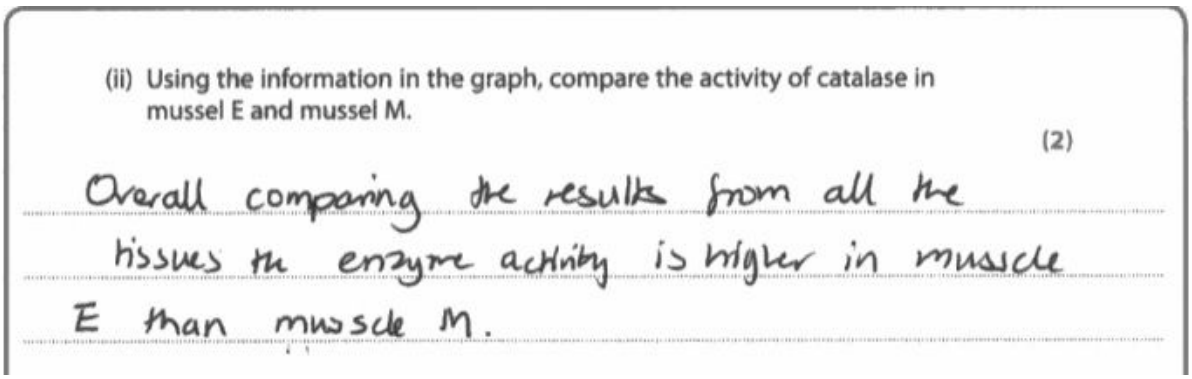
(2)

MUSSEL E and mussel M both have the greatest activity at Z, the next greatest at X and the smallest at Y. Both activities are ~~exa~~ equal at tissue Y with 5 units but there is a large difference of 9 units between E and M at tissue Z.

Results Plus: Examiner Comments

This candidate recognised that the order of activity is the same in both mussels and that activity is the same in tissue Y. They have also calculated the difference between the mussels in tissue Z.

This response scores one of the two available marks.



(ii) Using the information in the graph, compare the activity of catalase in mussel E and mussel M.

(2)

Overall comparing the results from all the tissues the enzyme activity is higher in muscle E than muscle M.

Results Plus: Examiner Comments

This candidate provides a good comparison of the overall activity in the two mussels, but has not gone on to make any other comparisons or calculate how much higher the overall activity is, so only matches one mark point.

Results Plus: Examiner Tip

If a comparison question is worth more than one mark you will need to make more than one statement and/ or back up your comparison with some supporting manipulation of figures.

b This question achieved a full spread of marks from 0 to 4. Surprisingly only a small amount of

candidates managed to score all four available marks, despite this being a straightforward question on experimental design.

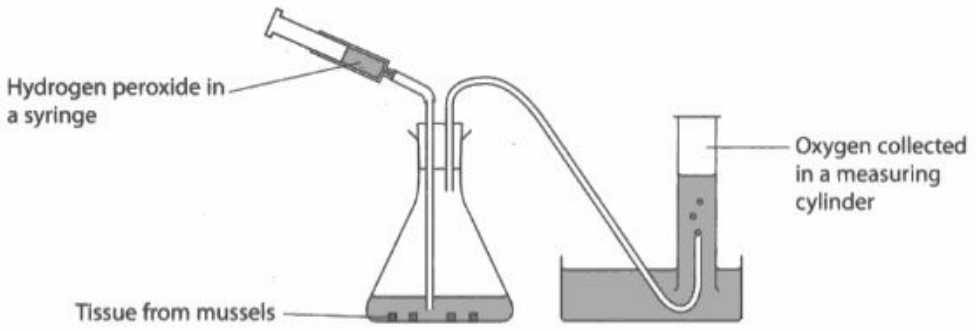
The most common correct answer was that candidates recognised the need to repeat measurements for reliability.

Many candidates lost marks for controlling variables or measuring oxygen produced by using the vague term *amount* instead of specifying something that can be measured e.g. the volume of oxygen produced, the volume of hydrogen peroxide added, the mass of tissue, etc.

The best candidates recognised that to compare activity of the tissues, they would want to measure the initial rate of reaction.

This response scored one of the four marks available.

Tissue from mussels is placed in the flask and hydrogen peroxide is added using the syringe. The oxygen produced from the breakdown of hydrogen peroxide is collected in the measuring cylinder.



Describe how this apparatus could be used to compare the catalase activity in two different types of mussel.

(4)

Both mussels would be placed in ~~the~~ seperate flasks ~~a~~ and the same amount of hydrogen peroxide would be added. The change in oxygen collected for each ~~more~~ tissue from the muscles would be recorded. The tissue with the greatest change would be the one with the higest activity of catalases. The same size pieces of tissue would have to be used under the same conditions, for example at room temperature.

Results Plus: Examiner Comments

Many of the variables stated in this example are too vague for credit e.g 'change in oxygen collected' should be 'volume of oxygen' or 'number of bubbles counted'; same amount of hydrogen peroxide;room temperature.

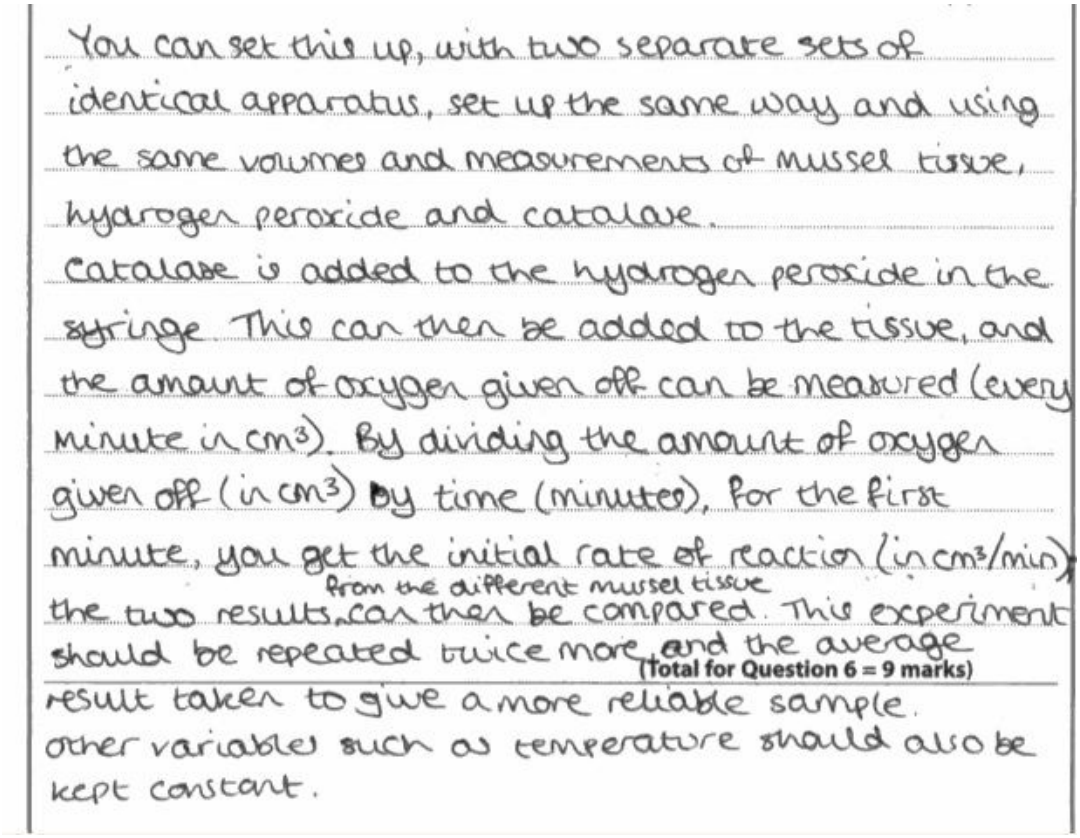
There is also no reference to time or repeats.

They did however get credit for reference to using the same size pieces of tissue.

Results Plus: Examiner Tip

When describing experiments be clear about your dependent and control variables, and avoid the term *amount*.

This response scored all four marks available.



You can set this up, with two separate sets of identical apparatus, set up the same way and using the same volumes and measurements of mussel tissue, hydrogen peroxide and catalase.
Catalase is added to the hydrogen peroxide in the syringe. This can then be added to the tissue, and the amount of oxygen given off can be measured (every minute in cm^3). By dividing the amount of oxygen given off (in cm^3) by time (minutes), for the first minute, you get the initial rate of reaction (in cm^3/min); from the different mussel tissue the two results can then be compared. This experiment should be repeated twice more and the average result taken to give a more reliable sample. other variables such as temperature should also be kept constant.

(Total for Question 6 = 9 marks)

Results Plus: Examiner Tip

This candidate clearly states a variety of clear variables to control, and has demonstrated a clear understanding of how they could calculate an initial rate of reaction. They have also recognised the value of repeats. Although 'amount of oxygen' is not clear enough for credit for the dependent variable alone, this response would have just been given credit as they have qualified their answer by stating what units to use.

Q13.

(a) This question scored very highly with over 70% of candidates gaining all three marks available. Virtually all of the candidates knew that the main part of the membrane was made up from phospholipids and due to their chemical properties there had to be a bilayer -however, a significant number of candidates didn't explain about the molecules' orientations, expecting credit marks for stating that the phospholipid was hydrophilic at the head end and hydrophobic on the tails. Most candidates recognised the presence of protein with many providing further clarification e.g. with reference to carrier/channel/intrinsic protein or glycoprotein. A significant

number of candidates also recognised the presence of cholesterol in the membrane structure.

Quite a few candidates aided the clarity of their answers through the use of clear annotated diagrams.

Unfortunately, a few candidates described function rather than structure and therefore did not score any/many marks.

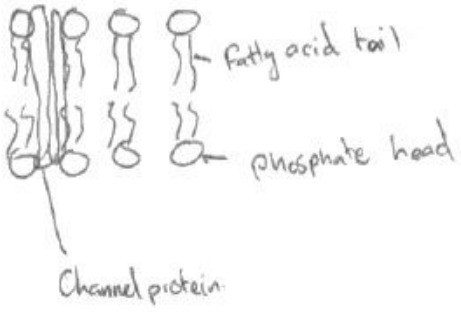
This response scores all three marks available.

3 Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

(3)

A Phospholipid bi layer. This Consists of a phosphate head which is hydrophillic and two fatty acid tails which are hydrophobic. They align with the heads facing out and tails facing together. (as shown) ~~This enables them~~ With channel proteins and other types of proteins, to allow larger and or polar molecules through



Results Plus: Examiner Comments

This response gains credit for:

- phospholipids;

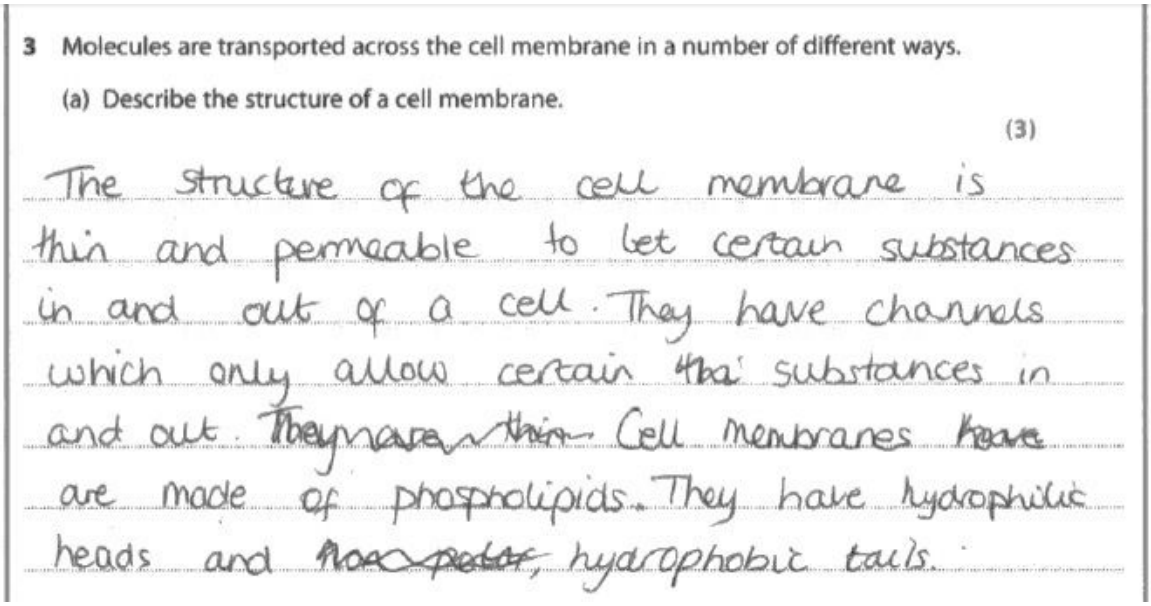
- the orientation of the phospholipids;

- channel proteins.

These points are also supported with a helpful labelled diagram that shows the orientation of the phospholipids and the position and nature of the channel protein and would have been able to gain the marks itself.

Results Plus: Examiner Tip

Annotated diagrams are often an effective way to clarify points and gain the marks available, particularly when describing structures.



3 Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

(3)

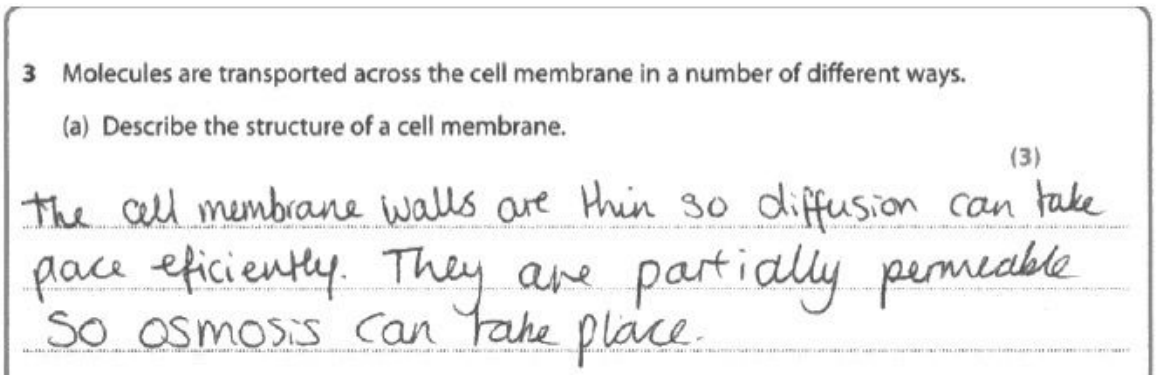
The structure of the cell membrane is thin and permeable to let certain substances in and out of a cell. They have channels which only allow certain substances in and out. ~~They have thin~~ Cell membranes ~~have~~ are made of phospholipids. They have hydrophilic heads and ~~non polar~~, hydrophobic tails.

Results Plus: Examiner Comments

This response gains just one mark for recognising that phospholipids are an important part of a membrane. The statements about the heads and tails is not enough for further credit as it has not been used to describe the orientation of the molecules in the membrane. Describing the function of the membrane is not relevant to the question asked.

Results Plus: Examiner Tip

Remember that cell membranes are not only made from phospholipids and if you are describing the structure of a membrane describe the orientation of the phospholipids in the bilayer.



3 Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

(3)

The cell membrane walls are thin so diffusion can take pace eficiently. They are partially permeable so osmosis can take place.

Results Plus: Examiner Comments

This is an example of a response that gained no marks because the candidate has not described the structure of the membrane as asked.

Results Plus: Examiner Tip

When asked to describe the structure of something focus on the components and arrangement of the molecules in the structure and do not be distracted by the function of the membrane.

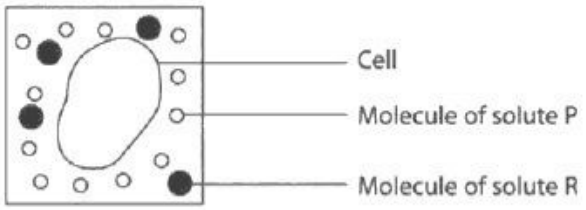
(b) (i) This question achieved the full range of marks. The majority of candidates recognised that solute P moved into the cell by diffusion down a concentration gradient for three marks, with many also recognising that it reaches equilibrium. However, a significant number of candidates confused osmosis and diffusion, either referring to solute P as water or stating that the particles diffused by osmosis. Others described the movement being "along a concentration gradient" that is not clear enough for credit. A number of candidates described the pattern of molecules every 10 minutes rather than stating the points clearly.

Rarely did candidates appreciate that the membrane was impermeable to solute R but often referred to the "cell not needing R" or "R was too big to fit through".

This response gains all five marks available.

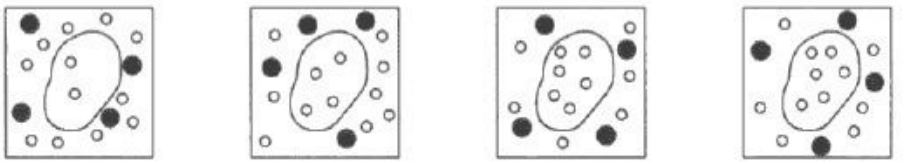
(b) Cells were placed in a solution containing two different solutes, solute P and solute R.

The diagram below represents the concentration of the two solutes outside one of the cells, when this cell was placed in the solution.



The cells were left in the solution for 50 minutes.

The diagrams below represent the concentrations of the two solutes, inside and outside the cell after 10, 20, 30 and 40 minutes in the solution.



(i) Using the information in the diagrams, describe the changes that have taken place in the concentrations of solute P and solute R, in the 40 minute period.

Suggest an explanation for these changes.

(5)

Solute P began with six molecules outside the cell and zero inside. After 10 minutes two molecules had entered. After 20 minutes this had doubled to 4 molecules entering. By 30 minutes half of the molecule P entered the cell, 6 molecules, this remained the same after 40 minutes although they had moved around.

This may have happened due to diffusion. Diffusion is the passive movement of particles from an area of high concentration to an area of low concentration. At the start Molcule P was concentrated outside the cell, with none inside so they diffused in. This continued until concentration was even, after 30minutes, then stopped. This was because net diffusion would remain unchanged. Solute R's molecules do not enter the cell. This may be because they are too large and endocytosis is not taking place.

Results Plus: Examiner Comments

The direction and explanation for the movement of solute P is described for four marks and they correctly state that solute R does not enter the cell.

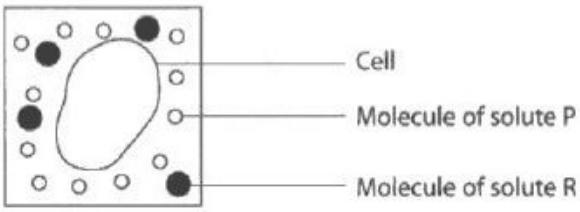
Results Plus: Examiner Tip

The first paragraph of this response is not very useful. Do not waste time by listing the numbers of molecules (data points) for every measurement. Most credit comes from identifying the correct trends, which in this case are successfully covered in the second and subsequent paragraphs.

This response scores four of the five marks available.

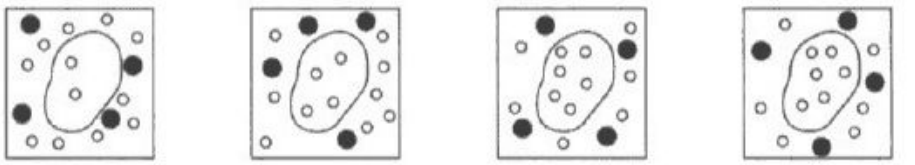
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The cells were left in the solution for 50 minutes.

The diagrams below represent the concentrations of the two solutes, inside and outside the cell after 10, 20, 30 and 40 minutes in the solution.



After 10 minutes | After 20 minutes | After 30 minutes | After 40 minutes

(i) Using the information in the diagrams, describe the changes that have taken place in the concentrations of solute P and solute R, in the 40 minute period.

Suggest an explanation for these changes.

(5)

up to 20 mins
~~As the length of time increases~~ the concentration of solute p increase inside the cell and decreases outside the cell this is because diffusion is taking place ~~through the cell~~ and the solute goes from a high concentration (outside the cell) to a low concentration (inside the cell). At 30 mins and 40 mins the concentration stays the same inside and outside the cell because it has reached an equilibrium so there is no concentration gradient for diffusion to happen. The concentration of solute R stays the same all the time because the particles are too large for diffusion to take place

Results Plus: Examiner Comments

This response gives a good description and explanation of the changes that take place with solute P and therefore gains the maximum marks for that part of the question. However, they have not stated that R does not go into the cell or that the membrane is impermeable to R so fail to gain the full 5 marks.

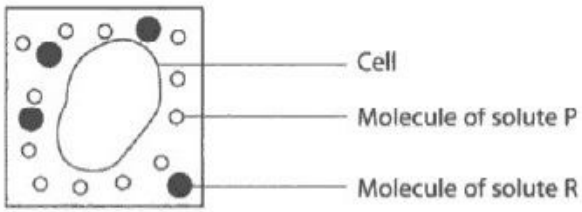
Results Plus: Examiner Tip

The concentration remains the same is not clear enough for an alternative to recognising that solute R does not enter the cell when comparing P and R. When answering questions aim to make positive clear statements.

This response gains two of the five marks available.

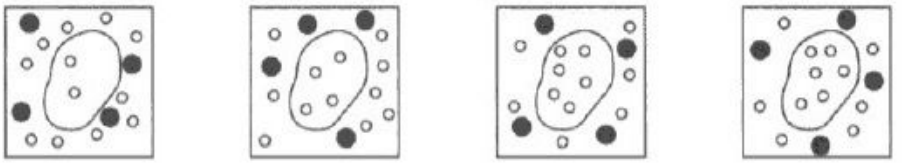
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(i) Using the information in the diagrams, describe the changes that have taken place in the concentrations of solute P and solute R, in the 40 minute period.

Suggest an explanation for these changes.

(5)

In the 40 minute period molecule of R is evenly spaced out ~~as~~ outside the cell and as are the molecules P because there are 6 molecules P inside the cell and 6 molecules of P on the outside of the cell. A reason for this would be osmosis which is the net movement of water A solute from an area of high concentration to an area of low concentration through a partially permeable membrane. Osmosis process occurs until equilibrium has been reached by the solute molecules, which ~~is~~ is why there is an equal ~~as~~ amount of solute P molecules both inside and out of cell.

Results Plus: Examiner Comments

The reference to osmosis in this response is clearly incorrect, but it did not stop them gaining

credit for recognising that the solute moved down a concentration gradient until equilibrium was reached.

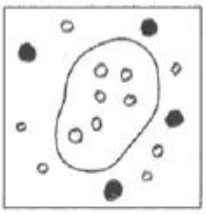
Results Plus: Examiner Tip

Don't forget that osmosis is the movement of water not solutes.

(b) (ii) The vast majority of candidates gained the mark for this question. There were a small number of careless answers missing a circle and also some with 2 larger black circles inside the cell and 2 outside. Any crossing out was generally clearly done, allowing access to the mark.

(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)

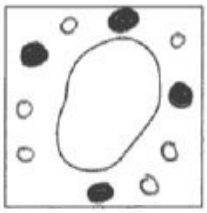


Results Plus: Examiner Comments

This is an example of the correct response that gained the mark.

(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)



Results Plus: Examiner Comments

This response gains no marks because solute P has disappeared from inside the cell.

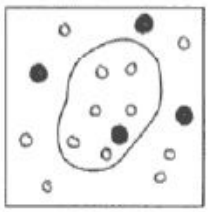
Results Plus: Examiner Tip

The question asks candidates to show the concentration both inside and outside the cell so do

not just partially answer the question asked.

(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)

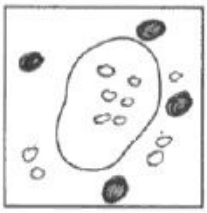


Results Plus: Examiner Comments

This response did not gain the mark because a molecule of R has slipped into the cell.

(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)



Results Plus: Examiner Comments

This response did not gain the mark because there are only five molecules of solute P drawn outside the cell.

Q14. In (a) candidates generally demonstrated an extremely good understanding of the structure of the cell membrane, with many candidates providing both a description and a diagram. Some candidates would not have gained access to some marks as their diagrams had not been suitably labelled and it was fortunate in many cases that some of these points had been covered in their descriptions. The quality of many of the diagrams was very good, but candidates should remember to label clearly. The majority of responses featured references to the phospholipid bilayer, the structure and orientation of phospholipids, hydrophobic and hydrophilic interactions and the presence of proteins. There were fewer references to protein locations and the presence of cholesterol. In a number of cases, although glycoprotein and glycolipids were referred to, they were not correctly described or properly labelled.

Item (b) was well answered by the majority of candidates. Marks were gained mainly for the idea

of molecules being small, non-polar or for being lipid (fat) soluble. However, very few responses referred to the idea of molecules being recognised by receptors. Also, some candidates did not gain access to marks because they referred to 'size', 'solubility' or 'polarity' without qualifying these descriptions. A small number of candidates did not read the question stem properly and referred to concentration gradients.

In item (c) was equally well answered with candidates generally demonstrating a good understanding of how diffusion and active transport take place and most scored well, especially on the differences between the mechanisms.
For similarities, responses frequently included references to the use of carrier or channel proteins, although a number of answers referred to proteins without qualifying this answer properly. Fewer responses referred to transporting hydrophilic, charged or polar molecules and there were some vague answers using the term transport protein.
Differences were covered using some very clear descriptions showing the requirement for ATP (energy) or the direction of transport with respect to the concentration gradient.

Q15. ***Question (a)***

This question was very well answered, with most candidates correctly identifying and stating the hydrophilic and hydrophobic nature.

Most candidates were not specific about the attraction of the hydrophilic heads to water (often it was that they "turn to water" or "face water" or are "in water"). Many candidates merely used the terms "water loving" and "water hating" to describe the orientation.

Several candidates got their heads and tails mixed up, or described the whole phospholipid as being polar with a positive head and a negative tail.

Some candidates answered from the point of view of arrangement in relation to function rather than orientation of molecules in a polar environment. Few clearly identified the significance of aqueous environment each side of the bilayer.

This response gains all three marks available.

6 The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

(3)

Phospholipid bilayers are formed due ~~to~~ to the phospholipids hydrophilic and hydrophobic nature. The phospholipid head is hydrophilic, this means that it is attracted to water and therefore will form the outer layer of the bilayer. ~~and~~ The tails of the phospholipid are hydrophobic, this means they repel water and hence go to the inside of the bilayer and form a fluid centre.

Results Plus: Examiner Comments

As well as describing the heads and tails as hydrophilic and hydrophobic, this response has also gained credit for recognising that the heads are attracted to water that causes their orientation.

This response gained two of the three marks available.

6 The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

(3)

phospholipid molecules form a bilayer because the phosphate head is hydrophilic and is arranged so that it faces outwards and the fatty acid tail is hydrophobic so it faces inwards. This makes the phospholipid bilayer soluble so it can be transported in a solvent easily.

As well as Phospholipids, there are also glycoproteins and glycolipids present, arranged like tiles in a mosaic.

Also Cholesterol is present and bonds with the phospholipid molecules making the membrane very rigid.

A bilayer is formed to allow small molecules like glucose to enter it by diffusion and large molecules cannot and need channel or carrier proteins to do so.

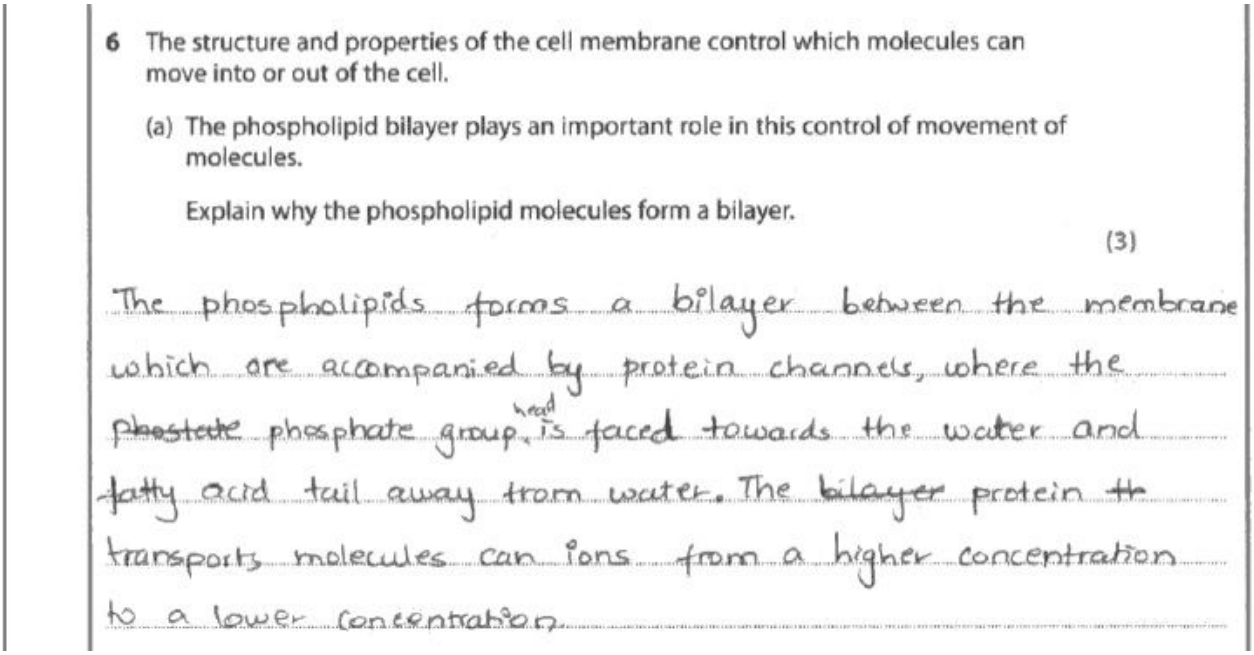
Results Plus: Examiner Comments

The candidate correctly identifies the hydrophilic and hydrophobic parts of the phospholipid for two marks. However, they fail to go on to explain the orientation of the molecules in the membrane in relation to the aqueous surroundings. Instead they are distracted by functions of the membrane and other features.

Results Plus: Examiner Tip

Concentrate on the question asked and avoid distractions if possible.

This response gained one of the three marks available.



6 The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

(3)

The phospholipids forms a bilayer between the membrane which are accompanied by protein channels, where the ~~phostate~~ phosphate group, head is faced towards the water and fatty acid tail away from water. The ~~bilayer~~ protein th transports molecules can ions from a higher concentration to a lower concentration.

Results Plus: Examiner Comments

This candidate has gained credit for the orientation of the fatty acid tails, but has not explained why the heads and tails will face in opposite directions.

The phosphate head facing the water is not sufficient for credit as it is chemically attracted to the water.

Question (c)(i)

Q(b):

Few candidates struggled to identify the correct transport processes for these multiple choice questions. The most common error was to either mark more than one process against the description, or to confuse facilitated diffusion, osmosis and diffusion (probably by ignoring the example molecule or ion transported by this method included in the table).

Q(c)(i):

Candidates often demonstrated poor writing skills in comparing the two models. They often described the fluid mosaic model but didn't compare it to the D-D model and struggled with the terms intrinsic proteins, protein channels and often just referred to the bilayer. Many just focussed on the lack of detail seen in the D-D model.

Many did, however, recall that cholesterol/glycoproteins were present in the fluid mosaic model.

This response gains both available marks.

(i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

(2)

Davson Danielli model has protein layer outside the phospholipid bilayer, where the fluid mosaic model has protein layer with the phospholipid bilayer. There is no indication of any cholesterol or glycoprotein and glycolipid in the Davson Danielli model where as the fluid mosaic model shows ~~glyco~~ glycoprotein and glycolipids along with integral and peripheral protein

Results Plus: Examiner Comments

This example of a very good response gains credit for recognising:

- both models have proteins and a phospholipid bilayer;
- the proteins are distributed differently in the two models;
- the fluid mosaic model includes other components in addition to the proteins and phospholipids, unlike the D-D model.

This response scored no marks.

(i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

(2)

The Dawson-Danielli model is very basaic, however the fluid mosaic model is more detailed showing you all components involved.

Results Plus: Examiner Comments

This response is typical of many responses that compared the simplicity of the models without going into details about the components themselves.

This response failed to score any marks.

(i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

(2)

The Davson - Danielli model has 3 three layers. Whereas, the fluid mosaic model has only two layers. ~~Cphospholipi~~ called the ~~phospholipid~~ bilayer.

Results Plus: Examiner Comments

This simplistic comparison of the models does not gain any credit, particularly as the D-D model is labelled as having a phospholipid bilayer.

Question (c)(ii)

This question was poorly answered by the majority of candidates. Many candidates did mention protein carriers/channels but not their function. Few recognised the likely inability of D-D model to carry out osmosis, diffusion, exocytosis or endocytosis.

This response gained both marks available.

(ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

(2)

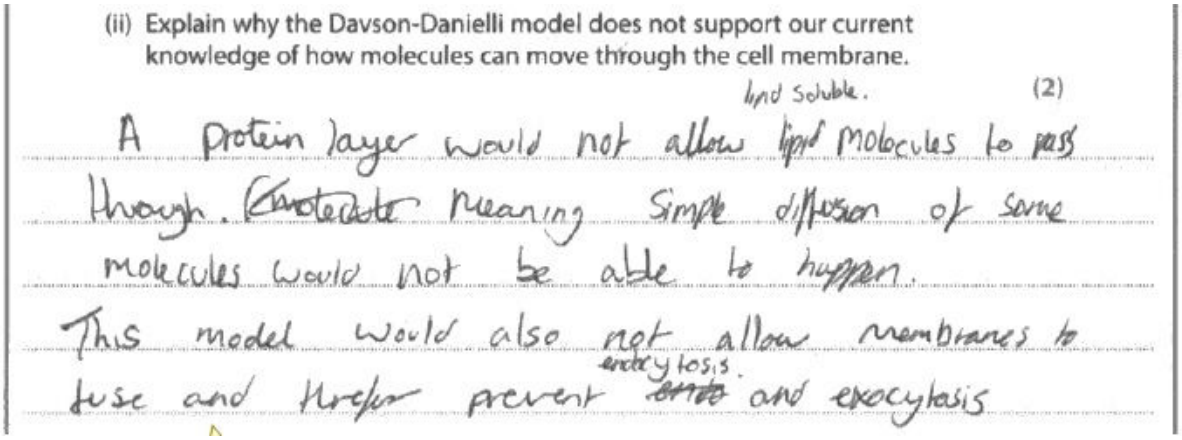
It doesn't show the different ~~proteins~~ protein types needed for the different transport methods. For example carrier proteins for active transport or channel proteins for facilitated diffusion. It also would not be able to explain the processes of Endocytosis or Exocytosis by vesicles for the cell membrane

(Total for Question 6 = 10 marks)

Results Plus: Examiner Comments

The candidate has clearly linked the lack of carrier proteins in the D-D model to the relevant transport process. They have also recognised that model will make endocytosis and exocytosis impossible.

This response gains both marks available.



(ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

(2)

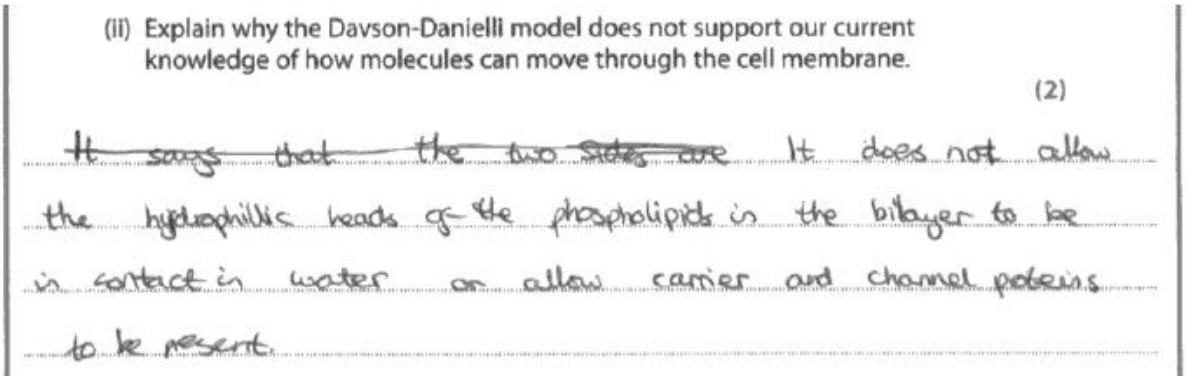
A protein layer would not allow lipid soluble. lipid molecules to pass through. ~~Protein~~ meaning simple diffusion of some molecules would not be able to happen.

This model would also not allow membranes to fuse and therefor prevent endocytosis. ~~and~~ and exocytosis

Results Plus: Examiner Comments

This candidate has recognised that the protein layer will be a barrier to diffusion and the barrier to membrane fusion will prevent endocytosis and exocytosis.

This response failed to score any marks.



(ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

(2)

~~It says that the two sides are~~ It does not allow the hydrophillic heads of the phospholipids in the bilayer to be in contact in water or allow carrier and channel proteins to be present.

Results Plus: Examiner Comments

The reference to carrier and channel proteins is correct, but unfortunately is not enough for credit as they need to be linked to a transport process for how molecules can move through the cell membrane.

Q16.

(a) Many candidates gave a correct definition often stating that 'one variable causes a change in another variable'. Some candidates correctly used examples, but sadly, others did not use examples properly to bring out the idea of causation. A significant number of candidates read it as "casual relationship", another indication of candidates not reading questions carefully enough - a recurring theme. There were a significant number of candidates who did not gain the mark by simply mentioning trends, links, relationships, correlations etc.

7 There is evidence for a causal relationship between blood cholesterol levels and cardiovascular disease (CVD).

(a) Explain the meaning of the term **causal relationship**.

(1)

When a change in one variable causes a change in another variable, this is a causal relationship between the variables.

Results Plus: Examiner Comments

This is an example of a response that gained the mark.

7 There is evidence for a causal relationship between blood cholesterol levels and cardiovascular disease (CVD).

(a) Explain the meaning of the term **causal relationship**.

(1)

~~The~~ A trend is shown between two variables

Results Plus: Examiner Comments

This is an example of a response that failed to gain the mark - a causal relationship is more than just a trend.

(b) (i) Most candidates demonstrated a good understanding of protein structure. Most gained marks for mentioning peptide bonds, providing details of the secondary structure and naming further bonds responsible for the folding of the protein. Few candidates provided specific details of where the peptide bonds form and many just mentioned primary structure without making it clear what the primary structure actually is.

This response gains all four marks available.

(b) Lipoproteins are composed of phospholipids, cholesterol and proteins.

(i) Proteins are made up of amino acids.

Describe how amino acids join together to form the three-dimensional structure of a protein.

(4)

amino acids are joined by peptide bonds between the amine group and the carboxyl group. They get there 3D structure from the order of amino acids which determines where hydrogen bonds form which product beta pleats and alpha helix. Ionic bonds also form aswell as disulphide bridges between R groups containing sulpher. All of these bonds help determine the 3D shape.

Results Plus: Examiner Comments

Mpt 1, 2, 5, 4 and 6 given

This response gains credit for:

- peptide bonds;

- where the peptide bond forms;

- describing the secondary structures;

- naming other bonds involved;

- recognising that bonds are formed between the R groups.

(b) Lipoproteins are composed of phospholipids, cholesterol and proteins.

(i) Proteins are made up of amino acids.

Describe how amino acids join together to form the three-dimensional structure of a protein.

(4)

Amino acids go through many stages to break down, ~~[illegible]~~ they then go into secondary structure where molecules form a chain - tertiary where they coil up tight and they then gain hydrogen bonds to hold the structure together.

Results Plus: Examiner Comments

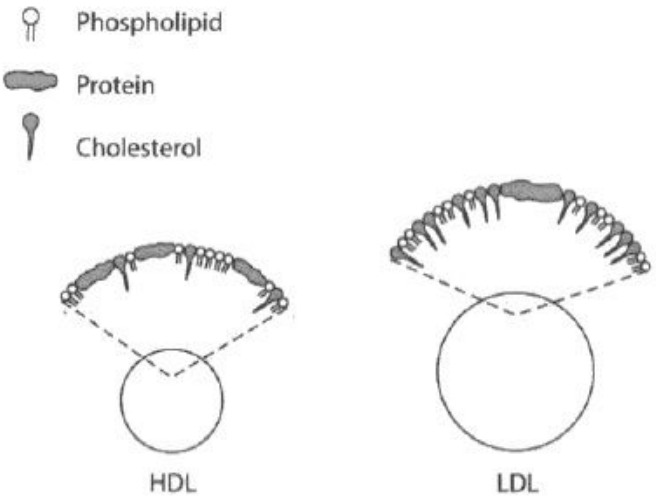
This response gains just one of the available four marks for recognising that hydrogen bonds are involved.

Results Plus: Examiner Tip

Just naming secondary and tertiary structure is not enough - make sure you describe what they are.

(b) (ii) The vast majority of candidates managed to gain both available marks for making clear comparisons between HDL and LDL. Where marks were lost it was for often just stating the number of molecules in the diagram or for comments about the surface area. Some candidates lost marks for using the words 'high' or 'low' rather than lower / higher / more / less etc. A number of candidates compared protein and cholesterol levels within either HDL or LDL rather than compare cholesterol or protein levels between HDL or LDL.

(ii) The diagrams below show part of the structure of the surface of high-density lipoprotein (HDL) and low-density lipoprotein (LDL).



Using the information in the diagram, describe the differences between the structure of HDL and the structure of LDL.

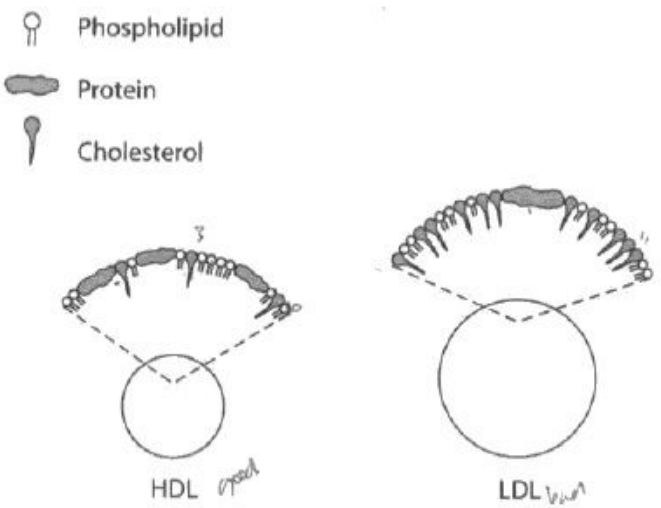
(2)

LDL's contain ~~more~~ many more cholesterol molecules compared to HDL. HDL also contain more protein compared to LDL. The LDL molecule is a lot bigger than the HDL molecule.

Results Plus: Examiner Comments

This response gained both marks having made three clear comparative comments.

(ii) The diagrams below show part of the structure of the surface of high-density lipoprotein (HDL) and low-density lipoprotein (LDL).



Using the information in the diagram, describe the differences between the structure of HDL and the structure of LDL.

(2)

LDL consists of one protein where as HDL consists of three. LDL contains 11 cholesterol molecules while HDL only has 3 cholesterol molecules.

Results Plus: Examiner Comments

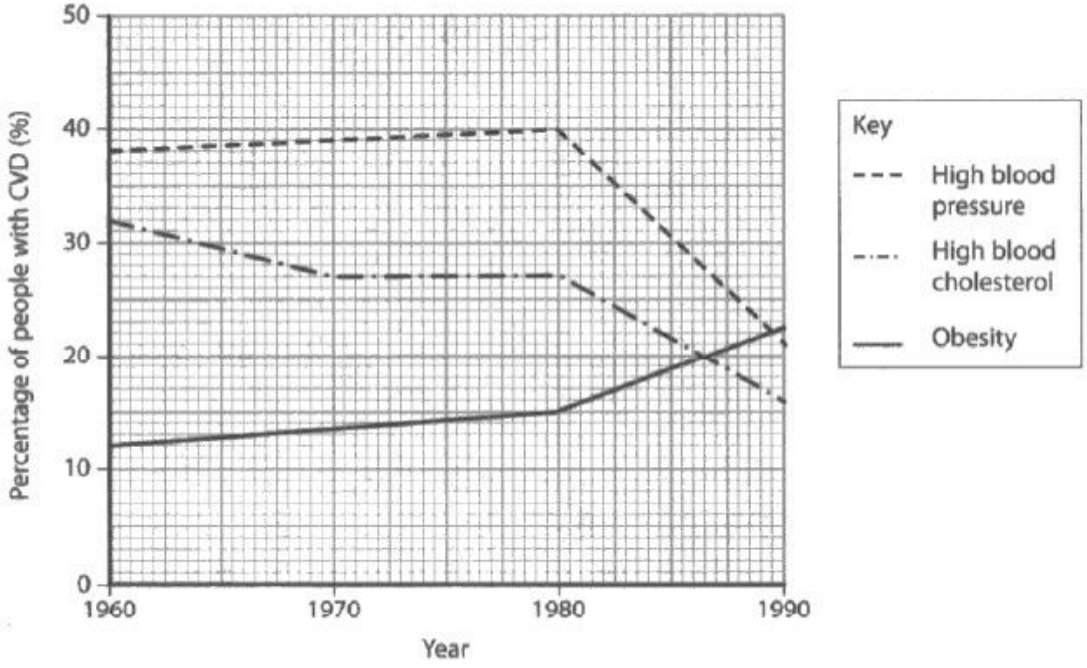
Just counting the molecules in the small part of the molecule depicted is not sufficient for the comparison so this response gained no marks.

(c) (i) With this question too many candidates failed to follow the instruction to describe overall changes (1960 - 1990) and only described changes between 1980 and 1990 or described changes for each decade leaving the examiner to link all the parts of their answer together. As a result many candidates did manage to pick up a couple of marks e.g. for the trend for obesity but often lost the mark for blood pressure by failing to make the overall trend clear by just describing a "steady increase" and "rapid decrease".

This response gained all three marks available.

(c) Obesity and high blood pressure are also factors that increase the risk of CVD.

The graph below shows the percentage of people with CVD who have high blood pressure or have high blood cholesterol or are obese for the period 1960 to 1990.



(i) Using the information in the graph, describe the overall changes that have occurred in these risk factors during this period.

(3)

High blood pressure and cholesterol as a risk factor has decreased overall. High blood pressure decreasing by 17% and high blood cholesterol decreasing by 16%, half it's original percentages in 1960.

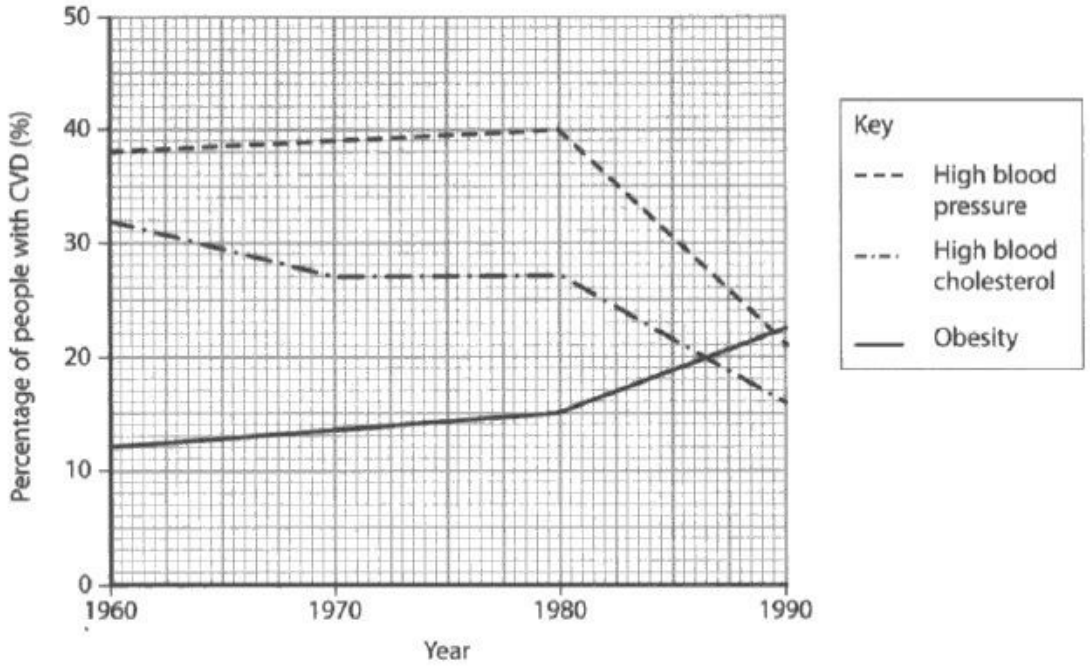
Obesity as a risk factor has increased overall, rising by ~~10½%~~ 10.5%.

Results Plus: Examiner Comments

This response correctly identifies all three overall trends, also supports the trends with some correct calculations of the overall changes in the risk factors.

(c) Obesity and high blood pressure are also factors that increase the risk of CVD.

The graph below shows the percentage of people with CVD who have high blood pressure or have high blood cholesterol or are obese for the period 1960 to 1990.



(i) Using the information in the graph, describe the overall changes that have occurred in these risk factors during this period.

(3)

high blood pressure and high blood cholesterol both rapidly reduces since 1980. Whereas high blood pressure dropped from 40% to 21%. Where as Obesity increased since 1980 and increased from 15% to 22.5%.

Results Plus: Examiner Comments

This response gained no marks because it only describes changes in the last ten years of the data rather than the total period of 1960-1990 as requested in the question.

Results Plus: Examiner Tip

Read the question carefully to make sure you cover the data required in your answer.

(c) (ii) The majority of candidates picked up one or two marks for this question. Where marks were lost, candidates vaguely referred to use of drugs to lower cholesterol, 'improving diet' or 'better medication'. A few candidates misread the question and described the effects of high cholesterol, or described ways to reduce blood pressure (such as using antihypertensives and eating less salt).

(ii) Suggest **two** reasons for the overall change in high blood cholesterol as a risk factor.

(2)

1 People have become more aware of healthy eating habits, so people have started eating less fatty foods with fewer saturated fats and fewer levels of LDLs.

2 Also, more people might have started taking medication, like statins, to lower their cholesterol levels. Introduction of specially designed foods like butter containing plant sterols and stanols can be commercially bought by people in shops, to reduce LDL levels but improve HDL levels.

Results Plus: Examiner Comments

This is typical of a response that gained both marks available for identifying two clear reasons for the drop in high blood cholesterol as a risk factor.

(ii) Suggest **two** reasons for the overall change in high blood cholesterol as a risk factor.

(2)

1 High blood cholesterol mean that there is more cholesterol in blood and if demeage to blood vessel happens, more cholesterol will be plugg the hole

2 LDLs especially are heard to break down so they stay in your blood for a while

Results Plus: Examiner Comments

This response gained no marks because instead of suggesting why high blood cholesterol is reducing as a risk factor, it attempts to explain why blood cholesterol is a risk factor.

Results Plus: Examiner Tip

Read the question carefully and answer the question asked.

(c) (iii) Most candidates could identify two risk factors for CVD. Failure to qualify an answer was the most common reason for not gaining the mark. For example just stating age instead of increase in age or just stating gender instead of indicating which gender (i.e. male).

(iii) State **two** factors, other than obesity, high blood pressure and high blood cholesterol, that increase the risk of CVD.

(1)

1 Smoking Gender - male

2 Excessive consumption of Age - older.

Results Plus: Examiner Comments

This response gained the mark because it provided suitable qualification of who is most at risk with both age and gender.

(iii) State **two** factors, other than obesity, high blood pressure and high blood cholesterol, that increase the risk of CVD.

(1)

1 smoking

2 genetic hereditary. poor diet

Results Plus: Examiner Comments

Smoking is a relevant factor, but poor diet is not specific enough so this response did not gain the mark available.

Q17.

In (a)(i), there were some candidates who confused themselves trying to describe the negative percentage changes and there were others who did not make directional comparisons. Candidates who did not make these mistakes picked up all three marks with ease. Parts (a)(ii) and (b) were not so high scoring, except by the more able candidates; the topic of these question parts is new material in the specification. Part (c) highlighted the fact that a number of candidates struggle to grasp some aspects of the How Science Works ideas and the terminology associated with it. There was a lot of confusion between incidence, which is what the data was showing, and risk, chance and likelihood. Some of the candidates who tried to quantify their statements were multiplying their values read from the graph by 1,000 to give the total number of individuals with heart disease. The small size of the graph was unfortunate and meant that some candidates had difficulty reading data off from the graph with accuracy.

Q18.

(i)

The vast majority of candidates identified that 8 would be the maximum number of amino acids that could be coded for by the mRNA molecule. 24 was the most common incorrect answer i.e. one amino acid per base.

(ii)

The majority of candidates wrongly stated 8 as the number of **different** tRNA molecules required. This was either because they did not pick up on the word different, or failed to spot that two of the codons were repeated. Some candidates did pick up on the word different, but only spotted one repeat so gave the answer incorrectly as 7.

Q19.

This question yielded some good answers.

In (a), candidates scored two marks fairly consistently and the grade A candidates three marks. Marking point 5 was less frequently awarded, either because the values were incorrectly read off from the graph or because candidates were simply quoting figures and not manipulating them.

Many candidates scored all three marks in (b). The commonest mistake was simply to write ***exercise*** or ***diet***, for example, without stating that these increased or improved respectively. Candidates have a good knowledge of the development of atherosclerosis. The grade E candidates generally scored two or three marks and the grade A candidates 4 max. Mistakes that were made included reference to fatty deposits for mp 4, the build up of plaque (as on teeth) for mp 6 and reference to the hardening of the arteries for mp 7.

Q20.

(a) This was answered very well by many candidates, who had obviously learned and understood the stages of atherosclerosis well. The majority of answers were set out in a logical order and therefore met the QWC criteria for this question. There were, however, some weak descriptions, which still managed to pick up 1 or 2 marks. Marks were often lost for vague descriptions which did not refer to the endothelium or lining of the artery OR which did not refer to the artery but only to the endothelium. A number of candidates also referred to narrowing of the artery rather than the lumen of the artery, thus losing a mark. Some extremely vague answers referred to 'reducing the size of the artery'.

Some candidates spent most of their time describing the blood clotting process rather than atherosclerosis.

This response scored all four marks available.

7 Cardiovascular disease (CVD) is responsible for many deaths.

*(a) One cause of CVD is atherosclerosis. Describe how atherosclerosis develops.

(4)

When Endothilial cells are damaged, there is an inflamatory response. White blood cells accumulate. Cholestarol also builds up at site. Calcium ions and fibrous tissue also build up, causing the atheroma to harden, resulting in a plaque. The blood vessels wall has now lost flexibility, and this results in higher blood pressure. This is a self perpetuating process.

Results Plus: Examiner Comments

This candidate has included nearly all points we were looking for in a logical sequence. The only significant omission is that they did not state that the endothelial cells are in the artery.

Results Plus: Examiner Tip

When a question is marked as a QWC response make sure you set your answer out in a logical sequence (like this example), as well as taking care over the spelling of key terms used.

(b) (i) Approximately only a third of candidates managed to explain the meaning of the term genotype, despite this being such a widely used term.

This is an example of a response that scored the mark.

(b) A number of factors have been identified that increase the risk of CVD. One of these factors is genetic.

The genotype of some individuals causes them to be more at risk of developing CVD. One gene that influences this risk is the *KIF6* gene. Carriers of the 719 Arg allele of this gene are more at risk of CVD.

(i) Explain the meaning of the term **genotype**.

(1)

Is the combination of the ~~genes~~ alleles inherited from your parents of different genes eg: could be homozygous or heterozygous.

Results Plus: Examiner Comments

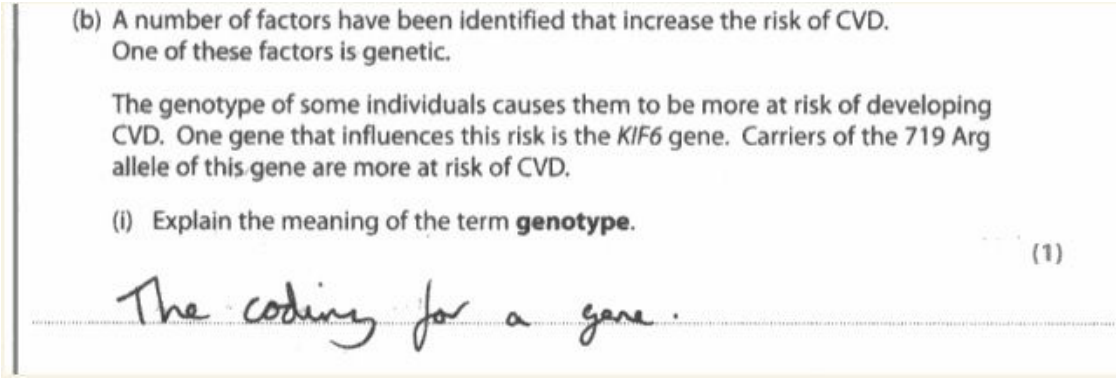
This is a typical good response that explained genotype in terms of the alleles an individual has.

Although not a very clear definition, this is how genotype is often described in a variety of textbooks, so this has been judged acceptable for the mark.

Results Plus: Examiner Tip

Although this was accepted, it is far better to provide a clear explanantion of the term, with reference to the alleles present in an organism.

This is an example of a reponse that failed to achieve the mark.


(b) A number of factors have been identified that increase the risk of CVD. One of these factors is genetic.

The genotype of some individuals causes them to be more at risk of developing CVD. One gene that influences this risk is the *KIF6* gene. Carriers of the 719 Arg allele of this gene are more at risk of CVD.

(i) Explain the meaning of the term **genotype**.

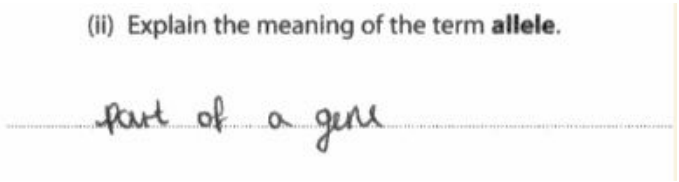
(1)

The coding for a gene.

Results Plus: Examiner Comments

Many candidates related answers to coding, or what the gene 'looks like', demonstrating a poor understanding of the term which is widely used.

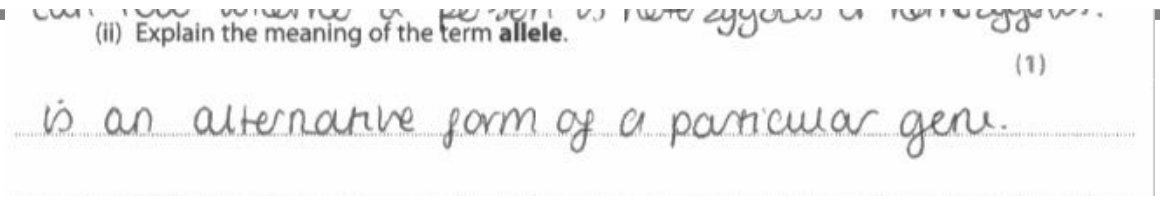
(ii) More candidates correctly explained the meaning of the term allele.


(ii) Explain the meaning of the term **allele**.

part of a gene

Results Plus: Examiner Comments

This is typical of the many incorrect explanations. Many candidates referred to coding, parts of genes or parts of chromosomes, without reference to alleles being different forms of a gene.


(ii) Explain the meaning of the term **allele**.

(1)

is an alternative form of a particular gene.

Results Plus: Examiner Comments

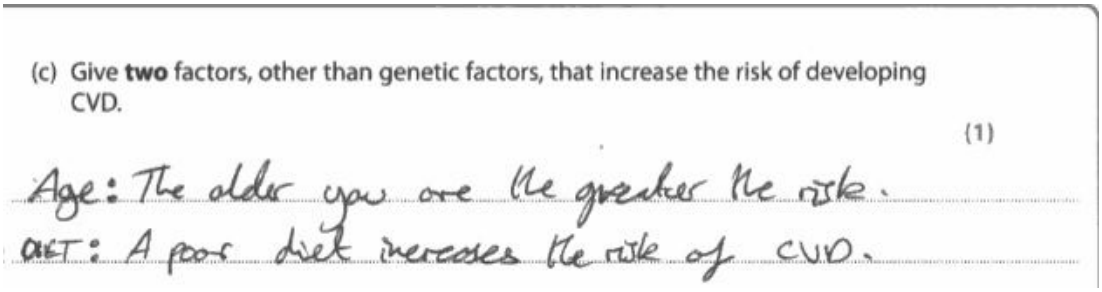
This is a typical example of a good credit worthy response.

(c) In this question, candidates were asked to identify two factors that increase the risk of developing CVD. Both factors named by the candidates needed to show clearly the increased risk of CVD. For example smoking and obesity are both conditions that clearly increase risk of CVD, howevever salt, diet, activity, etc by themselves do not increase the risk. These factors therefore need to be qualified e.g more salt, higher saturated fat

consumption, lack of exercise, become factors that increase risk.

Almost three quarters of candidates managed to identify two clear factors to gain the mark.

This is an example of a response that scored the mark.


(c) Give **two** factors, other than genetic factors, that increase the risk of developing CVD.

(1)

Age: The older you are the greater the risk.

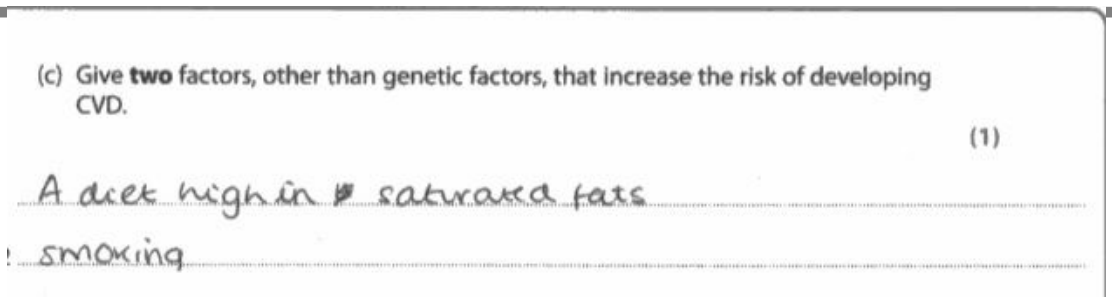
DIET: A poor diet increases the risk of CVD.

Results Plus: Examiner Comments

The comment about age is good in this response and has a clear direction for the increased risk. Unfortunately poor diet is too vague to be given credit.

Results Plus: Examiner Tip

When describing aspects of diet and risk for CVD, be as specific as possible e.g. increased saturated fat intake.


(c) Give **two** factors, other than genetic factors, that increase the risk of developing CVD.

(1)

A diet high in saturated fats

smoking

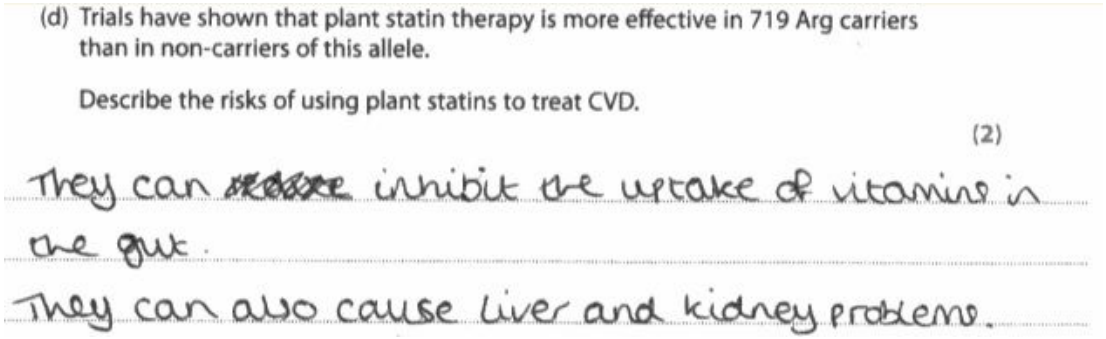
Results Plus: Examiner Comments

An example of a good response with two clear factors to gain the mark.

(d) This was well answered by many candidates who collectively identified many of the risks associated with the use of plant statins. The most common correct responses referred to liver, kidney and muscle problems. Nausea and constipation were also commonly identified.

Incorrect responses commonly referred to an increased risk of cancer, or the effects on blood pressure and vitamin absorption.

This response scored both available marks.


(d) Trials have shown that plant statin therapy is more effective in 719 Arg carriers than in non-carriers of this allele.

Describe the risks of using plant statins to treat CVD.

(2)

They can ~~reduce~~ inhibit the uptake of vitamins in the gut.

They can also cause liver and kidney problems.

Results Plus: Examiner Comments

This candidate has correctly recognised the risks of liver and kidney problems associated with statin use. However they also make reference to one of the most common errors of thinking they inhibit vitamin uptake.

Q21. ***Question (a)***

Many candidates failed to link the mutation to a change in the DNA base sequence – if anything, it was described as a change in the amino acid sequence, or an error in transcription.

Many candidates did, however, identify implications of stop codes, frame shifts, etc. and that a wrong protein would be synthesised, or transcription/translation would not occur. Some of the best responses recognised that a frame shift mutation would have a more significant impact on the protein than the substitution of a single base.

Many candidates did just mention mutations as 1 base change and then 1 amino acid change showing that many candidates think 1 amino acid change is automatically a completely different protein.

A majority of candidates merely concluded that the mutation would stop the protein being made – which was just repeating the stem of the question.

This response gains both available marks.

(a) For class I cystic fibrosis, suggest how a mutation in the CFTR gene could result in no CFTR protein being synthesised.

(2)

The mutation in the CFTR gene could change the sequence of bases on the CFTR gene. This could be through an inversion, insertion, duplication, deletion or substitution. This would in turn alter the mRNA sequence which travels to a ribosome, so would in turn alter the sequence of amino acids in the primary structure of the protein. For example, it may cause a stop codon to be introduced at the beginning of the triplet codons on the mRNA sequence, signalling to the ribosome to stop letting tRNA molecules bind to the mRNA, causing the protein to have no primary structure.

Results Plus: Examiner Comments

This response demonstrates a good understanding of different types of gene mutation and how they will affect the primary structure of a protein. It also provides a good example of a catastrophic mutation producing a stop codon in the wrong place.

This response gained no marks.

(a) For class I cystic fibrosis, suggest how a mutation in the CFTR gene could result in no CFTR protein being synthesised.

one or more ✓

(2)

During translation ~~the~~ incorrect anticodons could have joined resulting in ~~a faulty~~ no CFTR proteins being synthesised.

Results Plus: Examiner Comments

This response is typical of many responses that lacked precision and therefore did not gain any credit at this level.

This response gains both marks available.

(a) For class I cystic fibrosis, suggest how a mutation in the CFTR gene could result in no CFTR protein being synthesised.

(2)

A mutation such as a deletion or addition can change the sequence of bases. This means a different linear sequence of amino acids would be given. This is the primary structure and will affect/determine the tertiary structure of the protein due to interactions between R groups and different bonds such as ionic and hydrogen forming. Therefore, a different protein other than CFTR is produced. However, if substitution is on third base it might have no effect as it is said to be degenerate as more than one codon code for one amino acid

Results Plus: Examiner Comments

There is a good description of how a mutation could result in a different protein. In particular, the candidate has demonstrated a good understanding of the genetic code, including its degenerate nature, which is a level expected at A2 rather than AS level.

Question (b)

Many candidates knew the location of the CFTR protein but many failed to score full marks because the locations they gave were not precise enough e.g. "on cell membranes in lungs" rather than "in the cell membranes of lung epithelial cells".

Some candidates stated that the protein was on chromosome 7 confusing the gene with the protein.

This response gains both available marks.

(b) Class II cystic fibrosis results from the CFTR protein being located in the wrong place.

Describe the correct location for the CFTR protein.

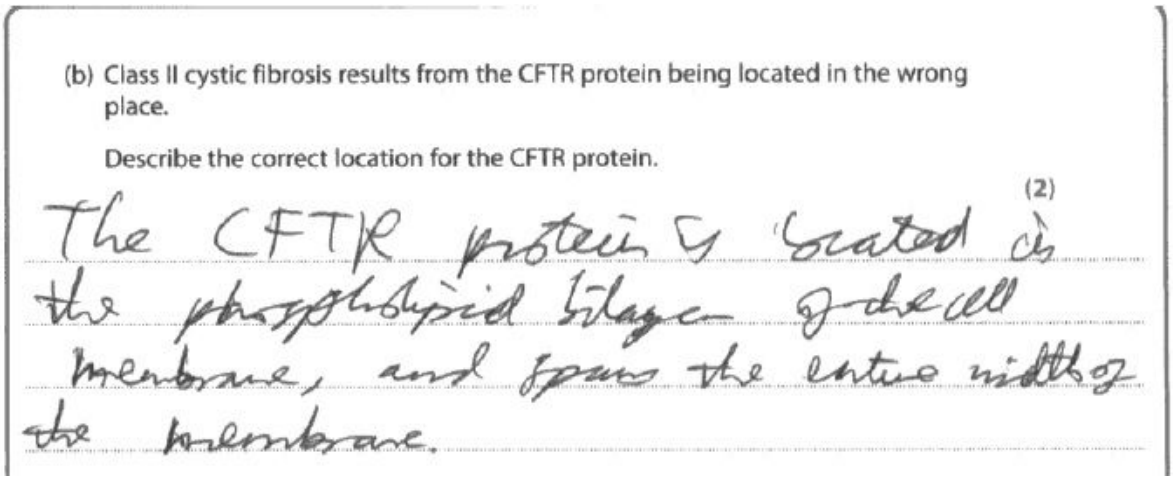
(2)

They are found incarporated within the phospholipid bilayer, like integral proteins. CFTR protein is found on cell surface membrane of mucus secreting cells present in trachea, bronchus, alveoli, ~~inten~~intestines, pancreatic ducts, and tracts of the reproductory system.

Results Plus: Examiner Comments

As well as getting the correct location in the cell for the protein, this candidate has also identified some cells it will be found in.

This response gains one of the two marks available.



(b) Class II cystic fibrosis results from the CFTR protein being located in the wrong place.

Describe the correct location for the CFTR protein.

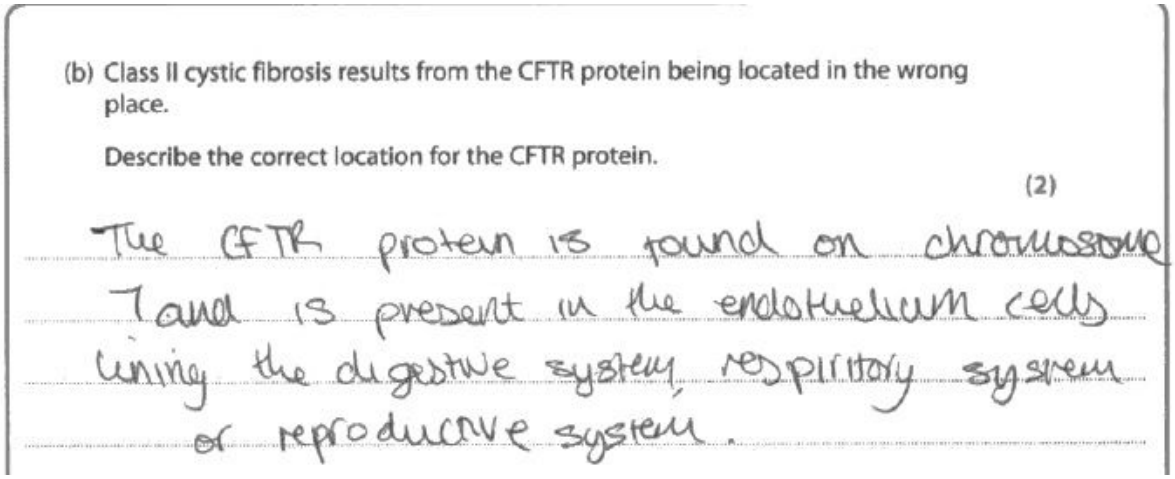
(2)

The CFTR protein is located in the phospholipid bilayer of the cell membrane, and spans the entire width of the membrane.

Results Plus: Examiner Comments

The candidate clearly identifies where in the cell you would find the protein, but not which cells it needs to be a part of.

This response gains one of the two marks available.



(b) Class II cystic fibrosis results from the CFTR protein being located in the wrong place.

Describe the correct location for the CFTR protein.

(2)

The CFTR protein is found on chromosome 7 and is present in the endothelium cells lining the digestive system, respiratory system or reproductive system.

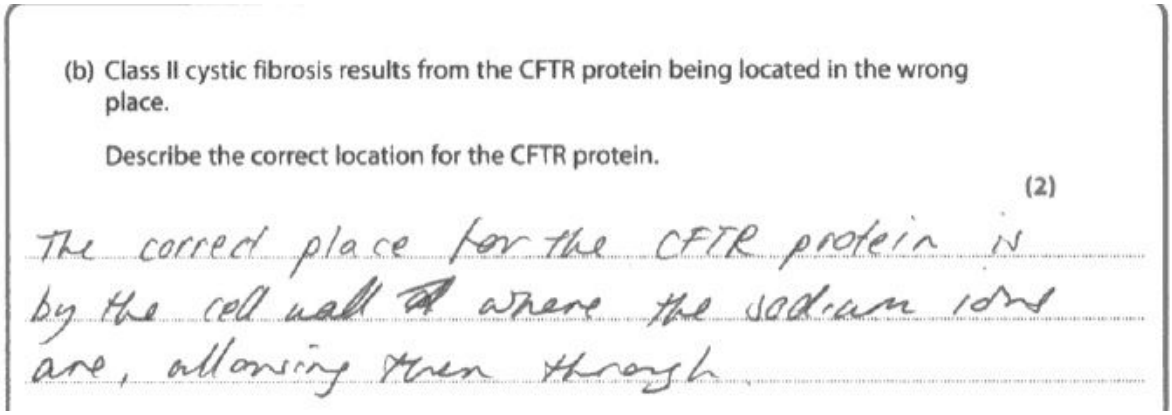
Results Plus: Examiner Comments

The candidate does not gain any credit for chromosome 7 as that is a position for the gene and not the protein. However, they have recognised which cells and systems the protein is needed in for a mark.

Results Plus: Examiner Tip

Try not to confuse genes and their products.

This is an example of a response that did not gain any marks.



(b) Class II cystic fibrosis results from the CFTR protein being located in the wrong place.

Describe the correct location for the CFTR protein.

(2)

The correct place for the CFTR protein is by the cell wall where the sodium ions are, allowing them through.

Results Plus: Examiner Comments

Remember you don't get cell walls in animals, but you do get walls made out of cells. Be very careful when using the term cell wall in a response unless you are describing a plant or bacterial cell.

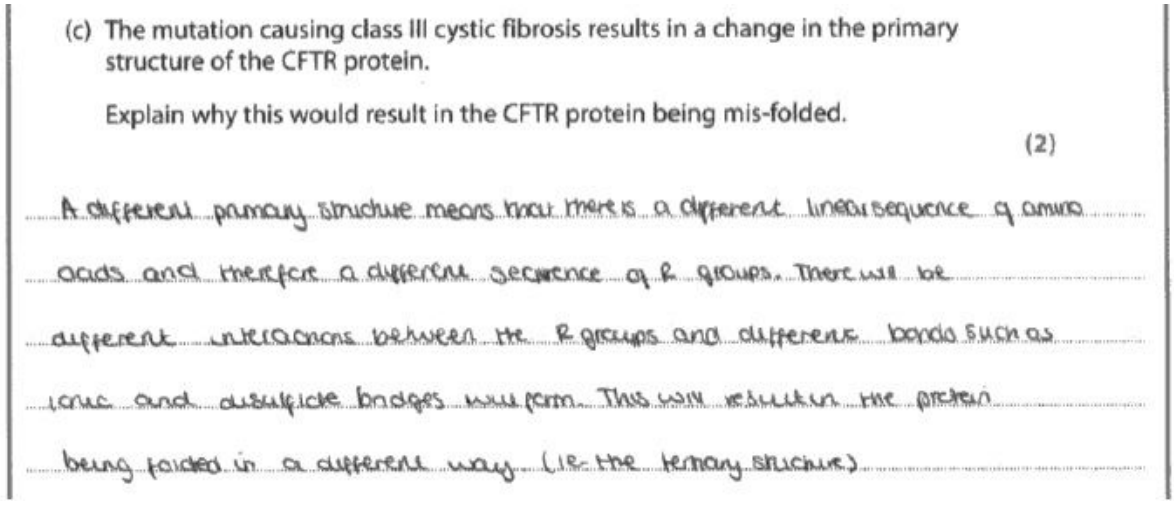
Question (c)

Many candidates could recall the primary structure definition well and most could then describe why this mis-folded. In direct contrast to question (a) many candidates described a change in the base sequence rather than amino acid sequence.

A significant number of candidates described the way in which the folding of the secondary structure would be wrong with reference to alpha helices and beta pleated sheets, without any mention of the bonding between the amino acids. Some referred to different peptide bonds.

Some candidates simply reworded the question in the answer.

This response gains both marks available.



(c) The mutation causing class III cystic fibrosis results in a change in the primary structure of the CFTR protein.

Explain why this would result in the CFTR protein being mis-folded.

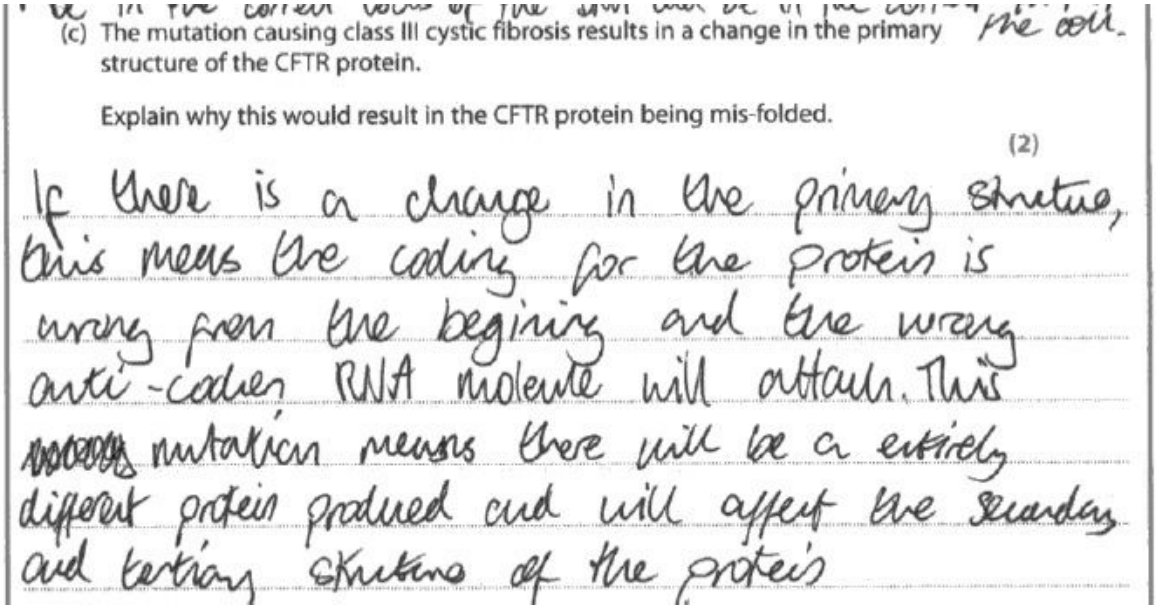
(2)

A different primary structure means that there is a different linear sequence of amino acids and therefore a different sequence of R groups. There will be different interactions between the R groups and different bonds such as ionic and disulfide bridges will form. This will result in the protein being folded in a different way. (i.e. the tertiary structure)

Results Plus: Examiner Comments

This response is typical of the many which demonstrated a good understanding of the primary structure of a protein and how the sequence of amino acids will affect the folding through the bonds made.

This response gained no marks.



(c) The mutation causing class III cystic fibrosis results in a change in the primary structure of the CFTR protein.

Explain why this would result in the CFTR protein being mis-folded.

(2)

If there is a change in the primary structure, this means the coding for the protein is wrong from the beginning and the wrong anti-codon RNA molecule will attach. This mutation means there will be a entirely different protein produced and will affect the secondary and tertiary structure of the protein

Results Plus: Examiner Comments

This response is typical of those that did not demonstrate an understanding of what the primary structure of a protein is, or how they are folded into their functional shapes.

Question (d)

Few candidates demonstrated a good recall and understanding of the CFTR function so the term channel protein was seldom used and many thought the CFTR channel transported sodium of calcium ions, or even chlorine. Many candidates confused the channel protein with an enzyme and there were a lot of references to active sites.

Many candidates gave a long but imprecise description of why you would get sticky mucus without addressing what this question asked with regard to the functioning of this protein.

This response gained both available marks.

(d) For class IV cystic fibrosis, explain why a faulty opening of the CFTR protein would affect the functioning of this protein.

(2)

A faulty opening of the CFTR protein, would mean that Cl^- ions could not move out of the cell into the mucus through CFTR channel protein. Therefore, Na^+ ions would move by facilitated diffusion from the mucus to the tissue fluid. Then it then by active transport into tissue fluid. This would create an electrochemical gradient which Cl^- ions would follow by diffusion. Resulting in water following by osmosis out of mucus making it thick and sticky.

Results Plus: Examiner Comments

This is an example of a good response from a candidate who clearly understands the causes of cystic fibrosis. Both marks needed for the question are covered in the first sentence. The rest of the response, although correct, is not relevant to the specific question asked about the functioning of the protein and is therefore not needed.

This response failed to score any marks.

(d) For class IV cystic fibrosis, explain why a faulty opening of the CFTR protein would affect the functioning of this protein.

(2)

Stops water entering into the cell membrane, causing the mucus to be thick and sticky.

Due to ~~Lack~~ increase in Sodium ions.

Results Plus: Examiner Comments

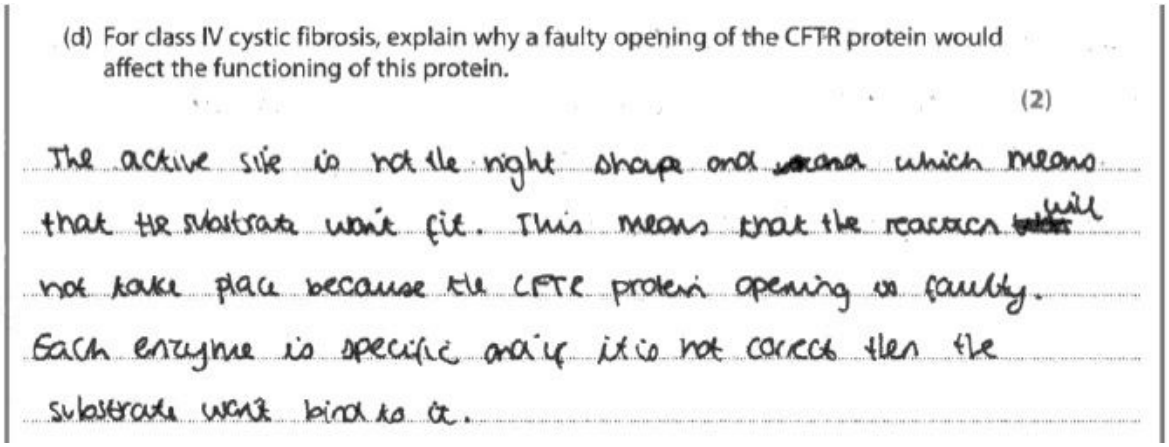
This is a typical response for those candidates who were aware of the some of the processes involved in the problems of cystic fibrosis, but did not answer the specific question asked.

Results Plus: Examiner Tip

This question specifically asks about the functioning of the CFTR protein which is not involved directly in the movement of water or sodium ions. Read the questions carefully and try to be as

precise as possible in your responses.

This response gained no marks.



(d) For class IV cystic fibrosis, explain why a faulty opening of the CFTR protein would affect the functioning of this protein.

(2)

The active site is not the right shape and ~~wrong~~ which means that the substrate won't fit. This means that the reaction ~~will~~ will not take place because the CFTR protein opening is faulty. Each enzyme is specific and if it is not correct then the substrate won't bind to it.

Results Plus: Examiner Comments

This response is typical of those who confused the CFTR protein with an enzyme and therefore failed to gain any marks.

Results Plus: Examiner Tip

All proteins have specific shapes that are important to their functions – not just enzymes and their active sites.

Question (e)

Many candidates failed to identify that there would be less chloride ions/water in the mucus, but described that the ions would move the wrong way, or not move (i.e. similar answers to some of the incorrect ones given in question (d))

When candidates did recognise that there would be an effect on the mucus they often simply said "sticky" rather than "stickier", not recognising that mucus is "sticky" in someone not affected by cystic fibrosis.

Some candidates recognised that this would affect the lungs, etc. but rarely gave examples of the consequences, or gave vague statements such as "digestive problems".

This is an example of a response that gained both marks available.

(e) For a person with class V cystic fibrosis, describe the effect of having smaller quantities of CFTR protein.

(2)

Less water is diffused into the mucus and so the mucus is thicker than a normal persons. This can lead to a greater risk of lung infections and coughs. It can also prevent the cilia from functioning properly as the mucus is too thick to move.

Results Plus: Examiner Comments

This candidate has ably described the consequence of having less CFTR in terms of less water in the mucus, the effect on the mucus and the consequences of the thicker mucus in the lungs.

This response did not gain any marks.

(e) For a person with class V cystic fibrosis, describe the effect of having smaller quantities of CFTR protein.

(2)

Water, ~~[illegible]~~ cannot be regulated as quickly or efficiently due to the limits on CFTR proteins present

Results Plus: Examiner Comments

This response is typical of those that lacked sufficient precision for credit at this level.

Question (f)

This question was left blank by a significant number of candidates. Reference to enzymes frequently gained a mark, but few candidates applied their knowledge of protein structure and consequently failed to refer to peptide bonds or hydrolysis.

Many candidates referred to the weakness of bonds in the protein or that the protein spontaneously broke down because it was unstable.

This response gains both marks available.

(f) For class VI cystic fibrosis, suggest how the CFTR protein is broken down.

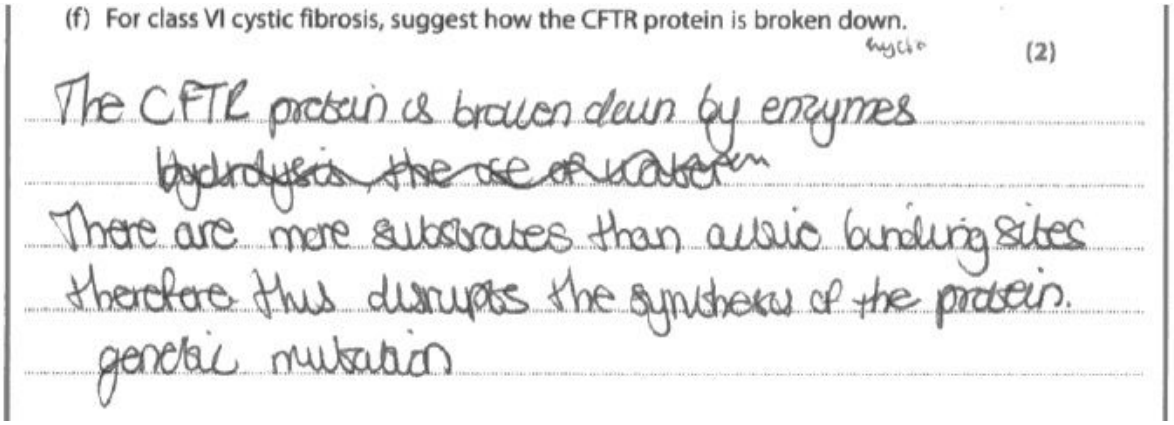
(2)

Enzymes hydrolyse the protein over time breaking the peptide bonds between amino acids.

Results Plus: Examiner Comments

This candidate makes three creditworthy statements in a clear and concise response. The involvement of enzymes, the type of reaction and what is broken.

This response gained one of the two marks available.



(f) For class VI cystic fibrosis, suggest how the CFTR protein is broken down.

(2)

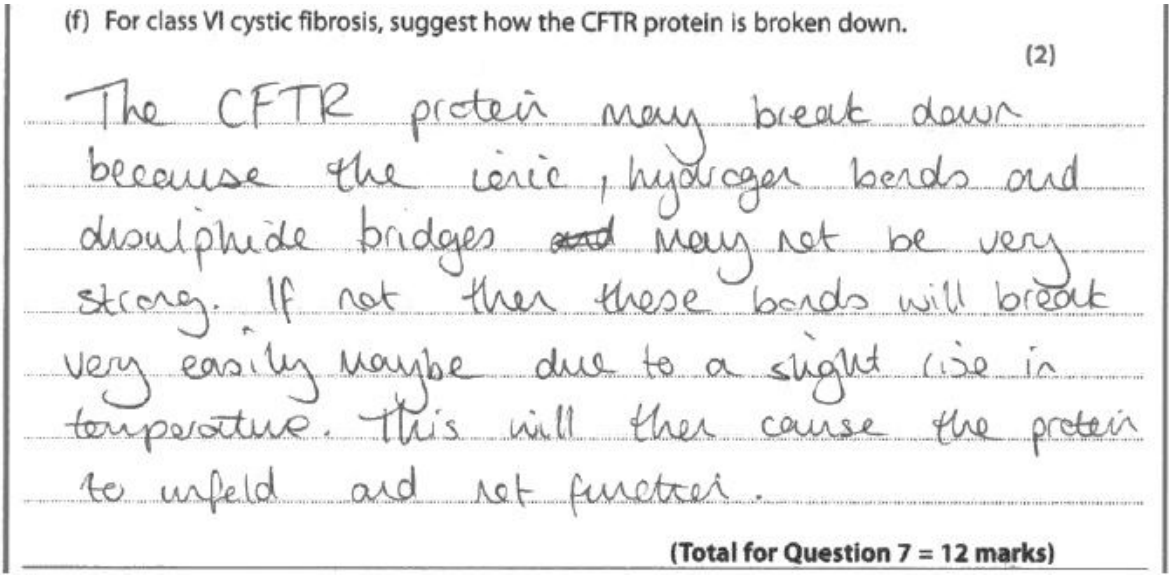
The CFTR protein is broken down by enzymes hydrolysis the use of water

There are more substrates than allelic binding sites therefore this disrupts the synthesis of the protein. genetic mutation

Results Plus: Examiner Comments

This is a typical response that gained credit for recognising that an enzyme must be involved. However, the rest of what they have written is irrelevant and they have not specified what is broken or what reaction takes place.

This response scored no marks.



(f) For class VI cystic fibrosis, suggest how the CFTR protein is broken down.

(2)

The CFTR protein may break down because the ionic, hydrogen bonds and disulphide bridges ~~and~~ may not be very strong. If not then these bonds will break very easily maybe due to a slight rise in temperature. This will then cause the protein to unfold and not function.

(Total for Question 7 = 12 marks)

Results Plus: Examiner Comments

This response is typical of many who related the question to the overall stability of the protein and the bonds in the secondary and tertiary structures.

Q22. Most candidates gave clear descriptions in (a)(i), however, a number thought that 'germ line' involved germs or bacteria. The more able candidates were able to distinguish between use of body cells and gametes in both procedures. However, some thought that this germ line therapy involved embryos rather than gametes. A good number of were also able to distinguish the difference in inheritance between the therapies. Fewer candidates scored on the legality issue, but a reasonable number (although still small) were able to point to the fact that somatic was temporary or was not a cure – in contrast to germ line therapy.

In (a)(ii) candidates mainly answered in sequence, with many responses scoring well on the first four marking points. The very best answers also gave some clear descriptions of chloride ion transport out and/or water moving by osmosis as well as the effect on the mucus. However, these marking points (5, 6 and 7) were rarely covered.

Candidates generally recognised the importance of using a vector to insert the gene into cells and although a majority referred to the gene coding for the CFTR protein, or made it clear in related statements in their responses, a disappointing number referred simply to a 'normal' gene or a 'healthy' gene, without any further clarification. Thankfully, only a small number of responses also referred to replacing the faulty gene.

Although inhalation/nebuliser is the preferred method of getting the vector into the lungs, a number of candidates referred to injection or referred to both aerosol and injection. Many descriptions clearly referred to the CFTR protein being made via transcription / translation, however, in a fair number of responses, either there was no mention of transcription or translation, or there was no clear reference to which protein was being made in the cells.

There were some good answers in part (b) with many candidates able to score either one or both marks. Most candidates were able to describe the mucus being removed from the lungs, while many also gave the idea of clearer airways or better breathing, although it was not always expressed well. A few scored on the idea of the mucus being looser or sticking less to the walls. There were a tiny number of responses giving very clear descriptions of a larger surface area being exposed for better gas exchange in the lungs.

Q23.

(a) A whole range of answers were seen for this question, ranging from zero up to 5 marks max.

5 Cystic fibrosis is a genetic disease that can affect many body systems, including the respiratory system.

*(a) Explain how a gene mutation causes a build up of mucus in the respiratory system of a person with cystic fibrosis.

(5)

A gene mutation of gene 7 causes mucus to build up in the respiratory system of a person with cystic fibrosis, because this mutation means that the CFTR (channel) is inhibited in people with CF and the Na^{2+} is always open. The mucus is sticky because it doesn't have enough water and because of this the cilia cannot move/brush it up which causes the build up in the respiratory system. And because water can't move as freely in and out because of the high concentration of Na^{2+}.

Results Plus: Examiner Comments

This was a typically vague answer where the candidate had an idea of the gist of the problem, but no knowledge of specific details. They only scored one mark for refering to the inability of cilia to move the mucus out of the respiratory system.

Results Plus: Examiner Tip

You need to do very thorough revision, ensuring that you know very fine detail that can be explained using correct terminology.

(b) (i) This was a very clear answer scoring 2 marks.

(i) Suggest why people with cystic fibrosis are more likely to suffer from these lung infections than people without cystic fibrosis.

(2)

This is because people with cystic fibrosis have thick sticky mucus that doesn't allow effective beating of the cilia. The beating of cilia moves bacteria trapped in the mucus. But the bacteria grow in the lungs of those with cystic fibrosis because the mucus isn't moved easily.

Results Plus: Examiner Comments

Part (b)(i) was generally done well, except by candidates who made vague responses to patients having impaired immune responses.

Results Plus: Examiner Tip

'Infections' do not get trapped in the mucus, bacteria do.

(b) (iii) Part (b)(iii) was poorly answered by many candidates as they really do not know how to answer a question where the command word is either 'compare' or 'give differences between'.

(iii) Using the information in the graph, give **two** differences between the percentages of people with infections due to *P. aeruginosa* and infections due to *S. aureus*.

(2)

1. No° of people with S.a decreases after 15 years of age. No° of people with P.a increases after 15 years of age.

2. °/o of people with P.a starts off at 24°/o. °/o of people with S.a starts of at 37°/o. Difference of 13°/o.

Results Plus: Examiner Comments

This response scored one mark for the first statement. However the second statement repeated figures without drawing conclusions and although they did a calculation there was no comment about the significance.

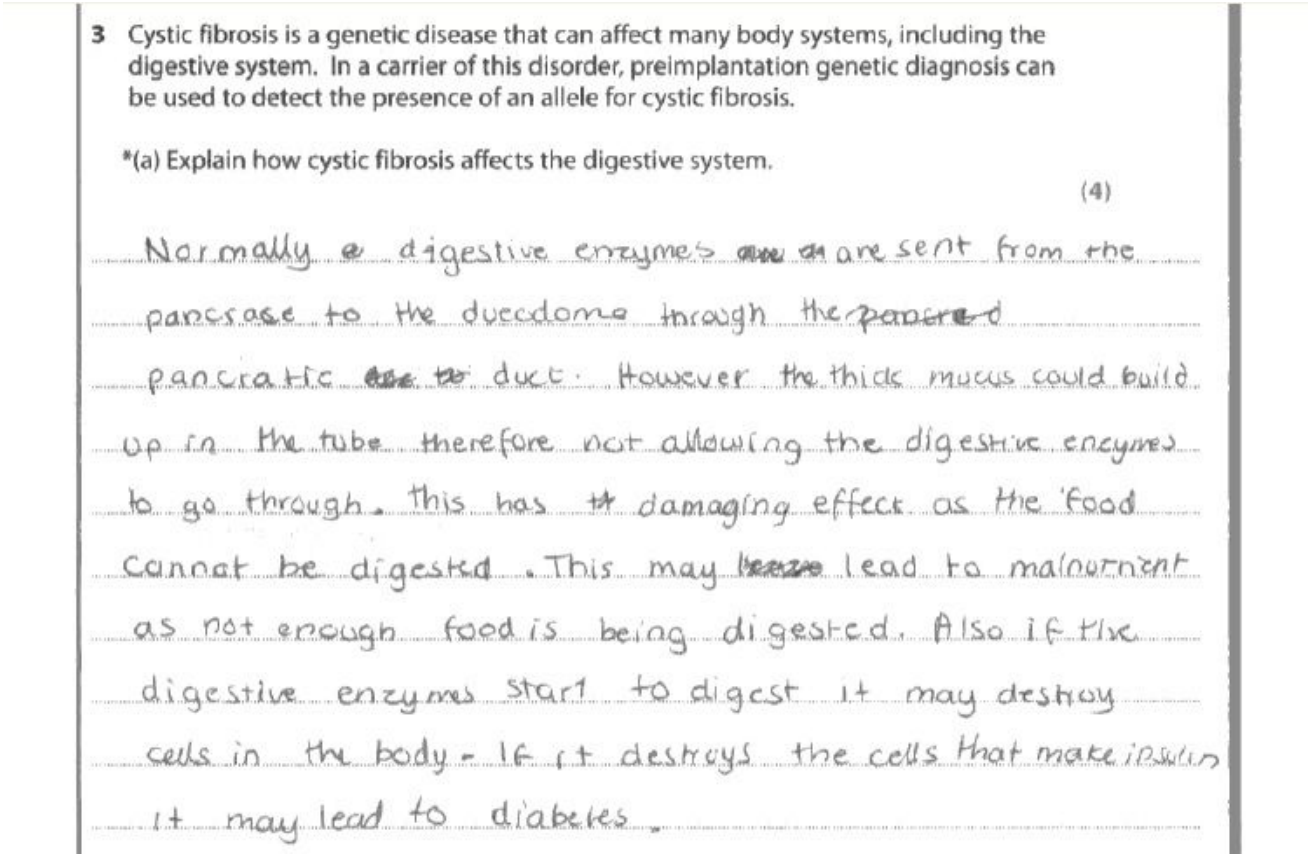
Results Plus: Examiner Tip

1. Do not give two separate descriptions; each sentence should give an equivalent piece of information about the two things that you are asked to {compare/ distinguish between}. 2. Pick significant differences, not random differences. 3. Do not just read the information off the graph, interpret it. The example shown, in the second statement, does not interpret the information shown on the graph. The candidate should have written that the percentage of people with S. aureus is higher at birth than those with S. aeruginosa. If they had then said by 13% , that would have been 2 marks.

Q24.

(a) We have not asked about the effect on the digestive system of Cystic Fibrosis before and were pleased to see some very good answers. There were some students who did not read the question properly and wrote about the effects on the respiratory system and there were others who had clearly seen the question in last summer's paper and described, in detail, how the abnormally thick mucus is produced.

The asterisk against this question indicates that QWC was assessed in the response to this question. Particular care should be taken with spelling, puntuation and grammar, as well as the clarity of expression, on these questions.



3 Cystic fibrosis is a genetic disease that can affect many body systems, including the digestive system. In a carrier of this disorder, preimplantation genetic diagnosis can be used to detect the presence of an allele for cystic fibrosis.

*(a) Explain how cystic fibrosis affects the digestive system.

(4)

Normally digestive enzymes are sent from the pancreas to the duodenum through the pancreatic duct. However the thick mucus could build up in the tube therefore not allowing the digestive enzymes to go through. This has damaging effect as the 'food cannot be digested. This may lead to malnutrient as not enough food is being digested. Also if the digestive enzymes start to digest it may destroy cells in the body - if it destroys the cells that make insulin it may lead to diabetes.

Results Plus: Examiner Comments

This response scored the maximum four marks. The mis-spelling of pancreas on the second line prevented marking point 4 from being awarded but did not affect the awarding of marking points three, five, six, eight and nine. The second mark point was not given as mucus is normally thick and we need to know that it is abnormally thick in Cystic Fibrosis patients.

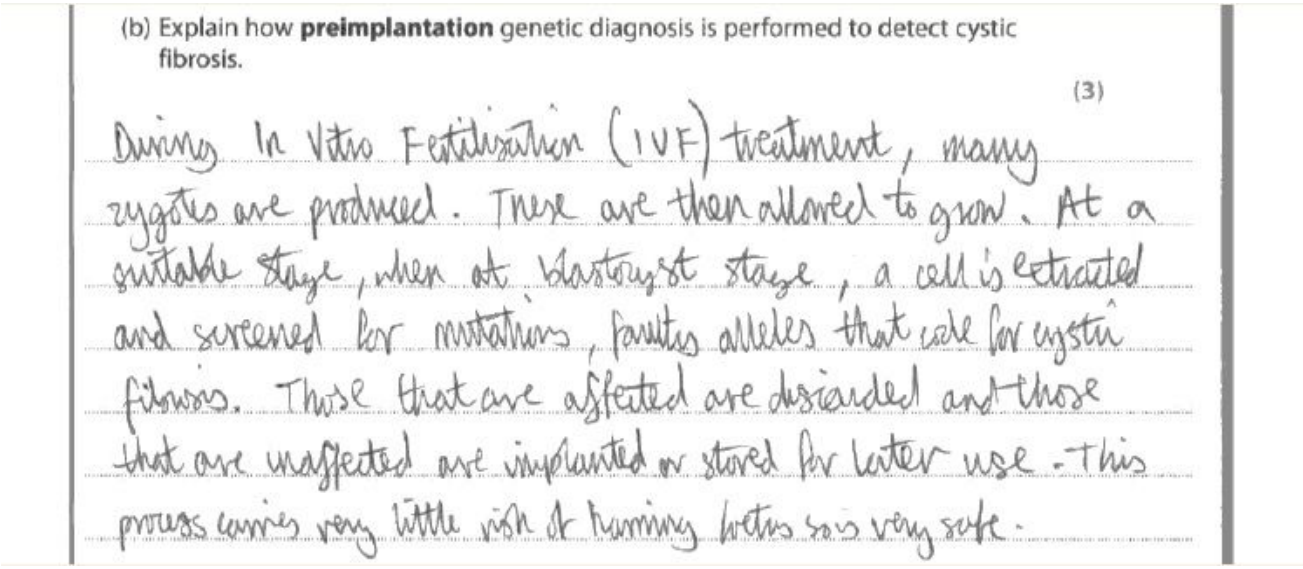
Results Plus: Examiner Tip

Look out for the two questions that have an asterisk against them and pay particular attention to your spelling and the clarity of your answer. Always try to write more statements than there are marks, in case you cannot be awarded one of them.

Make sure if you are writing about mutations, that they are occuring in the genes and not in the protein.

(b) This question was poorly done, despite previous similar questions being asked about this in the past in the context of amniocentesis and chorionic villus sampling.

In previous questions on genetic diagnosis we have expected the candidate to state that the DNA is analysed and that the mutated CFTR gene is looked for



(b) Explain how **preimplantation** genetic diagnosis is performed to detect cystic fibrosis.

(3)

During In Vitro Fertilisation (IVF) treatment, many zygotes are produced. These are then allowed to grow. At a suitable stage, when at blastocyst stage, a cell is extracted and screened for mutations, faulty alleles that code for cystic fibrosis. Those that are affected are discarded and those that are unaffected are implanted or stored for later use. This process carries very little risk of harming baby so is very safe.

Results Plus: Examiner Comments

This is a typical example of the reponses that we frequently saw for this question.The candidate was awarded the first marking point only.

Results Plus: Examiner Tip

Look carefully at previous mark schemes to learn what we award marks for. Be careful to use correct terminology - a zygote is different from an embryo.

(c) This question was probably the worst answered of all questions on the paper. Despite the fact that we have asked questions about ethics before there were still numerous answers refering to designer babies and playing god.

A large proportion of candidates appeared to have forgotten the context of the question and made reference to abortion and miscarriages, voiding their answers.

(c) Discuss either **one** ethical issue or **one** social issue relating to the use of preimplantation genetic diagnosis.

(2)

It is not right because you are tampering with cells to see if the CF allele is present and if it is, a couple may choose to have an abortion or to not have a baby at all. However, it is said that the fetus has a life and a right to live so should not be terminated.

Results Plus: Examiner Comments

This is an example of the answer being given in the wrong context to award the marks, which is a shame as the candidate was trying to answer the question appropriately.

Results Plus: Examiner Tip

Always reread the question to make sure that your answer is in the correct context.

(c) Discuss either **one** ethical issue or **one** social issue relating to the use of preimplantation genetic diagnosis.

(2)

This diagnosis allows only healthy embryos to be implanted which means it may induce 'designer babies' to only be accepted. People will get to choose how they want their baby to be which means only designer babies will be accepted. All embryos whether or not they have a disorder should be able to develop into human being as they could live a normal life and may not even have the disorder. By doing this, it is as if you are playing god and choosing how you want your baby

(Total for Question 3 = 9 marks)

Results Plus: Examiner Comments

This is a typical of a large number of response to this question.

Results Plus: Examiner Tip

When discussing ethical issues, avoid terms such as 'playing god' and 'designer babies'

Q25.

Results Plus: Examiner Tip

Candidates need to understand the difference between the term 'allele' and 'gene' and be careful to use them in the correct context. An appreciation of the terms 'haploid' and 'diploid' is also needed, with some careful wording when describing them.

(a) Suggest why cells from mouth swabs or blood samples are used rather than gametes.

(2)

It is a lot easier to get mouth swabs and blood samples. Gametes only contain half of the DNA of the person their taken from.

Results Plus: Examiner Comments

This was a fairly typical response and illustrates the point about haploid and diploid. The fact that the gametes have half the DNA is not the same as understanding that they only have one set of each

(a) Suggest why cells from mouth swabs or blood samples are used rather than gametes.

(2)

Gametes only contain half a set of chromosomes (ie half the genetic information). As not all gametes contain the same genetic information it would be impossible to see if either parent was a carrier using one set of ~~chromo~~ gametes as a recessive gene carried by a parent may not neccessarily be present in that particular gamete.

Results Plus: Examiner Comments

This candidate is a bit closer to appreciating the significance of the haploid cell but still the wording was not deemed to be good enough to award the third marking point. At the end of the response, the reference to 'gene' prevented marking point 6 from being awarded.

(a) Suggest why cells from mouth swabs or blood samples are used rather than gametes.

(2)

Gametes only contain half the full genetic make up of a person, so it may show that someone doesn't even carry the CF gene, when really they do but it just wasn't present in that gamete

Results Plus: Examiner Comments

This response also illustrates these two points about 'alleles and 'genes' and the significance of a haploid cell. It is also worth pointing out here, that the use of the term 'CF gene' is actually referring to the unaffected gene and not the mutated one.

(e)

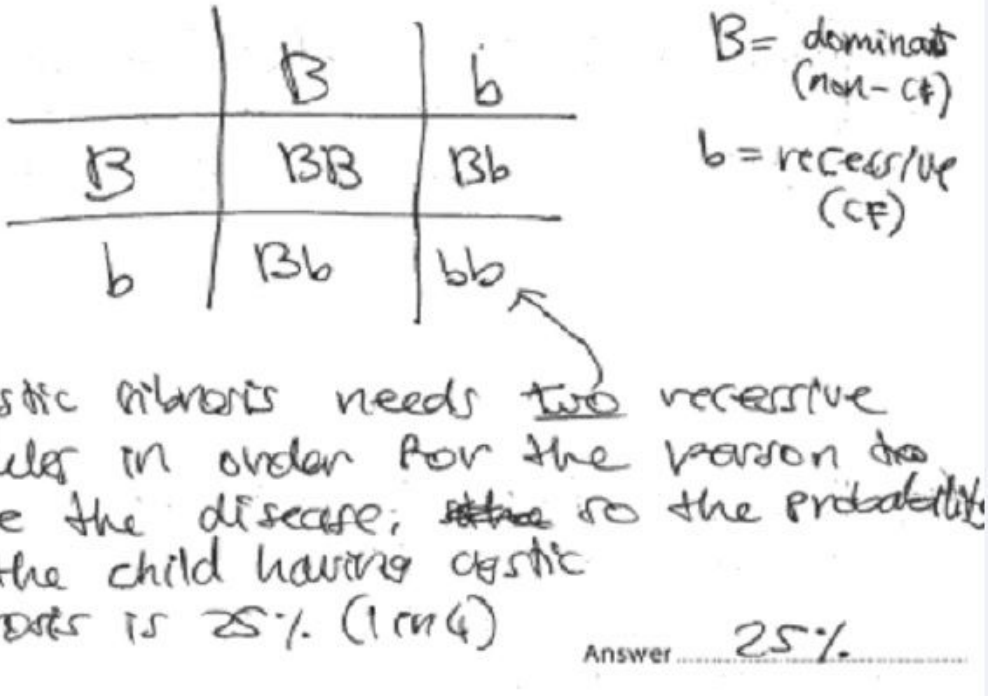
Results Plus: Examiner Tip

When a question asks for a genetic diagram to be drawn, there will be marks for showing each stage. In this case for indicating the genotype of the parents, the alleles present in the gametes, evidence of a cross being done, the genotype of the offspring and the corresponding

phenotypes. That is in addition to actually answering the question and stating the probability of a child having cystic fibrosis.

(e) Using your knowledge of monohybrid crosses, calculate the probability of having a child with cystic fibrosis if both partners are found to be carriers. Draw a genetic diagram to explain how you calculated this probability.

(5)



Results Plus: Examiner Comments

This was a very generous mark scheme and in this instance we did not insist on each step being clearly labelled. This was a fairly typical layout that enabled the candidate, in this case, to score marking points 2,3 and 4. Many responses did score 4 marks as the genotype of the parents was included. Fewer candidates scored all 5 marks as they did not link the phenotype to the corresponding genotype.

It is worth pointing out that consequential errors apply in a question of this type, so candidates should be encouraged to at least attempt the question and to not leave it blank.

Q26.

(i)

Most candidates were able to name a suitable prenatal technique. There were, however, a significant number who still state "chronic" villus sampling.

Some candidates failed to make it clear that the amniotic fluid contained cells and/or DNA for testing, or did not know what was involved in chorionic villus sampling.

Others were too vague about testing the DNA and gave answers which included references to

checking if the baby had CF or checking the DNA to see if it had mutations without noting that the allele or gene was being investigated.

A significant number answered this in terms of IVF and testing the embryo prior to implantation, or removing the foetus, testing it, and then returning it to the uterus. Others described parental testing or gene therapy.

This response gained all three marks available.

Cystic fibrosis can be detected using prenatal genetic testing.

(i) Describe how **one** named method of **prenatal** genetic testing can be carried out.

(3)

Aminocentsis can be used. This involves removing amnotic fluid. The amnotic fluid contain fetal cells, the sample is amplified. The presence of the defective The DNA is analysed and the presence of the defective CFTR gene is tested for.

Results Plus: Examiner Comments

Credit was given for:

- naming a suitable technique
- describing how cells were obtained for testing
- analysing the DNA for the presence of the CFTR gene.

(before birth)

Cystic fibrosis can be detected using prenatal genetic testing.

(i) Describe how **one** named method of **prenatal** genetic testing can be carried out.

(3)

- DNA samples can be obtained from the mother & father of the child to see if they are carriers & the probability of the child getting cystic fibrosis can be worked out.
- The parents can give blood samples, cheek swabs to obtain the DNA.

Results Plus: Examiner Comments

Instead of a prenatal test this candidate has described testing preconception.

This response did not gain any marks.

Cystic fibrosis can be detected using prenatal genetic testing.

(i) Describe how **one** named method of **prenatal** genetic testing can be carried out.

(3)

Pre-implantation genetic diagnosis (PIGD) is a method of prenatal genetic testing. The sperm and egg are fertilised in an IVF process (in intro fetilisation), and the developing embryo's DNA is then analysed for signs of genetic diseases, such as cystic fibrosis. Based on the results of the genetic scening and analysis, the parents will decide whether or not to go through with the pregnancy. If they decide that they do want to go through with it, the embryo is inserted ~~back~~ into the mother's womb to continue its development.

Results Plus: Examiner Comments

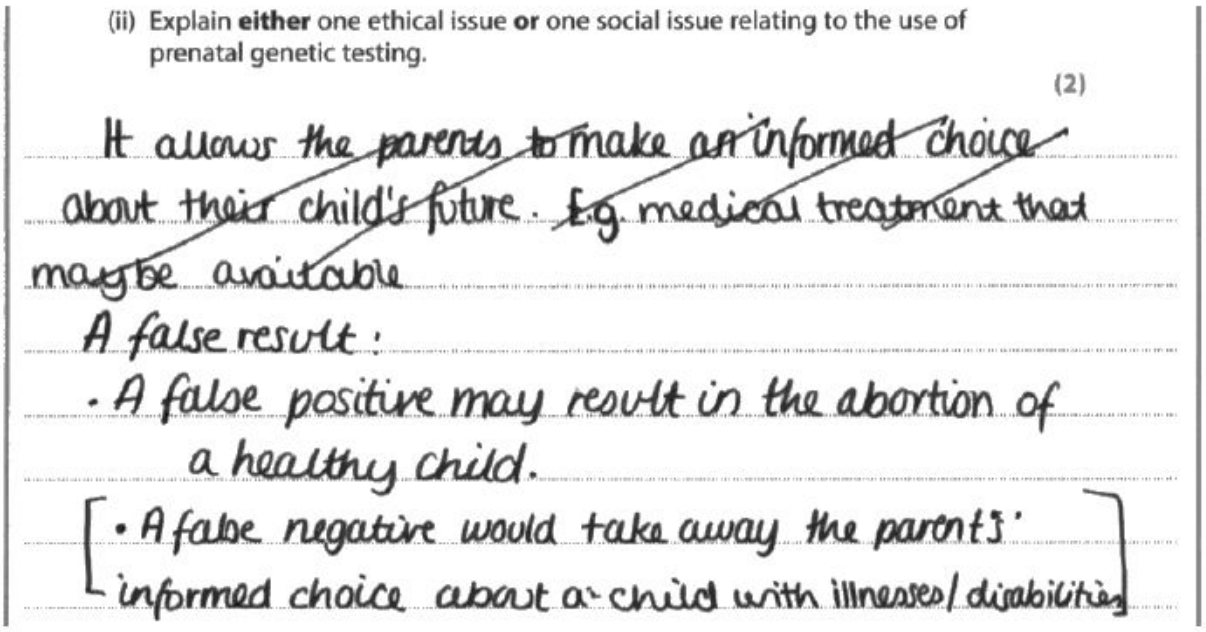
This is an example of a candidate who has described a pre-implantation technique instead of a prenatal test.

(ii)

Two thirds of candidates managed to gain both of the available marks. Normally for recognising that the choice of an abortion or risk of a miscarriage caused an ethical or social concern. Other candidates identified the risk of false positive or negative results and their potential consequence.

Where candidates did not gain the mark they sometimes listed several ethical or social concerns without explaining them and a few still refer to designer babies and playing God.

This response gained both available marks.



(ii) Explain **either** one ethical issue **or** one social issue relating to the use of prenatal genetic testing.

(2)

It allows the parents to make an informed choice about their child's future. E.g. medical treatment that may be available

A false result:

- A false positive may result in the abortion of a healthy child.
- A false negative would take away the parents' informed choice about a child with illnesses/disabilities

Results Plus: Examiner Comments

This response gives the consequences of both a false positive and a false negative result, only one of which would have been needed for full credit.

This response gained one of the two available marks.

(ii) Explain **either** one ethical issue **or** one social issue relating to the use of prenatal genetic testing.

(2)

If the ~~pre~~ prenatal genetic testing comes back positive and for a genetic disorder such as cystic fibrosis, the baby could ge aborted.

Results Plus: Examiner Comments

This example is typical of the many responses that recognised that an abortion may be carried out as a result of the test, but has not explain why this may be considered unethical.

This response gained no marks.

(ii) Explain **either** one ethical issue **or** one social issue relating to the use of prenatal genetic testing.

(2)

In vitro fertilisation can be used by parents to manipulate the phenotype of their offspring. for example blonde hair, green eyes.

Results Plus: Examiner Comments

Although the candidate has identified an ethical issue related to genetic testing it is not relevant to the context of this question.

Results Plus: Examiner Tip

Make sure you are clear about the context of the question being asked.

Q27. No Examiner's Report available for this question

Q28. No Examiner's Report available for this question

Q29.

This was very well answered by the majority of candidate with most scoring two or three marks. Common errors, however, were; misspelling of thymine (thyamine), not giving a complete comparative answer or describing the function instead of the structure. References to hydrogen bonds alone were not credited as the comparison was between DNA and RNA as tRNA for example does contain hydrogen bonds in its structure.

Q30. The multiple choice questions in parts (a) and (b) were generally answered well with the vast majority (around 80%) gaining a mark for each and demonstrating a good understanding of DNA structure as well as the technique of differential centrifugation in relation to DNA replication. In part (c) almost all candidates were aware that the mRNA is synthesised in the nucleus.

Candidates scored well in part (d)(i) and many were able to clearly give one advantage and one disadvantage of genetic screening. Most candidates were at least able to give at least one advantage or one disadvantage.

In the case of advantages, candidates commonly scored mp3 (preparation for the child) or mp4 (making an informed choice). In some cases mp4 was gained for the idea of perhaps choosing termination. There were some references to the idea of stress for the parents as well, but only a few extremely well expressed responses referred to the prevention of the child dying late in pregnancy.

In the case of disadvantages, most commonly mp5 (risk of miscarriage / spontaneous abortion) or mp8 (risk of false positive or negative) were found in responses. A small number referred to mp7 (cost) or to mp6 (the idea of more parental stress). There were some responses, however, which referred to the screening process leading to abortion and leaving this unqualified or qualifying it with moral or ethical reasons against this choice, rather than this causing some stress for parents.

In part (d)(ii), candidates generally scored very well here, gaining at least 3 marking points and with the clearest responses gaining all 4 marks. However, a number of candidates failed to show clearly the corresponding phenotypes to the genotypes of the children, thus failing to gain mp3 and thus the maximum score. It was very pleasing to see many examples of good practice in the layout of Punnett Squares or lines clearly going from parental genotypes to the gametes formed. Also pleasing was the fact that gametes were often circled to make them clearer – another example of good practice. Not so satisfactory were some responses which referred to 'carriers' as phenotypes.

It was extremely pleasing to see that the vast majority of candidates quoted a probability as asked and not a ratio.

In a few cases, candidates had not read the information carefully enough and started with the incorrect genotypes for the parents. A small number also became confused when working out the probability from the offspring genotypes, getting the probability as 75% or 3 in 4.

Q31.

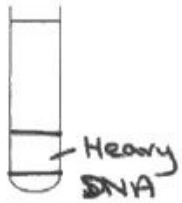
(b) This is the first time that we have used Meselson and Stahl's experiment to test candidate's understanding of DNA synthesis. The majority of candidates did attempt to answer the question and some of the more able candidates coped very well and scored full marks.

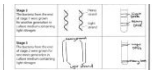
The bands drawn in the test tubes in this response are typical of a number of answers that we saw by the weaker candidates. The strands of DNA drawn as two sets of parallel lines were not typical.

The table below summarises the three stages of Meselson and Stahl's experiment and their results.

Complete the table by drawing, in the appropriate boxes, diagrams of the DNA molecules and mark the position and size of the DNA bands in the tubes.

(6)

Experimental stage	Diagram to show the strands in the DNA molecules of the bacteria	Position and size of DNA bands in the tube of separating solution
Stage 1 Bacteria grown for several generations in culture medium containing heavy nitrogen	Heavy strands 	



Results Plus: Examiner Comments

Although the bands are in the wrong place in the tube in the bottom box, we applied a consequential error mark to marking point 6. This was only just awardable as the bands have been drawn rather carelessly and only just show that they are of the same width. Candidates should be encouraged to draw diagrams carefully

Results Plus: Examiner Tip

When completing tables, whether with words, numbers or diagrams always look at the boxes that we have completed for clues as to what to do. We drew the DNA as a helix and represented the heavy and light strand as solid and dotted lines respectively - this is what the candidate should have done.

Q32. ***Question (a)***

This question specifically relates to specification point 2.12 'Explain the nature of the genetic code'. It was therefore disappointing to see how many candidates failed to pick up on the basic

idea of the triplet code.

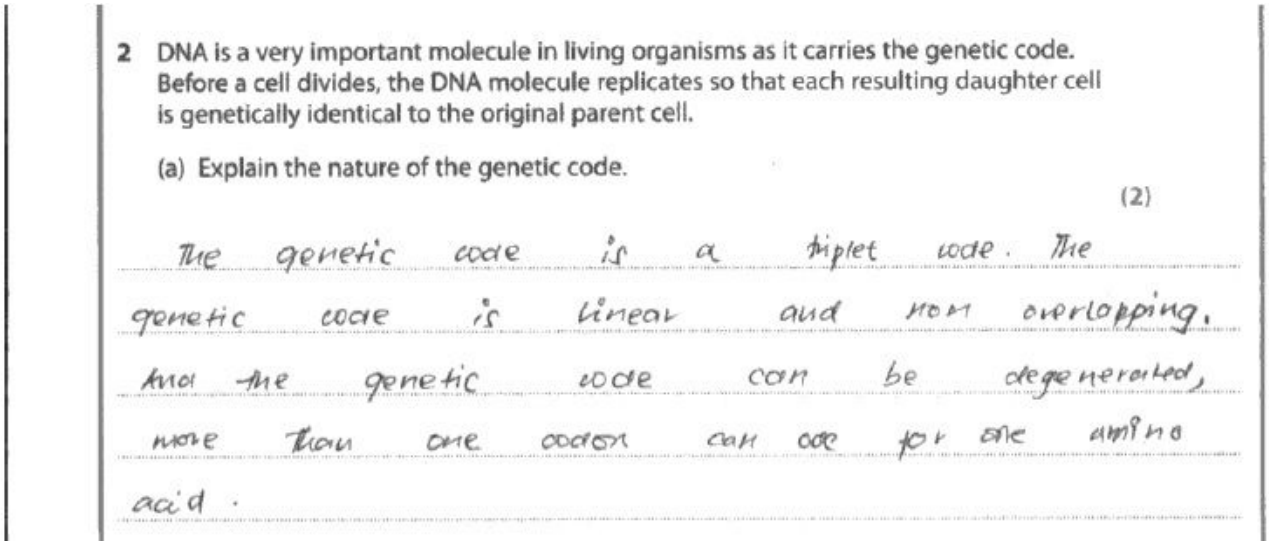
Many answers were general descriptions of genes controlling protein synthesis, references to alleles providing hereditary information, the structure of DNA, chromosomes, etc. Details of the structure of the DNA molecule were common also.

Where candidates did identify the importance of bases they often referred to the sequence coding for amino acids rather than specifically 3 bases coding for one amino acid. Some candidates thought that one triplet codes for one protein.

A significant number of candidates thought that the sequence of amino acids on the DNA was the genetic code.

Where the bases were listed, candidates often just referred to A, T, C and G (it should be noted that the full names are included as part of the specification) or made errors in the names e.g. glycine instead of guanine.

This response gained both marks available.



2 DNA is a very important molecule in living organisms as it carries the genetic code. Before a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

(a) Explain the nature of the genetic code.

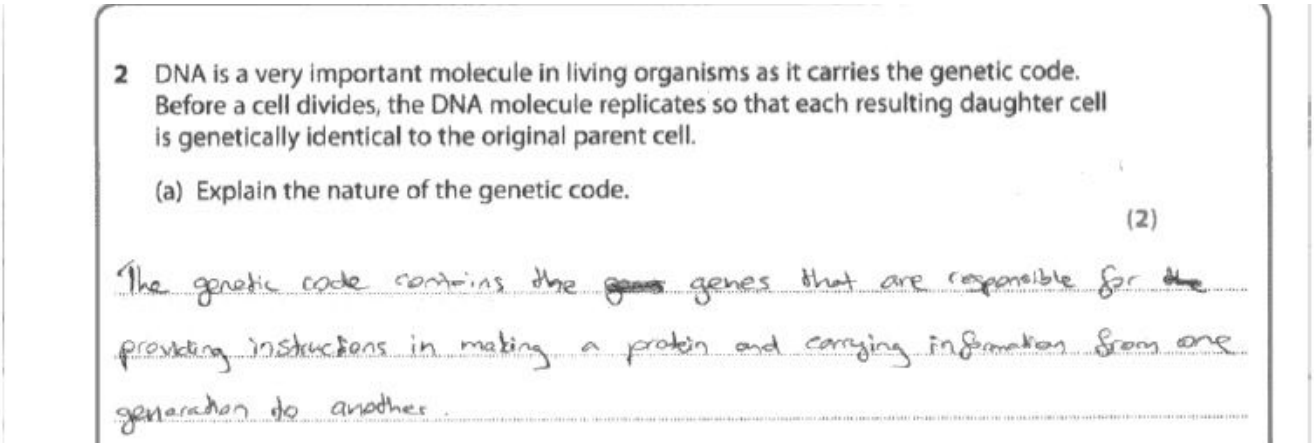
(2)

The genetic code is a triplet code. The genetic code is linear and non overlapping, and the genetic code can be degenerated, more than one codon can code for one amino acid.

Results Plus: Examiner Comments

This is an excellent response that goes beyond the scope of the AS specification as they have actually made five relevant comments about the nature of the genetic code in a concise response.

This response gained no marks.



2 DNA is a very important molecule in living organisms as it carries the genetic code. Before a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

(a) Explain the nature of the genetic code.

(2)

The genetic code contains the ~~gene~~ genes that are responsible for ~~the~~ providing instructions in making a protein and carrying information from one generation to another.

Results Plus: Examiner Comments

This is a typical example of a candidate who does not understand the meaning of the specification term 'genetic code'.

Results Plus: Examiner Tip

The genetic code is the language of the genes and is an important specification point. Make sure you understand the triplet nature of the code – 3 DNA bases code for one amino acid.

Question (b)

This was generally well answered with a significant number of candidates addressing at least 5 marking points successfully. The best responses demonstrated an understanding of semi conservative replication and bonding within the DNA molecule, with several candidates demonstrating knowledge beyond the AS specification.

It was very pleasing to see that spelling of key terms was good, and we rarely saw mistakes.

It was a common omission that the nucleotides line up along both strands – often only referring to complementary base pairing to one of the strands.

Unfortunately, many candidates confused DNA replication with protein synthesis and lost by describing stages of transcription or translation instead.

This response gained all five marks available.

*(b) Describe the process of DNA replication.

(5)

It is called semi-conservative replication - where copies of DNA are produced which are exact replicateds of the original parent DNA. In this new DNA, 1 strand originates from original DNA while the other is new. The DNA double helix unwinds, firstly, exposing the bases on the strand, DNA helicase enzyme is involved. These strands acts as templates where free bases in the nucleus/cytoplasm pairs off [complementary base pairing - with corresponding base of the DNA-strand] A-T, G-C. Hydrogen bonding takes place between the bases and later nucleoside bond is formed with deoxyribose pentose sugar and phosphodiester bond with a phosphate group. The [condensation] between Between these mononucleotides condensation takes place with the help of DNA polymerase and DNA ligase. As a result 2 new strands are formed.

(Total for Question 2 = 7 marks)

Results Plus: Examiner Comments

Although not all aspects of this response are perfect, this is an example of many candidates who had a very good grasp of the process of replication. The stages are clear, they understand the term semi-conservative and are aware of examples of enzymes and chemicals and bonds involved.

This response gained one of the five marks available.

*(b) Describe the process of DNA replication.

(5)

The DNA molecule contains two strands. The DNA molecule unwinds itself, after which the two strands are seperated. After these two strands are seperated, the the alleles in the DNA strand forms an opposite allele that goes with with the original one. Once the alleles are formed, the DNA strand gets together and recoils itself, reveling two new DNAs formed.

Results Plus: Examiner Comments

This candidate gained a mark for recognising that the DNA unwinds at the beginning. They have not included much specific detail and have confused some of their key terms such as alleles and nucleotides.

Results Plus: Examiner Tip

When revising biochemical processes like replication, make sure you learn the molecules involved in the process as it will help you gain credit at AS/A2 level.

This response gained two of the five marks available.

*(b) Describe the process of DNA replication.

(5)

DNA replication is the process of transcription and Translation. In transcription the DNA unwinds ~~one~~ and the Hydrogen bonds are exposed as RNA polymerase helps to break them up. One strand acts as a template. Complementary base pairing occurs between the free nucleotides. Transcription takes place in the nucleus. Translation takes place in the cytoplasm. The mRNA line up against the DNA strand and complementary base pairing occurs. different triplet codes code for different amino acid. A molecule of tRNA takes the amino acid from the cytoplasm back into the nucleus.

Results Plus: Examiner Comments

This is a typical example of a candidate describing the wrong process. However, they gained credit for recognising a relevant enzyme and that DNA needs to unwind as there are some similarities in the process of replication and transcription.

Results Plus: Examiner Tip

Read the question carefully and make sure you write about the correct process and not a process that was asked for in a previous exam.

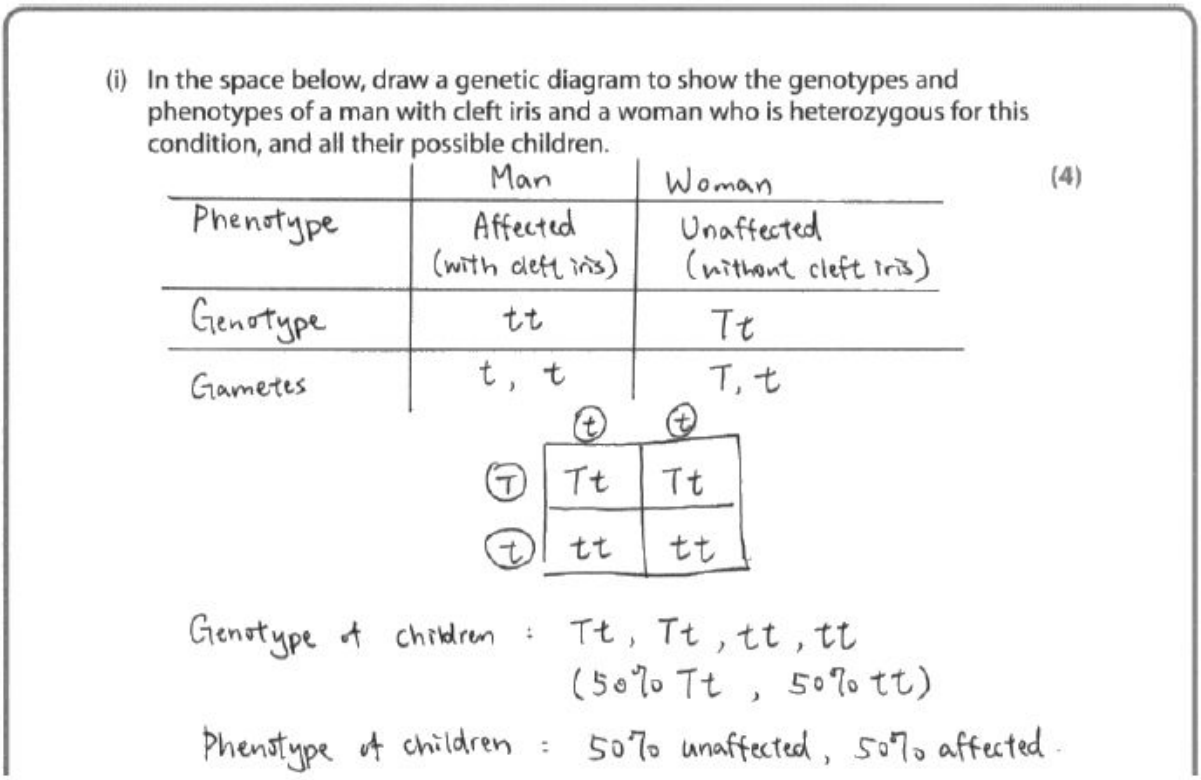
Q33. No Examiner's Report available for this question

Q34.

(i)

Almost all candidates appeared to understand the principles behind the genotypes and the use of a genetic diagram to establish the genotypes of the potential offspring. However, a significant number failed to follow the rubric of the question and only showed the genotypes and not the phenotypes. This was particularly so for the parental phenotypes (although the genotypes were correct). Consequently, many gained only two marks for showing the parental gametes and the possible crosses for the offspring's genotypes. This was usually written in the form of the Punnett square, which was acceptable.

This response gained all four available marks.



(i) In the space below, draw a genetic diagram to show the genotypes and phenotypes of a man with cleft iris and a woman who is heterozygous for this condition, and all their possible children. (4)

	Man	Woman
Phenotype	Affected (with cleft iris)	Unaffected (without cleft iris)
Genotype	tt	Tt
Gametes	t, t	T, t

	(t)	(t)
(T)	Tt	Tt
(t)	tt	tt

Genotype of children : Tt, Tt, tt, tt
(50% Tt, 50% tt)

Phenotype of children : 50% unaffected, 50% affected

Results Plus: Examiner Comments

This response has clearly identified and linked the genotypes and phenotypes of the parents and offspring and carried out the genetic cross correctly using a Punnett square.

This response gained two marks.

(i) In the space below, draw a genetic diagram to show the genotypes and phenotypes of a man with cleft iris and a woman who is heterozygous for this condition, and all their possible children.

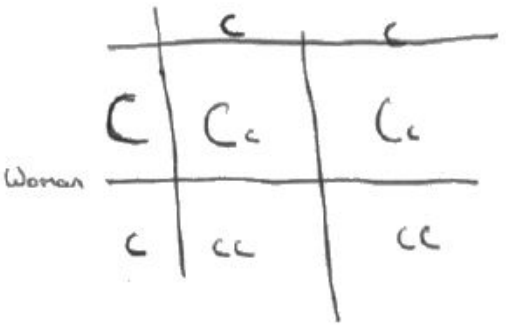
(4)

Man = cc Woman = cC

c = recessive cleft

C = dominant cleft

Man



Results Plus: Examiner Comments

This response is typical of the many responses that drew a correct genetic cross so gained marks for the gametes and genotypes of the offspring, but made no attempt to link genotypes and phenotypes together for either the parents or offspring.

Results Plus: Examiner Tip

To demonstrate that you understand genetic crosses it is always good practice to fully label everything. In particular make sure you clearly link the genotypes and phenotypes of both the parents and potential offspring of the cross, especially when it is asked for specifically in the question stem!

This response gained just one of the four marks available.

(i) In the space below, draw a genetic diagram to show the genotypes and phenotypes of a man with cleft iris and a woman who is heterozygous for this condition, and all their possible children.

(4)

~~AA~~ aa

Aa

Man = aa

Woman = Aa



Man

	a	a
A	Aa	aa
a	aa	aa

75% chance ~~Chalo~~

Results Plus: Examiner Comments

Some candidates (like this one) correctly identified the genotypes and therefore gametes of the parents, but then made mistakes in completing the cross, e.g. via a Punnett square.

(ii)

There were very few issues with this question with over 90% of candidates gaining the mark for the probability. Those who did lose the mark either did it through making a mistake on the genetic cross, or by expressing a ratio rather than a probability.

This response gained the mark.

(ii) State the probability that the first child of these parents will have a cleft iris.

(1)

50%

Results Plus: Examiner Comments

The vast majority of responses gave a correct probability like this response.

An example of an incorrect response.

(ii) State the probability that the first child of these parents will have a cleft iris.

(1)

25% probability.

Results Plus: Examiner Comments

This error was a result of assuming that both parents were heterozygous and therefore not reading the information given in the question.

Results Plus: Examiner Tip

With genetics questions, always read the context carefully to work out the genotypes of the parents to use in the cross.

Q35.

(a) (i)

Many candidates recognised that the cell membranes would become more permeable when boiled so that the vitamin C could leave the cells.

However, many answers are too vague, e.g. just recognising that vitamin C dissolves in water without stating that it would leave the cabbage cells.

Some candidates were confused about enzyme activity e.g. "enzymes denature and cannot oxidise vitamin C" as explanation for low levels of vitamin C. Others thought that the vitamin C would evaporate out of the cells.

(ii)

This was generally poorly attempted, with many candidates failing to identify that the enzyme would be denatured immediately and so prevent breakdown of vitamin C in the cabbage.

A significant number of candidates misread the question and attempted answers which described that less would be lost when placed in cold water. E.g. references to no membrane damage and cells get acclimatised to increasing heat, and so retain the vitamin.

Some candidates left this item blank.

(b)

This was well answered by the majority of the candidates whereby they correctly used the table of data to identify that sauerkraut still retained some of the vitamin after 3 months, unlike cabbage. Many candidates also appreciated that sauerkraut would not rot as quickly as cabbage.

However, some candidates focussed only upon the fact that sauerkraut has more Vitamin C than cabbage at the start, with no reference to storage over time despite the context of a long sea voyage.

Q36.

(i)

It was very disappointing to see that so many candidates did not read the question carefully and answer the question asked.

Almost all candidates correctly described the nature of the positive correlation shown by the data, so gaining the first mark point. However, for most candidates this was the maximum mark achieved. Most candidates approached this from a describe and manipulate the data point of view and gave lengthy descriptions and calculations of the data. This was because the word "explain" within the rubric of the question was overlooked and most candidates merely described the data.

Some candidates did attempt to discuss the facts that there would be more active sites available, that there would be more collisions between enzyme and substrate or that there would be no enzyme-substrate complexes formed. Some recognised that enzymes lower activation energies and that in this context the enzyme concentration was the limiting factor, or that the substrate concentration must have been in excess when calculating the initial rate.

This response gained all three available marks.

(i) Using the information in the graph, explain the effect of the concentration of lysozyme on the initial rate of destruction of bacteria.

(3)

As the concentration of lysozyme increased, so did the initial rate of bacteria destruction (e.g at 0.1 gam^{-3} only 1.8 arbitary units, at 0.4 gdm : 8 arbitary units. This is an increase of 6.2 arbitary units.) This is because lysozymes are enzymes, which are biological catalysts that lower the activation energy of an reaction to occur. As the concentration of lysozyme increased, there were more active sites for the bacteria to bind to, so more bacteria were broken down in a given time as more enzyme-substrate complex formed, that put pressure on the bonds in the bacteria so they were destructed.

Results Plus: Examiner Comments

Credit was given to this response, for the maximum of three marks, for:

- recognition that the enzyme increases the rate of reaction;
- enzymes lower the activation energy required for the reaction;
- the higher concentration of enzymes means there are more active sites available;
- more enzyme substrate complexes can be formed.

This response gained just one mark.

(i) Using the information in the graph, explain the effect of the concentration of lysozyme on the initial rate of destruction of bacteria.

(3)

There is positive correlation between the concentration of lysozyme and the initial rate of destruction of bacteria. As the concentration is increased, the initial rate of destruction also increases. Example: Concentration increased from 0.1 to 0.2 - rate of destruction increases from 1.9 to 4 arbitrary units

Results Plus: Examiner Comments

This response is a typical example of the many responses that gained one mark for recognising that the enzyme caused an increase in the rate of destruction of the bacteria in a description of the data instead of an explanation of the effect asked for in the question.

Results Plus: Examiner Tip

Just because you are provided with data don't assume that the question is asking you to describe the data - particularly when the question asks you to **explain** the effect!

(ii)

Many candidates stated correctly that the explanation was due to anomalies and so gained the mark. Others chose to appropriately describe inaccuracies in measuring or random errors. However, a significant number of candidates focussed on a description that it is a line of best fit, or just used the term outliers which gained no credit.

One mark for this response.

(ii) Suggest why some of the data points in the graph do not fit on a straight line.

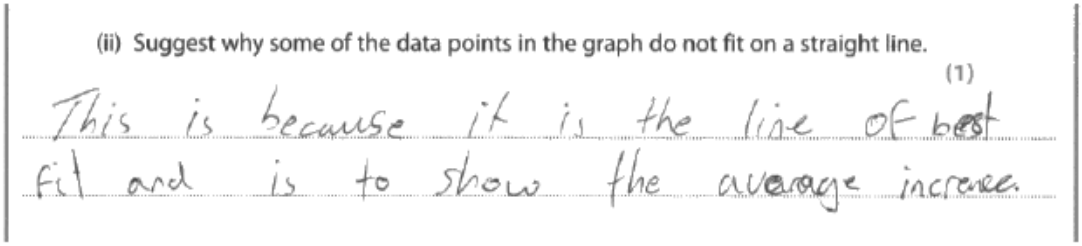
(1)

because they were anomalies.

Results Plus: Examiner Comments

This is a typical example of the many correct responses to this question.

This response gained no marks.


(ii) Suggest why some of the data points in the graph do not fit on a straight line.

(1)

This is because it is the line of best fit and is to show the average increase.

Results Plus: Examiner Comments

This example is typical of those who failed to get the mark having concentrated on the line and not on why there may be variation in the results.

Q37. No Examiner's Report available for this question

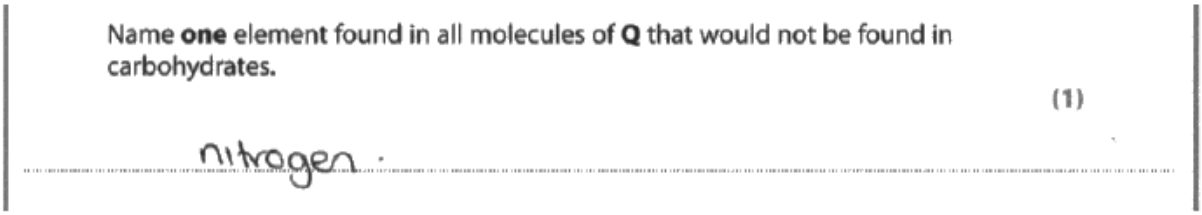
Q38. No Examiner's Report available for this question

Q39. No Examiner's Report available for this question

Q40.

Over 70% of candidates correctly identified nitrogen as the element present in all amino acids, but missing from carbohydrates. Where mistakes were made it tended to be for naming something that is not an element, e.g. R group, amino group of carboxylic acid group. N alone was not accepted as an answer as this is not the name of the element.

This gained the mark.


Name **one** element found in all molecules of **Q** that would not be found in carbohydrates.

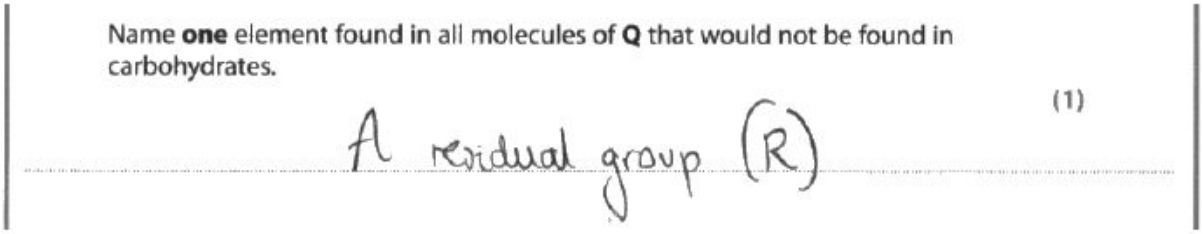
(1)

nitrogen .

Results Plus: Examiner Comments

An example of the typical correct response.

This response gained no marks.



Results Plus: Examiner Comments

This was the most common incorrect answer. They have identified something present on an amino acid that is not present in a carbohydrate, but ignored the fact that the question asks them to name an element - an R group is not an element.

Q41. No Examiner's Report available for this question

Q42. Part(a) was generally answered very well with many candidates gaining all three marks and a number with 2 marks and only a few with 1 or zero marks. Some very good diagrams were drawn and some were very clearly labelled as well. The candidates' knowledge here is generally good. The most common errors were NH3 without the + charge, COO without the − charge and an oxygen atom missing from the OH part of the carboxyl group. In a few cases the central carbon was missing the H atom. There were only a very few cases where candidates seemed totally confused.

In part(b)(i) there were some very good answers, with the most common being references to active sites (mp2), the effect on collisions and formation of complexes (mp3) and references to the substrate becoming the limiting factor (mp5). In the better answers there were good references to enzymes reducing activation energy, but unfortunately these were very rare. Some candidates bravely attempted to give the idea of the number of active sites occupied before and after 6au and a few were successful, but many were unclear or incorrect.

A reasonable number of candidates failed to read the question carefully and just described the data rather than offer explanations. This is an area for some centres to develop, so that candidates are familiar with terms such as 'explain' or 'describe' and what is expected in an answer.

In part(b)(ii) a good number of candidates understood the principle behind this experiment, but failed to name an enzyme and substrate and so could not gain access to mp4 or mp5. A number

of descriptions were also weak and poorly expressed, but still picked up some of the marks. However, there were some very good responses as well, which in some cases scored on as many as 7 marking points, for a maximum mark of 4. However, the weaker candidates found difficulty with this question.

The most common areas to gain marks were mp1 (range of concentrations of enzyme), mp4 measuring the dependent variable), mp6 (reference to an appropriate controlled variable) and mp7 (reference to replicates or repeats at each enzyme concentration). Only in the better and clearer answers were mp3 (reference to mixing), mp2 (idea of substrate not limiting) or mp8 (description of the use of a control) to be found.

In some cases it was clear that candidates had practical experience in carrying out an experiment, while in other cases it was clear that they had not. It was very disappointing, however, to read a reasonably high number of responses which referred to 'potato mash' and using 'scoops' or 'spatula's' as the measurement. This is very unscientific and not good practice.

Q43. **(a)** Most candidates stated that the enzyme increases the rate of reaction. Some candidates said that the rate of reaction with the enzyme present is non-linear and correctly manipulated figures. It was pleasing to see that most candidates did phrase this correctly along the lines that there was a decreasing rate of increase in the rate of reaction with increasing substrate concentration.

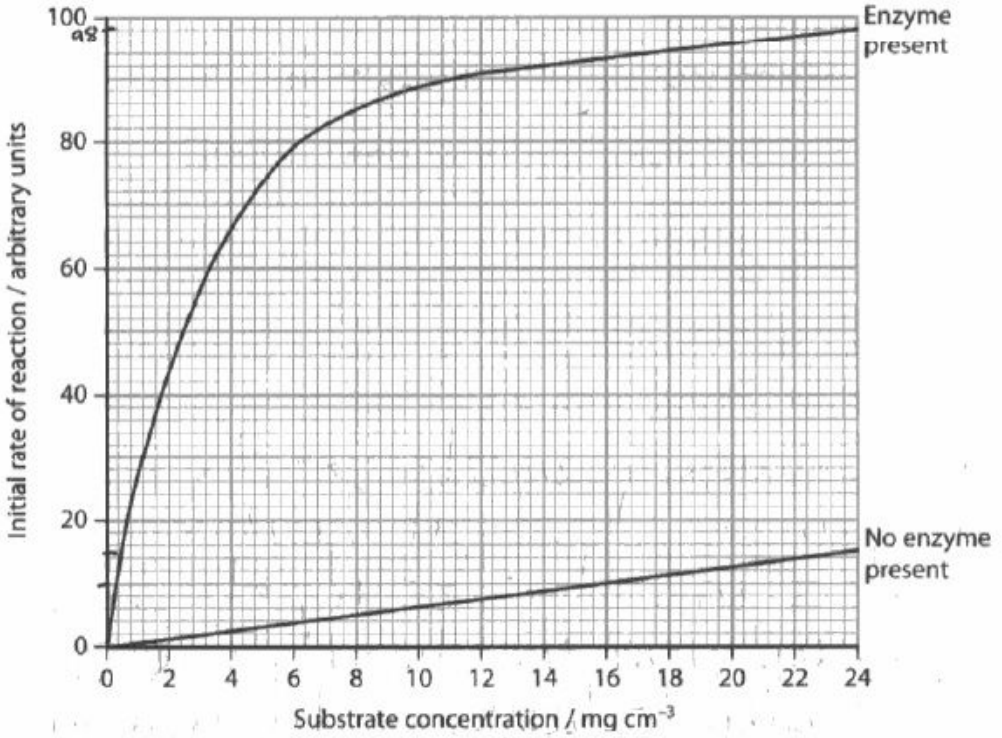
However, only a few candidates spotted that the increase in rate of reaction is the same with or without the enzyme present above substrate concentrations of 10/12.

The most common mistakes were to link the increase in the rate of reaction to the increase in substrate concentration; to state that the rate of reaction slowed down at higher concentrations; or to just quote figures straight from the graph without manipulating them.

This response scored both marks available.

4 Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

It increased the rate of reaction. At concentration of 24mg cm^{-3}, with no enzyme present, rate of reaction was 15 arbitrary units. With enzyme, rate of reaction was 83 units higher at 98 arbitrary units.

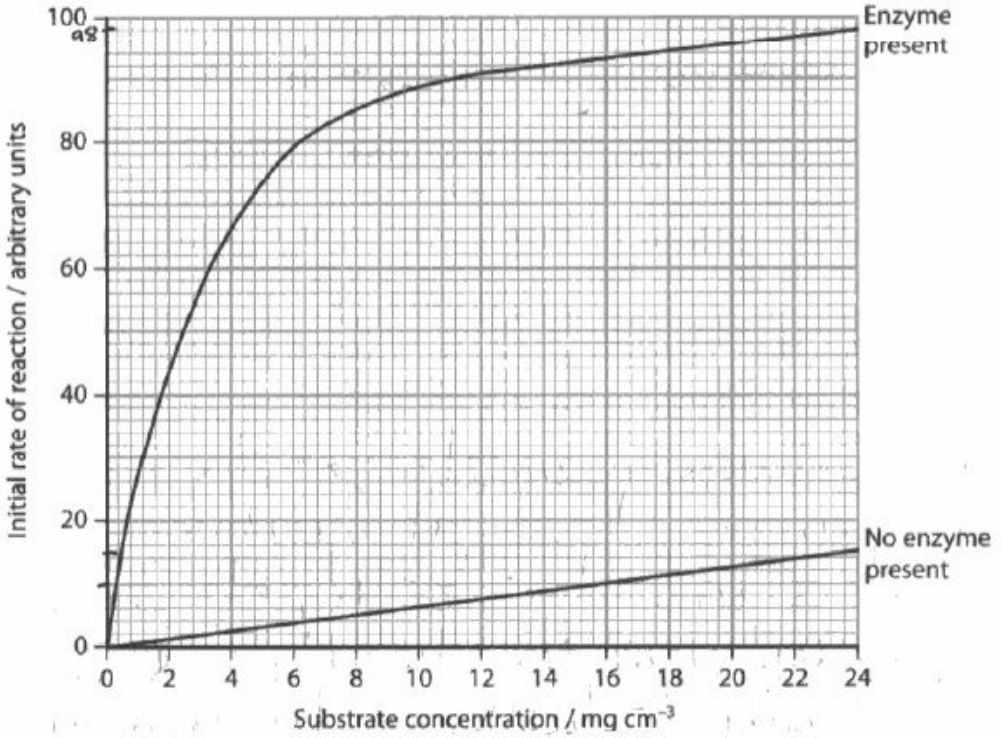
Results Plus: Examiner Comments

This candidate has recognised the effect of the enzyme and illustrated it with a correct manipulation of the figures by stating how much higher the rate is at a particular concentration.

This response scored one of the two marks available.

4 Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

The presence of an enzyme significantly increased the initial rate of reaction for all substrate concentrations compared to the experiment where no enzyme was present

Results Plus: Examiner Comments

This response is typical of the large number of responses which scored just one mark for recognising that the enzyme increases the rate of reaction.

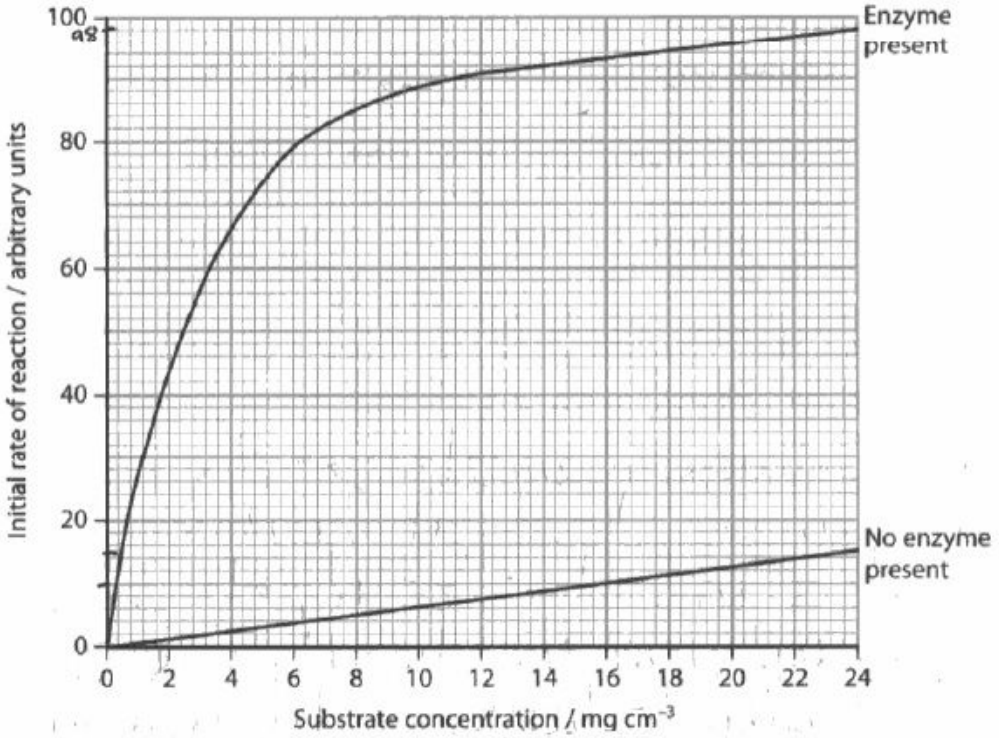
Results Plus: Examiner Tip

When describing a graph worth more than one mark identify any changes in the trend shown in the data and/or manipulate figures to illustrate the point made.

This response scored both marks available.

4 Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

The enzyme increased the initial rate of reaction. It was most effective while the substance concentration was low. From 12 mg the rate of reaction increased the the same amount for the enzyme as it did for the one without it.

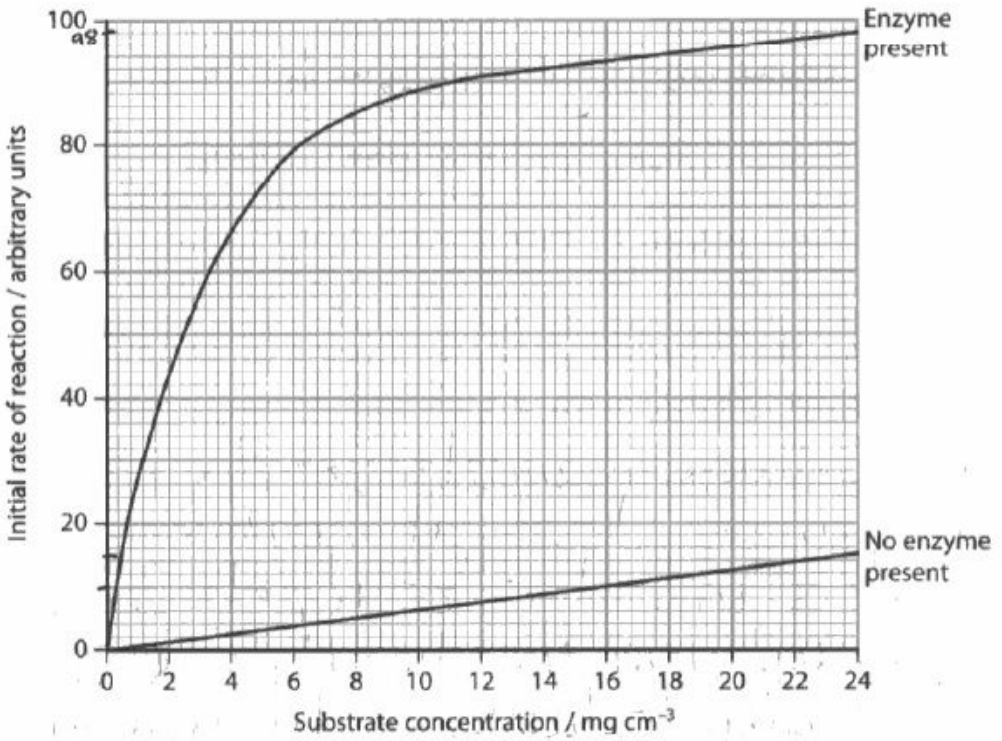
Results Plus: Examiner Comments

This candidate has recognised that the enzyme increases the initial rate of reaction, but they have also spotted that the rate of increase changes and actually matches the increase of rate without the enzyme at the higher concentrations.

This response scores no marks.

4 Enzymes are biological catalysts. They are involved in many chemical reactions in the body, including the digestion of lipids.

(a) The graph below shows the effect of an enzyme on the initial rate of reaction at different concentrations of the substrate.



Describe the effects that the enzyme had on this reaction.

(2)

The greater the concentration of substrate, the faster the initial rate of reaction - therefore showing that the enzyme had lowered the activation energy for the reaction to occur

Results Plus: Examiner Comments

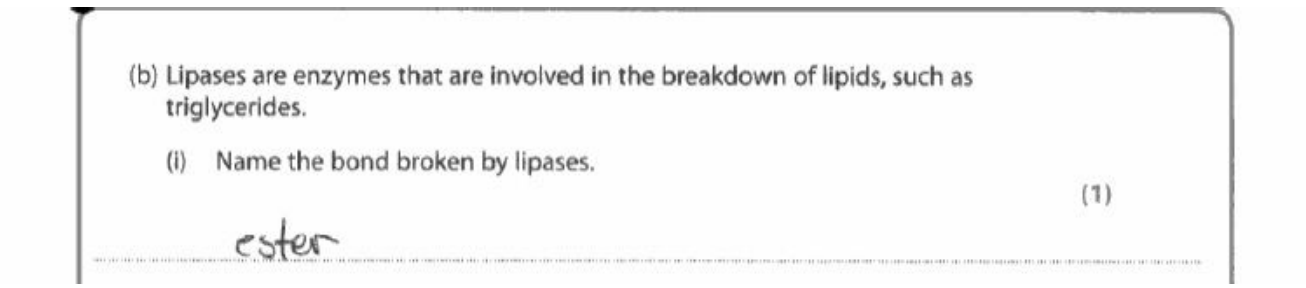
This response is typical of those that failed to score any marks as they have not answered the question asked. They are asked to describe the effects of the enzyme and instead describe the effects of the substrate concentration. They explain what the enzyme does, but again that has not been asked in the question.

Results Plus: Examiner Tip

Read the question carefully and answer the question asked.

(b) (i) Over three quarters of candidates correctly recognised that it would be an ester bond

broken. The most common mistakes involved naming glycosidic, peptide and hydrogen bonds.


(b) Lipases are enzymes that are involved in the breakdown of lipids, such as triglycerides.

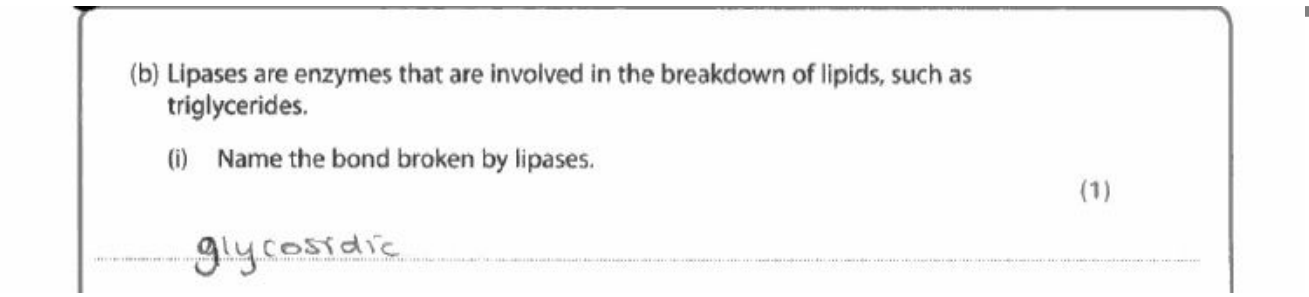
(i) Name the bond broken by lipases.

(1)

ester

Results Plus: Examiner Comments

This is a typical response that scored the mark.


(b) Lipases are enzymes that are involved in the breakdown of lipids, such as triglycerides.

(i) Name the bond broken by lipases.

(1)

glycosidic

Results Plus: Examiner Comments

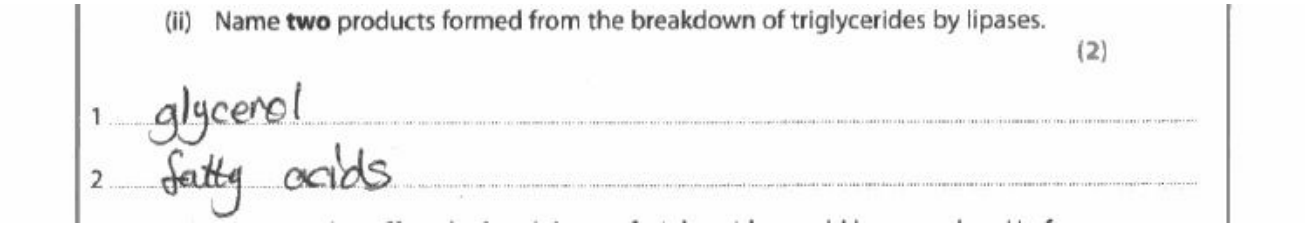
This is an example of one of the most common errors resulting in the mark not being awarded.

(b) (ii) Most candidates correctly recognised that glycerol and fatty acids were the products of the breakdown of triglycerides. The most common error was to include water as a product of this hydrolysis reaction.

Marks were also lost for triglycerides, oxygen, energy, or glycogen. Several candidates referred to fatty acid tails.

We were pleased to see propan1,2,3-triol occasionally.

This response scores both available marks.


(ii) Name **two** products formed from the breakdown of triglycerides by lipases.

(2)

1 glycerol

2 fatty acids

Results Plus: Examiner Comments

This is an example of the most common correct response.

This response scored no marks.


(ii) Name **two** products formed from the breakdown of triglycerides by lipases.

(2)

1 Glucose

2 water

Results Plus: Examiner Comments

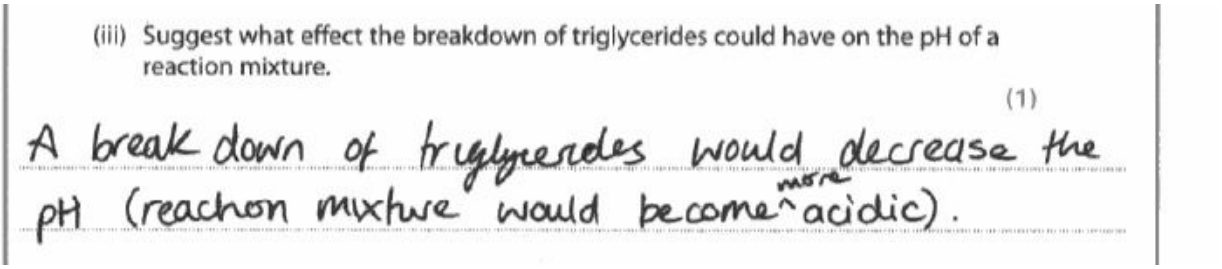
This response illustrates two of the most common errors: - confusing glucose and glycerol; and - thinking that water is a product of a hydrolysis reaction.

Results Plus: Examiner Tip

Remember that condensation reactions remove water and hydrolysis reactions add water to the molecules.

(b) (iii) There were an alarmingly high number of candidates who thought that the pH would increase some even qualifying this with the recognition that there would be more acid present. Some responses ignored the question asked and wrote about enzymes and rates of reaction instead. As a result only just over half of the candidates actually managed to obtain this mark.

This response gained the available mark.


(iii) Suggest what effect the breakdown of triglycerides could have on the pH of a reaction mixture.

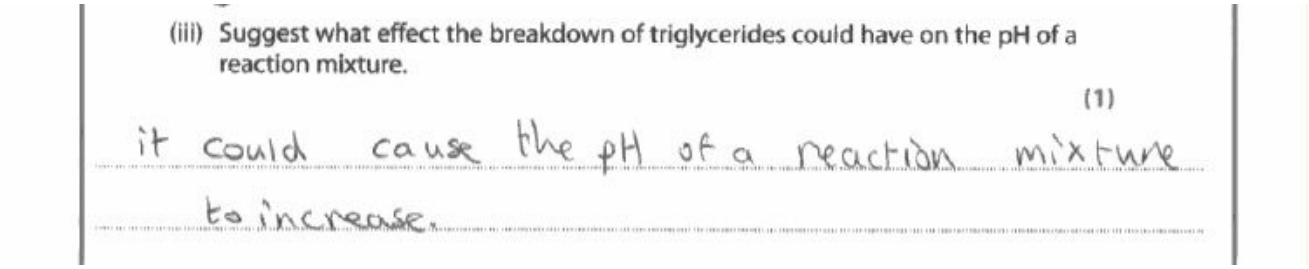
(1)

A break down of triglycerides would decrease the pH (reaction mixture would become more acidic).

Results Plus: Examiner Comments

This candidate has correctly recognised that the mixture would become more acidic and therefore the pH will decrease.

This response scores no marks.


(iii) Suggest what effect the breakdown of triglycerides could have on the pH of a reaction mixture.

(1)

it could cause the pH of a reaction mixture to increase.

Results Plus: Examiner Comments

This response illustrates the most common error - i.e. forgetting which way round the pH scale goes.

Results Plus: Examiner Tip

Check answers carefully to make sure they make sense - is producing a lot of fatty **acids** likely to make the mixture more alkaline/less acidic?

(c) A number of candidates described the catalase experiment from the January paper, others included potatoes, beetroots and a variety of other variations of core practicals. Many candidates correctly referred to a range (or a number) of different substrate concentrations, but a sizeable number of candidates described a range of enzyme concentrations while keeping the substrate concentration constant. This was disappointing, considering the amount of information the candidates had to help them using the graph at the beginning of the question. Candidates who described a different experiment from the one asked for managed to gain access to a reasonable number of marks for recognising key design features of a plan.

Many candidates referred to repeats for reliability and also for controlling variables such as temperature or volume of solutions. Pleasingly, some candidates also clearly referred to the value of repeats without the enzyme and to controlling the lipase concentration. It was also pleasing to see a number of references to equilibrating the solutions and then mixing the enzyme and substrate.

It was disappointing to note the number of candidates who still insist on using the word 'amount', or describing room temperature as a reliable control variable.

Responses ranged widely from poorly expressed answers lacking in detail to very fine answers, clearly expressed, some of which gathered around 8 or 9 marking points for a maximum of 5.

There were many responses with descriptions of how to plot and draw a graph as if this were part of the experimental procedure.

Some candidates spent some time on safety - goggles, lab coats and the effect on any animals in work area.

This response scores all five marks available.

*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)

Make about 10 solutions of the triglyceride each with a different concentration, and including a control with no triglyceride in. Use the same triglyceride in each solution. Measure the pH change in the first minute using an indicator (such as universal indicator - this will require the solution to be continuously stirred with something sterile); this will give the initial rate of reaction in pH/minute. Repeat the tests with the same concentrations but this time with the addition of lipase. Use the same volume and concentration of lipase each time when adding it to a solution. Ensure all other variables are kept constant throughout the experiment such as volume of substrate solution, amount of indicator, temperature. Repeat the whole experiment twice (so having done it 3 times in total) and average the results. Plot a graph of rate of reaction against concentration of substrate with two lines - one for without enzyme and one for with the enzyme.

Results Plus: Examiner Comments

This is example of a candidate who clearly understands both the context of the investigation and the key elements of what to include in a plan. This candidate has actually met ten separate mark points through their clear description of the different variables and how to measure them (including the rate of reaction),the need to mix the solutions, what to repeat and suitable controls etc.

Results Plus: Examiner Tip

Use excellent examples like this to explore the features of a good exam description of a practical, but do not learn it under the assumption that we will ask the same question about the same practical in next year's exam!

This response scored two marks.

*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)

- cut potato in same sized discs
- put in boiling test tube ~~in with~~ water bath ~~distilled water~~
- add buffer solution
- put plot on and lead a hollow tube to a tube ~~water~~ containg ~~tube~~ water
- count bubbles produced in 3 mins
- calculate volume of oxygen produced
- repeat two further time with same ~~amount~~ number of potato discs and then ~~#~~ with different number of potato discs.
- Independent Variable: concentration of enzyme → number of potato discs
  dependent varizble : oxygen produced per time
  controle varizble : · temperature
  · time
  · pH

Results Plus: Examiner Comments

This response is typical of many candidates who ignored the context of the investigation, but still managed to pick up a couple of marks for experimental design features - in this case control of temperature and measuring the time for the reaction. Using a buffer to control the pH is not useful in this context and the repeats are not clear or appropriate for the context of the investigation.

Results Plus: Examiner Tip

Don't ignore the question and answer a question you hoped would appear on the paper instead.

This response scored one mark.

*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)

the same
Different solutions of ↑ PH were placed in dishes and small amounts varying between 10 - 50 ml of lipase and triglycerides were added to the solutions.
This was repeated twice giving 10 results.
The mean was then calculated and the solutions with the highest PH level showed what the reaction levels would be.
The variables were kept the same such as temperature and amount of concentration used.
The experiment could be improved if more results were taken.

Results Plus: Examiner Comments

This candidate has a partial idea of what the context of the investigation is but loses marks for lack of clarity. They gain a mark for a clear control variable (temperature). (Note amount of concentration would not gain the mark). Just what is repeated is not clear and the dependent and independent variables are not clear.

Results Plus: Examiner Tip

When describing an experiment make sure you clearly state dependent, independent and control variables and how they can be measured. Do not use amounts - use a variable that is measurable such as volume. Make it clear what you are repeating.

This response scored one mark.

*(c) The action of lipase can be investigated using a triglyceride as the substrate.

Describe an experiment, using lipase and a triglyceride, that could be carried out to collect data to plot a graph similar to the one shown in part (a).

(5)

Measuring the beetroot premeability, in this experiment we would be measuring permability. In which in this case would be investigating the lipase using triglyceride as the substrate. The change in colour of the beetroot would determine how ~~~~ permable the substance is.

Results Plus: Examiner Comments

This is typical of the candidate who is ignoring the context of the question and has got themselves confused - hoping for a question about a different core practical.

Results Plus: Examiner Tip

Use the context of the whole question to help cue you into what might be needed.

Q44.

Most candidates successfully compared the two processes often comparing the nucleotides, enzymes and sections of the DNA used. Others compared what was made, e.g. two double strands of DNA compared to a single strand of RNA and a few described and compared semiconservative replication with transcription.

However, candidates often lost marks for not making a clear comparison or thinking that the processes took place in different parts of the cell (comparing transcription with translation). Some candidates concentrated on what is eventually produced (proteins and cells) or where the products went (e.g. outside the nucleus) which is not part of the process being compared.

This response gained all three marks available.

Describe **three** differences between the processes of replication and transcription of DNA.

(3)

1 DNA polymerase is used to join up the deoxyribo nucleotides in replication whereas RNA polymerase is used to join up the ribonucleotides in transcription.

2 short strand of mRNA is produced as the result of transcription whereas 2 long molecules of DNA is produced as the result of replication.

3 Only one strand of DNA (template strand) is used in transcription whereas both strands of DNA are used in replication.

Results Plus: Examiner Comments

This response did not get credit for the opening statement as deoxyribonucleotides and ribonucleotides are not suitable names of the components for comparison. However, they have gone on to give three valid comparisons:

- enzymes used
- comparisons about the nature of what is produced - short single strand compared to two long molecules
- comparisons about what sections of the DNA are used for each process.

Results Plus: Examiner Tip

When asked to describe differences make sure your response refers to both things being compared.

This response gained one of the three marks available.

Describe **three** differences between the processes of replication and transcription of DNA.

(3)

1 In replication DNA polymerase is used but in transcription RNA polymerase is used

2 In transcription mRNA strand is transcribed and it diffuses out of the nucleus to attach to a ribosome but this doesn't happen in replication.

3 transcription can be used to make new proteins but replication is only to copy a DNA

Results Plus: Examiner Comments

This response gained credit for the comparison of the enzymes involved. However, the rest of the response is not worth credit because it describes what happens as a result of the processes rather than comparing the processes themselves.

This response gained one mark.

Describe **three** differences between the processes of replication and transcription of DNA.

(3)

1 In DNA replication new cells are made which contain half the information of the original cell. In transcription the DNA is only copied and no new cells are formed.

2 In transcription mRNA are formed by copying section of the DNA whereas in DNA Replication mRNA are not used or formed.

3 In transcription a section of the DNA is unziped whereas in replication, the entire double helix strand is unziped.

Results Plus: Examiner Comments

This response gained a mark for the comparison made about how much of the DNA is 'unzipped'. Replication is not only used in meiosis and we are interested in the process not what is eventually made after the process (cells or proteins). mRNA formed was not sufficient for credit for the comparison of the processes.

Q45.

This was generally well answered, although only just over 40% of candidates gained all four marks. The most common mistakes included:

• thinking CFTR is a carrier protein

• chlorine or sodium instead of chloride

• not reading the last sentence and therefore writing respiratory as the missing system.

This response gained all four marks available.

Cystic fibrosis is an inherited condition.

Read through the following passage about cystic fibrosis then write on the dotted lines the most appropriate word or words to complete the sentences.

(4)

Cystic fibrosis is a disorder caused by one of a number of gene mutations.

The symptoms of the disorder are seen only in an individual who is

homozygous for the recessive allele. The gene codes for

a channel protein called CFTR. This protein is responsible for the

movement of chloride ions across the cell membranes. Cystic fibrosis

impairs the functions of the gaseous exchange, digestive and reproductive

systems in the body.

Results Plus: Examiner Comments

This is an example of a fully correct response.

This response gained two marks.

Cystic fibrosis is an inherited condition.

Read through the following passage about cystic fibrosis then write on the dotted lines the most appropriate word or words to complete the sentences.

(4)

Cystic fibrosis is a disorder caused by one of a number of gene mutations.

The symptoms of the disorder are seen only in an individual who is

genotype for the recessive allele. The gene codes for

a globular protein called CFTR. This protein is responsible for the

movement of chloride ions across the cell membranes. Cystic fibrosis

impairs the functions of the gaseous exchange, digestive and respiratory

systems in the body.

Results Plus: Examiner Comments

Credit was given for chloride ions and we allowed globular for the type of protein made. However, genotype is not suitable for the first gap and the respiratory system has effectively already been covered in the list of systems affected so an alternative was needed, i.e. the reproductive system.

Q46.

A common error here was the discussion that the enzyme would be denatured, rather than specifically mentioning the active site. Nevertheless, many then went on to correctly identify that the active site shape would change and this would prevent the formation of enzyme/substrate complexes. As a result over 50% of candidates gained the maximum two marks for this question.

This response gained both available marks.

Temperature affects the activity of lysozyme.

Suggest why increasing the temperature above 45 °C causes a decrease in the activity of lysozyme.

(2)

45°c is the optimum temprature of the lysozome. After 45°c the active site of the lysozome denatures which means it cannot form enzyme substrate complex

Results Plus: Examiner Comments

This response clearly shows the effect on the enzymes active site and the reason this then decreases the activity of the enzyme.

This response gained no marks.

Temperature affects the activity of lysozyme.

Suggest why increasing the temperature above 45 °C causes a decrease in the activity of lysozyme.

(2)

This would cause a decrease in activity due to the fact that enzymes can only work best at a temperature of 37°c or below, otherwise anything above this temperature and the enzymes will denature and will not work. 37°c is an enzymes optimum temperature.

(Total for Question 6 = 9 marks)

Results Plus: Examiner Comments

This is a typical example of a response that did not go beyond a GCSE level response to include some AS level explanation of cause and effect that would have been relevant to this question.

Results Plus: Examiner Tip

Just stating that an enzyme is denatured is not sufficient information for AS level Biology in a topic that has been covering the structure and functioning of proteins.

This response gained no marks.

Temperature affects the activity of lysozyme.

Suggest why increasing the temperature above 45 °C causes a decrease in the activity of lysozyme.

(2)

This is because it gets too hot as the temperature gets higher and looses energy.

Results Plus: Examiner Comments

This candidate was clearly confused about the relationship between temperature and energy

and made no reference to the enzyme itself.

Q47.

Most candidates had few difficulties in describing what was meant by recessive; either describing the need to be homozygous, or that it could not be expressed in the presence of a dominant allele. However, many candidates did not make it clear what is meant by the term allele. Those who did tended to recognise that they were different forms of the same gene. Few candidates gained the third and final mark for some further detail, e.g. recognising that the alleles are at the same locus or have a different base sequence.

This response gained all three marks available.

The photograph below shows a cleft iris, a rare condition in humans. Cleft iris may be due to the inheritance of recessive alleles.



Magnification ×1

Explain the meaning of the term **recessive allele**.

(3)

A ~~type~~ allele is a variation of a particular gene found on a specific locus. A recessive allele must be ~~do~~ homozygous to be displayed in the phenotype. ~~of the organism by coding for a particular gene~~ If it is heterozygous it has no effect. This is because only the dominant allele will code for the specific gene.

Results Plus: Examiner Comments

This response makes it clear what an allele is - variation of a particular gene (one mark) and found at a specific locus (one mark). As well as recognising what it means to be 'recessive' (one mark).

Results Plus: Examiner Tip

When terms are highlighted in bold make sure you explain all highlighted words.

This response gained two of the three marks available.

The photograph below shows a cleft iris, a rare condition in humans. Cleft iris may be due to the inheritance of recessive alleles.



Magnification ×1

Explain the meaning of the term **recessive allele**.

(3)

A recessive allele is only ~~present~~ expressed if the individuals genotype is homozygous. ~~with~~ A recessive allele is ~~the~~ only produced if both parents are carries (have a heterzgous genotype) or one suffers. A recessive allele is a different fom of the gene will only be expressed if the dominate allele is not present.

Results Plus: Examiner Comments

This response illustrates the mistake that some candidates made in describing the recessive allele in terms of inheritance from the parents rather than expression in the phenotype.

An allele is also not part of a gene.

This response gained no credit.

The photograph below shows a cleft iris, a rare condition in humans. Cleft iris may be due to the inheritance of recessive alleles.



Magnification ×1

Explain the meaning of the term **recessive allele.**

(3)

~~A recessive allele is a part of a gene.~~

An allele is a part of a gene that codes for a certain trait for example hair colour. A recessive allele, therefore is an allele that requires both parents to have this allele in order for the trait to be produced. If both parents do have this recessive allele, then the child is more likely to develop this trait.

Results Plus: Examiner Comments

This response is a typical example of the responses that clearly recognised what recessive meant and that it is one form of a gene.

Q48.

Most candidates gave lengthy descriptions of the mechanisms involved which bring about thicker and stickier mucus, often only getting extra marks in the last few lines where they started to explain what effect this has on breathing. Some responses were not specific enough, writing about less oxygen to lungs or cells rather than alveoli or blood. Some candidates mentioned trapped bacteria but then failed to say what they would cause. A few confused villi and cilia. Some candidates used the word viscous without understanding what it meant, e.g. 'mucus becomes less viscous'.

Many candidates thought that the main effect of the mucus was to increase the diffusion difference for the oxygen rather than reducing air flow, etc.

This response gained all four marks available.

Explain why people with cystic fibrosis can have breathing difficulties.

(4)

People with CF have a faulty CFTR protein and so the CFTR channel is faulty. Therefore the sodium channel protein is constantly open meaning that Na^+ ions are constantly removed from the mucus in the trachea and bronchioles. The Na^+ then diffuses into the tissue fluid because of the higher conc. in the cell. Cl^- also diffuses from the mucus to the tissue fluid through the epithelial cells. Water is drawn out of the mucus via osmosis. The mucus is, therefore, thin sticky and viscous and, the cilia cannot remove the mucus from the airways.

The surface area for diffusion in gaseous exchange is reduced and the mucus blocks the flow of air causing breathing problems. The lungs as a result expand and lose their elasticity causing a smaller volume of air not being able to be breathed in.

Results Plus: Examiner Comments

The maximum four marks were awarded for:

- the mucus is stickier
- cillia are unable to move the mucus
- loss of surface area
- reduction in gaseous exchange.

They are also close to credit for reduced flow of air (but it should be clearer where the air should be flowing to - the alveoli) and the idea that the mucus causes a blockage (but they have not said where).

This response gained one of the four marks available.

Explain why people with cystic fibrosis can have breathing difficulties.

(4)

People with cystic fibrosis have very sticky mucus. This is because they don't have a functioning CFTR protein. As the CFTR protein's not functioning, osmosis across the cell membrane can't happen. This means the Na^+ ions can't move up through the CFTR protein, therefore creating a sticky mucus. The mucus sticks to the ciliated endothelial cells in the air ways, making it very difficult to breath.

Results Plus: Examiner Comments

This is typical of the many responses that only really described why the mucus was sticky (one mark) and did not explain why this caused breathing difficulties.

Results Plus: Examiner Tip

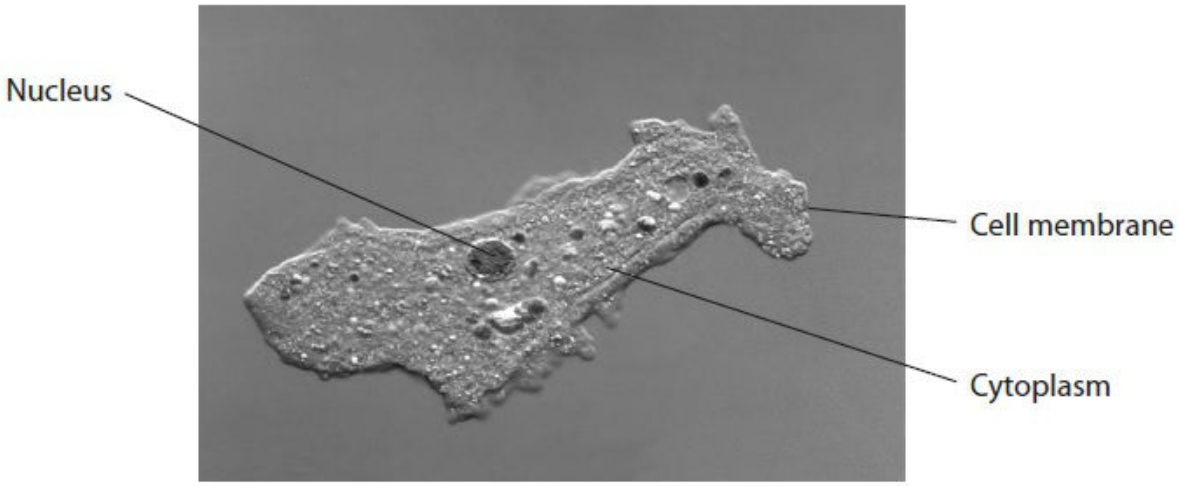
Read the question carefully and make sure you address the question asked.

This response gained no marks.

Q1.

An amoeba is a single-celled organism that lives in water. Gas exchange in an amoeba occurs between the water and the cytoplasm.

The photograph below shows an amoeba, as seen using a microscope.



Magnification x800

Dr Jeremy Burgess / Science Photo Library

*(a) Using the information shown in the photograph and your own knowledge, suggest how gas exchange occurs in an amoeba.

(4)

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(b) Suggest how oxygen passes from the cell membrane into the centre of an amoeba.

(2)

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(Total for question = 6 marks)

Q2.

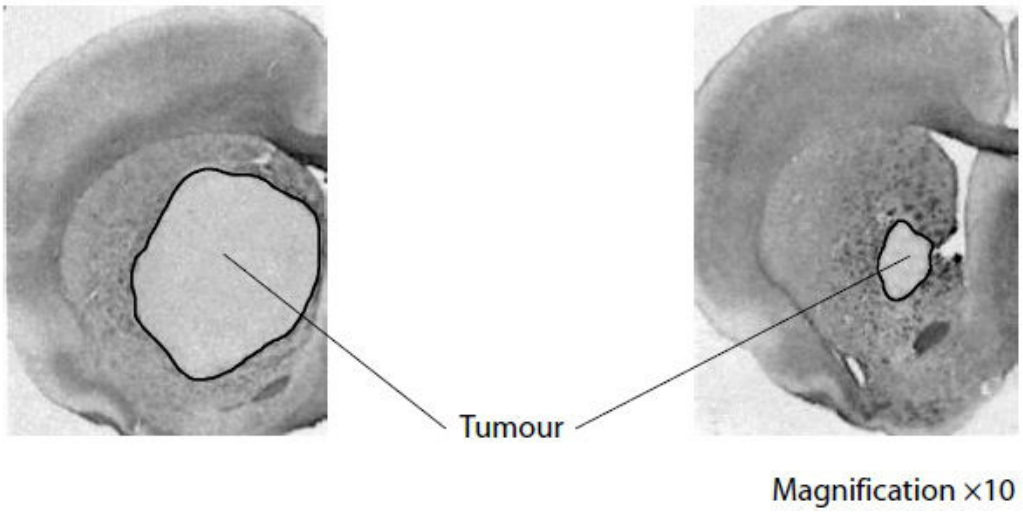
Some types of cancer lead to the production of tumours (a group of rapidly-dividing cancer cells).

Gene therapy has the potential to cure a number of human diseases, including cancer. At present, research into gene therapy relies on animal models of diseases.

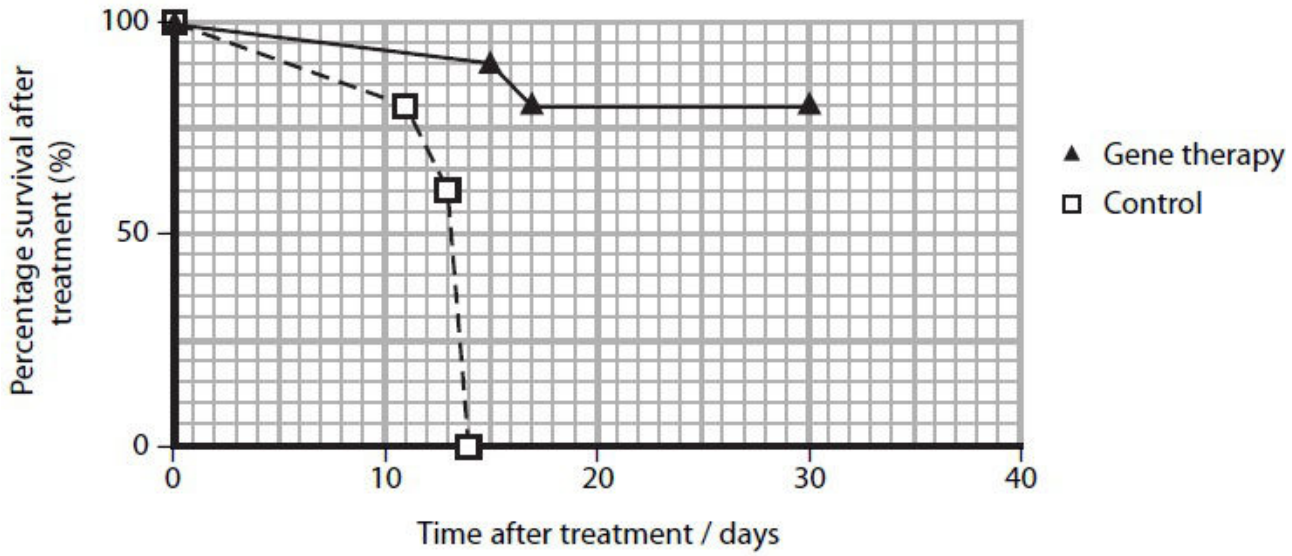
(a) In one investigation, brain tumours were induced in two groups of rats. One group of rats was given gene therapy and the other group of rats acted as a control.

The photographs below show the appearance of a tumour in the brain of a control rat and in a rat given gene therapy.
Both photographs have the same magnification.

Brain of control rat **Brain of rat receiving gene therapy**



The graph below shows the percentage survival after treatment of the rats in the two groups.



Using the information shown in the photographs and in the graph, describe the effects of gene therapy on these rats.

(3)

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(b) Cancer can cause a lot of pain. Pain can be reduced by a chemical called endorphin that is made by cells in the brain and spinal cord. Endorphin reduces the activity of neurones that carry impulses from pain receptors.

Gene therapy has been used in rats to increase the tolerance to pain. Viruses, containing a gene coding for endorphin, were developed. These viruses were injected into the spinal cords of a group of rats. The level of tolerance to pain was tested in these rats and in the rats in a control group.

(i) Describe the role of the viruses in this investigation.

(2)

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(ii) Suggest why the injection was made into the spinal cord.

(1)

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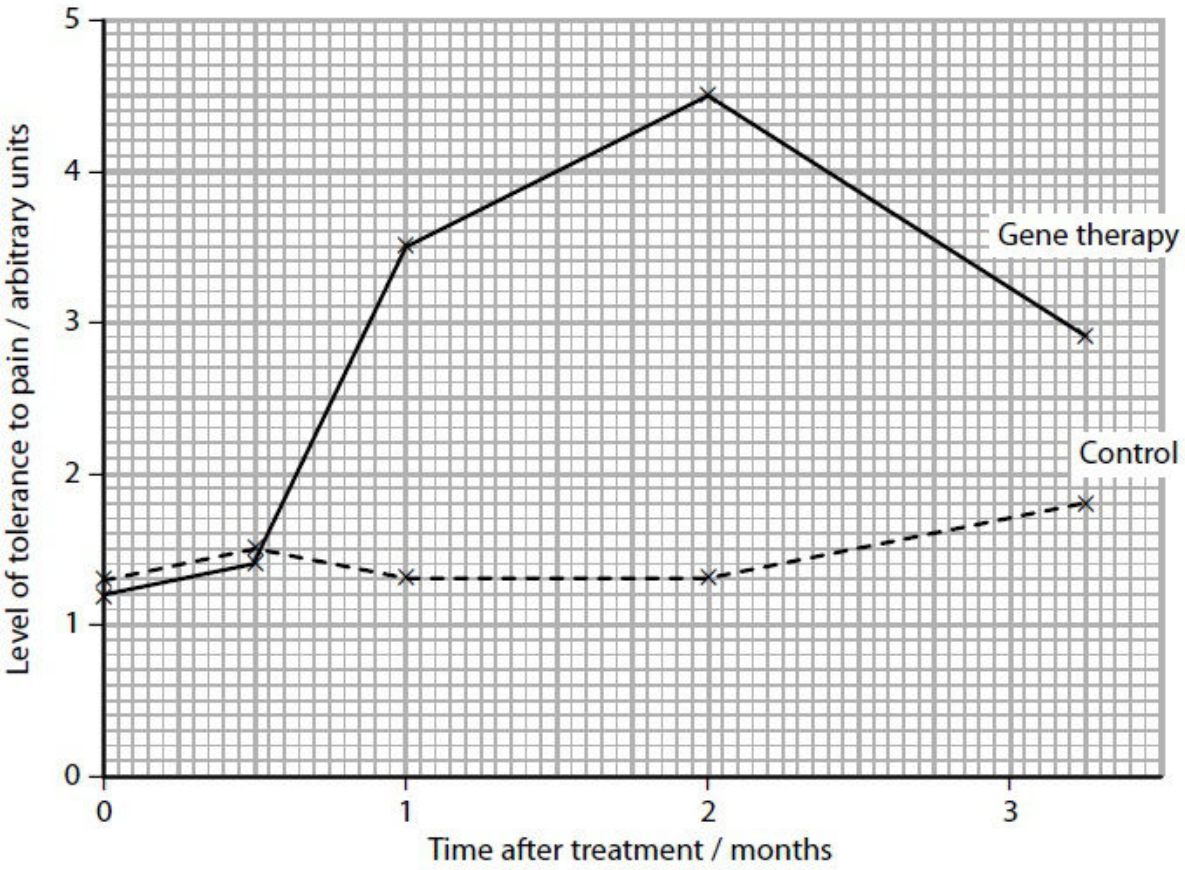
(iii) Suggest why a gene coding for an endorphin was used in this investigation.

(1)

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(iv) The results of this investigation are shown in the graph below.



Using the information in the graph, compare the levels of tolerance to pain in the rats given gene with the therapy control group.

(3)

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(Total for question = 10 marks)

Q3.

*(a) Explain how the expression of a gene mutation in a person with cystic fibrosis causes a build-up of mucus in their respiratory system.

(5)

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(b) Describe **one** way in which gene therapy could be used to treat cystic fibrosis.

(3)

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(Total for question = 8 marks)

Q4.

Metachromatic leukodystrophy (MLD) is an inherited disorder. This disorder, due to brain damage during the first two years of life, can prevent a child learning how to walk and talk.

In one of the first gene therapy treatments approved in Europe, one child from each of three families with a history of MLD, was treated.

As a result of this treatment the children were able to talk at an age when some of their untreated brothers and sisters were unable to talk.

MLD is associated with a recessive allele.

(a) Two parents, who are physically unaffected by the disorder, have already had one child with the disorder.

Using a suitable genetic diagram, calculate the probability that the next child of these parents will also be affected by this disorder.

(4)

probability .....

(b) Suggest how a newborn baby could be tested for MLD before brain damage develops.

(2)

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(c) The gene therapy involved taking bone marrow stem cells from the child to be treated. A virus was then used to transfer DNA with the dominant allele into the stem cells. These modified stem cells were then injected into this child.

(i) Suggest how these modified stem cells can result in the prevention of MLD.

(3)

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(ii) Suggest why the development of the treated children was compared with the development of their untreated brothers and sisters.

(2)

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(d) There are some risks associated with somatic gene therapy.

Suggest why the parents of these children gave consent for their children to be involved in the gene therapy treatment for MLD.

(2)

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(Total for question = 13 marks)

Q5.

Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	Cells removed from the embryo
Preimplantation genetic diagnosis		
Prenatal genetic screening		

(b) (i) Name **one** method of prenatal genetic screening.

(1)

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(ii) Discuss either **one** ethical issue or **one** social issue relating to the use of this method of prenatal genetic screening.

(2)

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(c) Gene therapy has the potential to treat some genetic disorders.

(i) Explain why gene therapy has the potential to treat some genetic disorders.

(2)

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(ii) Suggest how patients with cystic fibrosis could be treated using gene therapy.

(3)

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(Total for question = 10 marks)

Q6.

Cystic fibrosis and albinism are examples of recessive genetic disorders.

Tay-Sachs disease is another example of a recessive genetic disorder.

(a) Explain the meaning of the term **recessive genetic disorder**.

(2)

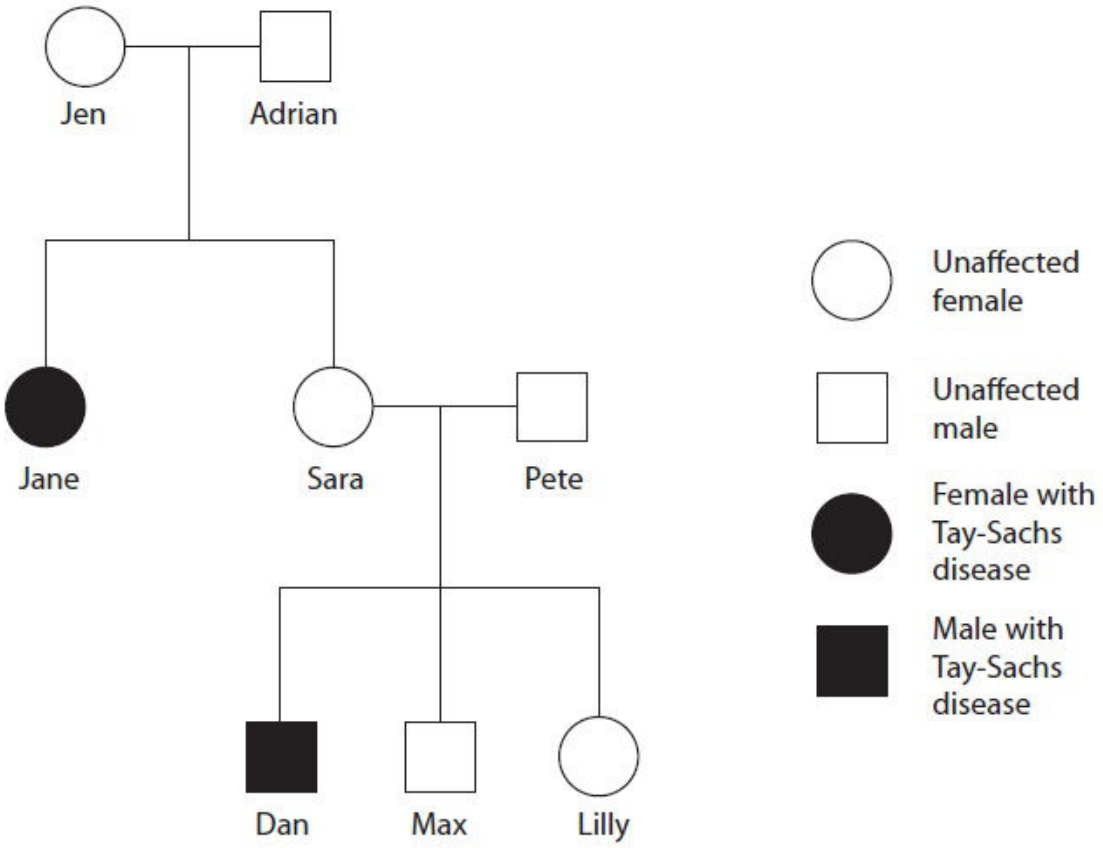
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(b) The genetic pedigree diagram below shows the inheritance of Tay-Sachs disease in one family.



For each of the statements below, put a cross (☒) in the box that correctly completes the statement.

(i) The female who definitely has a homozygous genotype is

(1)

☒ **A** Jane

☒ **B** Jen

☒ **C** Lilly

☒ **D** Sara

(ii) The female whose genotype cannot be identified from the diagram is

(1)

☒ **A** Jane

☒ **B** Jen

☒ **C** Lilly

☒ **D** Sara

(iii) A male who definitely has a heterozygous genotype is

(1)

☒ **A** Adrian

☒ **B** Dan

☒ **C** Max

☒ **D** none of them

(iv) A male who definitely is homozygous dominant is

(1)

☒ **A** Adrian

☒ **B** Dan

☒ **C** Max

☒ **D** none of them

*(c) Tay-Sachs disease is caused by a gene mutation that results in the build up of lipid in the brain. It is hoped that gene therapy will be able to treat this disease in the future.

Sheep can also suffer from Tay-Sachs disease. Investigations have found that gene therapy increases the life span of these animals.

Suggest how these gene therapy investigations could have been carried out.

(5)

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(Total for question = 11 marks)

Q7.

Albinism is a genetic trait resulting from the inheritance of recessive alleles.

(a) (i) Distinguish between the terms **allele** and **gene**.

(2)

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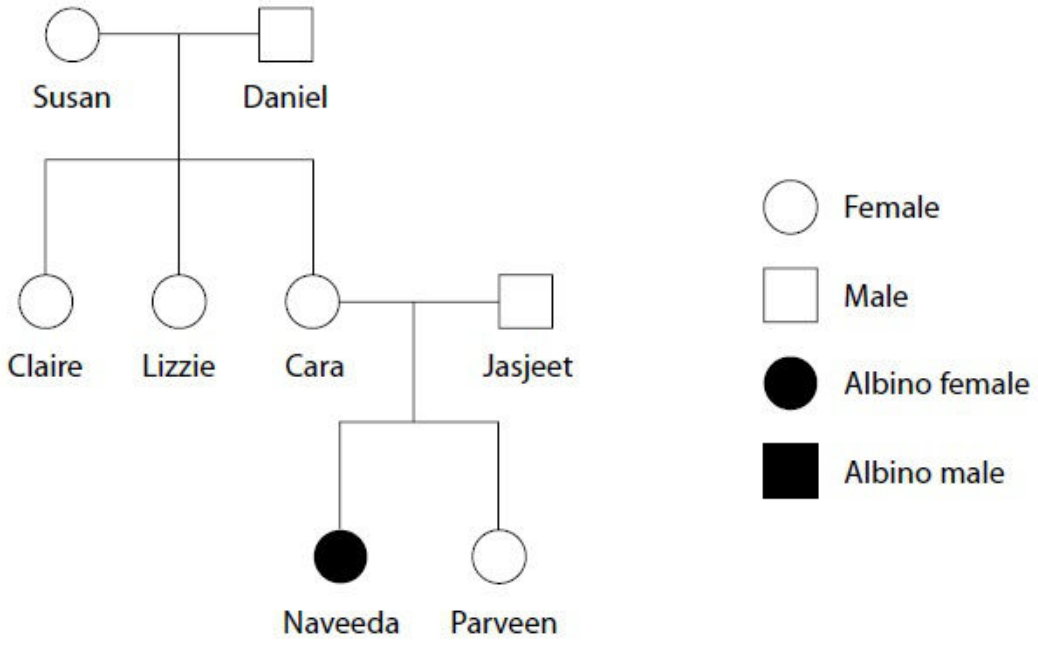
(ii) Explain the meaning of the term **recessive** allele.

(1)

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(b) The pedigree diagram below shows the inheritance of albinism in one family.



(i) Naveeda is homozygous. Explain the meaning of the term **homozygous**.

(1)

(ii) Susan is also homozygous. Name the members of this family who are definitely carriers of albinism, giving reasons for your answer.

(4)

(c) Albinism occurs in a number of different animals, including squirrels as shown in the photograph below.



The incidence of albinism in squirrels is 1 in 100 000 births, which is much lower than the incidence of albinism in humans. Suggest why the incidence of albinism in squirrels is lower than the incidence in humans, giving a reason for your answer.

(2)

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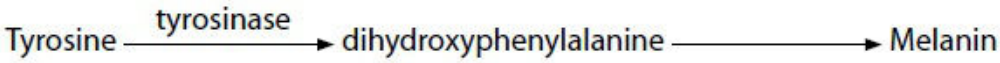
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(d) Individuals with albinism are unable to produce the pigment melanin. This can be due to the absence of the enzyme tyrosinase. The diagram below shows the role of tyrosinase in melanin production.



Explain why melanin cannot be produced in the absence of the enzyme tyrosinase.

(2)

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(Total for question = 12 marks)

Q8.

The DNA base sequence for part of a gene is shown below.

A	C	T	T	T	C	G	C	C	C	G	A

Write the mRNA base sequence produced from this sequence of bases.

(2)

Q9.

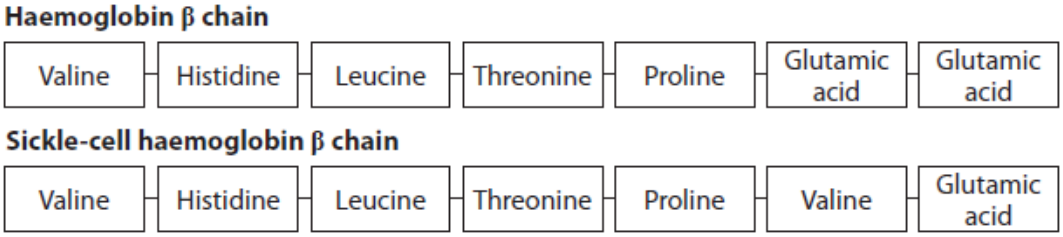
Haemoglobin contains four polypeptide chains, two α chains and two β chains. Haemoglobin has the amino acid glutamic acid at position 6 in each β chain.

The R group for glutamic acid is $—CH_2—CH_2—COOH$

Sickle-cell haemoglobin is another form of haemoglobin that causes sickle-cell anaemia. Sickle-cell haemoglobin has the amino acid valine at position 6 in each β chain.

The R group for valine is —CH—$(CH_3)_2$

The diagram below shows the first seven amino acids in the β chains of haemoglobin and sickle-cell haemoglobin.



(i) Using the information given, suggest why sickle-cell anaemia could be caused by a mutation in a single DNA base.

(2)

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(ii) Explain why the change in the amino acid at position 6 in the β chains changes the properties of the haemoglobin molecule.

(3)

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(Total for question = 5 marks)

Q10.

Active transport and facilitated diffusion are two ways in which some molecules can move through cell membranes.

Vitamin C and vitamin D are essential for human health.

Vitamin C is water-soluble. Vitamin D is lipid-soluble.

Explain how the structure of the cell surface membrane affects how each of these vitamins passes through the membrane.

(4)

Vitamin C

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Vitamin D

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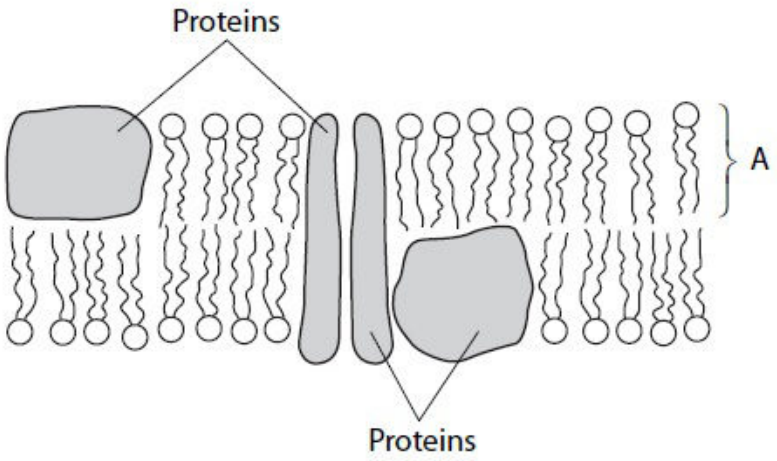
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(Total for question = 4 marks)

Q11.

The fluid mosaic model describes the structure and properties of cell membranes.

(a) The diagram below shows the structure of a cell membrane based on this model.



(i) Name the molecule labelled A and describe its structure.

(3)

Name .....

Structure

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(ii) Explain how the properties of molecule A contribute to the structure of the cell membrane.

(3)

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(b) Some proteins in the cell membrane are involved in active transport and facilitated diffusion. Describe the role of proteins in these cell transport mechanisms.

(3)

Active transport

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Facilitated diffusion

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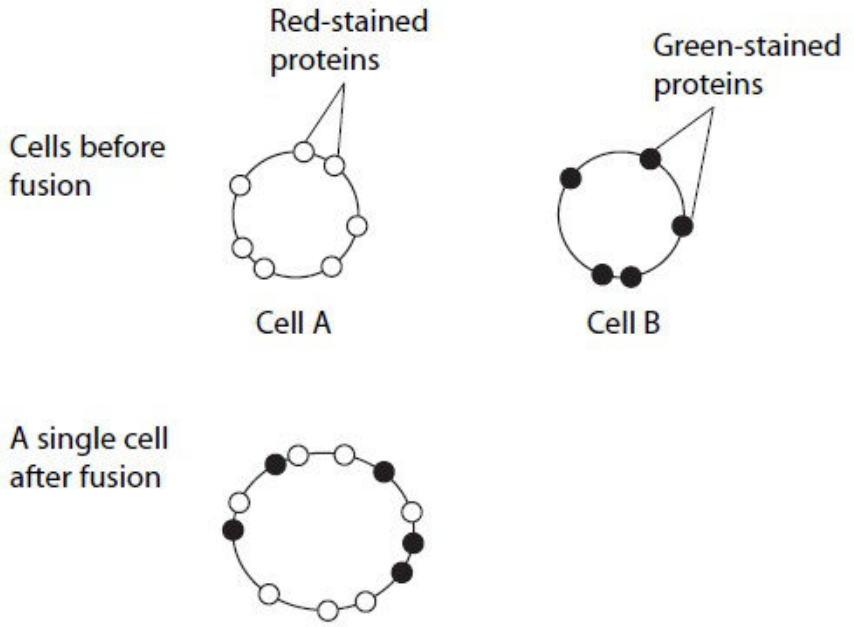
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(c) In an investigation into the properties of the cell membrane, the proteins in the membranes of two cells, A and B, were stained using different dyes. The proteins of one cell were stained green and the proteins of the other cell were stained red. The cells were then fused (merged together) to form a single cell.

The diagram below shows the distribution of the proteins in the cell membranes before and after fusion.



(i) Describe the distribution of the proteins in this single cell after fusion.

(2)

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(ii) Describe how the results of this investigation can be explained by the fluid mosaic model.

(2)

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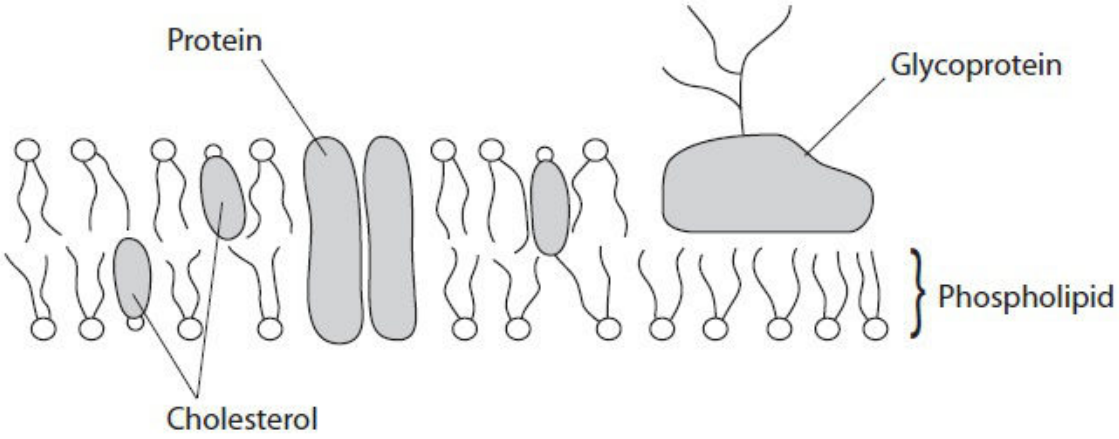
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(Total for question = 13 marks)

Q12.

One function of the cell membrane is to control which molecules can enter or leave the cell.

The diagram below represents the structure of the cell membrane.



(a) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) The phospholipids form a bilayer because

(1)

☒ **A** the hydrophobic heads dissolve in the aqueous (water) environment

☒ **B** the hydrophobic heads move away from the aqueous environment

☒ **C** the hydrophobic tails dissolve in the aqueous environment

☒ **D** the hydrophobic tails move away from the aqueous environment

(ii) The protein, labelled in the diagram, could be involved in

(1)

☒ **A** endocytosis

☒ **B** exocytosis

☒ **C** facilitated diffusion

☒ **D** phagocytosis

(iii) The fluidity of the membrane is determined by the proportion of

(1)

☒ **A** cholesterol

☒ **B** glycoprotein

☒ **C** phospholipid

☒ **D** protein

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through

membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 ºC. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

The procedure was repeated at five other temperatures.

The results are shown in the table below.

Temperature / °C	Colour of fluid
5	pale pink
22	pale pink
42	pale pink
64	pink
87	dark pink
93	red

Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

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(c) A second student carried out a very similar experiment, using three samples of beetroot at each temperature. She used a colorimeter to determine the intensity of the colour of the fluid produced.

The results of her experiment are shown in the table below.

Temperature / °C	Intensity of colour of fluid / arbitrary units		
	Sample 1	Sample 2	Sample 3
5	0.0	0.0	0.0
22	10.1	9.8	11.1
42	26.3	29.9	31.0
64	80.1	77.0	76.9
87	93.9	95.0	96.0
93	100.0	100.0	100.0

(i) State **two** variables that both of these students must keep the same if their results are to be compared.

(2)

1

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(ii) Give **two** reasons why the results obtained by the second student are more reliable than those of the first student.

(2)

1

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(iii) In the first student's experiment at 5 ºC, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference.

(2)

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(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells.

Suggest **one** way in which these two descriptions might differ.

(1)

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(Total for question = 12 marks)

Q13.

Molecules are transported into and out of cells by several mechanisms.

(a) Read through the following passage that describes some of these mechanisms, then write on the dotted lines the most appropriate word or words to complete the passage.

(4)

Some molecules move across a cell surface membrane by passing down a

concentration gradient, through the phospholipid bilayer. The movement of some polar

molecules across the membrane involves carrier and channel

..... molecules. When this movement occurs down a

concentration gradient, the process is called
..... and

when it occurs against a concentration gradient the process is called

..... .

Energy in the form of ..... is used in the movement of

molecules against a concentration gradient.

(b) A student wanted to sweeten some strawberries, so she sprinkled some sugar on top of them, one hour before eating them. The student noticed that the sugar that she had sprinkled on them was no longer visible and that there was some juice at the bottom of the bowl.



Appearance on adding sugar



Appearance one hour after adding sugar

The student thought that the juice was the sugar dissolved in water and that the water had come from the fruit.

In order to test this hypothesis, she weighed some fresh strawberries and sprinkled them with sugar. One hour later she rinsed off the juice and reweighed the strawberries. The mass of the strawberries before adding the sugar was 77 g. The mass after rinsing off the juice was 70 g.

(i) Calculate the percentage decrease in the mass of the strawberries.

Show your working.

(2)

Answer ..... %

(ii) Suggest **one** possible source of error in the student's procedure that could make this value for the percentage decrease in the mass of the strawberries inaccurate.

Explain how this source of error would affect the value for the percentage decrease in the mass of the strawberries.

(3)

Source of error

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Effect on value and explanation

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(iii) Using your knowledge of cell transport mechanisms and the properties of water, explain how the juice is formed from the water that came from the fruit.

(3)

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(Total for question = 12 marks)

Q14.

Thalassaemia is the name of a group of inherited blood disorders that affect the body's ability to produce haemoglobin in red blood cells. Red blood cells are produced in bone marrow.

Oxygen in the lungs binds to haemoglobin and is carried to the cells of the body to be used in respiration.

Beta thalassaemia is the result of a mutation in the gene coding for the β chain of haemoglobin. If a person inherits gene mutations from both parents, this person will show symptoms of anaemia and will require blood transfusions. Symptoms of anaemia include tiredness and breathlessness.

*(a) Using the information given above and your knowledge of gene mutation, suggest why a person with beta thalassaemia has symptoms of anaemia.

(4)

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*(b) If the phenotypes of the parents are known, the probabilities of having a child with beta thalassaemia, an unaffected child or a child who is a carrier, can be calculated.

Complete the table below to show the results of these calculations.

(4)

Parent 1	Parent 2	Probability of having a child with beta thalassaemia	Probability of having an unaffected child	Probability of having a child who is a carrier
Unaffected	carrier	no chance	50%	50%
Carrier	carrier			
Unaffected	has beta thalassaemia			
Carrier	has beta thalassaemia	50%	no chance	50%

(c) Gene therapy could potentially be used to treat beta thalassaemia.

Suggest how gene therapy could be carried out to treat this disorder.

(4)

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(Total for question = 12 marks)

Q15.

Nucleic acids, DNA and RNA, are very important molecules in living organisms. Messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of proteins.

For each of the statements (a) to (f), put a cross ☒ in the box that corresponds to the correct statement.

(a) DNA and RNA are polynucleotides composed of mononucleotides joined by

(1)

☒ **A** catabolic reactions

☒ **B** condensation reactions

☒ **C** hydrolysis reactions

☒ **D** redox reactions

(b) The mononucleotides of RNA consist of a phosphate joined to the sugar

(1)

☒ **A** deoxyribose

☒ **B** dextrose

☒ **C** ribose

☒ **D** ribulose

(c) The mononucleotides in mRNA are joined together by

(1)

☒ **A** disulphide bridges

☒ **B** glycosidic bonds

☒ **C** hydrogen bonds

☒ **D** phosphodiester bonds

(d) The bases in RNA are

(1)

☒ **A** adenine, cytosine, guanine and thymine

☒ **B** adenine, cytosine, guanine and uracil

☒ **C** adenine, cytosine, guanine and uracil

☒ **D** adenine, cytosine, guanine and uracil

(e) DNA is a double stranded molecule twisted into

(1)

- ☒ **A** a beta-pleated sheet
- ☒ **B** a double helix
- ☒ **C** a triple helix
- ☒ **D** an alpha helix

(f) The two DNA strands are held together by

(1)

- ☒ **A** disulphide bridges
- ☒ **B** glycosidic links
- ☒ **C** hydrogen bonds
- ☒ **D** phosphodiester bonds

(g) Describe the role of each of the following in protein synthesis.

(4)

mRNA

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tRNA

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(Total for question = 10 marks)

Q16.

In an osmosis investigation, a student prepared five pieces of raw potato of equal mass and a range of sucrose solutions of different concentrations.

One piece of potato was placed in each sucrose solution. After two hours, the potato pieces were removed and blotted dry and the change in mass of each potato piece was calculated.

The results are shown in the table below.

Concentration of sucrose solution / mol dm^{-3}	Change in mass of potato piece / g
0.2	+1.34
0.4	+0.82
0.6	+0.31
0.8	−0.11
1.0	−0.65

(a) Explain the meaning of the term **osmosis**.

(2)

(b) (i) Explain why the piece of potato placed in 0.2 mol dm^{-3} sucrose solution had the largest change in mass.

(3)

(ii) The student suggested that there would be no change in the mass of a piece of potato placed in a sucrose solution of 0.75 mol dm^{-3}. Give an explanation for this suggestion.

(2)

(c) The student repeated this investigation using another potato and the results were different.

The student concluded that there was a difference in water content of the two potatoes. Suggest **two** reasons for this difference in water content.

(2)

1

2

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(d) A second student wanted to perform this investigation by measuring the change in length of the potato pieces. The student was advised that this method would not be as accurate as weighing the potato pieces.

Suggest **two** reasons why measuring the change in length would not be as accurate as weighing the potato pieces.

(2)

1

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2

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(Total for question = 11 marks)

Q17.

The size and solubility of molecules has an effect on their ability to be taken up by cells.

*(a) Describe an experiment you have carried out to investigate the permeability of cell membranes.

(5)

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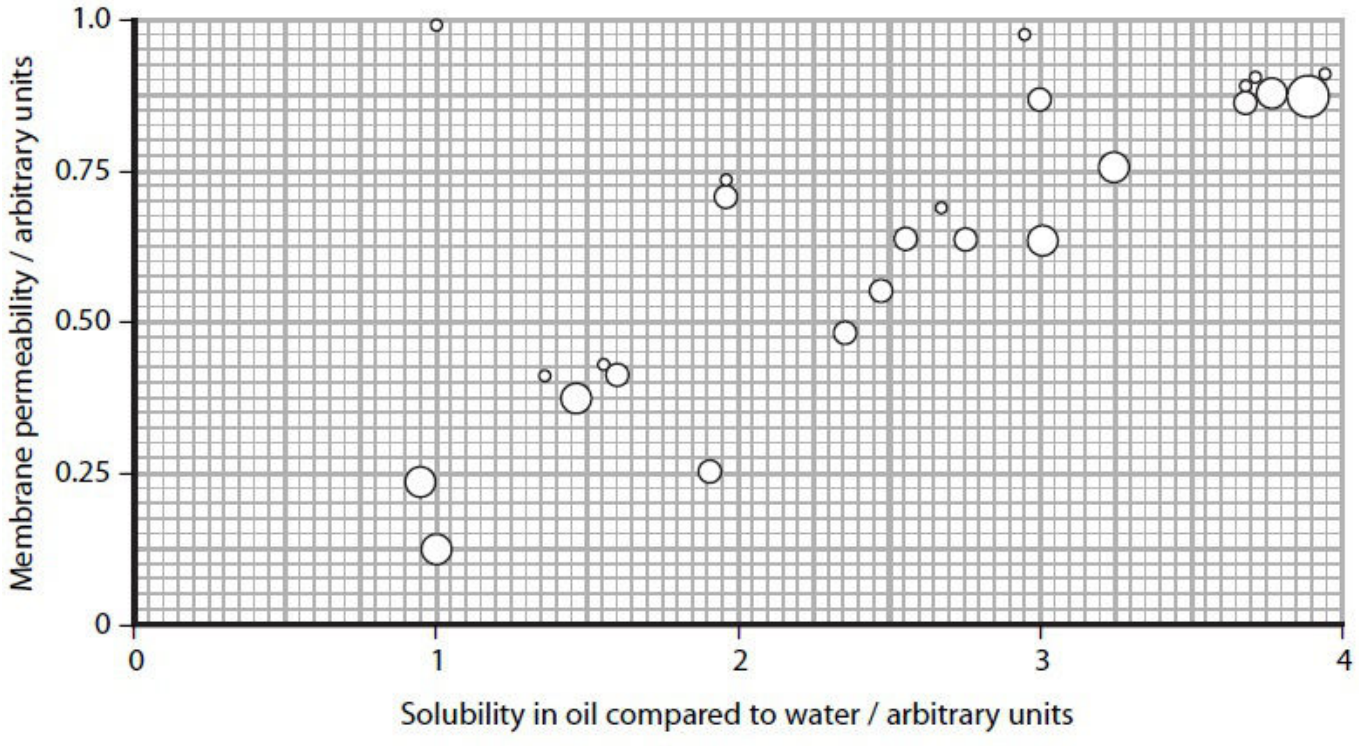
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(b) An investigation was carried out into the permeability of a cell membrane to a number of different non-polar, organic molecules. The molecules differed in their size and in their solubility in oil compared with their solubility in water. The higher the solubility, the more soluble the molecule is in oil compared with water.

The graph below shows the results of this investigation.

The size of the circle drawn on the graph indicates the size of the molecule; the larger the circle, the larger the molecule.



(i) Describe what relationship, if any, there is between the permeability of this cell membrane and the **size** of the molecules.

(1)

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(ii) Describe what relationship, if any, there is between the permeability of this cell membrane and the **solubility** of the molecules in oil compared with water.

(1)

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(iii) Water is able to diffuse through a cell membrane, even though it is a polar molecule.

On the graph, draw a circle, labelled W, to indicate the permeability of the cell membrane to water. The size of the circle should represent the size of the water molecule.

(2)

(iv) Use your knowledge of the structure and properties of cell membranes to explain the results of this investigation.

(3)

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(Total for question = 12 marks)

Q18.

The cell vacuoles of beetroot *(Beta vulgaris)* contain the red pigment betalain.

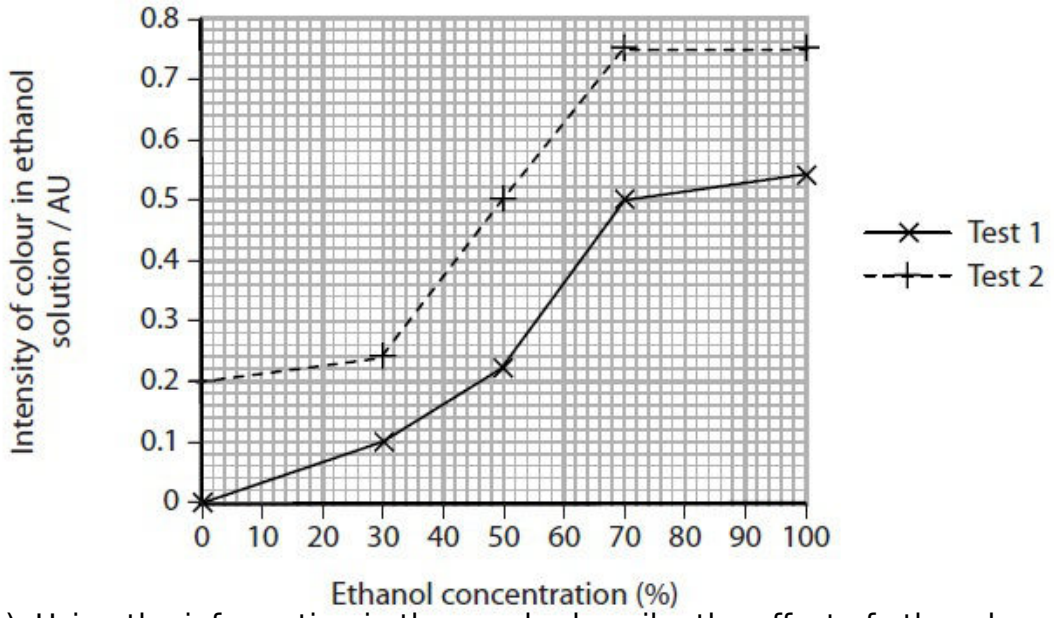
A student investigated the effect of ethanol on the permeability of beetroot cell membranes.

In this investigation, 10 identical pieces were cut from one beetroot. One piece of beetroot was left in
10 cm^3 of 30% ethanol for 20 minutes at 20 °C.

After 20 minutes, the piece of beetroot was removed and the intensity of the colour of the ethanol solution was measured using a colorimeter.

This was repeated with other pieces of beetroot that were left in ethanol concentrations of 0%, 50%, 70% and 100%, at 20 °C.

The student repeated this investigation with the other five pieces of beetroot at the same temperature of 20 °C. The graph below shows the results of these investigations.



(a) Using the information in the graph, describe the effect of ethanol concentration on the intensity of colour.

(3)

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(b) Using the information in the graph and your knowledge of membrane structure, explain the effect of ethanol on the permeability of beetroot cell membranes.

(4)

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(c) Suggest why the results for these two investigations are different.

(2)

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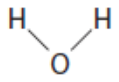
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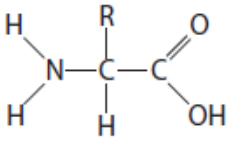
(Total for question = 9 marks)

Q19.

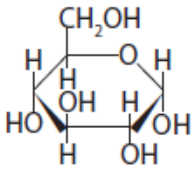
The diagram below shows four molecules, P, Q, R and S, found in living organisms.



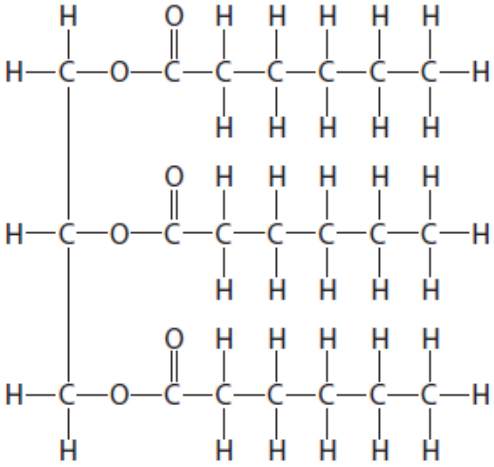
P



Q



R



S

Place a cross ☒ in the box to complete each of the following statements.

(i) Two molecules of **P** can be joined together by

(1)

☒ **A** a hydrogen bond

☒ **B** a hydrophobic interaction

☒ **C** an ionic bond

☒ **D** a peptide bond

(ii) A condensation reaction between two molecules of **Q** forms

(1)

☒ **A** an ester bond

☒ **B** a glycosidic bond

☒ **C** a hydrogen bond

☒ **D** a peptide bond

(iii) Molecule **R** is

(1)

☒ **A** a fatty acid

☒ **B** an amino acid

☒ **C** deoxyribose

☒ **D** glucose

(iv) One of the products of the hydrolysis of molecule **S** is

(1)

☒ **A** a triglyceride

☒ **B** an amino acid

☒ **C** glycerol

☒ **D** water

Q20.

Proteins, such as enzymes, are important molecules found in all living organisms.

(a) Read through the following passage on the primary structure of proteins, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

Proteins are made of monomers called ..... These monomers

are joined together by ..... bonds, formed during

..... reactions.

Each monomer of a protein consists of a central carbon atom attached to a hydrogen

atom, an R group, an ..... group and

a ..... group. The sequence of monomers determines the primary

structure of the protein.

(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

(3)

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(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

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(Total for question = 11 marks)

Q21.

Enzymes, messenger RNA (mRNA) and transfer RNA (tRNA) are involved in the synthesis of proteins.

(a) The diagram below represents the structure of an enzyme.
Each circle represents an amino acid.



(i) An enzyme is a protein and has a primary structure.
Explain the meaning of the term **primary structure**

(2)

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(ii) Using the diagram and your own knowledge of enzymes, explain the importance of the primary structure of an enzyme to its function.

(5)

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(b) Describe the roles of messenger RNA (mRNA) and transfer RNA (tRNA) in protein synthesis.

(i) Messenger RNA

(3)

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(ii) Transfer RNA

(3)

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(Total for question = 13 marks)

Q22.

Transcription and translation are processes involved in the synthesis of proteins.

(a) Put a cross ☒ in the box to complete each of the following statements.

(i) Individual mononucleotides in a molecule of mRNA are joined together by

(1)

- ☒ **A** glycosidic bonds
- ☒ **B** hydrogen bonds
- ☒ **C** peptide bonds
- ☒ **D** phosphodiester bonds

(ii) The maximum number of amino acids coded for by a molecule of mRNA that is 600 mononucleotides long is

(1)

- ☒ **A** 100
- ☒ **B** 200
- ☒ **C** 300
- ☒ **D** 600

(iii) When a gene that contains 22% adenine is transcribed, the mRNA produced will have

(1)

- ☒ **A** 22% adenine
- ☒ **B** 0% cytosine
- ☒ **C** 0% thymine
- ☒ **D** 28% uracil

(b) Describe the structure of a mononucleotide found in RNA.

(2)

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*(c) Describe the process of protein synthesis that occurs in the cytoplasm.

(5)

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(Total for question = 10 marks)

Q23.

Read through the following passage on protein synthesis, then write on the dotted lines the most appropriate word or words to complete the passage.

(6)

Protein synthesis involves two stages. The first stage is ..... and

takes place in the nucleus of the cell. During this stage, a molecule called

..... is made using the antisense DNA strand as a template.

The second stage, known as ..... , takes place in the cytoplasm of

the cell on structures called ..... . During this stage,

..... molecules enable the amino acids attached to them to line

up in the correct order. The amino acids are joined together by the formation of

..... bonds.

(Total for question = 6 marks)

Q24.

Cystic fibrosis and albinism are examples of recessive genetic disorders. Krabbe disease is another example of a recessive genetic disorder.
Krabbe disease is caused by mutations in the GALC gene, resulting in a deficiency of an enzyme called galactocerebrosidase.

(a) Explain the meaning of each of the following terms.

(i) Mutation

(2)

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(ii) Recessive

(1)

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(b) Suggest how a mutation in the GALC gene could result in a change in the enzyme galactocerebrosidase.

(3)

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(c) Two parents are both carriers of the recessive allele for Krabbe disease.

In the space below, draw a genetic diagram to show the possible genotypes and phenotypes of their children.

Use the genetic diagram to find the probability of these parents having a child with Krabbe disease.

(5)

Probability .....

(d) State how these parents could determine whether or not their unborn child has Krabbe disease.

(1)

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(Total for question = 12 marks)

Q25.

Messenger RNA (mRNA) and transfer RNA (tRNA) are important nucleic acids involved in the process of protein synthesis.

(a) Describe how a molecule of mRNA is made during transcription.

(4)

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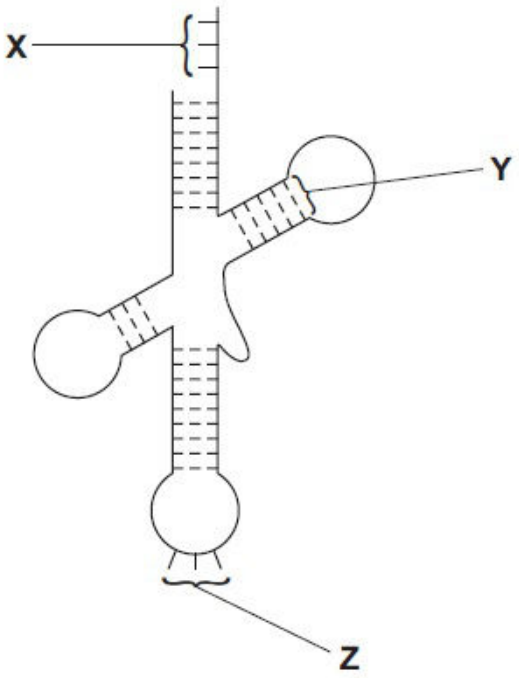
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(b) The diagram below represents a tRNA molecule.



For each of the statements below, put a cross (☒) in the box that corresponds to the correct statement.

(i) Part **X** binds to

(1)

☒ **A** an amino acid for transcription

☒ **B** an amino acid for translation

☒ **C** mRNA for transcription

☒ **D** mRNA for translation

(ii) Part **Y** is a

(1)

☒ **A** glycosidic bond

☒ **B** hydrogen bond

☒ **C** peptide bond

☒ **D** phosphodiester bond

(iii) Part **Z** binds to

(1)

☒ **A** an amino acid during transcription

☒ **B** an amino acid during translation

☒ **C** mRNA during transcription

☒ **D** mRNA during translation

(c) Using the information shown in the diagram, describe two ways in which the structure of a tRNA molecule differs from the structure of a mRNA molecule.

(2)

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(Total for question = 9 marks)

Q26.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

The primary structure of lysozyme is a specific sequence of 129 amino acids.

Two of the amino acids that make up the active site are in positions 35 and 52 in the primary structure.

Suggest how these two amino acids could be brought closer together to form part of the active site of this enzyme.

(3)

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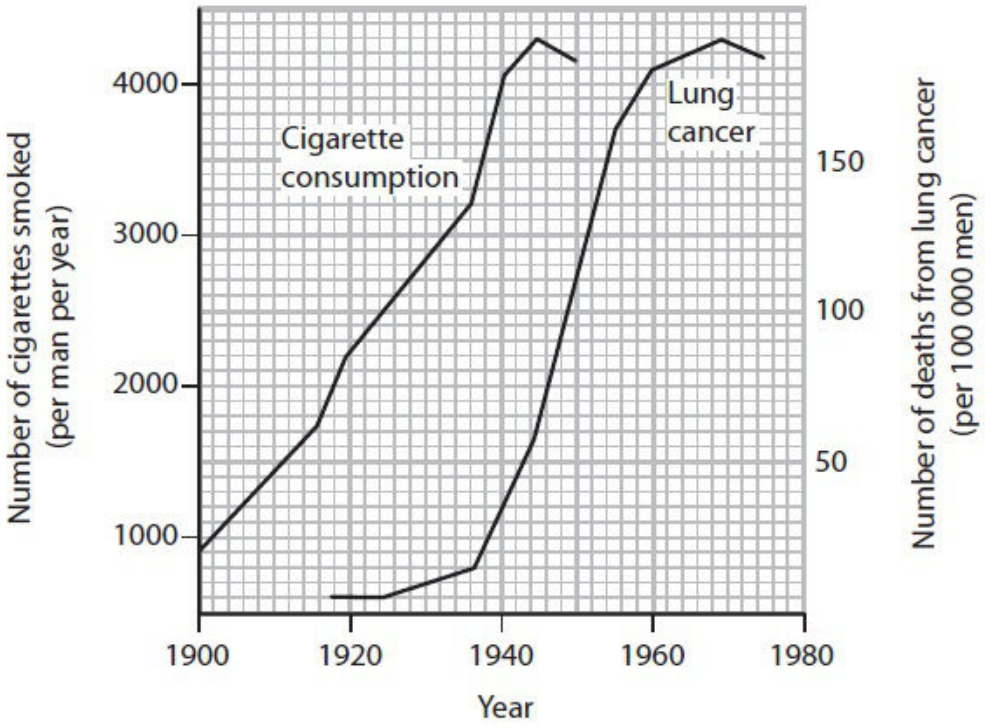
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Q27.

A study was carried out into the number of cigarettes smoked by men per year and the number of deaths from lung cancer.
The graph below shows the results of this study.



(a) Describe the changes in the number of deaths from lung cancer between 1920 and 1975.

(3)

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(b) The results of this study indicate that there is a correlation between cigarette smoking and lung cancer.

(i) Explain the meaning of the term **correlation**.

(1)

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(ii) Describe the evidence shown in this graph that suggests there is a correlation between cigarette smoking and the number of deaths from lung cancer.

(2)

(iii) Give **two** additional pieces of information that would increase the **validity** of any conclusions made from this study.

(2)

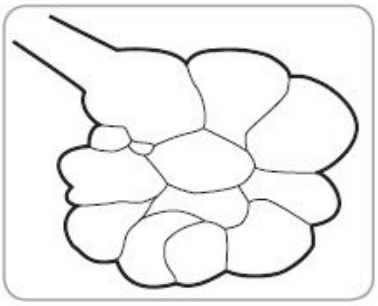
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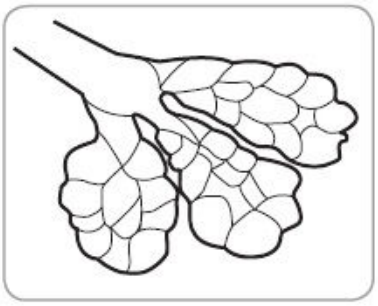
(c) Emphysema is another lung disease associated with cigarette smoking. One symptom of emphysema is shortness of breath. This is due to the damage to the alveoli and destruction of capillaries surrounding the alveoli.

The diagram below show alveoli from a lung of a person with emphysema and some alveoli from a healthy person.

Alveoli from a lung of a person with emphysema



Alveoli from a healthy person



Use your knowledge of the structure of the lung and its adaptations for gas exchange to explain why a person with emphysema has problems with gas exchange.

(4)

(Total for question = 12 marks)

Q28.

Enzymes act as biological catalysts.

Amylase is an enzyme present in saliva that catalyses the hydrolysis of starch into maltose.

*(a) Describe the structure of starch.

(5)

(b) Explain the meaning of the following terms.

(i) Catalyst

(2)

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(ii) Hydrolysis

(2)

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(c) Bread contains a high proportion of starch. If bread is chewed for a long period of time it begins to taste sweet.

Suggest why bread tastes sweet after chewing for a long period of time.

(1)

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(Total for question = 10 marks)

Q29.

One function of DNA is to act as a template for the synthesis of messenger RNA.

State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

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Q30.

Haemoglobin contains four polypeptide chains, two α chains and two β chains. Haemoglobin has the amino acid glutamic acid at position 6 in each β chain.

The R group for glutamic acid is $—CH_2—CH_2—COOH$

Draw a structural diagram of the amino acid glutamic acid.

(3)

(Total for question = 3 marks)

Q31.

(a) In the space below, draw a labelled diagram to show the structure of an artery.

(3)

(b) Explain how the structure of an artery relates to its function.

(2)

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(c) Give **two** differences between the structure of a vein and the structure of a capillary.

(2)

1

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2

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(Total for question = 7 marks)

Q32.

Read through the following passage on the structure of DNA, then write on the dotted lines the most appropriate word or words to complete the passage.

(8)

A DNA molecule consists of two strands of mononucleotides. Each of these strands

is twisted around the other, forming a ..... .

Each mononucleotide consists of a pentose sugar called ..... ,

a base and a ..... . In each strand, the mononucleotides are

held together by ..... bonds.

The two strands are held together by complementary base pairing. Adenine bonds

with ..... and cytosine bonds with ..... .

The name of the bond that forms between these bases is a

..... bond. A DNA molecule that is composed of 34% adenine

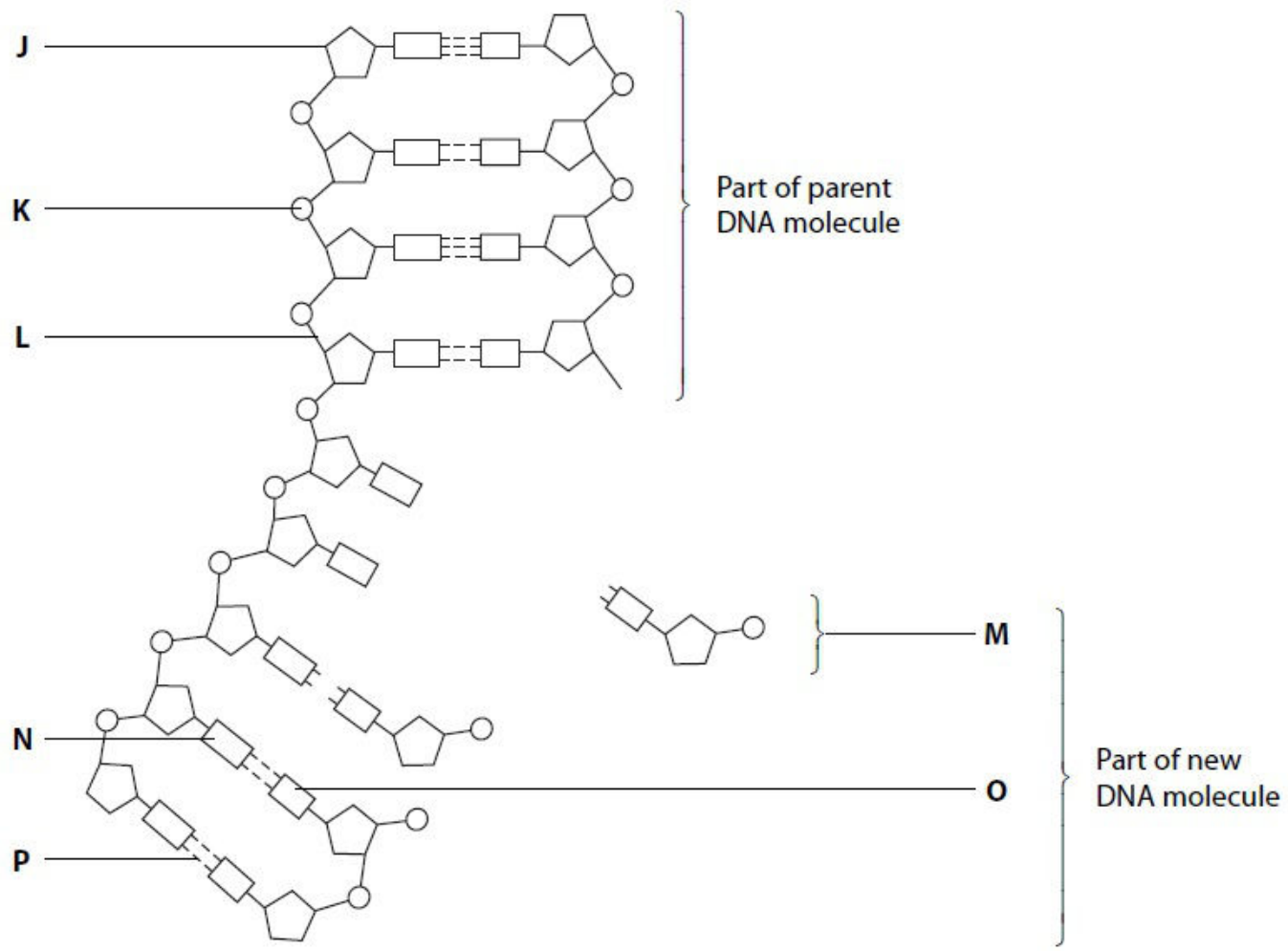
will be composed of ..... % cytosine.

(Total for question = 8 marks)

Q33.

DNA is a very important molecule in living organisms as it carries the genetic code that controls all characteristics. When a cell divides, the DNA molecule replicates so that each resulting daughter cell is genetically identical to the original parent cell.

The diagram below shows part of this process of DNA replication.



For each of the statements below, put a cross in the box that corresponds to the correct statement about DNA structure or DNA replication.

(a) The structure labelled **J** is

(1)

☒ **A** ribose

☒ **B** α glucose

☒ **C** β glucose

☒ **D** deoxyribose

(b) The structure labelled **K** is a

(1)

☒ **A** phosphate group

☒ **B** phosphorus atom

☒ **C** sulphate group

☒ **D** potassium atom

(c) The bond labelled **L** is a

(1)

☒ **A** peptide bond

☒ **B** phosphodiester bond

☒ **C** hydrogen bond

☒ **D** glycosidic bond

(d) The structure labelled **M** is a

(1)

☒ **A** polynucleotide

☒ **B** mononucleotide

☒ **C** polypeptide

☒ **D** mononucleoside

(e) If the base labelled **N** on the parent DNA molecule is adenine, the base labelled **O** on the new DNA molecule is

(1)

☒ **A** uracil

☒ **B** guanine

☒ **C** thymine

☒ **D** cytosine

(f) The bond labelled **P** is a

(1)

☒ **A** peptide bond

☒ **B** phosphodiester bond

☒ **C** hydrogen bond

☒ **D** glycosidic bond

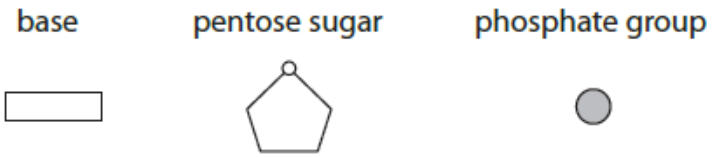
(Total for question = 6 marks)

Q34.

The polynucleotides, DNA and RNA, are involved in the process of protein synthesis.

For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

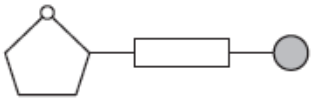
(i) A mononucleotide consists of three components represented by the diagrams below.



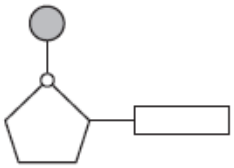
The diagram that shows the correct arrangement of these components in a mononucleotide is

(1)

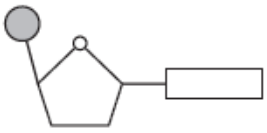
☒ **A**



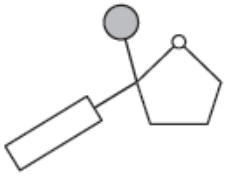
☒ **B**



☒ **C**



☒ **D**



(ii) During transcription of the section of DNA shown below, **a single base** is paired **incorrectly**.

C - T - A - A - C - T - G - C - A

This transcription error results in an mRNA molecule with the following sequence.

(1)

☒ **A** C - A - T - T - G - A - C - G - T

☒ **B** G - A - U - U - C - A - C - G - U

☒ **C** G - A - U - U - G - A - C - G - U

☒ **D** G - T - U - U - G - U - C - G - U

(iii) The following stages occur in the production of a protein from a section of DNA:

1. the mRNA molecule leaves the nucleus

2. peptide bonds form between adjacent amino acids

3. the base sequence is transcribed

4. the tRNA anticodons pair with the mRNA codons.

The sequence of events occurs in the following order.

(1)

☒ **A** 1 3 4 2

☒ **B** 2 4 1 3

☒ **C** 3 1 4 2

☒ **D** 3 4 1 2

(Total for question = 3 marks)

Q35.

Active transport and facilitated diffusion are two ways in which some molecules can move through cell membranes.

High concentrations of sodium chloride in blood plasma can damage red blood cells.

Explain the effects on red blood cells of high concentrations of sodium chloride in blood plasma.

(3)

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(Total for question = 3 marks)

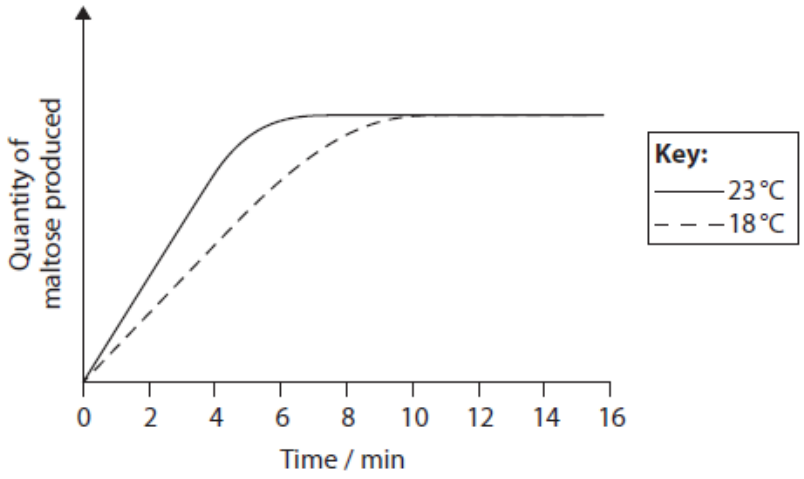
Q36.

Amylase is an enzyme that catalyses the breakdown of starch to maltose.

The effect of temperature on the breakdown of starch by amylase was investigated.

The quantity of maltose produced was measured during the course of two experiments: one carried out at 18 °C and the other at 23 °C.

The graph below shows the results of this investigation.



(i) State why the quantity of maltose produced became constant in this investigation.

(1)

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(ii) Explain why, in the first four minutes of this investigation, more maltose was produced at 23 °C than at 18 °C.

(2)

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(iii) On the graph, draw the curve you would expect to obtain if the experiment at 23 °C is repeated with an increased amylase concentration.

(2)

(iv) Describe how the effect of amylase concentration on the breakdown of starch at 23 °C could be investigated.

(4)

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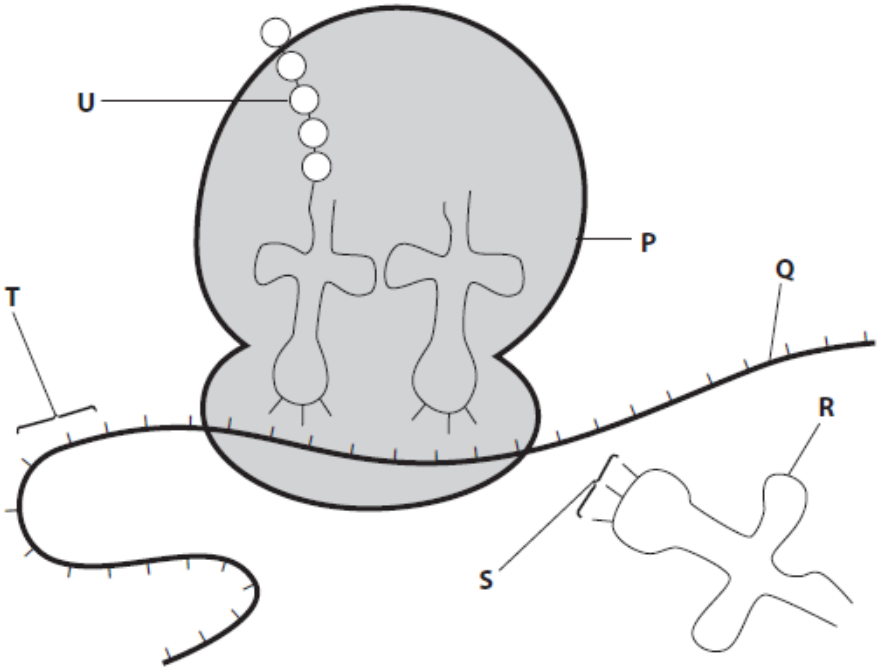
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(Total for question = 9 marks)

Q37.

The molecules DNA and RNA are involved in protein synthesis.

The diagram below shows part of the process of protein synthesis.



For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) mRNA is represented on the diagram by the

(1)

☒ **A** letter P

☒ **B** letter Q

☒ **C** letter R

☒ **D** letter S

(ii) The anticodon is represented on the diagram by the

(1)

☒

A letter Q

☒ **B** letter R

☒ **C** letter S

☒ **D** letter T

(iii) The bonds linking the structures labelled **U** are called

(1)

☒ **A** amino bonds

☒ **B** hydrogen bonds

☒ **C** peptide bonds

☒ **D** phosphodiester bonds

(iv) Name the stage of protein synthesis illustrated in this diagram.

(1)

(Total for question = 4 marks)

Q38.

The molecules DNA and RNA are involved in protein synthesis.

(i) Name the sugar in DNA.

(1)

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(ii) State how many carbon atoms are present in the sugar in DNA.

(1)

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(iii) Name the nitrogenous base that is present in DNA but not in RNA.

(1)

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(Total for question = 3 marks)

Q39.

The sequence of amino acids in a polypeptide chain is determined by the sequence of bases in DNA. This sequence of bases is used as a template to synthesise messenger RNA (mRNA).

(a) Describe the structure of an amino acid.

(2)

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(b) Describe how mRNA is synthesised.

(4)

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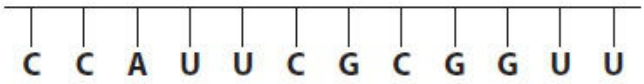
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(c) The table below shows the amino acids coded for by the codons on **mRNA**.

Three-letter codons of mRNA and the amino acids specified by the codons			
AAU, AAC — Asparagine	CAU, CAC — Histidine	GAU, GAC — Asparatic acid	UAU, UAC — Tyrosine
AAA, AAG — Lysine	CAA, CAG — Glutamine	GAA, GAG — Glutamate	UAA, UAG — Stop
ACU, ACC, ACA, ACG — Threonine	CCU, CCC, CCA, CCG — Proline	GCU, GCC, GCA, GCG — Alanine	UCU, UCC, UCA, UCG — Serine
AGU, AGC — Serine; AGA, AGG — Arginine	CGU, CGC, CGA, CGG — Arginine	GGU, GGC, GGA, GGG — Glycine	UGU, UGC — Cysteine; UGA — Stop; UGG — Tryptophan
AUU, AUC, AUA — Isoleucine; AUG — Methionine	CUU, CUC, CUA, CUG — Leucine	GUU, GUC, GUA, GUG — Valine	UUU, UUC — Phenylalanine; UUA, UUG — Leucine

The diagram below shows part of a messenger RNA molecule.



(i) Place a cross ☒ in the box next to the complementary sequence of bases found on the strand of the **DNA** molecule, from which part of this mRNA molecule was synthesised.

(1)

☒ **A** G G T A A G C G C C T T

☒ **B** G G U A A C G C G G A A

☒ **C** A A C G G A U A U U G G

☒ **D** A A C G G A T A T T G G

(ii) Place a cross ☒ in the box next to the sequence of amino acids found in the polypeptide chain that is coded for by this part of the **mRNA** molecule.

(1)

☒ **A** proline lysine alanine valine

☒ **B** proline phenylalanine alanine valine

☒ **C** glycine lysine arginine glutamine

☒ **D** proline lysine alanine glutamine

(iii) Place a cross ☒ in the box next to the final codon on this mRNA molecule if GUU is the last codon for an amino acid.

(1)

☒ **A** AGU

☒ **B** ACU

☒ **C** UCA

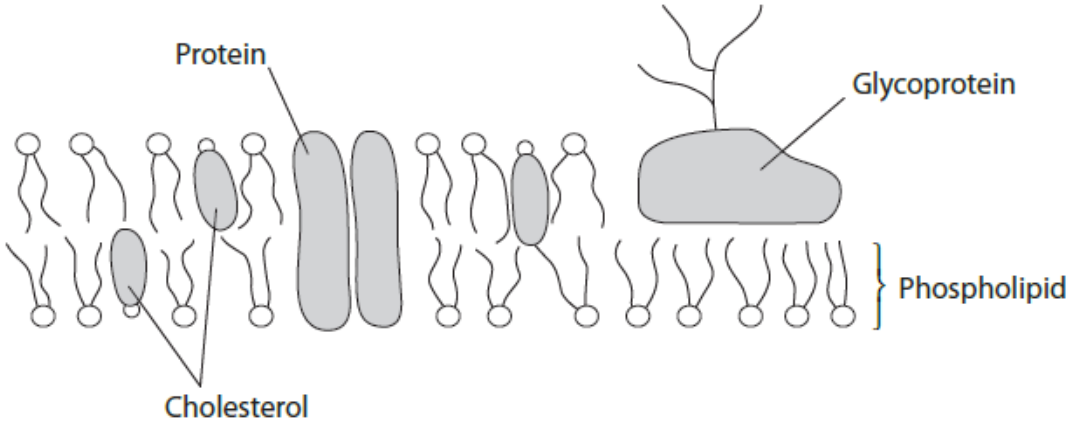
☒ **D** UGA

(Total for question = 9 marks)

Q40.

The fluid mosaic model explains our current knowledge of the structure of cell membranes and the movement of molecules in and out of cells.

The diagram below illustrates some of the components of the fluid mosaic model.



For each of the statements below, put a cross ☒ in the box that corresponds to the correct sentence.

(i) Osmosis is an example of

(1)

☒ **A** active transport

☒ **B** mass transport

☒ **C** movement of a solute down a concentration gradient

☒ **D** passive transport

(ii) During facilitated diffusion

(1)

☒ **A** ATP is used to move ions

☒ **B** ions move against a concentration gradient

☒ **C** ions move down a concentration gradient

☒ **D** ions move directly through the phospholipid bilayer with no other molecules involved

(iii) Endocytosis

(1)

☒ **A** involves the bulk release of molecules from a cell

☒ **B** involves the production of a vacuole or vesicle

☒ **C** is a passive process

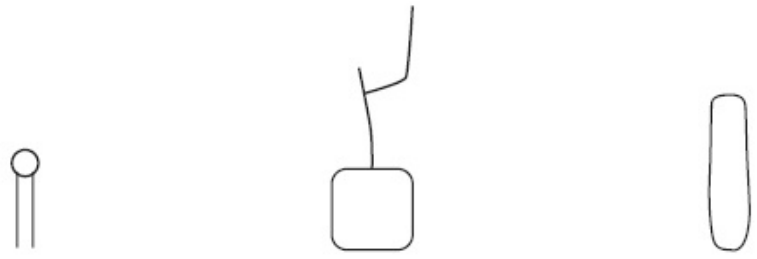
☒ **D** is involved in gas exchange

(Total for question = 3 marks)

Q41.

The cell surface membrane is involved in the transport of materials into and out of the cell.

The symbols below represent some of the components of a cell surface membrane.



(a) Using these three symbols and your own knowledge, in the space below draw a diagram to show the structure of a cell surface membrane.

(3)

(b) The table below gives statements relating to the processes of diffusion, facilitated diffusion and active transport.

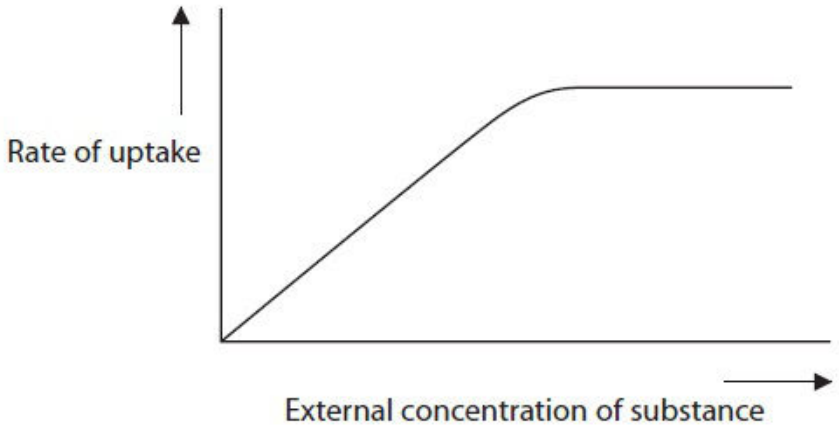
For each process, place a tick (✓) in the box if the statement applies to that process.

Place a cross (✗) in the box if the statement does not apply to the process.

(3)

Statement	Process		
	Diffusion	Facilitated diffusion	Active Transport
ATP is required			
Membrane proteins are involved			
Direction of transport is always down a concentration gradient			

(c) The graph below shows the rate of uptake of a substance by facilitated diffusion into a cell.



Using the information in the graph, explain why the rate of uptake changes.

(2)

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(Total for question = 8 marks)

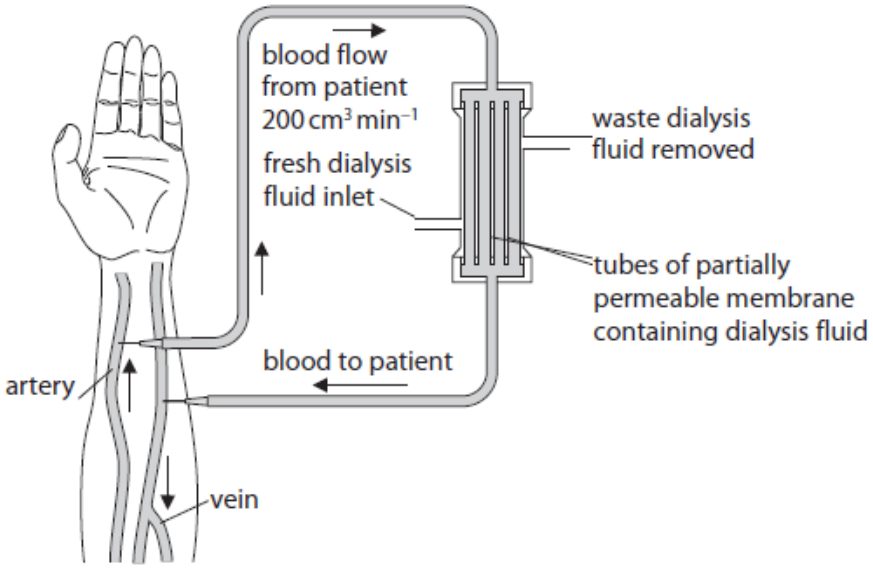
Q42.

Patients with kidney failure may be treated with a dialysis machine.

This removes excess water and solutes, such as urea, from their blood.

A dialysis machine includes a partially permeable membrane and dialysis fluid. This fluid consists of water with controlled concentrations of salts and glucose.

The diagram below shows a dialysis machine in use.



(i) The rate of blood flow through the dialysis machine is 200 cm^3 min^{-1}.

Calculate how long it would take this dialysis machine to process 5 dm^3 of blood.

Show your working.

(2)

..... minutes

(ii) Name the process that removes urea from the blood of the patient during dialysis.

(1)

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(iii) Suggest why fresh dialysis fluid is added and waste dialysis fluid is removed during this procedure.

(2)

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(Total for question = 5 marks)

Q43. Lipoprotein lipase is a biological catalyst and is involved in the hydrolysis of triglycerides.

(a) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) A catalyst

(1)

☒ **A** decreases the rate of reaction by increasing the activation energy

☒ **B** decreases the rate of reaction by reducing the activation energy

☒ **C** increases the rate of reaction by increasing the activation energy

☒ **D** increases the rate of reaction by reducing the activation energy

(ii) Hydrolysis results in bonds between glycerol and a fatty acid

(1)

☒ **A** being broken and water being formed

☒ **B** being broken and water being used

☒ **C** being formed and water being formed

☒ **D** being formed and water being used

(iii) A triglyceride is made from

(1)

☒ **A** one glycerol and one fatty acid

☒ **B** one glycerol and three fatty acids

☒ **C** three glycerols and one fatty acid

☒ **D** three glycerols and three fatty acids

(iv) A type of bond found in a triglyceride is

(1)

☒ **A** an ester bond

☒ **B** a glycosidic bond

☒ **C** a hydrogen bond

☒ **D** a phosphodiester bond

(b) Some people have a mutation in the gene coding for lipoprotein lipase.

The table below shows the mean concentration of some types of lipid in the blood of people without the mutation and in the blood of people with the mutation.

Type of lipid	Mean concentration of lipid in blood / mg dm^{-3}	
	People without the mutation	People with the mutation
Triglyceride	102	93
LDL cholesterol	121	111
HDL cholesterol	48	49
Total cholesterol	186	179

It has been suggested that people with this mutation may be more at risk of developing cardiovascular disease (CVD).

(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

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2 .....

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(ii) Name the type of drug that could be given to people with this mutation, to reduce the risk of developing CVD.

(1)

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(iii) State **one** health risk associated with using this type of drug.

(1)

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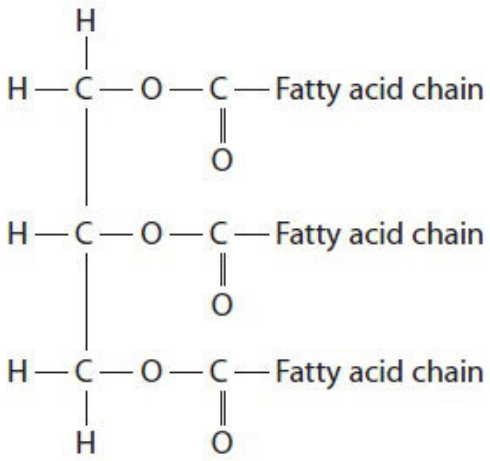
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(Total for Question = 8 marks)

Q44.

Triglycerides are lipids that are an important source of energy for the body. Triglycerides are broken down and reassembled in the body.

(a) The diagram below shows the structure of a triglyceride.



In the space below, draw a diagram to show the molecules produced from the complete hydrolysis of the triglyceride.

(3)

(b) Suggest the possible consequence of a very low fat diet for someone who has a very active lifestyle.

(2)

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*(c) Groups of enzymes help the body to break down and process triglycerides.

Abnormalities in these enzymes can lead to the build-up of lipids that would have been broken down.

Explain why a gene mutation can result in an enzyme that is unable to break down lipids.

(5)

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(Total for question = 10 marks)

Q45.

One function of DNA is to act as a template for the synthesis of messenger RNA.

Place a cross ☒ in the box to complete each of the following statements.

(i) DNA and mRNA both

(1)

- ☒ **A** contain ribose
- ☒ **B** contain thymine
- ☒ **C** have a double helix structure
- ☒ **D** have a sugar-phosphate chain

(ii) One advantage of DNA having two complementary strands is that

(1)

- ☒ **A** diploid cells can inherit DNA from both parents
- ☒ **B** hydrolysis of DNA is faster
- ☒ **C** semi-conservative replication is possible
- ☒ **D** transcription and replication can occur at the same time

(iii) Analysis of a sample of DNA found that 40% of the nucleotides contained cytosine. In the same sample of DNA the percentage of nucleotides containing adenine would be

(1)

- ☒ **A** 10%
- ☒ **B** 20%
- ☒ **C** 40%
- ☒ **D** 60%

Q46.

* Haemoglobin is a protein found in red blood cells that helps transport oxygen in the blood.

In sickle cell anaemia, the presence of the allele (**a**) in place of the normal allele (**A**) results in a change of one amino acid in the haemoglobin molecule.

This mutation changes the properties of haemoglobin and can result in red blood cells becoming less flexible and blocking small blood vessels.

The frequency of the recessive allele (**a**) is much higher in populations in West Africa than in populations in Northern Europe.

People in West Africa have a much higher risk of being infected with malaria parasites and developing severe anaemia than people in Northern Europe.

People who are heterozygous for sickle cell anaemia have sufficient amounts of normal haemoglobin to prevent severe anaemia.

One theory suggests that the malaria parasite (*Plasmodium sp*.) causes red blood cells with any modified haemoglobin to rupture. This occurs before the parasite can reproduce.

Explain how a change of one amino acid can lead to a change in the structure and properties of the haemoglobin protein.

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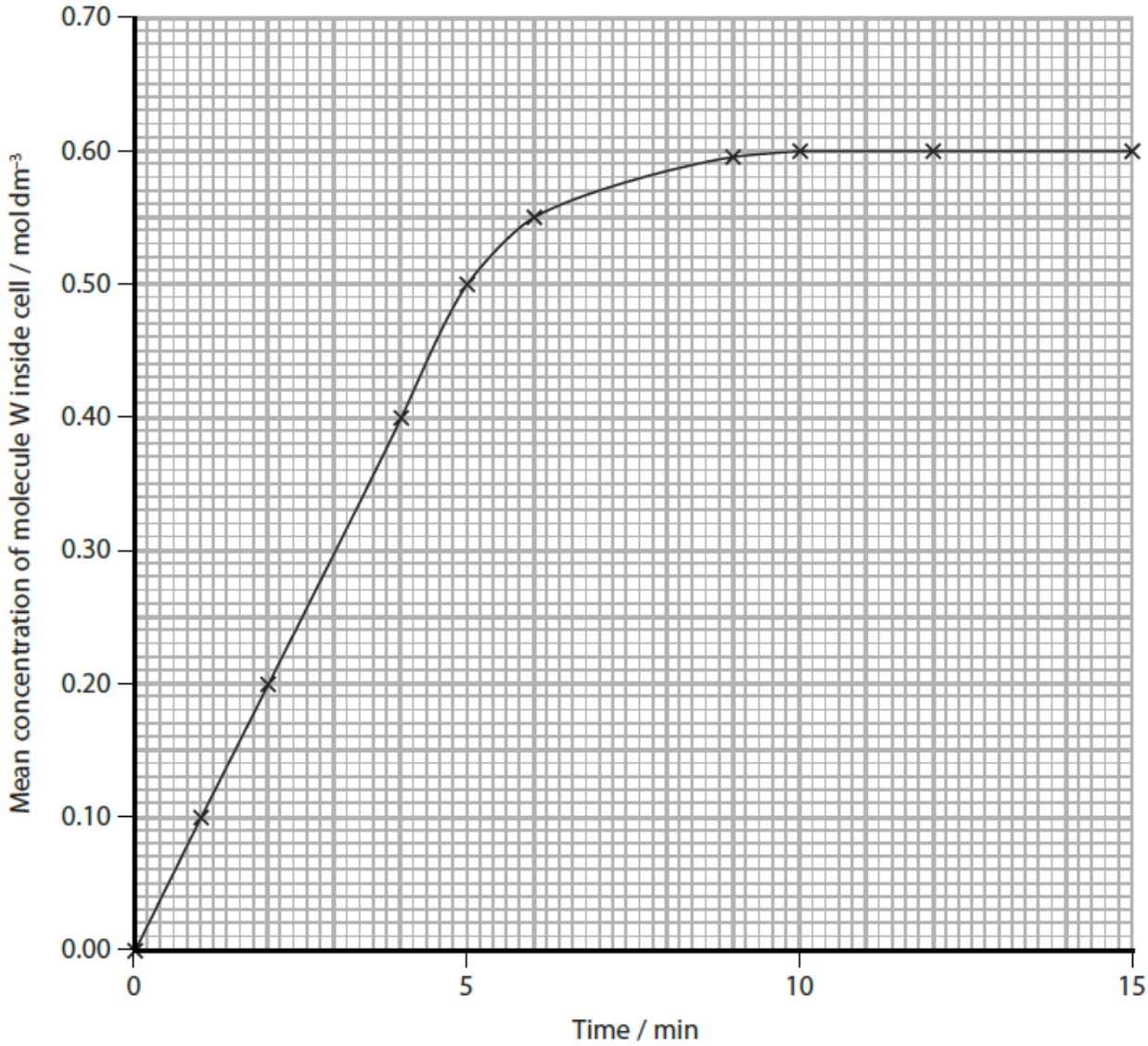
(Total for question = 4 marks)

Q47.

A student investigated the movement of molecules into red blood cells. He placed red blood cells into a solution of molecule W.

He then measured the concentration of W inside the cells over a period of 15 minutes.

The graph below shows the results of this investigation.



The student then left the red blood cells in distilled water.

After 2 minutes, he observed that some of the red blood cells had a larger volume and some had burst.

Suggest an explanation for his observations.

(3)

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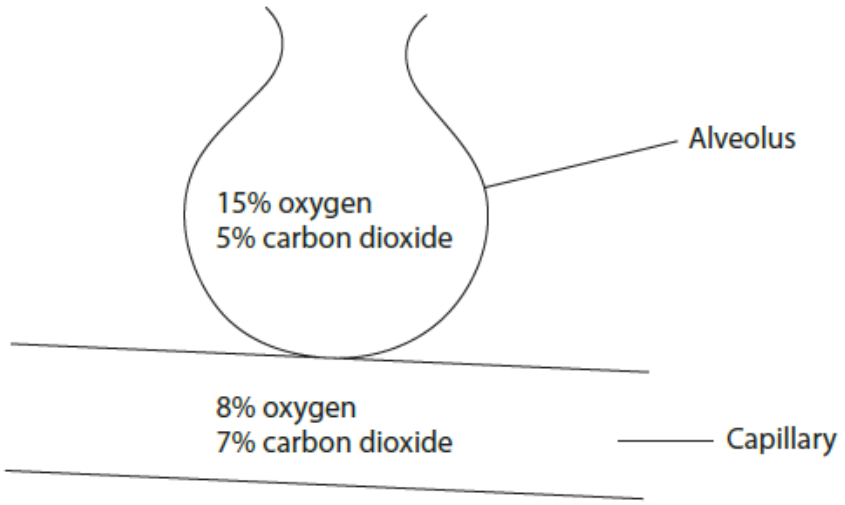
(Total for question = 3 marks)

Q48.

The lungs in a mammal are adapted for efficient gas exchange.

The diagram below represents the approximate concentrations of oxygen and carbon dioxide inside an alveolus and a capillary in the lungs.

These gases will diffuse at different rates.



Using the information in the diagram, explain the difference in the rate of diffusion of these gases.

(2)

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(Total for question = 2 marks)

Q49.

The lungs in a mammal are adapted for efficient gas exchange.

Fick's law of diffusion states that the rate of diffusion is proportional to the surface area, the difference in concentration and the length of the diffusion pathway.

This law is represented by the following formula.

$$\text{Rate of diffusion is proportional to } \frac{\text{surface area} \times \text{difference in concentration}}{\text{length of diffusion pathway}}$$

* Using the information given in the question and your own knowledge, explain how rapid gaseous exchange takes place in a mammal.

(5)

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(Total for question = 5 marks)

Q1.

(a) This question was designed to test the candidates' understanding of gas exchange in a different context to the lungs, and the circulation system in a mammal. Candidates were directed to use the information in the photograph to inform their answer. They were also informed that the amoeba is a single-celled organism.

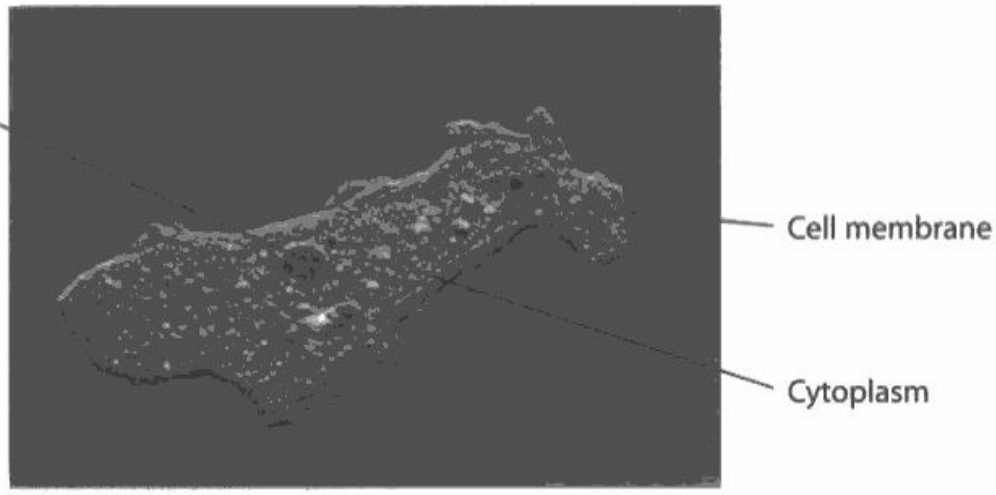
Many candidates scored highly on this question, recognising that gas exchange takes place by diffusion across the cell membrane, involving oxygen and carbon dioxide moving from an area of high concentration to an area of lower concentration.

Unfortunately, several candidates ignored the context and described gas exchange with blood. Others described other transport processes, most commonly osmosis.

This is a typical response scoring all four available marks.

2 An amoeba is a single-celled organism that lives in water. Gas exchange in an amoeba occurs between the water and the cytoplasm.

The photograph below shows an amoeba, as seen using a microscope.



Magnification x800

Dr Jeremy Burgess / Science Photo Library

*(a) Using the information shown in the photograph and your own knowledge, suggest how gas exchange occurs in an amoeba.

(4)

Gas exchange happens by diffusion, where molecules move from an area of high concentration to low concentration until equilibrium is reached. In the ~~amoeba~~ amoeba, small molecules, such as oxygen and carbon dioxide, are able to force their way through the gaps in the phospholipid bilayer. In polar molecules or ions, gas exchange happens through channel or carrier proteins situated in the membrane. In the amoeba, oxygen will diffuse out of the ~~water~~ water and into the cell through the cell membrane (phospholipid bilayer) and carbon dioxide will diffuse out of the cell into the water. Both oxygen and carbon dioxide move down their respective concentration gradients, and the process is passive. The oxygen can then be used in cell processes.

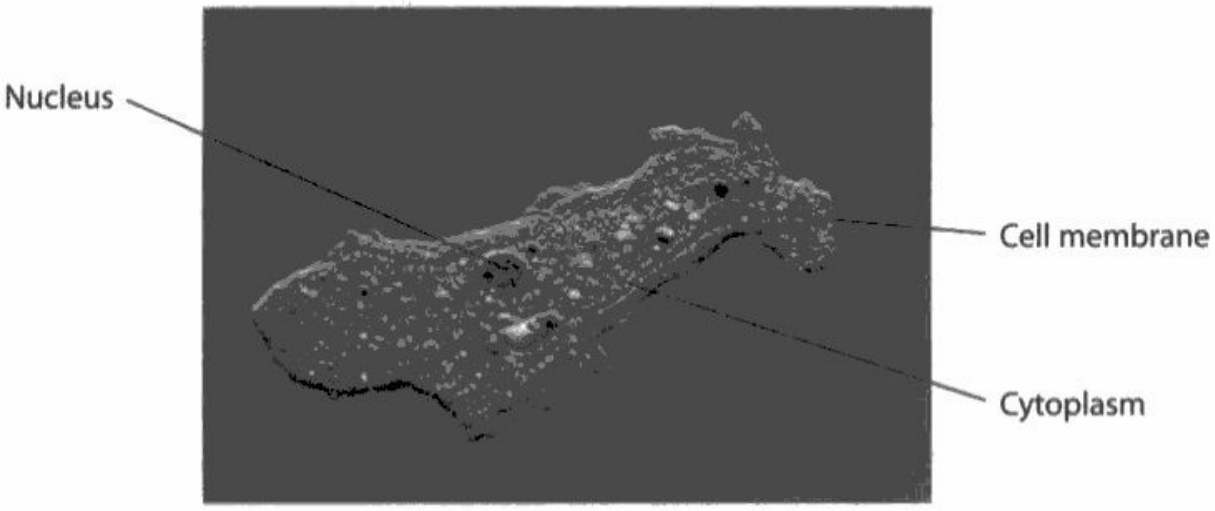
Results Plus: Examiner Comments

This candidate successfully identifies where and how diffusion takes place. They also describe the direction the relevant gases will diffuse, also recognising that oxygen and carbon dioxide are small molecules.

This response managed to score three of the four available marks, but also shows some typical mistakes.

2 An amoeba is a single-celled organism that lives in water. Gas exchange in an amoeba occurs between the water and the cytoplasm.

The photograph below shows an amoeba, as seen using a microscope.



Magnification x800

Dr Jeremy Burgess / Science Photo Library

*(a) Using the information shown in the photograph and your own knowledge, suggest how gas exchange occurs in an amoeba.

(4)

The amoeba has an open circulatory system. The oxygen and other particles may diffuse through the cell membrane into the cytoplasm by osmosis. This is where ~~particles~~ molecules move from an area of high concentration to an area of low concentration. ~~As the amoeba is a single-celled organism it has a thin cell membrane which diffusion can easily happen~~ through a partially permeable membrane.

Results Plus: Examiner Comments

This response gains credit for recognising the direction oxygen moves, the involvement of the

cell membrane and the concentration gradient. However, they name osmosis as the transport process and describe an open circulatory system for the amoeba.

Results Plus: Examiner Tip

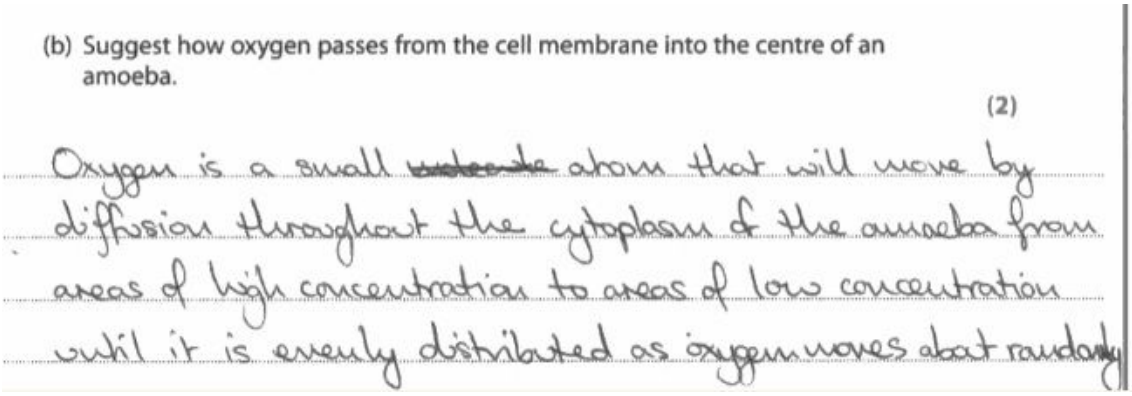
Just because an aqueous environment is described, osmosis is not the only transport process possible.

(b) The first part of question 2 asked specifically about gas exchange in the organism. This part of the question asked candidates to describe how oxygen moves from the cell membrane to the centre of the cell.

Many candidates readily recognised that the transport process involved was diffusion and that it was taking place in the cytoplasm from an area of a high concentration to an area of low concentration.

However, many candidates described transport across the membrane rather than within the cell, and many described alternative transport processes (often endocytosis or active transport).

This is an example of a response scoring both marks available.


(b) Suggest how oxygen passes from the cell membrane into the centre of an amoeba.

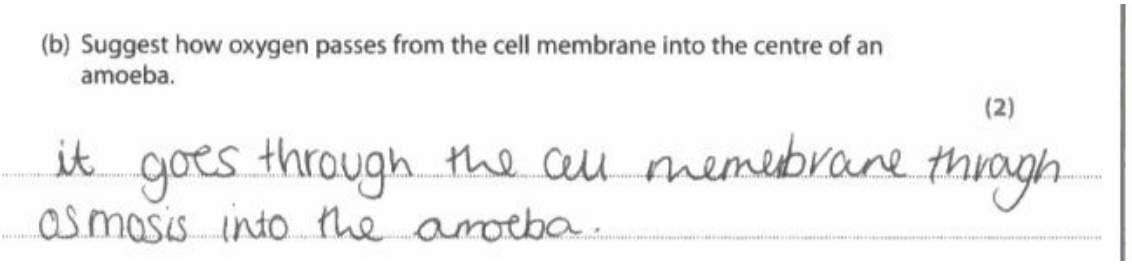
(2)

Oxygen is a small ~~molecule~~ atom that will move by diffusion throughout the cytoplasm of the amoeba from areas of high concentration to areas of low concentration until it is evenly distributed as oxygen moves about randomly

Results Plus: Examiner Comments

Credit can be given to this response for recognising that diffusion is taking place in the cytoplasm. They would also get credit for describing the concentration gradient if it was needed.

This response is typical of those scoring no marks.


(b) Suggest how oxygen passes from the cell membrane into the centre of an amoeba.

(2)

it goes through the cell memebrane thragh osmosis into the amoeba.

Results Plus: Examiner Comments

Both the location and process are wrong for the question asked. Both of these mistakes occurred quite frequently.

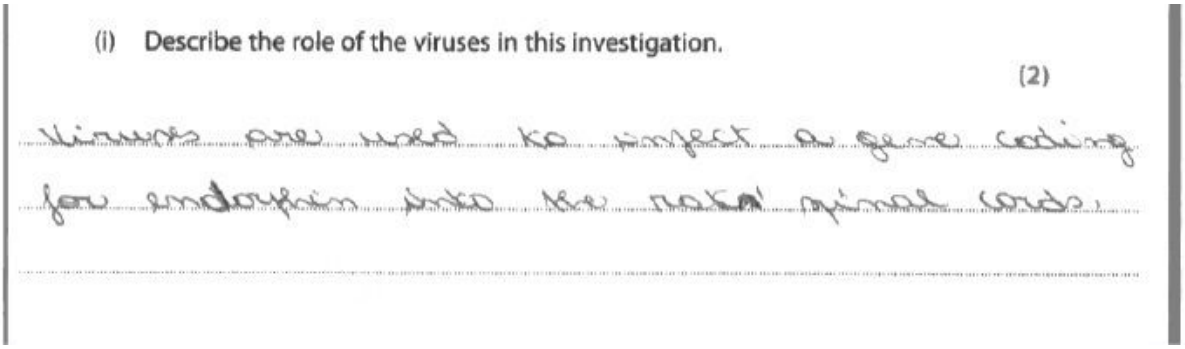
Results Plus: Examiner Tip

Read the question carefully and think about the location asked and what molecule is being moved.

Q2.

(a) Part (a) was well done, provided the candidates described the effects of the gene therapy and not what happened to the control rats.

(b) (i) Candidates do not fully understand the role of viruses, in this case, in gene therapy. Many candidates did not identify the virus as a vector and even more did not appreciate that the virus introduced the gene into the CELL.


(i) Describe the role of the viruses in this investigation.

(2)

Viruses are used to inject a gene coding for endorphin into the rats' spinal cords.

Results Plus: Examiner Comments

This was a typical vague response.

Results Plus: Examiner Tip

The vector introduces the gene into the CELL

Candidates should do as many practice exam papers as they possibly can in the run up to the exam, including reading through the mark schemes afterwards. This not only familiarises the candidates with the format of the paper and style of the questions, but more importantly illustrates the sort of points we are looking for on the various topics.

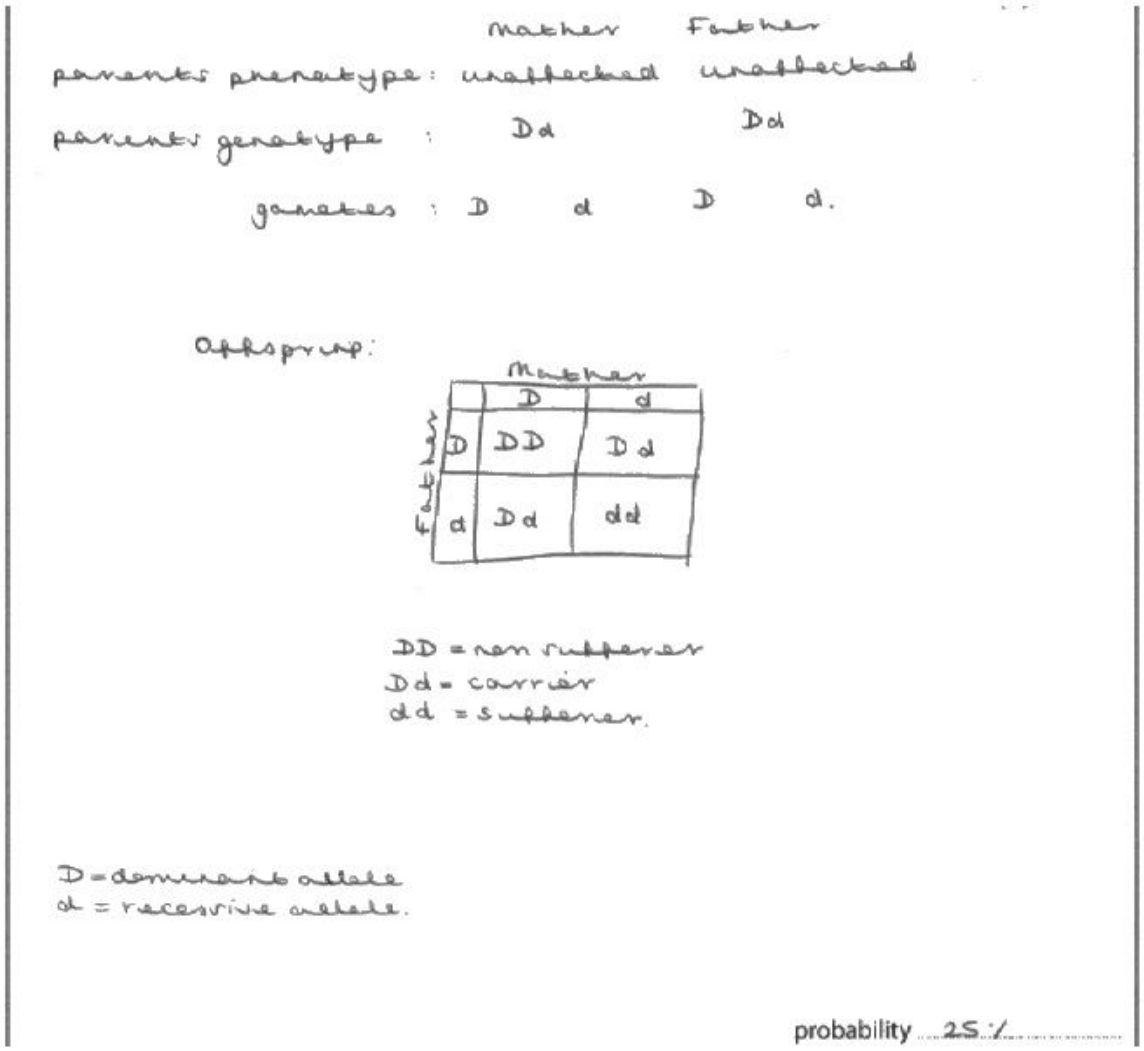
Q3. No Examiner's Report available for this question

Q4.

Question (a)

Most candidates gained at least two marks by correctly drawing a Punnett square and identifying the resulting 25%. However, a much smaller proportion also identified the phenotypes of the potential offspring and even fewer clearly identified the genotype of the parents separately from the Punnett square. A few candidates thought that the probability would be 0, because the couple had already had an affected child. Thankfully very few candidates included a ratio as their answer instead of the requested probability.

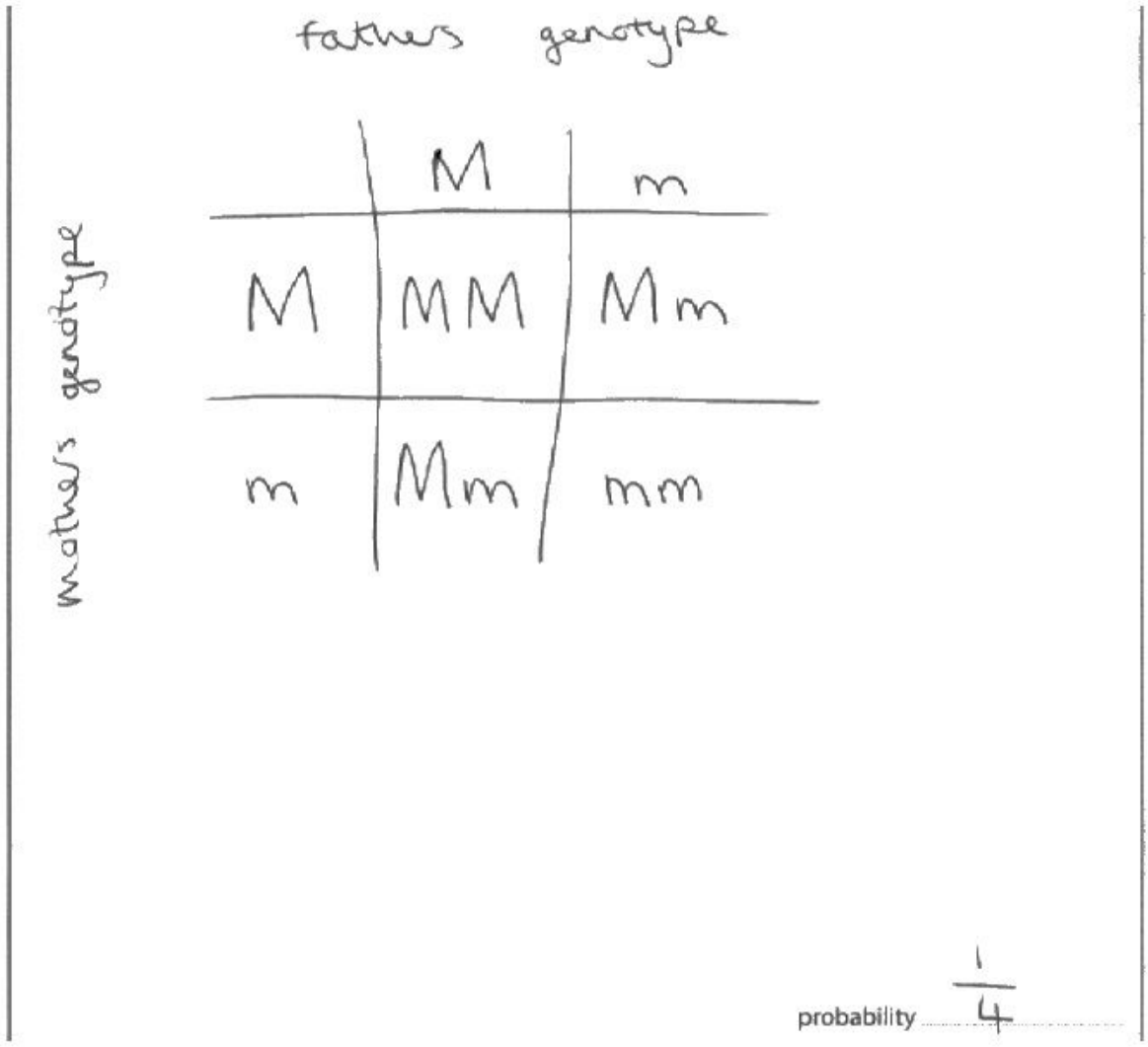
This response gained all four available marks.



Results Plus: Examiner Comments

Marks were awarded for:
genotype and gametes of the parents clearly shown;
genotypes of the possible children clearly shown;
genotypes of the possible children clearly linked to the phenotypes;
probability correct.

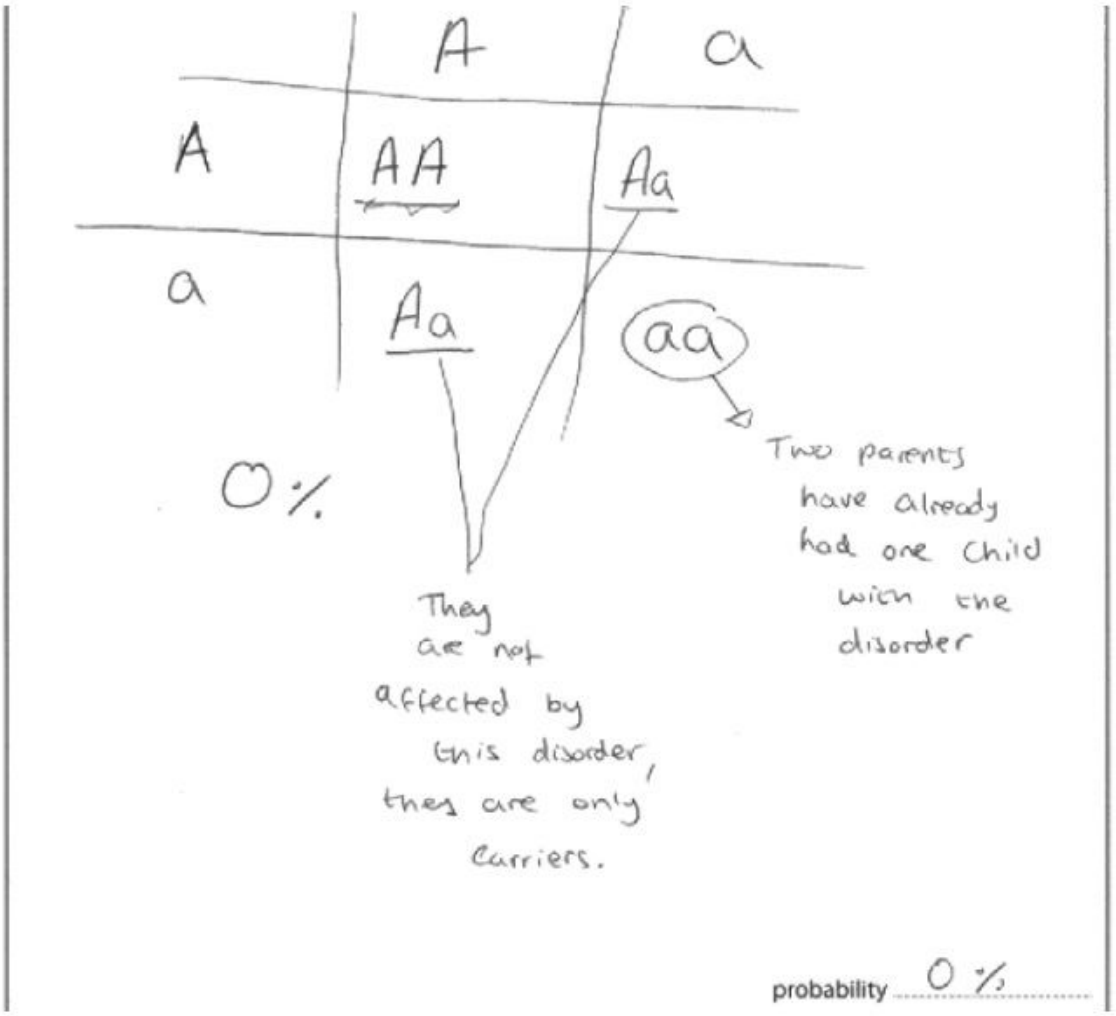
This response gained two of the four marks available.



Results Plus: Examiner Comments

The Punnett square and resulting probabilities are both correct.
A full genetic diagram should ideally include clearly the parents' genotype - labelling the Punnett square as genotype is not sufficient as the Punnett square sets out the gametes from each parent. It should also make it clear what phenotypes the possible resulting genotypes will cause.

This response gained one of the four marks available.



Results Plus: Examiner Comments

One mark was gained for the genotypes of the possible children being shown.
Just because the parents have already had one child who was affected the probability for each child will remain 25% and not fall to 0%.

Question (b)

The most common correct answers involved getting cells via a mouth swab or blood test and many candidates gained a mark for testing for the MLD allele. Many candidates lost marks via stating Amniocentesis or Chorionic Villus Sampling as suitable techniques. Answers were even written this way with the words 'new born baby' included. Some candidates wanted to screen the parents rather than test the baby. Brain scans were also thought to be a good idea by some. Alleles and genes were occasionally being examined under a microscope.

Some candidates confused gene therapy and gene testing and therefore described the potential treatment rather than the diagnostic test.

This response gained both marks available.

a sample of cells could be taken from the baby (cheek swab). Then these cells would be tested to see ~~if they were a~~ what there genotype is, and if they carried both recessive alleles

Results Plus: Examiner Comments

Marks were awarded for a suitable method of getting sample cells from the baby and recognising what you are looking for in the test. Even though this response gained full marks, ideally it would also recognise that you would need to extract the DNA from the cells for testing.

This response gained no marks.

It could be tested when it is in the womb using prenatal testing. This can be done via amniocentesis or chorionic villus sampling. They involve collecting fetal cells and scanning them for genetic disorders, this means the parents would be aware of the disease before the child is born. In Amniocentesis it is done at 16 weeks of pregnancy and amniotic fluid is obtained using a syringe, the fetal cells are cultured for 2 weeks and the chromosomes examined. There is a 1% chance of miscarriage

Results Plus: Examiner Comments

This response is typical of many that suggested using a prenatal test on a new born baby. Screening for genetic disorders is also not clear enough for credit at this level.

Results Plus: Examiner Tip

Read the question and context carefully when selecting which genetic screening test to use. Ask yourself whether the context relates to pre-implantation, prenatal (before birth), after birth, or screening of the parents.

This response gained no marks.

~~the gene therapy~~. A somatic cell could be removed from the new born baby and can be studied under a microscope. The scientist would be looking for any mutations which may have occured within the DNA, in the nucleus? If this mutation has occured and is observed by the scientist where the incorrect sequence of bases has formed, the treatment can begin as the new born baby has been tested for MLD and has been successful diagnosed to be a sufferer of MLD

Results Plus: Examiner Comments

This response has the context of what to test, but has not suggested how the somatic cell would be removed. MLD and mutations in the DNA are not clear enough to credit for what is being tested for.

Question (c)(i)

Many candidates concentrated upon detailed descriptions of the dominant gene (stated in the question stem) being carried by the virus (rather than the modified stem cell) into the child, rather than the normal/functioning gene/allele and so scored no mark here. Similarly, many described that this dominant gene would replace the recessive allele and so again gained no credit.

Transcription and translation were occasionally mentioned, along with the idea that the normal protein can now be produced by these modified cells.

A significant number of candidates gained credit by describing replication/mitosis of the stem cells, although some were confused between the virus and the stem cell and many had stem cells invading the nucleus of other cells and producing new genes.

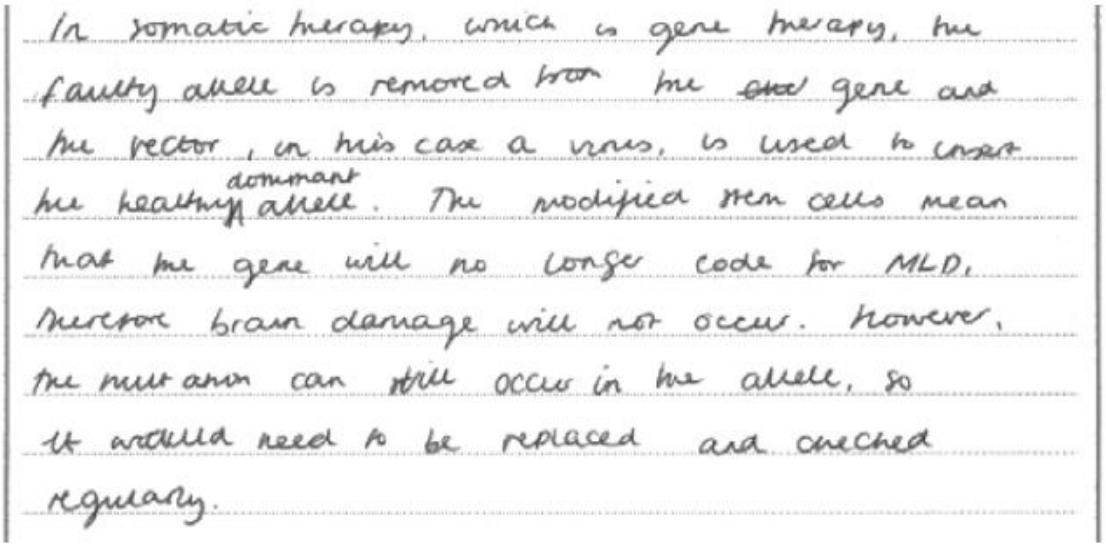
This response gained all three available marks.

These stem cells contain the dominant normal allele, therefore this allele will be expressed rather than the recessive allele. The stem cells can differentiate to become any type of cell, so they could move to the brain, become brain cells and because they contain the ~~no~~ normal allele, this allele will be expressed so the protein that the allele codes for will be made which will prevent the brain damage that would otherwise occur. When the stem cells divide, more cells containing the dominant normal allele will be produced.

Results Plus: Examiner Comments

Marks were awarded for:
normal allele now in the stem cells;
protein produced from the normal allele;
stem cells can divide and make more cells.

This response gained no marks.


In somatic therapy, which is gene therapy, the faulty allele is removed from the ~~and~~ gene and the vector, in this case a virus, is used to insert the healthy dominant allele. The modified stem cells mean that the gene will no longer code for MLD, therefore brain damage will not occur. However, the mutation can still occur in the allele, so it would need to be replaced and checked regularly.

Results Plus: Examiner Comments

This response is typical of the many candidates who still think that somatic gene therapy removes or replaces faulty alleles, rather than adding an additional allele.

Results Plus: Examiner Tip

Think carefully about what is happening in somatic gene therapy, particularly when treating a recessive genetic disorder. Don't forget that the purpose is to get a normal gene into the nucleus for transcription so that the correct protein can be made to restore normal functioning of the cell if possible.

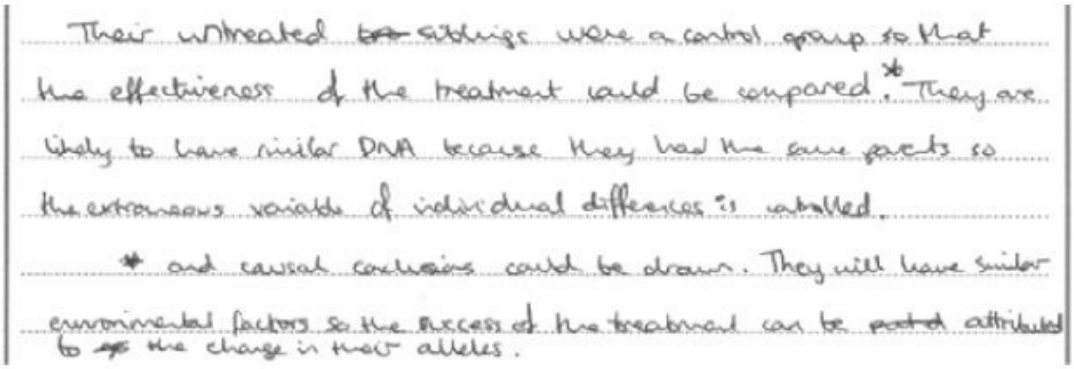
Question (c)(ii)

A number of candidates gained one of the two available marks; they would establish the idea of a control group or the concept of the treatment being effective but didn't then go on to explain why they were a good control.

Similar genes were most popular with relatively few candidates identifying other factors such as the environment in which they are raised. A number of candidates lost a mark as they wrote about siblings having the same/identical genes or about DNA rather than genes/ alleles. Candidates often described how the comparison showed that the treatment was effective but failed to mention that the siblings acted as a control or that they made the comparison valid. Just stating that they would be compared was not sufficient for credit as that is what was stated

in the question.

This response gained both available marks.


Their untreated ~~bro~~ siblings were a control group so that the effectiveness of the treatment could be compared.* They are likely to have similar DNA because they had the same parents so the extraneous variable of individual differences is controlled.
* and causal conclusions could be drawn. They will have similar environmental factors so the success of the treatment can be ~~pasted~~ attributed to ~~as~~ the change in their alleles.

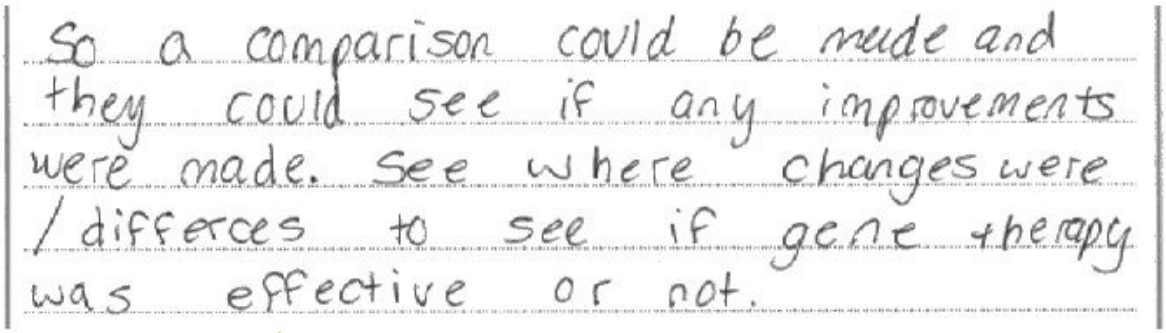
Results Plus: Examiner Comments

Marks were awarded for recognition that the siblings were a control group and that they are a suitable group because other variables are controlled e.g. similar environment.

Results Plus: Examiner Tip

Similar DNA is a bit vague as they can be said to have similar DNA to a cucumber, which would not be a suitable control for this investigation.

This response gained no marks.


So a comparison could be made and they could see if any improvements were made. See where changes were / differences to see if gene therapy was effective or not.

Results Plus: Examiner Comments

This response does not go much beyond restating the question so does not gain any credit.

Results Plus: Examiner Tip

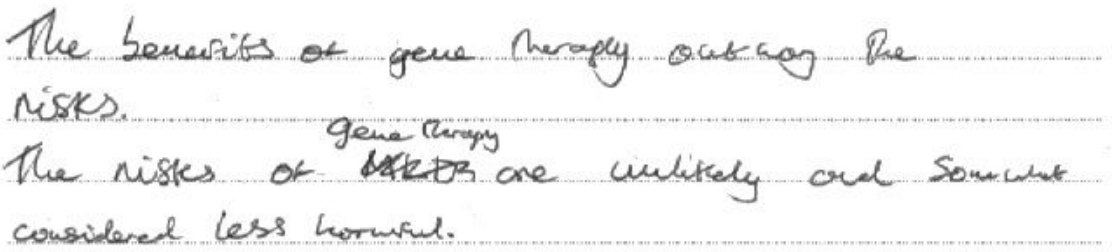
Compare is stated in the question so you need to either explain why this is a valid comparison or make it clear that you understand the concept of making use of a scientific control in an investigation.

Question (d)

A large number of candidates successfully described the benefits outweighing the risks and the desire of the parents to give their child a better future. It was good to see that there were a number of candidates who described the value of scientific research and the potential future benefit to others of such trials.

Some candidates approached this question from the wrong perspective focussing on why a parent would be asked to give consent, rather than of why the consent might be given. For example, they focused upon the ethical and moral issues, such as the parents' responsibility to the child, and the legal implications if the treatment failed or went wrong. Others described that the parents would have to give consent because the baby was not able to.

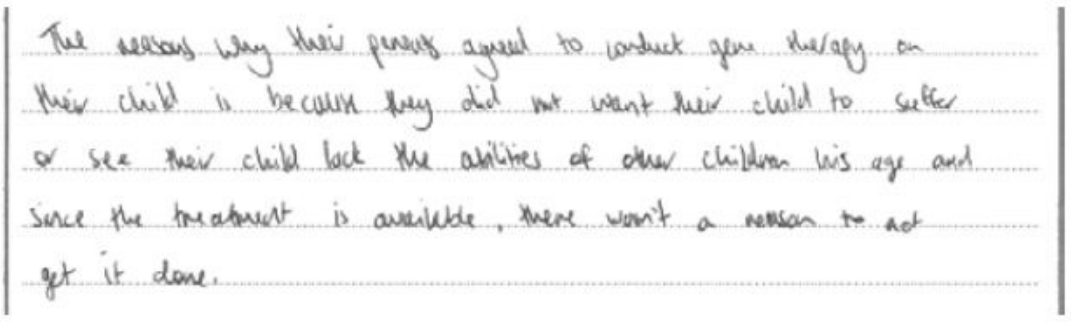
This response gained both marks.



Results Plus: Examiner Comments

Marks were awarded for:
benefits outweigh the risks;
the risk of gene therapy are small.

This response gained one of the two marks available.



Results Plus: Examiner Comments

This is an example of one of the most common correct lines of reasoning. However, only one clear point has been made so this only gets one mark.

Q5.

(a) This question tested the candidates' understanding of the processes of preimplantation genetic diagnosis and prenatal genetic screening. The key to success for this question was understanding the terms **preimplantation** and **prenatal**.

5 Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✗) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	Cells removed from the embryo
Preimplantation genetic diagnosis	✗	✓
Prenatal genetic screening	✓	✗

Results Plus: Examiner Comments

This is an example of a response that scored both marks.

Results Plus: Examiner Tip

This is a good example of how you can clearly show that you have changed your mind when making a change in a tick or cross response.

This response receives one of the two available marks.

5 Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✖) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	**Cells removed from the embryo**
Preimplantation genetic diagnosis	✗	✓✗
Prenatal genetic screening	✓	✓

Results Plus: Examiner Comments

Both responses in the first column are correct, but neither of the responses in the second column are worthy of credit. This is an example of where a change to a response is not clear enough, and because it is ambiguous we are not able to award it credit.

Results Plus: Examiner Tip

If you change your mind make it clear by clearly crossing out the entire tick and replacing it with a separate cross.

This response receives one of the two available marks.

5 Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✖) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	Cells removed from the embryo
Preimplantation genetic diagnosis		✓
Prenatal genetic screening	✓	

Results Plus: Examiner Comments

Both ticks are correct for one mark, but we can't mark blanks as crosses.

Results Plus: Examiner Tip

If you are asked to fill in a table with a tick or a cross in the appropriate box make sure you do not leave blank boxes.

This response scored one of the two marks available.

5 Genetic screening can be used to determine if an embryo has a genetic disorder, such as cystic fibrosis.

(a) The table below refers to the methods used in preimplantation genetic diagnosis and prenatal genetic screening.
If the statement is correct, place a tick (✓) in the appropriate box and if the statement is incorrect, place a cross (✖) in the appropriate box.

(2)

Method of screening	Statement	
	Screening performed during pregnancy	Cells removed from the embryo
Preimplantation genetic diagnosis	✓ ✗	✓
Prenatal genetic screening	✗ ✓	✓

Results Plus: Examiner Comments

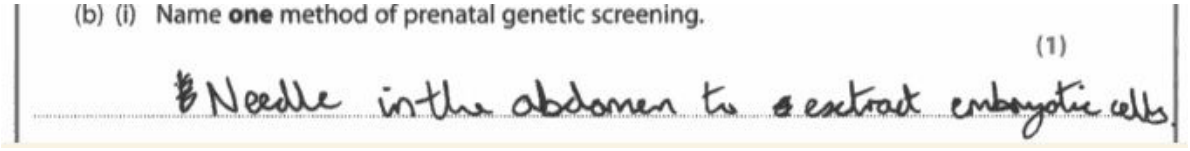
This is an example of one of the most common errors where candidates think that prenatal screening involves embryos rather than a fetus.

Results Plus: Examiner Tip

Make sure that you are clear that preimplantation involves cells being removed from an embryo before it is implanted in the uterus; whereas prenatal screening involves the developed fetus during pregnancy and before birth.

(b) (i) Just over half of the candidates managed to successfully name (not describe) one method of prenatal genetic screening.

This response does not gain any marks.


(b) (i) Name **one** method of prenatal genetic screening.

(1)

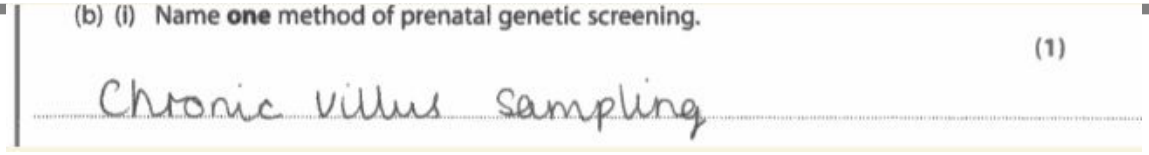
Needle in the abdomen to extract embryotic cells

Results Plus: Examiner Comments

This response contains two mistakes: 1. they are asked to name not describe the process; 2. many candidates think that prenatal screening involves embryos.

Results Plus: Examiner Tip

Make sure you learn the names of processes included in the specification.


(b) (i) Name **one** method of prenatal genetic screening.

(1)

Chronic villus sampling

Results Plus: Examiner Comments

This is a common example of a response that failed to score the available mark because the spelling error makes the first word into something completely different and is not phonetically correct.

Results Plus: Examiner Tip

Chronic instead of **chorionic** is a common error that occurs frequently everytime a question like this has been asked. Make sure you are aware of the danger.

(b) (i) Name **one** method of prenatal genetic screening.

(1)

amniocentesis

Results Plus: Examiner Tip

This was the most common correct response.

(ii) The majority of candidates managed to score two marks for this question, identifying and discussing an ethical or social issue related to prenatal genetic screening.

The most common correct responses either explored the possible loss of a healthy fetus through miscarriage, or discussion over the issue of abortion as contradicting the 'right to life' of the fetus.

The most common error for candidates was to discuss their answers in the context of an embryo, demonstrating that they had either recalled previous mark schemes or did not understand the context of the question.

This response scores both marks available.

(ii) Discuss either **one** ethical issue or **one** social issue relating to the use of this method of prenatal genetic screening.

(2)

~~Have a choice to give women a choice for having~~ ~~an abo~~ The procedure could cause a miscarriage so a potentially healthy baby could be lost, this will cause the mother stress and cause her to become depressed.

Results Plus: Examiner Comments

This candidate has actually managed to identify an issue and develop two consequences; the loss of the healthy baby and the stress/ depression of the mother. Either of these would have been enough for the second mark.

This response scored one of the two marks available.

(ii) Discuss either **one** ethical issue or **one** social issue relating to the use of this method of prenatal genetic screening.

(2)

One ethical issue is that the parents may terminate the embryo if it has the genetic disorder. And this is taking away a potential human life. A social issue ~~is~~ could be that the parents may decide to keep the baby so they can plan financially for the future.

Results Plus: Examiner Comments

This candidate does not receive the mark for taking away the right to life of the embryo because prenatal genetic screening does not involve embryos. However, they have been given credit for the separate point about helping the parents prepare for the future.

Results Plus: Examiner Tip

Make sure you check the context of the question and do not repeat answers from previous exam papers. Prenatal genetic screening involves obtaining cells from the fetus or placenta (not an embryo).

(c) (i) Most candidates gained a mark for recognising that genetic disorders are caused by faulty alleles. Disappointingly, a very common error was to state that this allele was removed or replaced by the normal allele by gene therapy.

Only the better candidates referred to the correct protein being formed by the cells as a result of gene therapy.

This response scores both marks available.

(c) Gene therapy has the potential to treat some genetic disorders.

(i) Explain why gene therapy has the potential to treat some genetic disorders.

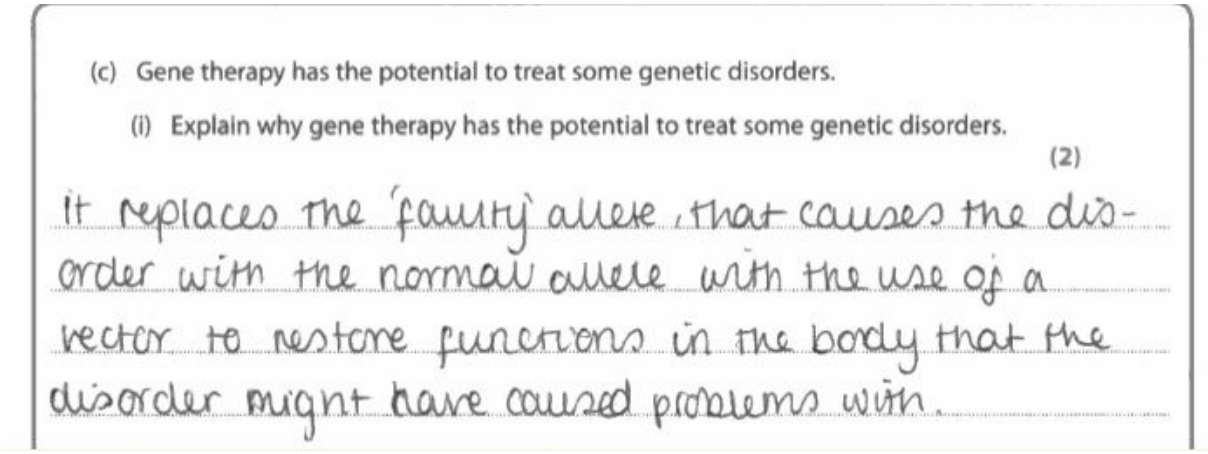
(2)

Genetic disorders are caused by a ~~f~~ mutation of the DNA, but gene therapy can use vectors to insert the normal form of the allele into cells, so it can be transcribed and translated.

Results Plus: Examiner Comments

This candidate has recognised that the disorder is caused by a faulty allele and that gene therapy inserts a normal allele into the cells. They would also have gone on to achieve the third marking point available if they had told us what is produced by transcription or translation of the normal allele.

This response scores one of the available two marks.



(c) Gene therapy has the potential to treat some genetic disorders.

(i) Explain why gene therapy has the potential to treat some genetic disorders.

(2)

it replaces the 'faulty' allele, that causes the disorder with the normal allele with the use of a vector to restore functions in the body that the disorder might have caused problems with.

Results Plus: Examiner Comments

This candidate gains a mark for recognising that the genetic disorder is caused by a faulty allele, but they are wrong to state that this allele is replaced by gene therapy, and they go on to start describing how to carry out gene therapy (previous question ii) rather than explaining how gene therapy can treat the disorder.

Results Plus: Examiner Tip

It is very difficult to remove, replace or correct an allele within a cell. Gene therapy is designed to place a 'normal' allele within a cell, in addition to the existing alleles in the genome.

(ii) This question allowed most candidates to easily gain 2 marks for reference to a vector, and to a suitable delivery mechanism for the vector. A third point was gained by the more able candidates, usually for reference to the introduction of the alleles into cells. It was pleasing to note that some candidates understood the need to repeat the treatment.

Few candidates correctly referred to the site of delivery (eg. the lungs). Only the best candidates correctly identified the use of genes coding for the CFTR protein OR channel.

This response gained all three marks available.

(ii) Suggest how patients with cystic fibrosis could be treated using gene therapy.
(3)

In cystic fibrosis, the normal form of the allele coding for the CFTR protein is inserted into epithelial cells by a vector (a virus or liposomes). The functioning gene is then transcribed and translated, so the functioning form of the protein is produced. Repeated treatement would be needed as epithelial cells die. The virus or liposomes could be in the form of an aerosol which is breathed in.

Results Plus: Examiner Comments

This candidate has identified what allele is needed and how to insert it into cells via a vector and aerosol. They have also recognised the need to repeat the treatment because the epithelial cells die. The only significant thing missing from this very good answer is recognition of which organ to target.

Q6.

(a) Q(a) Most candidates gained one mark for this recognising that two recessive alleles were needed to show the disorder in the phenotype. However, surprisingly few candidates referred to the disorder being due to a faulty gene or allele, ignoring the full name in bold or recognising that the question was worth two marks.

Q(b)(i) - (b)(iv) These multiple choice questions were discriminatory and were well answered by the majority of candidates. (b) (iv) caused the most problems, this may be due to parts (i)-(iii) requiring the name of a person to be identified but part (iv) required the choice 'none of them' to be made. Candidates may have been reluctant to choose a negative statement.

8 Cystic fibrosis and albinism are examples of recessive genetic disorders.

Tay-Sachs disease is another example of a recessive genetic disorder.

(a) Explain the meaning of the term **recessive genetic disorder**.
(2)

Recessive genetic disorders are caused by the inheritance of two recessive alleles that cause the genetic disorder as they are faulty / disease causing.

Results Plus: Examiner Comments

This is an example of a response that gained both marks available as they have recognised that a recessive genetic disorder is caused by two recessive, faulty alleles.

8 Cystic fibrosis and albinism are examples of recessive genetic disorders.

Tay-Sachs disease is another example of a recessive genetic disorder.

(a) Explain the meaning of the term **recessive genetic disorder**.

(2)

It means that it needs a homozygous genotype to occur within the person. Two recessive alleles are needed ~~to~~ for the disease to be present in the phenotype.

Results Plus: Examiner Comments

This is typical of the most common response where one mark has been awarded for recognising that two recessive alleles are needed for the disorder to be present. However, they have not explained what a genetic disorder is for the second mark.

Results Plus: Examiner Tip

Don't forget that genetic disorders are caused by faulty/mutant alleles.

8 Cystic fibrosis and albinism are examples of recessive genetic disorders.

Tay-Sachs disease is another example of a recessive genetic disorder.

(a) Explain the meaning of the term **recessive genetic disorder**.

(2)

Somebody has to be a carrier or has the disease and two carriers are needed for the genetic disorder to continue down the family line

Results Plus: Examiner Comments

This is an example of a response that failed to gain any marks as rather than defining the term they have concentrated on how it could be inherited.

8 Cystic fibrosis and albinism are examples of recessive genetic disorders.

Tay-Sachs disease is another example of a recessive genetic disorder.

(a) Explain the meaning of the term **recessive genetic disorder.**

(2)

This is when your ~~have two different genotype~~ genotype alleles are ~~is~~ different e.g Ff

Recessive alleles are not shown in the phenotype

Results Plus: Examiner Comments

This is an example of a response that failed to gain any marks because they have described heterozygous rather than recessive genetic disorder.

(c) This was a very discriminating question achieving the full range of marks, although less than 6 % of candidates managed to structure a full answer that gained them the full five marks available. Interestingly candidates often either wrote a reasonably detailed description of the gene therapy process or described how the investigation could be carried out by selecting a suitable control group and monitoring the life spans of treated and non-treated sheep. Few candidates combined both approaches. The most common mark was gained for identifying a suitable vector (e.g. a virus).

There were a significant number of answers referring to screening techniques rather than therapy. Some responses were also in the context of cystic fibrosis rather than adjusting to the context of Tay-Sachs disease (for example the use of a nebuliser to insert the vector into the lungs), suggesting that they had learnt a particular area of the syllabus and could not apply it to a different context/ Some candidates even went into detail about the CFTR protein. Others wrote in general terms about the application of gene therapy in humans, and completely ignored the experimental design component.

Unfortunately, many students still think that the purpose of gene therapy is to replace faulty alleles rather than provide a copy of a functioning gene.

This response scored all five marks available.

*(c) Tay-Sachs disease is caused by a gene mutation that results in the build up of lipid in the brain. It is hoped that gene therapy will be able to treat this disease in the future.

Sheep can also suffer from Tay-Sachs disease. Investigations have found that gene therapy increases the life span of these animals.

Suggest how these gene therapy investigations could have been carried out.

(5)

Firstly you would need to get a healthy ~~ver~~ ~~allele for~~ correct allele for the gene. Then you would attach it to a vector for example a virus. Then you would inject the virus into the right part of the ~~brain~~ body of the sheep. The virus would ~~the~~ now go into the body and replace the faulty gene. However you would have to keep on repeating this procedure because cells ~~always~~ always are renewing themselves. Therefore you would have the independent variable as the virus and the dependent variable as life span of sheep. Use lots of sheep and inject them with vectors and ~~8~~ compare their life span with healthy sheep to see if gene therapy actualy increase life span. But you would have to control the type of sheep used.

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

Results Plus: Examiner Comments

This response gained credit for:

- inserting the healthy allele into a vector; - naming a suitable vector; - recognising that the treatment needs repeating; - measuring the life spans of the sheep; - using a large sample of sheep for reliability; - comparison to a suitable control group.

Results Plus: Examiner Tip

Although this is a good response, this candidate has made a mistake in thinking that gene therapy replaces faulty genes.

This response scores two of the five marks available.

*(c) Tay-Sachs disease is caused by a gene mutation that results in the build up of lipid in the brain. It is hoped that gene therapy will be able to treat this disease in the future.

Sheep can also suffer from Tay-Sachs disease. Investigations have found that gene therapy increases the life span of these animals.

Suggest how these gene therapy investigations could have been carried out.

(5)

They could have looked at a normal sheep without the Tay-Sachs disease and measured its lifespan. They then could have looked at the same type of sheep with Tay-Sachs disease and see how long its lifespan is. Finally they could treat another sheep with Tay-Sachs disease using gene therapy to see how long its lifespan is before determining if the lifespan increases or decreases with gene therapy.

Results Plus: Examiner Comments

This response is typical of those candidates who did not describe how gene therapy could be carried out, but did gain some credit for looking at the overall experimental design in the correct context i.e. measuring lifespan and comparing to control groups.

This response gained no marks.

*(c) Tay-Sachs disease is caused by a gene mutation that results in the build up of lipid in the brain. It is hoped that gene therapy will be able to treat this disease in the future.

Sheep can also suffer from Tay-Sachs disease. Investigations have found that gene therapy increases the life span of these animals.

Suggest how these gene therapy investigations could have been carried out.

(5)

Amniocentesis is one way of discovering if a offspring (s) is effected or not. It consists of a portion of embryo/amniotic fluid being taken from around the uterus. With this it can be determined whether or not an infant has the gene mutation. Another form of therapy ✓called preimplantation involves IVF and can allow the infant to grow and at the same time we know if they're effected. If they are effected certain actions can be taken to prevent any happening. Ultrasound investigation could also be beneficial. Samples of womb ✓uterus tissue could be taken and analysed to determine if the baby is effected.

Results Plus: Examiner Comments

This response is typical of those candidates who have confused genetic screening with gene therapy and therefore not covered any relevant mark points.

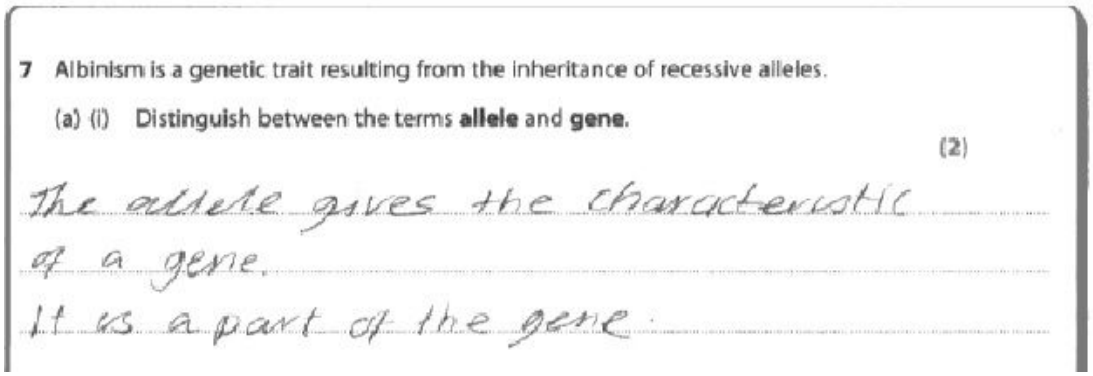
Results Plus: Examiner Tip

Make sure you know the difference between therapy and screening and read the question carefully to make sure you write about the correct one.

Q7.

Defining the terms again caused problems to candidates, especially gene and allele. Genes were frequently described as ***something that codes for our characteristics*** and alleles as ***types of gene***.

Below are some examples to illustrate these points:

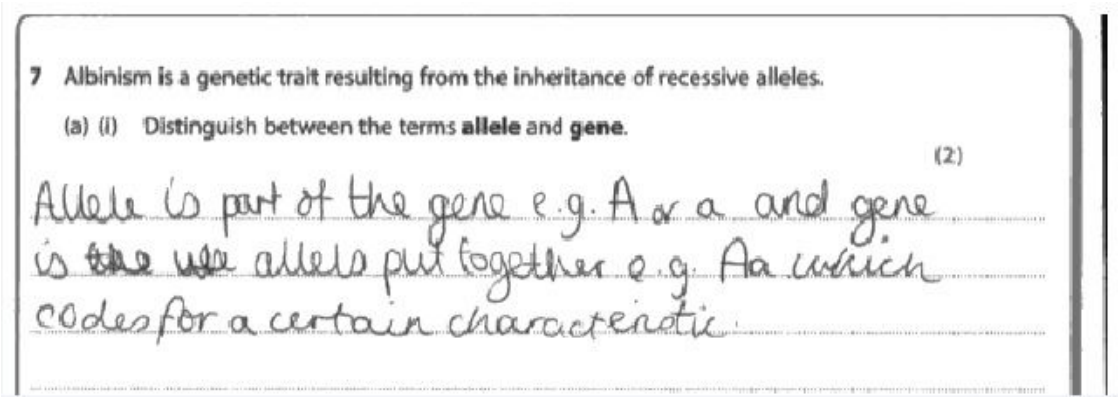


7 Albinism is a genetic trait resulting from the inheritance of recessive alleles.

(a) (i) Distinguish between the terms **allele** and **gene**.

(2)

The allele gives the characteristic of a gene.
It is a part of the gene.

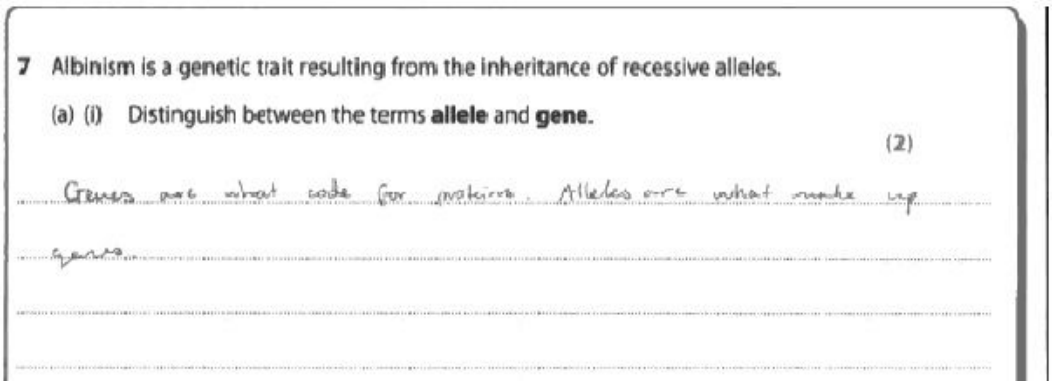


7 Albinism is a genetic trait resulting from the inheritance of recessive alleles.

(a) (i) Distinguish between the terms **allele** and **gene**.

(2)

Allele is part of the gene e.g. A or a and gene is ~~the~~ use alleles put together e.g. Aa which codes for a certain characteristic.



7 Albinism is a genetic trait resulting from the inheritance of recessive alleles.

(a) (i) Distinguish between the terms **allele** and **gene**.

(2)

Genes are what code for proteins. Alleles are what make up genes.

In (b), many candidates could identify that Cara, Jasjeet and Daniel were carriers of albinism but some went on to penalise themselves by suggesting that other family members were too. Naveeda was frequently named, as there are candidates who do not appreciate that the heterozygous individual is referred to as a carrier and not the recessive homozygous individual. Vague reasons were given for their choices, with few candidates actually explaining that an allele was being passed on from parent to child.

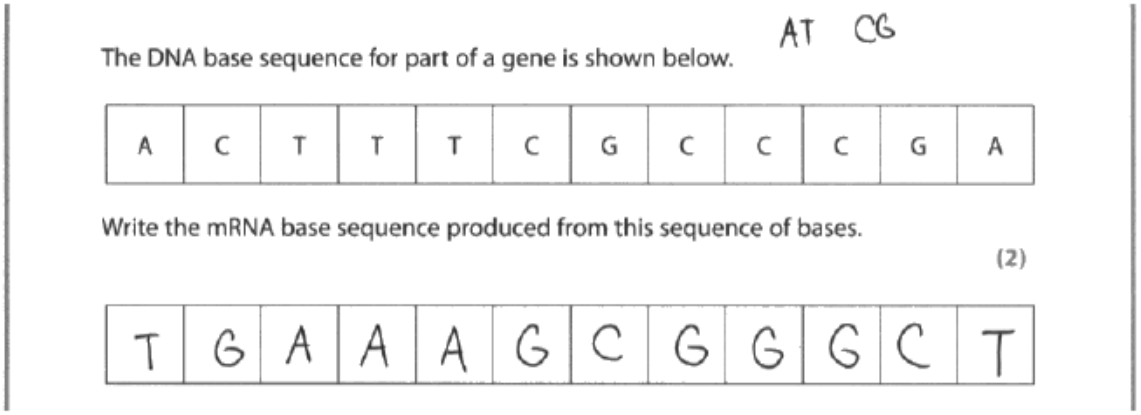
Part (c) saw a variety of answers, the most frequent being the lack of camouflage that albino squirrels would have. There were suggestions that white squirrels would not appear attractive to other coloured squirrels and there were one or two candidates who commented on the number of predators that squirrels had, compared to humans who have none.

The final part of this question must have appeared too straightforward to some candidates as there were some very long and complicated answers. The weaker candidates simply rewrote the information shown in the equation.

Q8.

The vast majority of candidates managed to gain both marks available for this question on transcription.

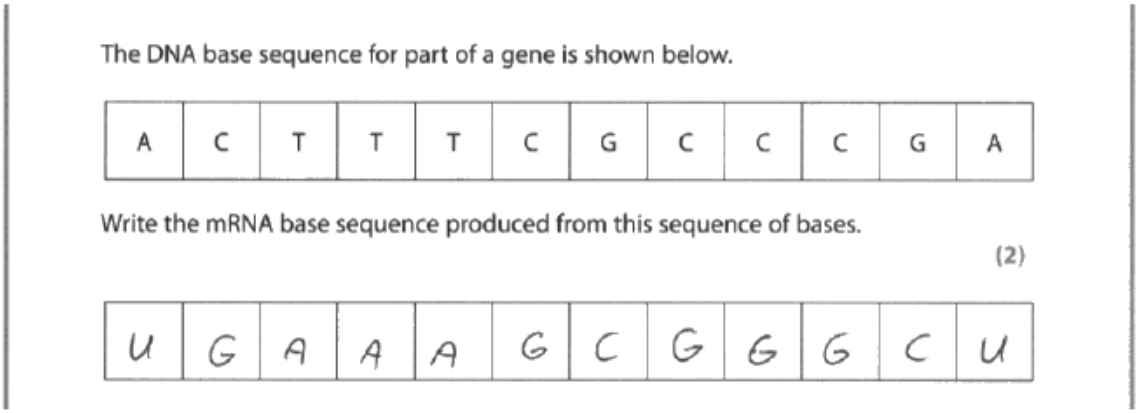
This response gained both marks available.



Results Plus: Examiner Comments

An example of the correct response.

This response scored just one of the two marks.



Results Plus: Examiner Comments

This is an example of the most common mistake with this question where the candidate did not recognise that Uracil (U) replaces Thymine (T) in RNA; or they thought this was replication.

This response gained no marks.

The DNA base sequence for part of a gene is shown below.

A	C	T	T	T	C	G	C	C	C	G	A

Write the mRNA base sequence produced from this sequence of bases.

(2)

A	C	U	U	U	C	G	C	C	C	G	A

Results Plus: Examiner Comments

This candidate recognised that U replaces T in RNA, but did a direct copy, rather than recognising that complementary base pairing would form the mRNA.

Q9. No Examiner's Report available for this question

Q10. No Examiner's Report available for this question

Q11.

(a) (i) Part (a) highlighted the fact that many candidates do not understand the difference between terms such as structure, role or properties.

(i) Name the molecule labelled A and describe its structure.

(3)

Name phospholipid

Structure Has a positively charged polar head, which is hydrophilic, and so can be in contact with water. Attached, is a fatty acid tail, which has a slightly negative charge and is hydrophobic. These lipids are not soluble in water.

Results Plus: Examiner Comments

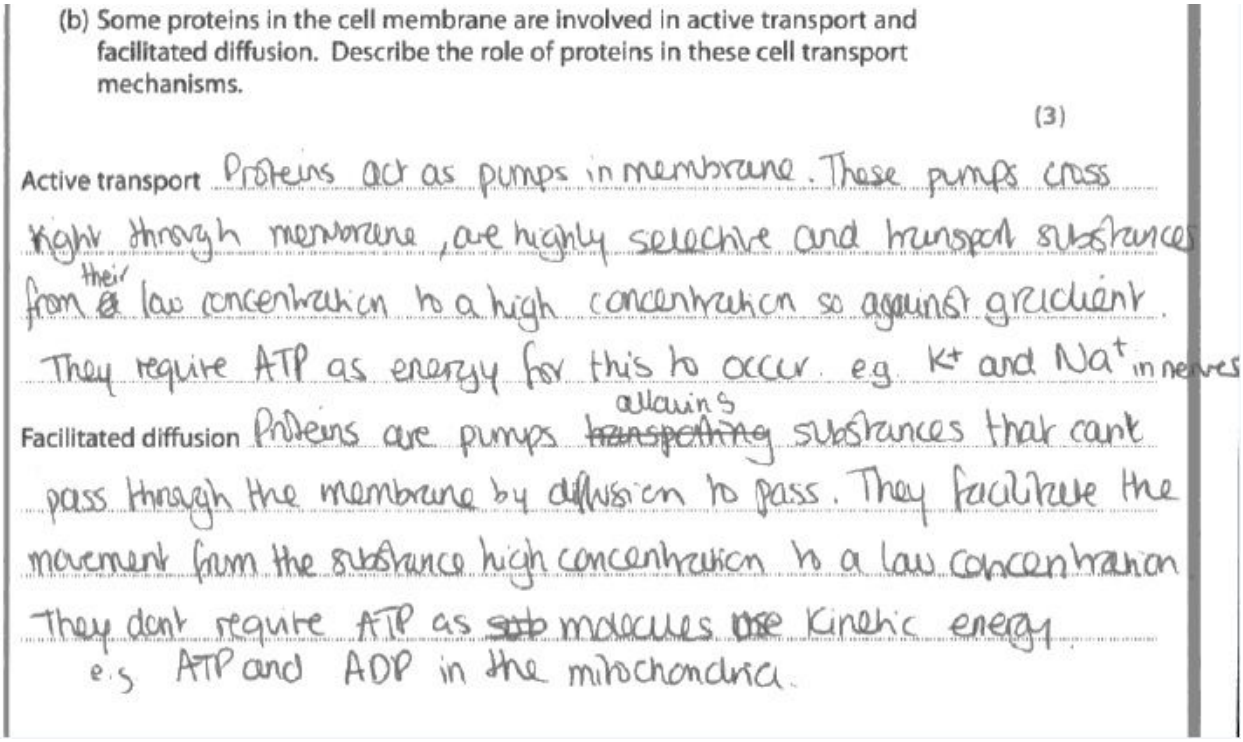
A large number of candidates described the properties of the phospholipid molecule in part (i), as illustrated by this response.

Results Plus: Examiner Tip

Make sure before you go into the exam that you know the difference between the terms structure, function and properties and that you read the question carefully to identify exactly what you are being asked to describe.

(a) (ii) Unfortunately, those candidates that had described the properties of the phospholipid molecule in part (a)(i) tried to write something different in part (ii). As a result, they scored no marks, even though it was clear from their previous answer that they knew the Biology.

(b) In part (b), many candidates scored 3 marks and there were some very good responses.



(b) Some proteins in the cell membrane are involved in active transport and facilitated diffusion. Describe the role of proteins in these cell transport mechanisms.

(3)

Active transport Proteins act as pumps in membrane. These pumps cross right through membrane, are highly selective and transport substances from their low concentration to a high concentration so against gradient. They require ATP as energy for this to occur. eg K^+ and Na^+ in neurones

Facilitated diffusion Proteins are pumps attains ~~transporting~~ substances that can't pass through the membrane by diffusion to pass. They facilitate the movement from the substance high concentration to a low concentration They don't require ATP as ~~sub~~ molecules ~~use~~ Kinetic energy e.g ATP and ADP in the mitochondria.

Results Plus: Examiner Comments

Although this candidate scored 3 marks max, the reference to 'pumps' in the second part of their answer would have negated a reference to channel protein; this is because 'pumps' implies active transport.

Results Plus: Examiner Tip

When describing concentration gradients, do not refer to 'along', 'with' or 'against' concentration gradients as such descriptions are too vague.

(c) (ii) Part (c) (ii) was poorly done. Very few candidates really understand that the phospholipids can move within the membrane and therefore contribute to the fluidity of the membrane. As a result, they could not explain how the results of this investigation could be explained by the fluid mosaic model.

Q12.

(b) This question asked candidates to use the information from a table to describe the effect of temperature on permeability.

Most candidates spotted the overall trend, but only a few candidates described where significant changes in permeability were shown (or didn't change) to receive the second mark.

Some candidates did not answer the question asked (describe the effect on permeability) and lost marks by limiting their answer to describing the colour changes alone.

This response scores one of the two marks available.

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 °C. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

The procedure was repeated at five other temperatures.

The results of this experiment are shown in the table below.

Temperature / °C	Colour of fluid
5	pale pink
22	pale pink
42	pale pink
64	pink
87	dark pink
93	red

Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

As the temperature increases the colour of the fluid gradually becomes darker. For the temperatures 5°C, 22°C and 42°C the colour of the fluid stayed the same.

Results Plus: Examiner Comments

This candidate has identified that the colour does not change between 5ºC and 42ºC. However, they have not answered the question asked about the effect of temperature on permeability.

Results Plus: Examiner Tip

Read the question carefully and make sure your answer addresses the question asked.

This is a good example of a response that scored both marks available.

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 °C. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

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64	pink
87	dark pink
93	red

Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

As temperature increases, permeability will also increase, after temperatures of 42°.

Results Plus: Examiner Comments

This response clearly, and concisely, identifies the correct trend and identifies when the permeability change is occurring.

Results Plus: Examiner Tip

When a 'describe' question is allocated two or more marks you will need to include more than just an overall trend.

This is a typical response that scored only one of the two marks available.

There is a positive correlation between the temperature of the water and the permeability of the cell membrane, as the amount of pigment leaving cut has increased, suggesting the membranes have been broken down. This is because the temperature increase causes an increase in the kinetic energy of the phospholipids, causing them to vibrate more and break apart, releasing the contents of the vacuole.

Results Plus: Examiner Comments

This candidate described the overall trend correctly, but rather than looking at the data more closely, they wasted time explaining the data rather than describing it.

Results Plus: Examiner Tip

Make sure candidates understand the difference between 'describe' and 'explain'.

This response did not score any marks.

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 °C. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

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Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

An increase in temperature, decreases the permeability of the membrane ~~bee~~ as more pigament has leaked out of the cell by osmosis as the temperature has risen.

Results Plus: Examiner Comments

This response demonstrates two frequent errors. The trend is the wrong direction and they link the movement of pigment to osmosis.

Results Plus: Examiner Tip

Candidates should be reminded what is meant by the terms permeability and osmosis.

(c) (i) The majority of candidates easily identified two clear control variables.

The most common mistake was to use a vague term, such as amount, rather than something that can clearly be controlled like volume or mass.

This is a typical response that scores both marks available.

(c) A second student carried out a very similar experiment, using three samples of beetroot at each temperature. She used a colorimeter to determine the intensity of the colour of the fluid produced.

The results of her experiment are shown in the table below.

Temperature / °C	Intensity of colour of fluid / arbitrary units		
	Sample 1	Sample 2	Sample 3
5	0.0	0.0	0.0
22	10.1	9.8	11.1
42	26.3	29.9	31.0
64	80.1	77.0	76.9
87	93.9	95.0	96.0
93	100.0	100.0	100.0

(i) State **two** variables that both of these students must keep the same if their results are to be compared.

(2)

1 Have the same volume of water ($10cm^3$)

2 keep the ~~beetroot~~ beetroot in the water for the same time (20minutes)

Results Plus: Examiner Comments

Although this is not needed, specifying values (and units) for the control variables adds further clarity to this response.

This response scores one mark.

(2)

1 Beetroot size/mass

2 the amount of water.

Results Plus: Examiner Comments

One mark is allowed for beetroot size/mass. However 'amount of water' is too vague for credit.

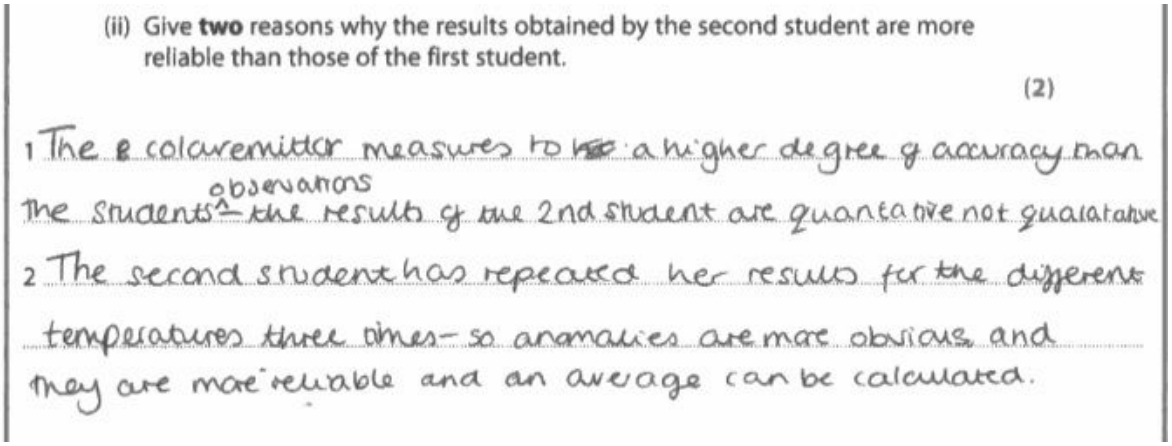
Results Plus: Examiner Tip

Avoid using the term amount. State a specific measurement that can be made/controlled e.g.

mass, surface area, etc.

(ii) The majority of candidates were able to identify two clear reasons for the second set of results being more reliable than the first set.

This is a good example of a response that scored both available marks.



(ii) Give **two** reasons why the results obtained by the second student are more reliable than those of the first student.

(2)

1 The colorimeter measures to a higher degree of accuracy than the students observations the results of the 2nd student are quantative not qualatative

2 The second student has repeated her results for the different temperatures three times - so anamalies are more obvious and they are more reliable and an average can be calculated.

Results Plus: Examiner Comments

One mark is awarded for the comment on accuracy and quantitative measurements. The second mark is awarded here for repeating results.

Results Plus: Examiner Tip

Reliability is down to the repeatability and reproducibility of the data. Repeating measurements and making objective quantifiable measurements are more likely to be more reliable than subjective judgements and observations.

When making a comparison make sure it is clear which set of data is being referred to in your answer.

(iii) Many candidates demonstrated an understanding of the core practical and recognised that the colour was due to pigment released when the cells had been damaged. They recognised that the pieces of beetroot may not have been rinsed as thoroughly.

Some candidates who failed to score on this question thought that the colorimeter was less sensitive than the human eye so therefore could not pick up on the colour. Others thought that it could be down to other uncontrolled variables such as the size of the beetroot or the volume of the water. These may change the intensity of colour, but would not affect whether the membrane was permeable or not.

This response scored no marks.

(iii) In the first student's experiment at 5 °C, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference.

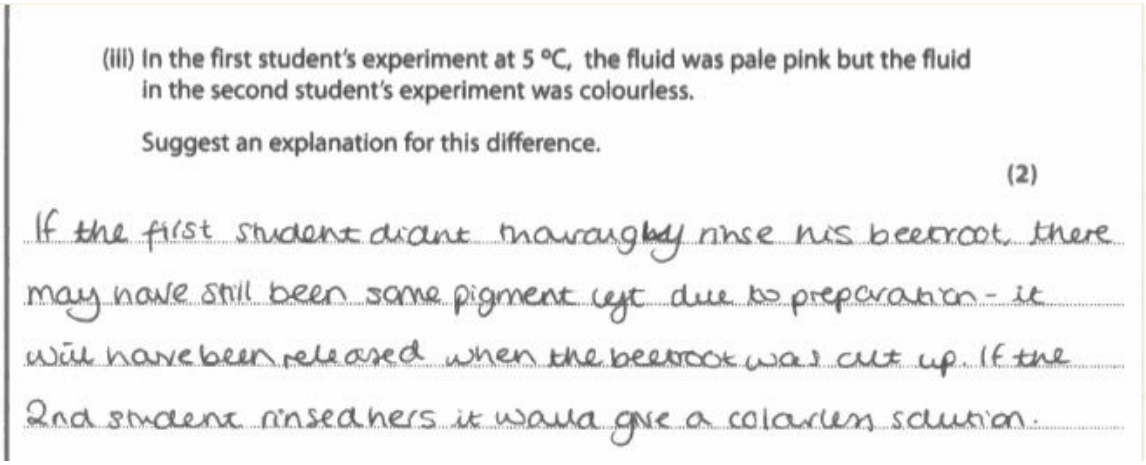
(2)

This may be because the colorimeter was not able to detect colour to that low an amount

Results Plus: Examiner Comments

This is an example of a common mistake where the candidates think that the colorimeter is not sensitive enough.

This response scored both marks available.



(iii) In the first student's experiment at 5 °C, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference.

(2)

If the first student didnt thoroughly rinse his beetroot, there may have still been some pigment left due to preparation - it will have been released when the beetroot was cut up. If the 2nd student rinsed hers it would give a colorless solution.

Results Plus: Examiner Comments

This candidate has scored marks for recognising that the colour in the first experiment could be due to lack of rinsing and the pigment.

Results Plus: Examiner Tip

Although this answer scored full marks, it would have been better if they had stated what was damaged and where the pigment was being released from as a result of the beetroot being cut.

This response scored no marks.

(iii) In the first student's experiment at 5 °C, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference.

(2)

first student kept the beetroot in the water for a longer period of time, than the second student.

Results Plus: Examiner Comments

This is a typical example of a candidate identifying a variable that would affect intensity of colour, but not whether colour would be present or not.

(iv) There were a wide range of responses acceptable for this question, asking candidates to suggest ways in which the descriptions of the data may differ. These centred around either the numerical nature of the data for set 2, or the different descriptions of the effect on permeability at different temperatures.

This is an example of a response that did not score any marks.

(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells. the beetroot.

Suggest **one** way in which these two descriptions might differ.

(1)

The second student may have more accurate results as she did repeats and therefore could find anomalies.

(Total for Question 3 = 12 marks)

Results Plus: Examiner Comments

This candidate has compared the quality of the data (essentially asked in the previous parts of the question) and ignored the instruction to compare the descriptions of the effect of temperature on the permeability of the membranes.

Results Plus: Examiner Tip

Another example of where it is important to read the question carefully.

This response scores one marks.

(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells.

Suggest **one** way in which these two descriptions might differ.

(1)

The seconds student's results will be more accurate because they will have figures and numbers to compare rather than just differences in colour. They will be able to compare the effects of each temperature on the cell membrane, because they repeated the experiment and so he will be able to account for any anomalies.

(Total for Question 3 = 12 marks)

Results Plus: Examiner Comments

This is an example of a response that focuses on the differences between the numerical nature of the two descriptions possible.

This response also gains the mark available.

(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells.

Suggest **one** way in which these two descriptions might differ.

(1)

The 2nd students description will say permiability increases with every increase in temp. Whilst 1st student may say the permeability only increases above 42° (at 64°)

(Total for Question 3 = 12 marks)

Results Plus: Examiner Comments

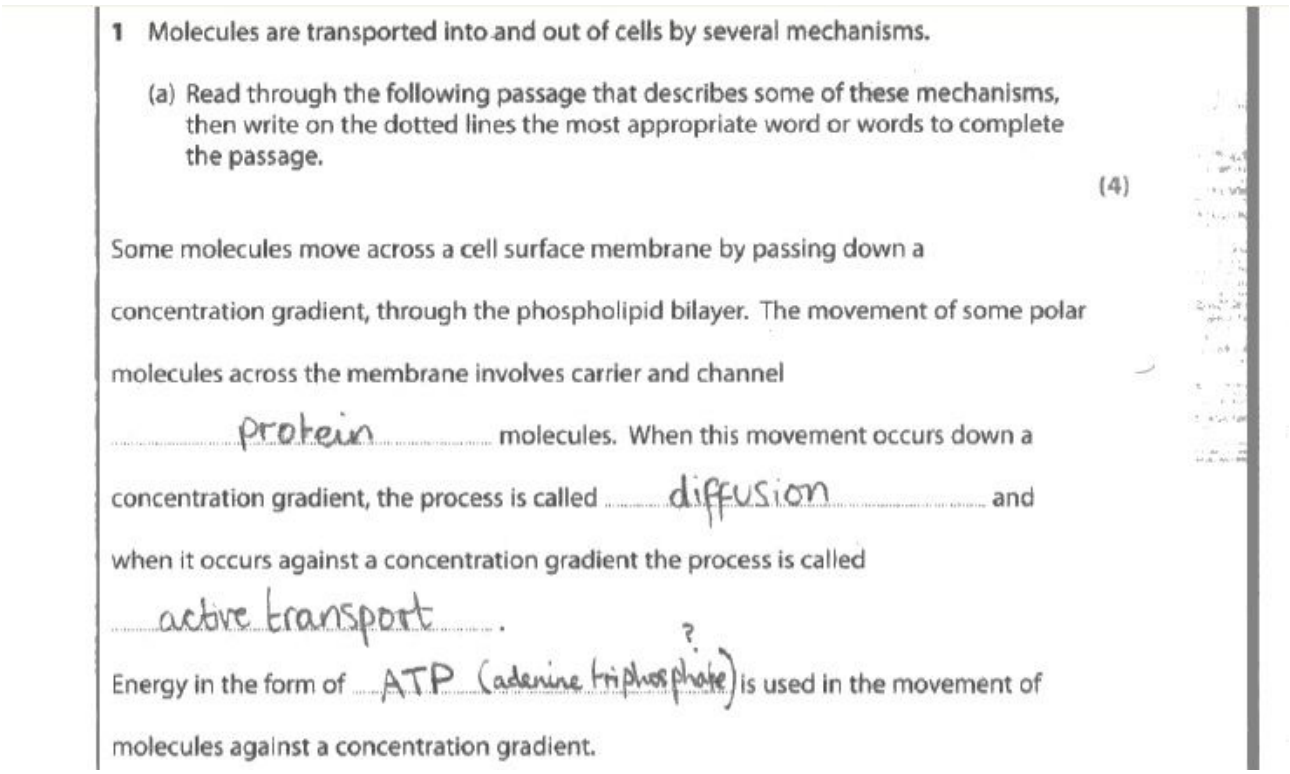
This response is an example of the other common way of comparing the descriptions - comparing the descriptions of permeability at different temperatures.

Q13.

(a) This was generally a high-scoring question, despite an unfamiliar context for assessing knowledge and understanding of osmosis and the properties of water. As we have seen in previous papers, students find calculating percentage changes very difficult and this was no exception. However, the majority attempted the question and scored at least the first marking point.

A straightforward question to start the paper with, but many candidates only scored three marks as they were not specific enough in their answer to the second blank. This response is typical of many that we saw where answers simply stated diffusion and did not qualify it as facilitated

diffusion.



1 Molecules are transported into and out of cells by several mechanisms.

(a) Read through the following passage that describes some of these mechanisms, then write on the dotted lines the most appropriate word or words to complete the passage.

(4)

Some molecules move across a cell surface membrane by passing down a concentration gradient, through the phospholipid bilayer. The movement of some polar molecules across the membrane involves carrier and channel protein molecules. When this movement occurs down a concentration gradient, the process is called diffusion and when it occurs against a concentration gradient the process is called active transport.

Energy in the form of ATP (adenine triphosphate?) is used in the movement of molecules against a concentration gradient.

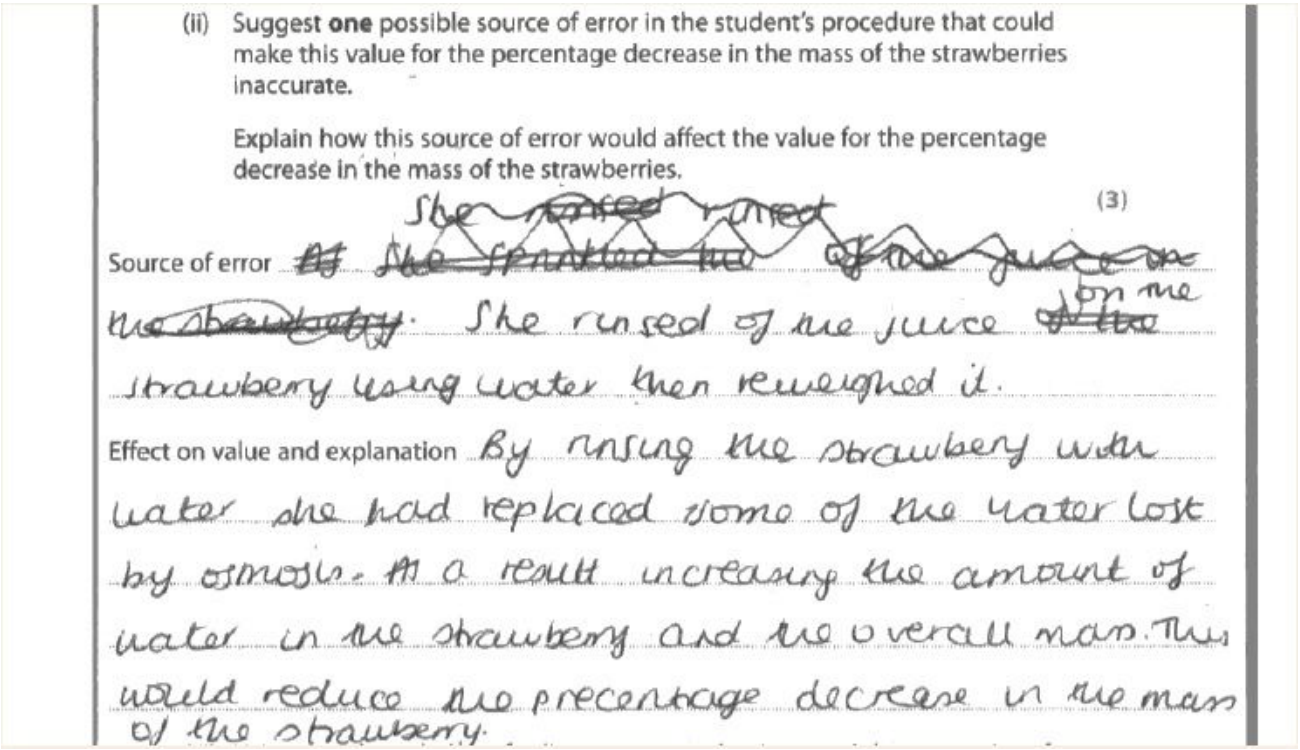
Results Plus: Examiner Comments

Candidates are expected to be familiar with the terms and names of processes referred to in the specification and consequently their answers should show an appropriate level of detail. Candidates can use abbreviations in their answer if we have used them in the specification, without attempting to write them out in full. In this example we ignored the incorrect attempt to give ATP in full, however this would not have been possible if ATP had not been written as well.

Results Plus: Examiner Tip

Only use abbreviations if we have used them in the specification, do not invent your own.

(b) (ii) There were some very good attempts at this question, although there were some candidates who had clearly not read the question through carefully and offered us a source of error as not rinsing the strawberries before weighing them. We did award consequential error marks for candidates who did not give us reasonable sources of error but correctly told us the subsequent effect that it would have on the mass and the percentage decrease.



(ii) Suggest **one** possible source of error in the student's procedure that could make this value for the percentage decrease in the mass of the strawberries inaccurate.

Explain how this source of error would affect the value for the percentage decrease in the mass of the strawberries. (3)

Source of error She ~~rinsed~~ rinsed ~~the strawberry~~ the strawberry on the strawberry using water then reweighed it.

Effect on value and explanation By rinsing the strawberry with water she had replaced some of the water lost by osmosis. As a result increasing the amount of water in the strawberry and the overall mass. This would reduce the precentage decrease in the mass of the strawberry.

Results Plus: Examiner Comments

In this response, there is insufficient information to award the first mark point at the top, as the candidate has only repeated part of the information given in the question. However they go and suggest that water could reenter the strawberry, scoring all three marks.

Results Plus: Examiner Tip

Be careful to not simply repeat information that we have given in the question without elaborating on it.

In questions asking about sources of error in results we expect the equipment to have been used properly and the stated procedure to have been followed. Therefore comments on these are no appropriate sources of error.

(ii) Suggest **one** possible source of error in the student's procedure that could make this value for the percentage decrease in the mass of the strawberries inaccurate.

Explain how this source of error would affect the value for the percentage decrease in the mass of the strawberries.

(3)

Source of error Incorrect mass readings

Effect on value and explanation This would significantly change the value of the mass and change the value of the percentage decrease.

Results Plus: Examiner Comments

This response did not score any marks. The source of error given was not credit-worthy and the vague reference to 'changes' in mass and percentage decrease could not be considered as consequential error marks.

Results Plus: Examiner Tip

If you are refering to changes occuring, always be specific and say what these changes are, e.g. go up or go down.

(b) (iii) Responses were variable depending on whether or not the candidate had read the question and used their knowledge of both transport mechanisms and properties of water.

As in previous papers, candidates need to be clear which molecule is being refered to when discussing concentration gradients. A number of candidates did not do this and could not be awarded the first marking point.

(iii) Using your knowledge of cell transport mechanisms and the properties of water, explain how the juice is formed from the water that came from the fruit.

(3)

The water moved out of the fruit by osmosis. This is the movement of water from a high concentration to a low concentration, down a concentration gradient. Glucose affects the osmotic potential of cells, the sugar added to the strawberries meant there was a lower concentration of water outside the strawberry than inside them. So the water from inside the strawberries moved out of the them, down a concentration gradient, leaving a pool of water on the plate.

Results Plus: Examiner Comments

In this response the candidate could not be awarded the first marking point until line 6 where they make it very clear that the water availability is lower on the outside of the strawberry.

Results Plus: Examiner Tip

Always name the molecule that is in a high or low concentration. Only water moves by osmosis, no other molecule.

Q14.

(a) Candidates need to identify which parts of the specification are being tested in a question of this style and not write detailed accounts of Biology that are not part of the specification. Candidates are expected to know about the affect that mutations have on the structure of DNA and the subsequent structure of a protein, not about sickle cell anaemia or iron deficiency.

5 Thalassaemia is the name of a group of inherited blood disorders that affect the body's ability to produce haemoglobin in red blood cells. Red blood cells are produced in bone marrow.

Oxygen in the lungs binds to haemoglobin and is carried to the cells of the body to be used in respiration.

Beta thalassaemia is the result of a mutation in the gene coding for the β chain of haemoglobin. If a person inherits gene mutations from both parents, this person will show symptoms of anaemia and will require blood transfusions. Symptoms of anaemia include tiredness and breathlessness.

*(a) Using the information given above and your knowledge of gene mutation, suggest why a person with beta thalassaemia has symptoms of anaemia.

(4)

A person with β Thalassaemia could have symptoms of anaemia because β Thalassaemia will reduce the levels of haemoglobin in red blood cells which in turn would result in tiredness and breathlessness (symptoms of anaemia) because there will be a lack of oxygen being carried in the circulatory system, due to oxygen not being efficiently diffused to the red blood cells as a result of the lack of haemoglobin. Oxygen is required for cells to respire and is transported to the cells which require it with red blood cells, however a person with β Thalassaemia will have less ability to oxygenate cells causing tiredness and breathlessness (anaemic symptoms).

Results Plus: Examiner Comments

Candidates frequently wrote vague statements that did not specifically describe individual reasons for tiredness and breathlessness (the symptoms of anaemia). This candidate scored marking points 5 and 6 but not 7 and 8. We frequently saw responses that explained the reasons for both tiredness and breathlessness in one sentence but did not state which factor caused which effect.

Results Plus: Examiner Tip

Write very short snappy sentences that contain one piece of information only.

5 Thalassaemia is the name of a group of inherited blood disorders that affect the body's ability to produce haemoglobin in red blood cells. Red blood cells are produced in bone marrow.

Oxygen in the lungs binds to haemoglobin and is carried to the cells of the body to be used in respiration.

Beta thalassaemia is the result of a mutation in the gene coding for the β chain of haemoglobin. If a person inherits gene mutations from both parents, this person will show symptoms of anaemia and will require blood transfusions. Symptoms of anaemia include tiredness and breathlessness.

*(a) Using the information given above and your knowledge of gene mutation, suggest why a person with beta thalassaemia has symptoms of anaemia.

(4)

a person with beta thalassaemia has symptoms of anaemia because their body produces insufficient haemoglobin, this means that less oxygen can bind to the haemoglobin in the blood to be transported around the body for respiration. This reduced rate in respiration would result in a lack of energy being produced so would then cause tiredness. breathlessness would be as a result of the body trying to gain sufficient oxygen

Results Plus: Examiner Comments

An exemplary answer. Mark point 4 on the 3rd line, mark point 5 on the 5th, mark point 6 on the 6th, mark point 8 on the 8th and mark point 7 on the last line, max 4.

(c) This is a very good example where a standard mark scheme for a particular specification point needs to be learnt and applied to a question.

With respect to gene therapy, we expect the candidates to know that the normal allele is incorporated into an appropriate vector such as a virus which is used to introduce the DNA into the cell and that this needs to be repeated. This will be the framework of our mark scheme in questions of this type.

(c) Gene therapy could potentially be used to treat beta thalassaemia.

Suggest how gene therapy could be carried out to treat this disorder.

(4)

A virus could be used as a vector, ~~with~~ if it has been genetically modified so it will not replicate and contains the healthy gene for the B chain of haemoglobin. It would be placed inside the body by nasal spray or otherwise. The virus containing the gene would then travel into a cell by endocytosis, and the gene would travel into the nucleus and attach to the DNA strands already present. The cell would then produce functioning haemoglobin, but the nasal spray would need to be taken again after a week or so as the cells affected previously may have died. Alternatively a lipoprotein could be used as a vector.

Results Plus: Examiner Comments

This was a very good response that scored 4 max. Mark points 6,5,1,2,3 and 8, in that order in the account.

Results Plus: Examiner Tip

Use past paper mark schemes to learn what are the salient mark points for each specification point and then write these in your answer, in the context of the question.

(c) Gene therapy could potentially be used to treat beta thalassaemia.

Suggest how gene therapy could be carried out to treat this disorder.

(4)

Using a vector a 'correct' or 'normal' gene could be carried into to bone marrow where red blood cells are created. This 'normal' gene would then potentially replace the mutated gene which asserts the bodys ability to produce haemoglobin. With the 'normal' gene it will be fully functionally able to create haemoglobin which will make the anaemic symptoms less severe. However gene therapy is not totally efficient and is only temporary therefore it would have to be repeated.

Results Plus: Examiner Comments

A common miss-conception associated with gene therapy is that the defective allele is somehow removed and therefore replaced by the normal allele. This response was very typical.

Results Plus: Examiner Tip

In gene therapy, the defective alleles are not replaced. The functioning allele is inserted to take over the production of the normal protein.

Always read through your answers carefully to ensure that you have used plain English that means exactly what you want it to mean.

Q15.

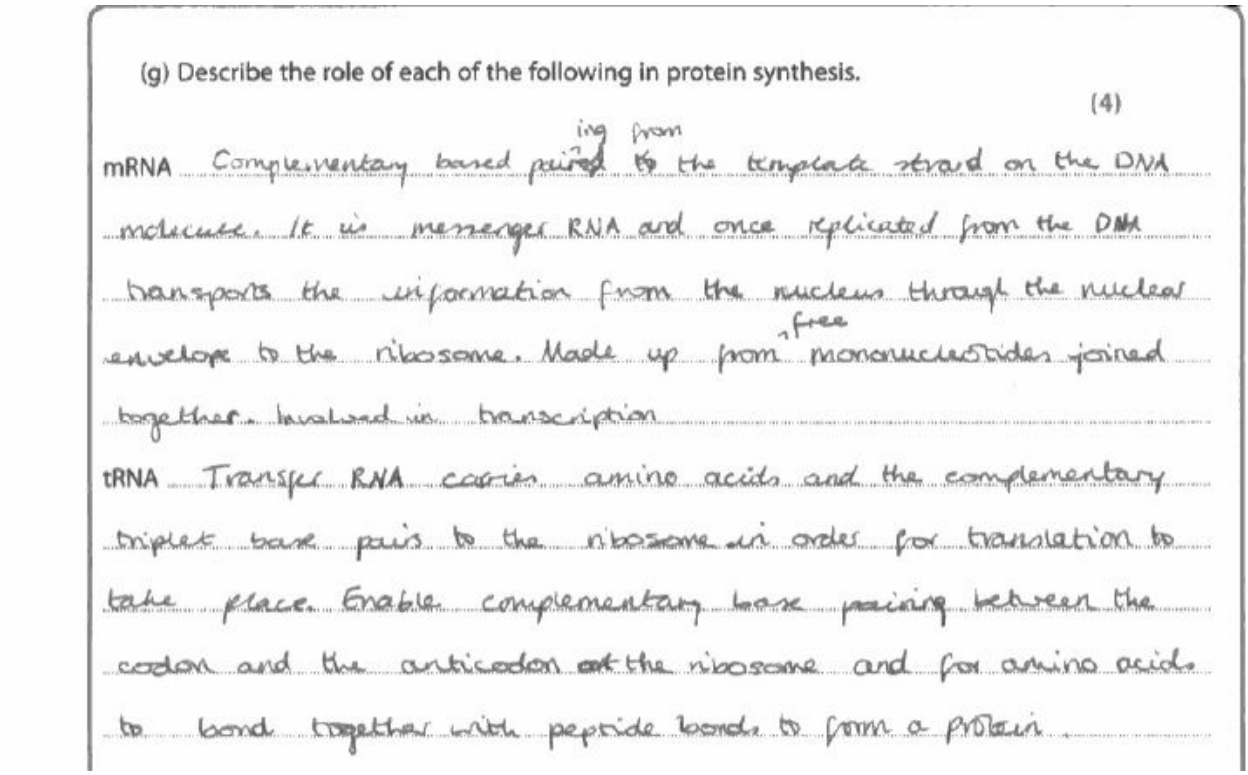
(g) These responses are a cross section of the range of marks on offer. More candidates gained all four marks than scored no marks.

Most candidates stated correctly that mRNA leaves the nucleus and is used in translation. Few candidates told us that mRNA is a copy of the coding strand of the DNA and that it binds to the ribosome. The most frequent mistake was to say that mRNA is a copy of DNA, without specifying the strand involved in being copied or to describe the translation of DNA, sometimes in a wrong manner.

The majority of candidates recognised that tRNA is involved in translation, carries amino acid and binds to codons present in mRNA. Few candidates told us that two tRNA bring amino acids together for peptide bonds to be formed. A common mistake was to state the tRNA is made of

amino acids.

This is an example of a good response scoring all four marks available.



(g) Describe the role of each of the following in protein synthesis.

(4)

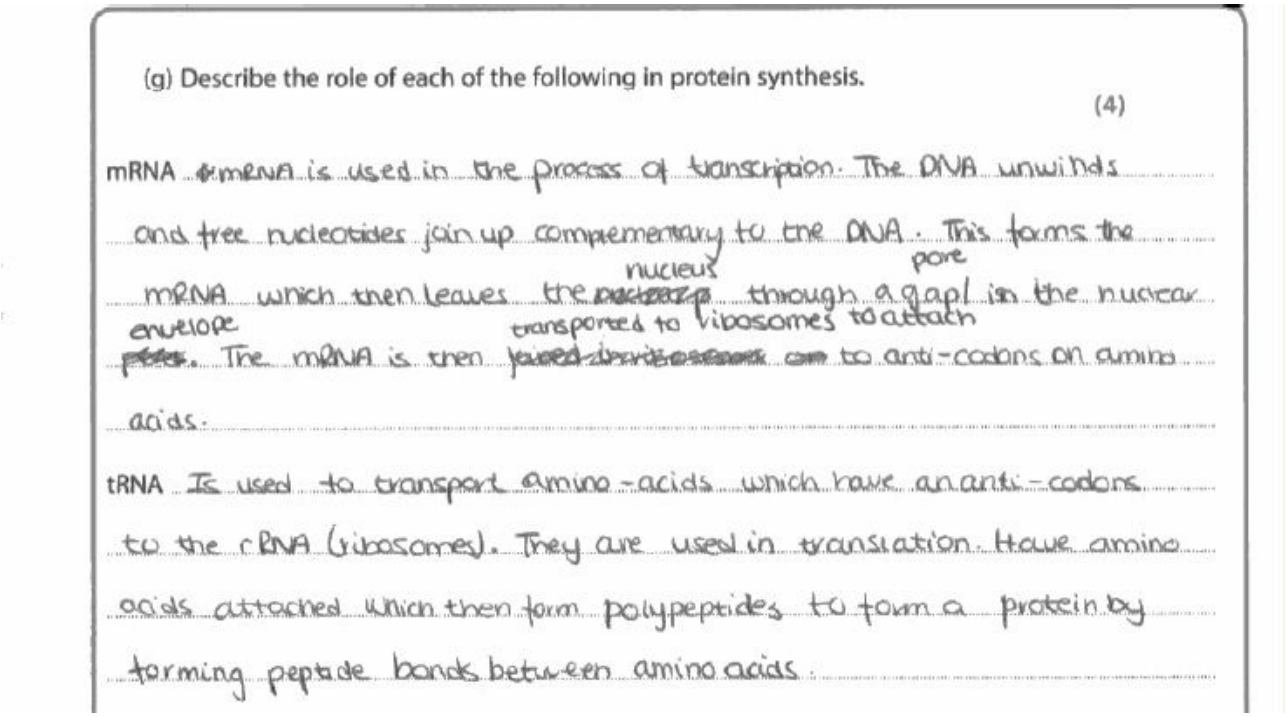
mRNA Complementary based paired ing from to the template strand on the DNA molecule. It is messenger RNA and once replicated from the DNA transports the information from the nucleus through the nuclear envelope to the ribosome. Made up from free mononucleotides joined together. Involved in transcription

tRNA Transfer RNA carries amino acids and the complementary triplet base pairs to the ribosome in order for translation to take place. Enable complementary base pairing between the codon and the anticodon at the ribosome and for amino acids to bond together with peptide bonds to form a protein.

Results Plus: Examiner Comments

This candidate has gained credit for recognising that mRNA is formed from complementary base pairing to part of the DNA and that it can be transported out of the nucleus. The tRNA has also been correctly described as carrying amino acids and being involved in translation, with anticodons interacting with codons.

This response scores three of the four available marks.



(g) Describe the role of each of the following in protein synthesis.

(4)

mRNA ~~it~~ mRNA is used in the process of transcription. The DNA unwinds and free nucleotides join up complementary to the DNA. This forms the mRNA which then leaves the ~~nucleus~~ nucleus through a gap/pore in the nuclear envelope ~~pores~~. The mRNA is then transported to ribosomes to attach ~~joined to ribosomes~~ to anti-codons on amino acids.

tRNA Is used to transport amino-acids which have an anti-codons to the mRNA (ribosomes). They are used in translation. Have amino acids attached which then form polypeptides to form a protein by forming peptide bonds between amino acids.

Results Plus: Examiner Comments

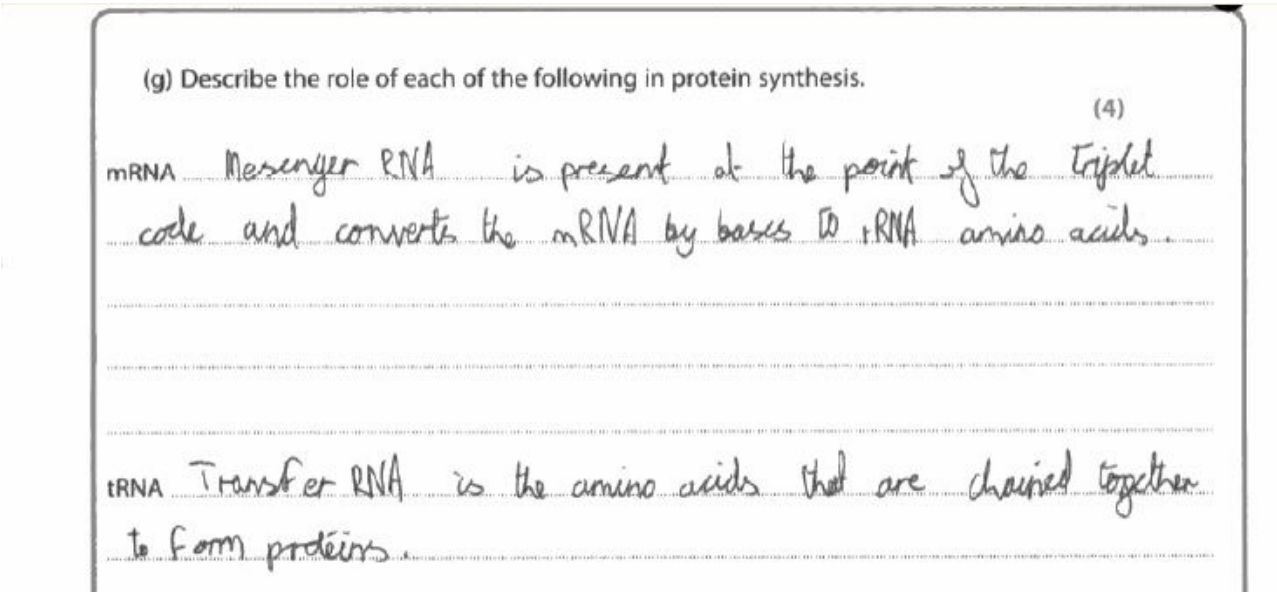
This response gained credit for recognising that mRNA can leave the nucleus and be transported to ribosomes, tRNA transporting amino acids and tRNA being used in translation.

Please note that free nucleotides complementary to DNA are not enough for a mark as they could be describing replication.

Results Plus: Examiner Tip

Transcription only copies a small part of the DNA so this should be made clear in any description of transcription.

This response scores no marks.



(g) Describe the role of each of the following in protein synthesis.

(4)

mRNA Messenger RNA is present at the point of the Triplet code and converts the mRNA by bases to tRNA amino acids.

tRNA Transfer RNA is the amino acids that are chained together to form proteins.

Results Plus: Examiner Comments

This response illustrates some of the problems a few candidates had by confusing RNA, amino acids and DNA.

Results Plus: Examiner Tip

Check that you understand that DNA and RNA are essentially codes and that proteins are made from the amino acids joined together in a specific order during translation.

Q16.

This question caused candidates the most problems, even though it was based on a very basic and traditional biological experiment.

If (a) had been well answered we could have made the comment that candidates knew the meaning of the term, but had no understanding of the process. However, very few candidates could clearly explain the meaning of the term, giving vague statements that did not clearly indicate what concentrations they were referring to. This is illustrated in the response below that could only be awarded mp 1.

(a) Explain the meaning of the term **osmosis**.

(2)

The movement of water particles through a partially permeable membrane from low concentration to high concentration.

The marks for this question were generally scored in (c) and (d), although very few candidates who tried to discuss the use of a rule could actually explain why it would be less accurate than a balance. This is illustrated below in the candidate's second statement.

(d) A second student wanted to perform this investigation by measuring the change in length of the potato pieces. The student was advised that this method would not be as accurate as weighing the potato pieces.

Suggest **two** reasons why measuring the change in length would not be as accurate as weighing the potato pieces.

(2)

1 The change would be very slight as the cells are so tiny and the overall absorbtion isn't much.

2 It would be difficult to measure with a ruler and so mistakes could be made that makes the results less accurate.

Q17.

(a) It was wonderful to see a question on a core practical that had clearly been done in centres and learnt by candidates.

The experiment I carried out was to observe the permeability of beetroot cell membranes at different temperatures. The ~~temep~~ temperatures were : 0°c, 20°c, 40°c, 60°c. ~~Em~~ Eight 1 cm³ cubes of bet beetroot were cut and each placed in a testube with 10ml of water in it. There was two testubes for each temperature. The testubes were left in water basin's which had ~~the~~ water of the before mentioned temperatures in them. They were left for half an hour. After the time each test ~~table~~ tube was taken out and the permeability was measured ~~was~~ using colorimeter. Beetroot has a red pigment within its cells so we used this knowledge to test how ~~transparent~~ much the water solutions from the test tube absorbed the light ~~was with the given temperatures the test~~. An average result was taken between ~~tes~~ the two test tubes that had been in the same water basin. The more light absorbed meant the more permeable the membrane was

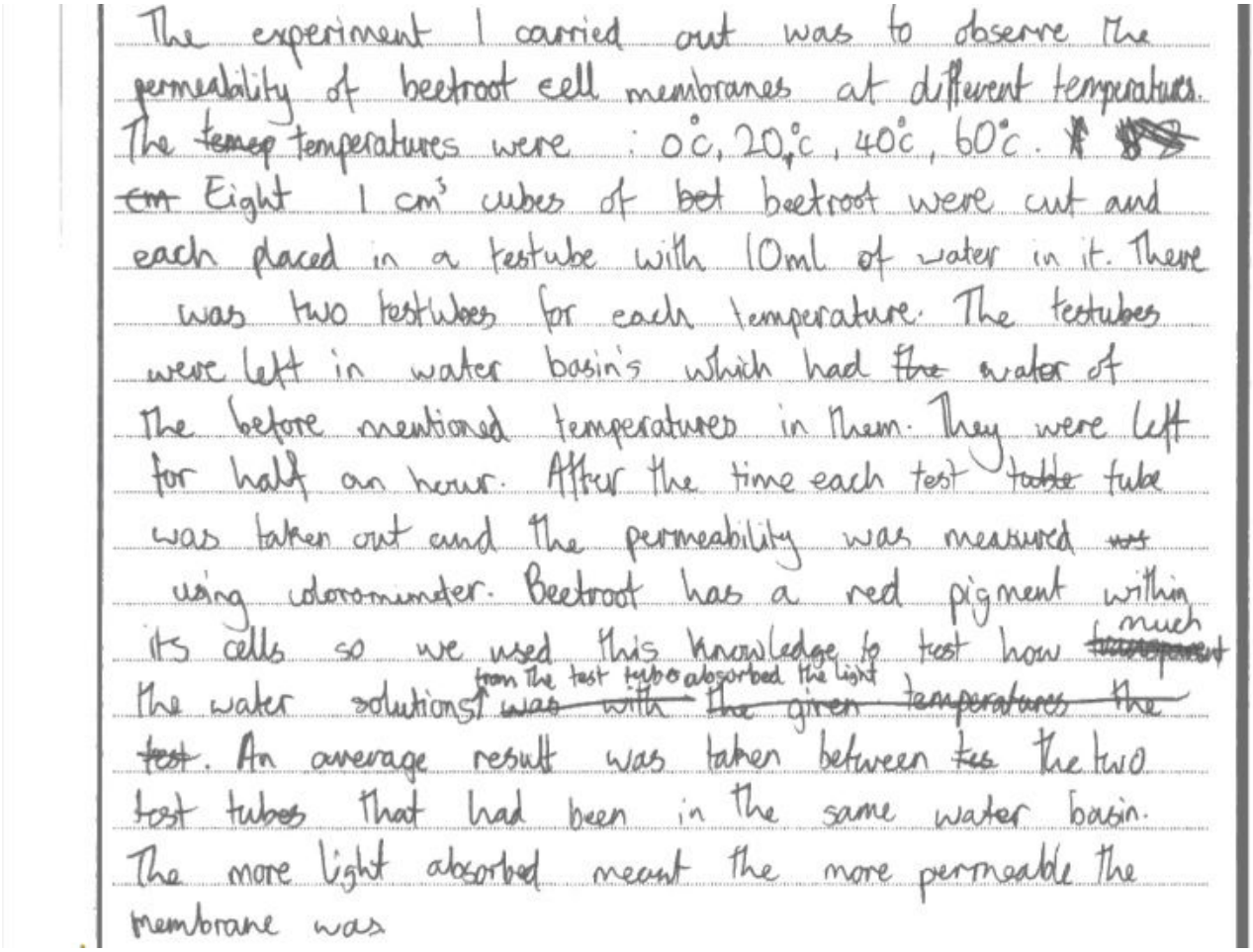


Results Plus: Examiner Comments

This is an example of a typical answer seen. This response scored mark points 1,5,8,7 and 6, in that order in the response.

Results Plus: Examiner Tip

Learn the fine details of the core practical thoroughly.


The experiment I carried out was to observe the permeability of beetroot cell membranes at different temperatures. The ~~temep~~ temperatures were : 0°c, 20°c, 40°c, 60°c. ~~em~~ Eight 1 cm³ cubes of bet beetroot were cut and each placed in a testube with 10ml of water in it. There was two testubes for each temperature. The testubes were left in water basin's which had ~~the~~ water of The before mentioned temperatures in them. They were left for half an hour. After the time each test ~~table~~ tube was taken out and the permeability was measured ~~not~~ using colorimeter. Beetroot has a red pigment within its cells so we used this knowledge to test how ~~temperature~~ much The water solutions from the test tube absorbed the light ~~was with the given temperatures the test~~. An average result was taken between ~~tes~~ the two test tubes that had been in the same water basin. The more light absorbed meant the more permeable the membrane was

Results Plus: Examiner Comments

Although we expect candidates to demonstrate that a minimum of 5 values of the independent variable should be tested, we do expect the values to be realistic. -10 would not work! A common error was to write c a lorimeter (line 17).

This response was still awarded 5 marks.

Results Plus: Examiner Tip

Always try to write more points than there are allocated marks. This candidate made two mistakes that meant that they could not be awarded the two marks, but because they had written seven relevant points they still scored the full marks allocated to this question.

(b) (iii) This question was slightly unusual but was a good illustration of how candidates should identify the theme of the question and think about what they have been taught. The stem of question 6 tells the candidate that the question is about transport of molecules across a membrane. The stem to part b indicates that they should be thinking about water specifically and its polar nature. They are supposed to know that membranes are hydrophobic in nature and that water is a polar molecule (which we even told them) and they are supposed to know water is a small molecule and passes through membranes by osmosis.

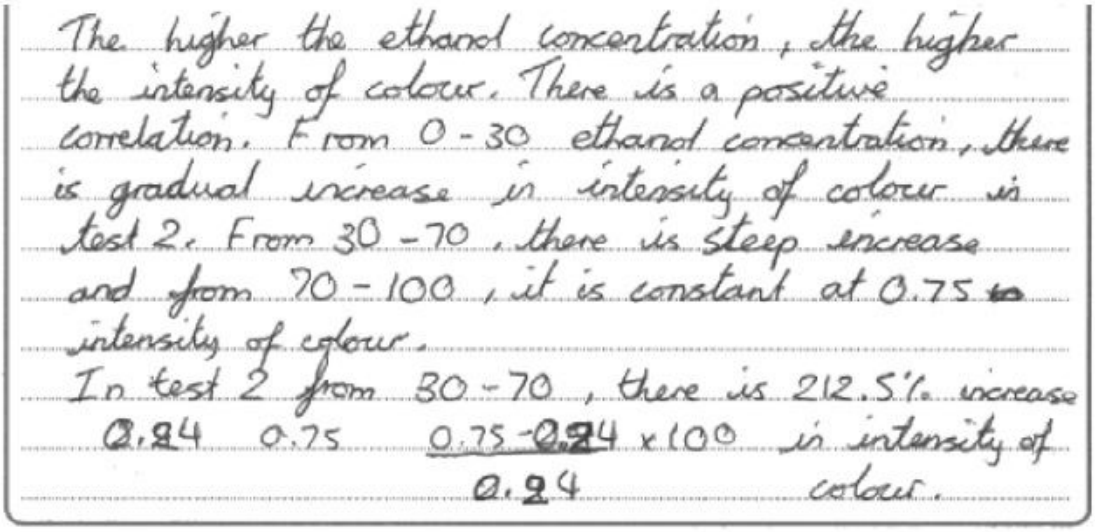
Q18.

Question (a)

Most candidates correctly stated the general trend shown in the graph. A significant number of candidates just stated data from the table, without manipulating it or making it expressly clear that this linked to a non-linear increase. A number of candidates made reference to speed / time in relation to the data. Many candidates did attempt manipulation of figures, rather than just quoting them. However, some misread the scale on the graph and used inaccurate values to give incorrect manipulated answers.

Many candidates failed to recognise that the intensities of colour for test 2 were consistently higher than in test 1, despite subsequent questions asking about this. Some candidates lost marks for confusing test 1 and test 2 when they were describing the non-linear trend or calculating the differences.

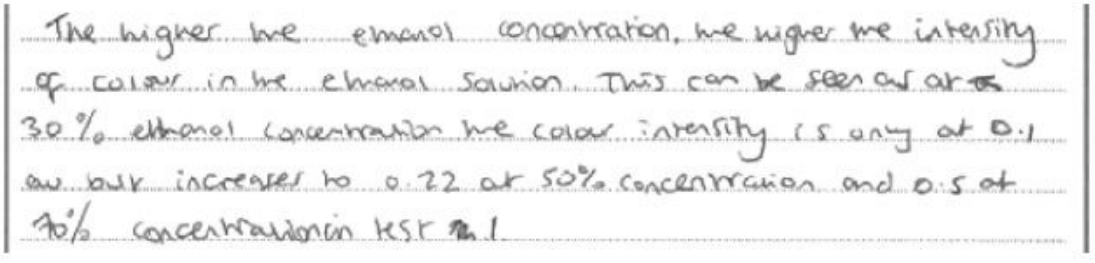
This response gained all three marks available.


The higher the ethanol concentration, the higher the intensity of colour. There is a positive correlation. From 0-30 ethanol concentration, there is gradual increase in intensity of colour in test 2. From 30-70, there is steep increase and from 70-100, it is constant at 0.75 intensity of colour.
In test 2 from 30-70, there is 212.5% increase
0.24 0.75 $\frac{0.75-0.24}{0.24} \times 100$ is intensity of colour.

Results Plus: Examiner Comments

One mark was awarded for the positive correlation; one for the description of the non-linear trend; and one mark for the manipulation of the figures. Although this is a good response that gained full marks, candidates should ignore that there are two sets of data on the graph and a description of the effect on ethanol should compare both sets of data provided.

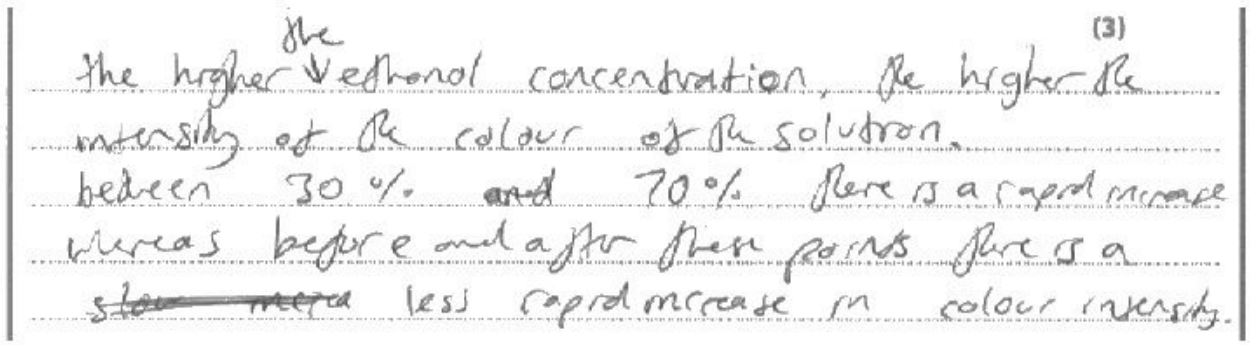
This response gained one of the three marks available.


The higher the ethanol concentration, the higher the intensity of colour in the ethanol solution. This can be seen as at 30% ethanol concentration the colour intensity is only at 0.1 and but increases to 0.22 at 50% concentration and 0.5 at 70% concentration in test 1

Results Plus: Examiner Comments

The overall trend has been correctly identified, but the candidate has just gone onto quote various points on the graph.
To gain credit for recognising that a trend is non-linear candidates need to clearly state what is happening at each stage, even if it is just a simple statement such as the greatest increase was between 30 and 70% ethanol.
With descriptions of data candidates will often be awarded marks for manipulating the figures (not just stating the data points) e.g. "there was a 0.1 increase (in the intensity of colour) between 0 and 30% ethanol concentration in test 1"

This response gained one of the three marks available.



Results Plus: Examiner Comments

This candidate recognised the general trend, but in trying to describe the non-linear nature of the trend they ignored what was being measured and referred to rapid and less rapid changes.

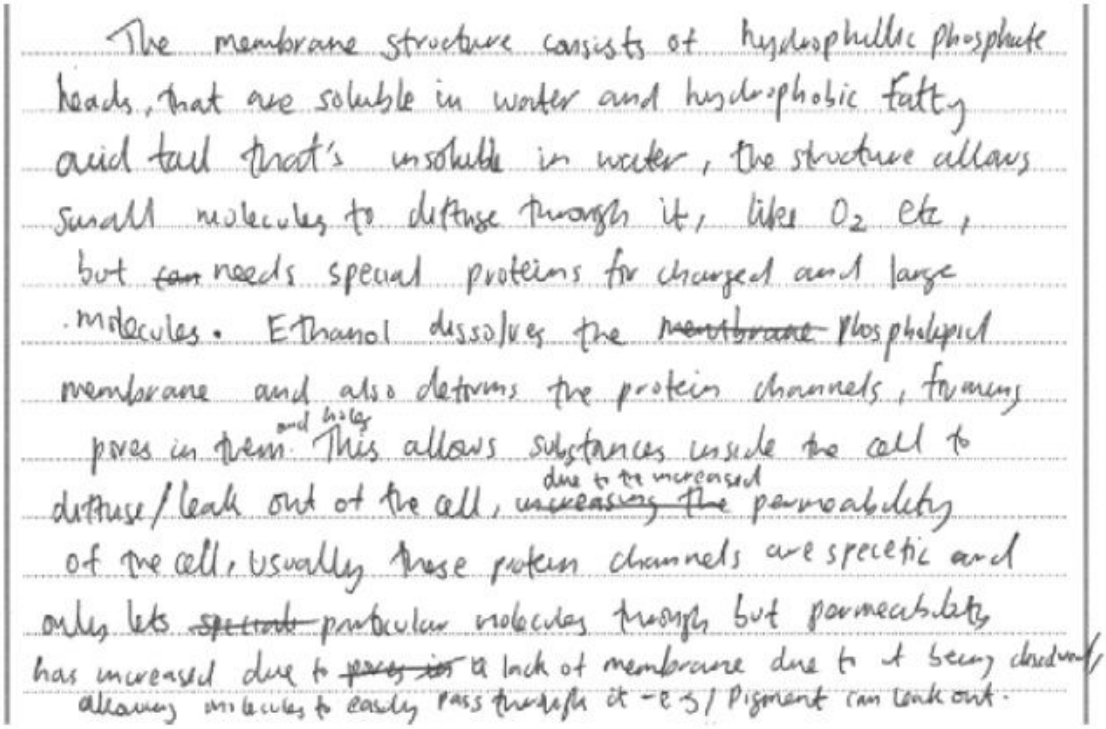
Results Plus: Examiner Tip

Always check the axis of a graph carefully for what is being measured. If there is no measurement of time then a description of an effect should not refer to time e.g. with use of words such as rapid, faster, slower, etc.

Question (b)

Many candidates were able to simply explain that the membrane had been disrupted but many were unable to explain this further as to how this disruption takes place. Very few linked this to potentially denaturing membrane proteins but some were able to comment on ethanol dissolving lipids. Some candidates lacked some detail especially to do with comments on where the pigment is escaping from or stating that it escaped from the cell membrane. Few made any comments about the vacuole. Some candidates just commented on the increased permeability and used data from the graph to describe the trend shown by the graph, instead of explaining the effect. A significant number of candidates used osmosis or diffusion of the ethanol explanations in an attempt to explain what was happening. Some thought that the disruption was due to the pH of the ethanol.

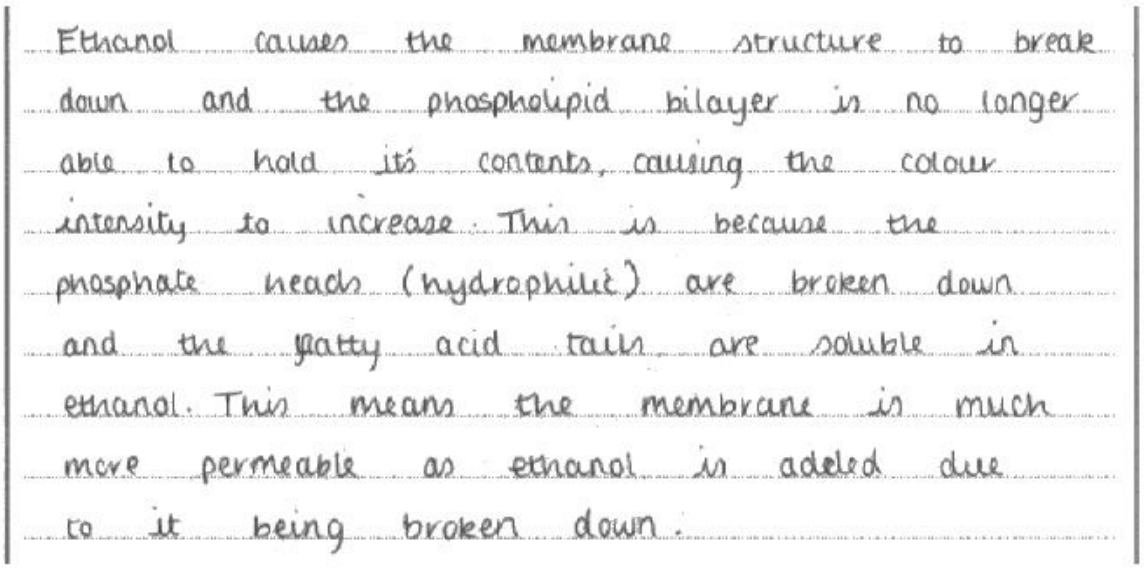
This response gained all four available marks.


The membrane structure consists of hydrophillic phosphate heads, that are soluble in water and hydrophobic fatty acid tail that's insoluble in water, the structure allows small molecules to diffuse through it, like O_2 etc, but ~~can~~ needs special proteins for charged and large molecules. Ethanol dissolves the ~~membrane~~ phospholipid membrane and also deforms the protein channels, forming pores in them and this allows substances inside the cell to diffuse/leak out of the cell, due to the increased ~~increasing the~~ permeability of the cell, usually these protein channels are specific and only lets ~~specific~~ particular molecules through but permeability has increased due to ~~pressure~~ a lack of membrane due to it being disrupted allowing molecules to easily pass through it - e.g. pigment can leak out.

Results Plus: Examiner Comments

Marks were awarded for:
disruption of the membrane (lack of membrane);
ethanol dissolves phospholipid;
ethanol deforms protein channels (an equivalent allowed for denaturing the protein);
pigment can leak out of the cell (pieced together across the response).

This response gained two of the four marks available.

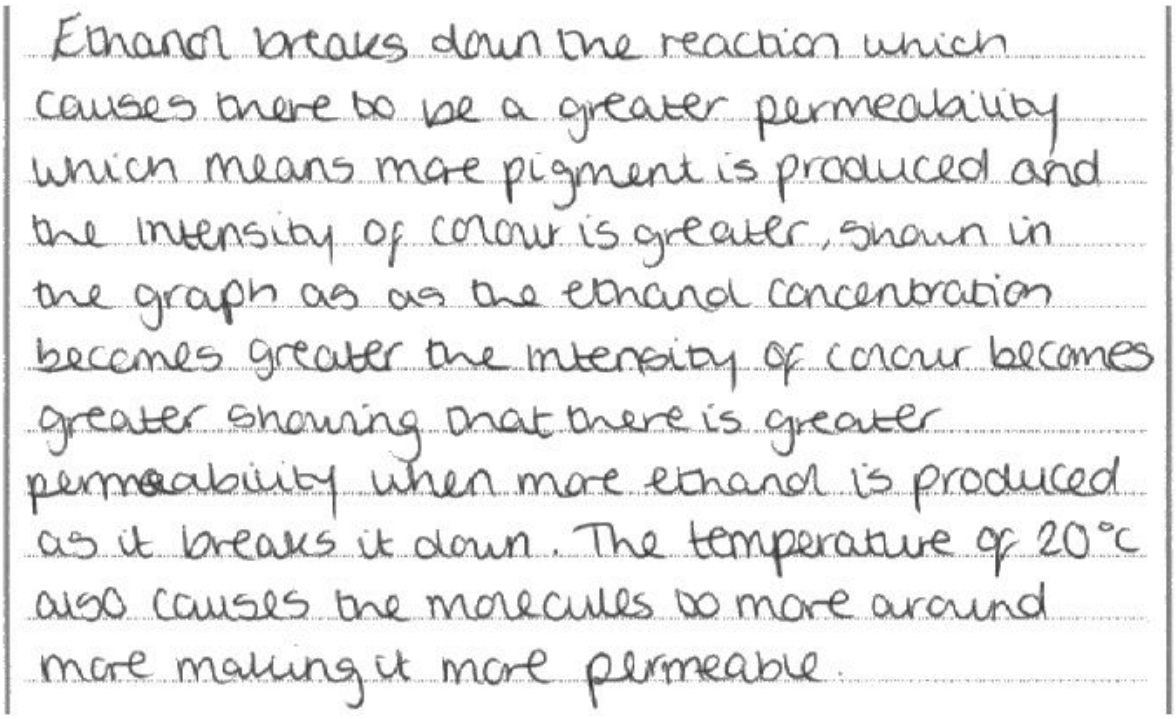

Ethanol causes the membrane structure to break down and the phospholipid bilayer is no longer able to hold its contents, causing the colour intensity to increase. This is because the phosphate heads (hydrophilic) are broken down and the fatty acid tails are soluble in ethanol. This means the membrane is much more permeable as ethanol is added due to it being broken down.

Results Plus: Examiner Comments

This response is typical of those that recognise that the membrane is disrupted by the ethanol and that this is because the lipid tails are soluble in ethanol. No attempt is made to explain what

is causing the colour intensity and the phosphate heads are not broken down.

This response gained no marks.


Ethanol breaks down the reaction which causes there to be a greater permeability which means more pigment is produced and the intensity of colour is greater, shown in the graph as as the ethanol concentration becomes greater the intensity of colour becomes greater showing that there is greater permeability when more ethanol is produced as it breaks it down. The temperature of 20°C also causes the molecules to move around more making it more permeable.

Results Plus: Examiner Comments

This is an example of the many responses that primarily gave the trend of greater permeability without explaining why it became more permeable. Some candidates also thought that the pigment is produced rather than released from the cell.

Results Plus: Examiner Tip

Make sure you know the difference between describe and explain type of questions.

Question (c)

Most candidates gained at least one mark but many only made one point or made a good point followed by a general statement such as the variables weren't kept controlled, or restated one of the control variables already stated in the question e.g. temperature or using a different beetroot. Both of these should have been ruled out as possible answers if the information in the stem of the question had been read carefully.

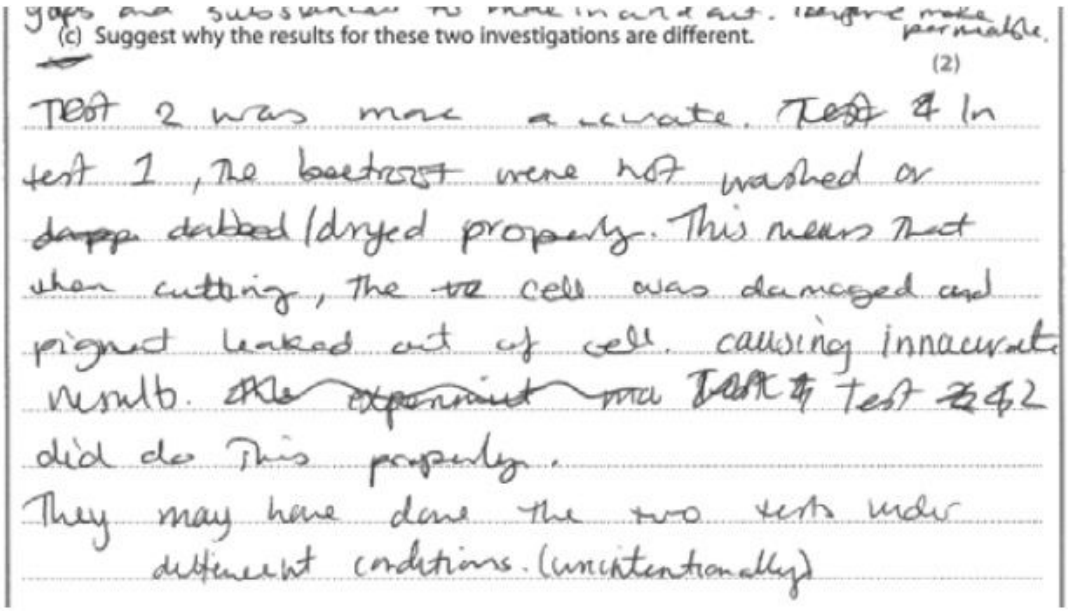
Most candidates who gained both marks referred described that there would be damage to the cells and there was a need to rinse the pieces which could have caused the discrepancy in results. Although some did not make it clear which set of test results would have been affected by the error (or got the test wrong e.g. test 1 was left in ethanol for a longer time).

Some candidates made a correct reference to differences in the use of the colorimeter, e.g.

calibration.

A few candidates just described the data suggesting that they had not read the question properly.

This response gains both marks available.

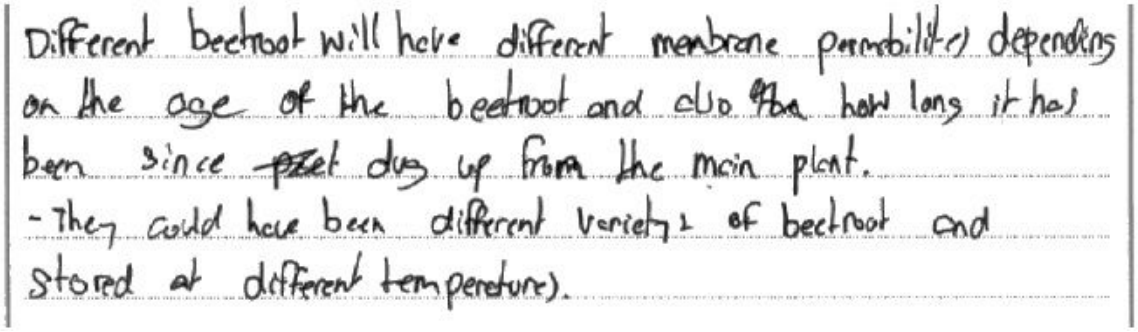

(c) Suggest why the results for these two investigations are different.
(2)

Test 2 was more accurate. Test 1 In test 1, the beetroot were not washed or dabbed/dryed properly. This means that when cutting, the ~~ve~~ cell was damaged and pigment leaked out of cell. causing innacurate result. ~~the experiment~~ ~~you~~ ~~Test~~ ~~1~~ test 2 & 2 did do this properly.
They may have done the two tests under different conditions. (unintentionally)

Results Plus: Examiner Comments

Marks were awarded for beetroot cells damaged when cutting and test 2 not being washed properly.
Although this gained full credit, be careful when suggesting that beetroot cylinders need to be dried before use as this can cause errors.

This response gained no marks.


Different beetroot will have different membrane permability depending on the age of the beetroot and also how long it has been since ~~pzel~~ dug up from the main plant.
- They could have been different variety's of beetroot and stored at different temperature).

Results Plus: Examiner Comments

Different beetroots could cause differences in results, but the question stem clearly states that the 10 identical pieces used for test 1 and test 2 were cut from the same beetroot, so this is not a credible reason for the differences in the context of this investigation - so no credit given.

Results Plus: Examiner Tip

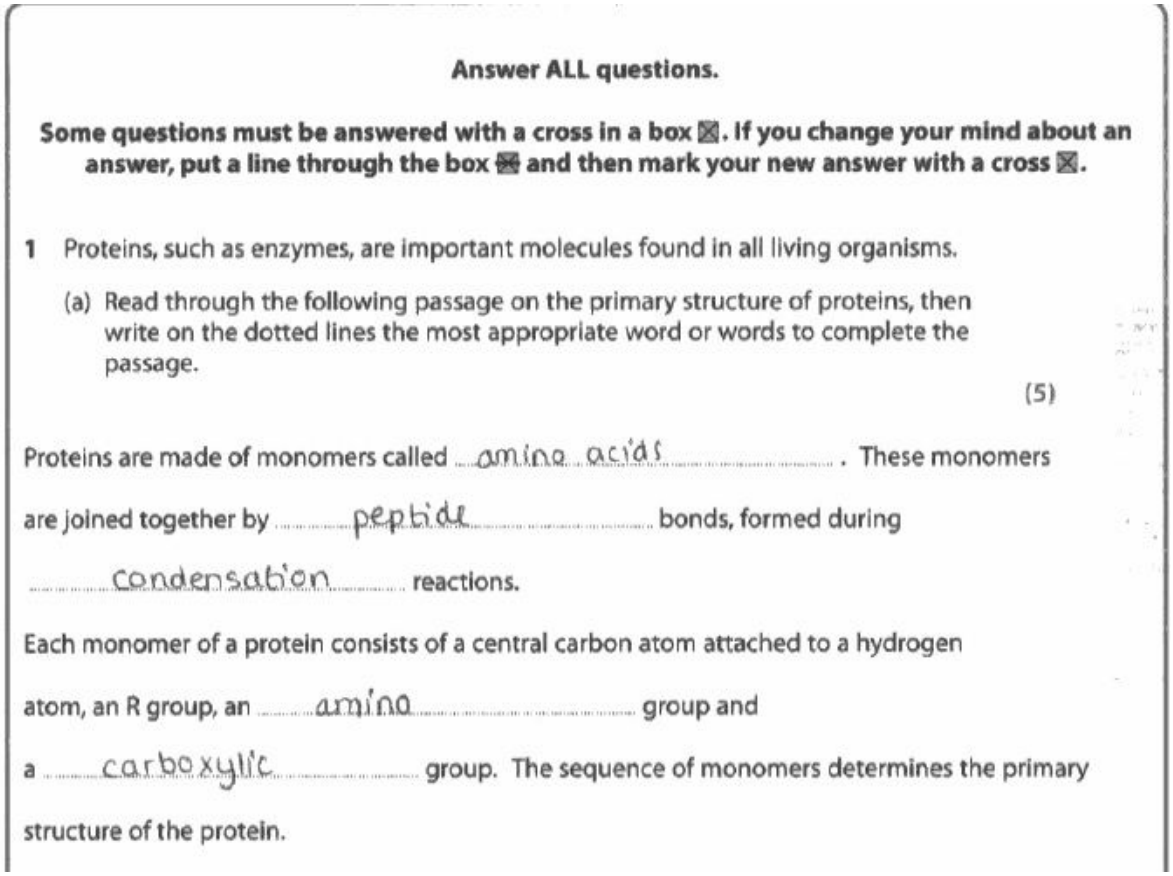
Read all of the information given in the question carefully to make sure you do not repeat information already given.

Q19.

These multiple choice questions caused few issues for most candidates with typically about 85% of candidates getting each item correct. The most frequent errors were for (iv) with answers of triglyceride or water as the product of hydrolysis.

Q20.

(a) This was a straightforward cloze question about protein structure to start the paper. Over half of the candidates scored all five marks available. The most common error was to name the bond in proteins as a glycosidic bond rather than a peptide bond.



Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Proteins, such as enzymes, are important molecules found in all living organisms.

(a) Read through the following passage on the primary structure of proteins, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

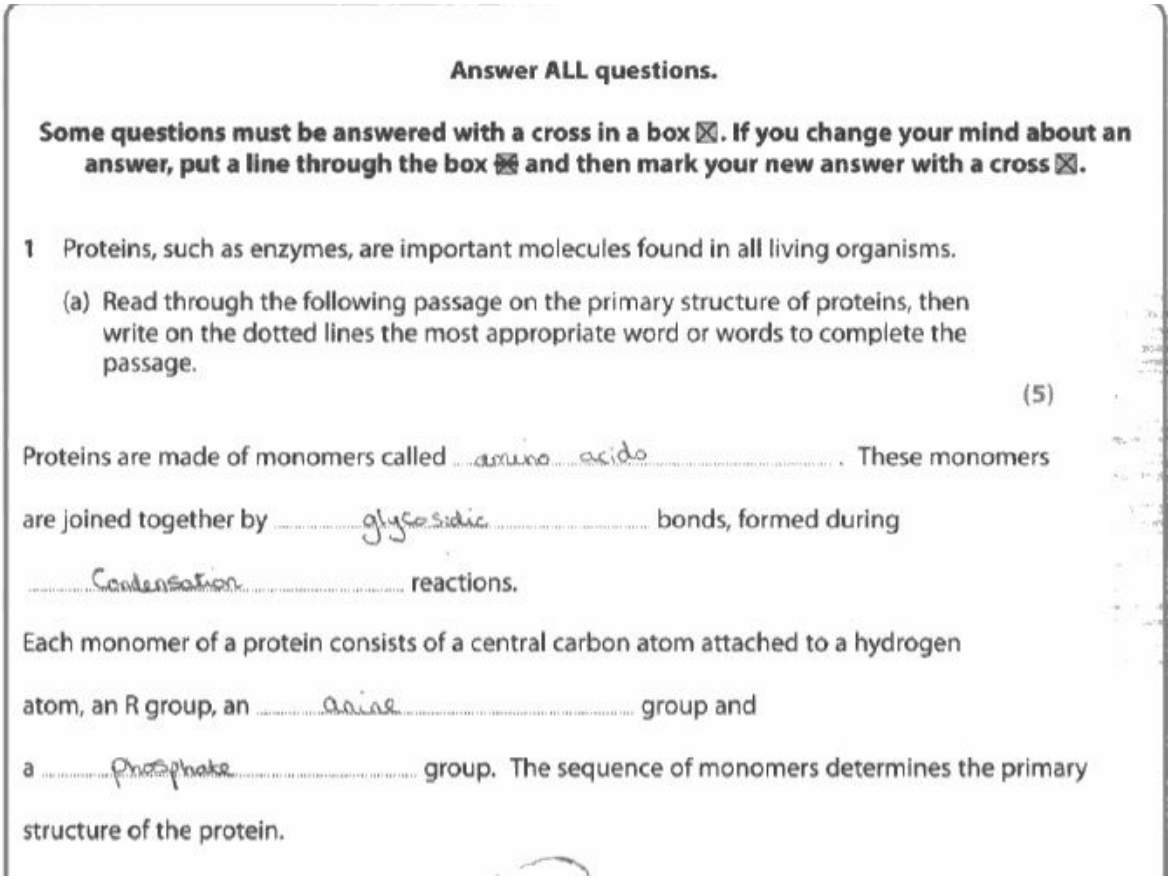
Proteins are made of monomers called amino acids. These monomers are joined together by peptide bonds, formed during condensation reactions.

Each monomer of a protein consists of a central carbon atom attached to a hydrogen atom, an R group, an amino group and a carboxylic group. The sequence of monomers determines the primary structure of the protein.

Results Plus: Examiner Comments

This is a typical answer that scores all five marks available.

This candidate's answer only scores two of the available five marks.



Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Proteins, such as enzymes, are important molecules found in all living organisms.

(a) Read through the following passage on the primary structure of proteins, then write on the dotted lines the most appropriate word or words to complete the passage.

(5)

Proteins are made of monomers called amino acids. These monomers are joined together by glycosidic bonds, formed during Condensation reactions.

Each monomer of a protein consists of a central carbon atom attached to a hydrogen atom, an R group, an Anine group and a Phosphate group. The sequence of monomers determines the primary structure of the protein.

Results Plus: Examiner Comments

Many candidates made the mistake of naming the bond as glycosidic instead of peptide, mixing up their carbohydrate and protein structures.

Similarly they have also thrown in some knowledge about nucleic acid structure with reference to phosphate groups.

Candidates should also take care with spelling. We will accept phonetic spelling of words (unless it is a question designed to assess quality of written communication) but words with clear errors that are non-phonetic will not be allowed. 'Anine' here is an example of something not acceptable, particularly as they have correctly identified the monomers as amino acids.

Results Plus: Examiner Tip

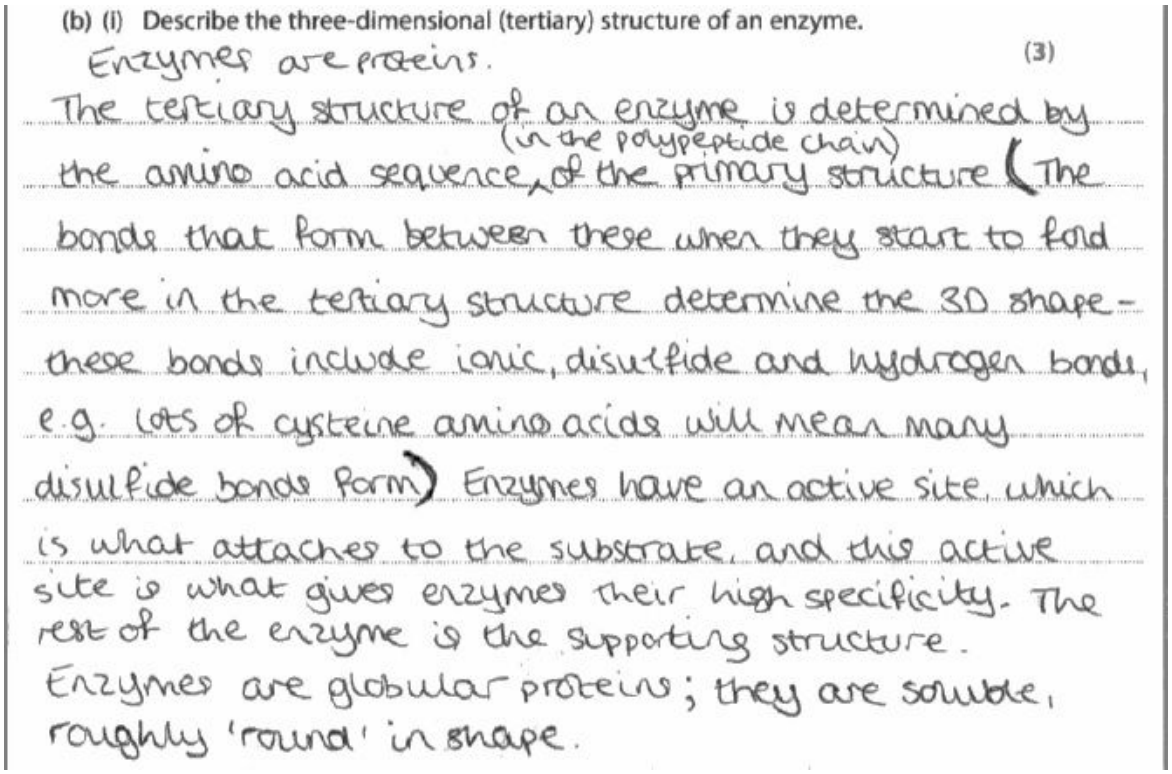
Candidates should be careful when recalling specific structural terminology. It is always good to check if the names of parts and groups make sense based on the name of the molecule involved.

(b) (i) This question asked specifically about the tertiary structure of enzymes. Many candidates answered the question well, but a significant number wrote about primary and secondary

structures and proteins in general, for example by describing how they could be fibrous or globular.

The most common marks picked up were for naming some of the bonds involved in the tertiary structure, but many candidates did not refer to these bonds being between R groups. Many candidates did not mention the significance of the shape of the active site, or even mention an active site.

This is a typical example of a response that scored all three marks available.



(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

(3)

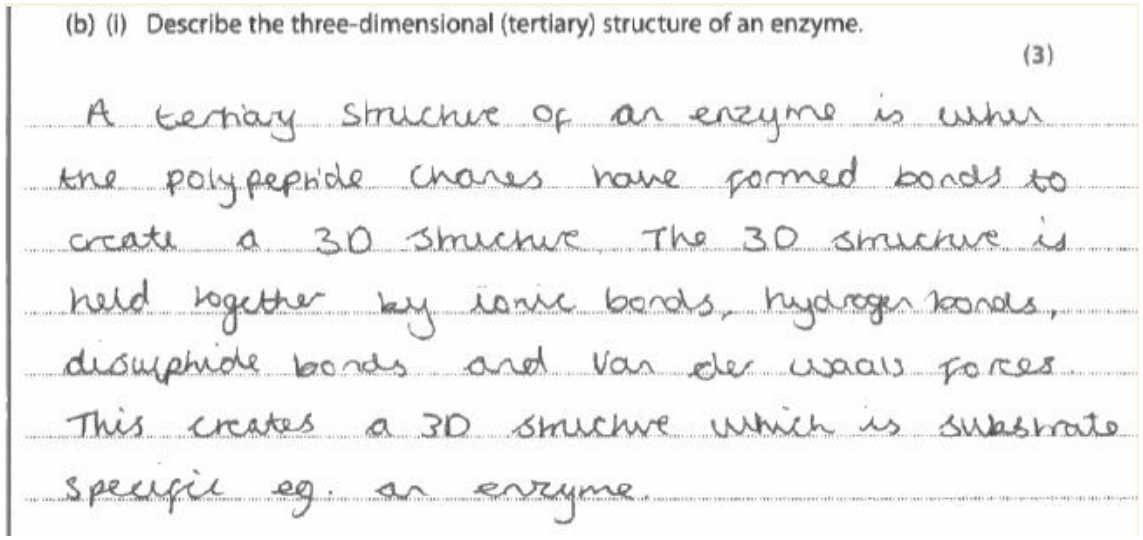
Enzymes are proteins.

The tertiary structure of an enzyme is determined by the amino acid sequence (in the polypeptide chain) of the primary structure (The bonds that form between these when they start to fold more in the tertiary structure determine the 3D shape - these bonds include ionic, disulfide and hydrogen bonds, e.g. lots of cysteine amino acids will mean many disulfide bonds form) Enzymes have an active site which is what attaches to the substrate, and this active site is what gives enzymes their high specificity. The rest of the enzyme is the supporting structure. Enzymes are globular proteins; they are soluble, roughly 'round' in shape.

Results Plus: Examiner Comments

This response scores marks for recognising specific bonds in the tertiary structure, the presence of an active site and that they are globular proteins.

This is a typical response that only scored one of the three marks available.



(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

(3)

A tertiary structure of an enzyme is when the polypeptide chains have formed bonds to create a 3D structure. The 3D structure is held together by ionic bonds, hydrogen bonds, disulphide bonds and Van der waals forces. This creates a 3D structure which is substrate specific eg. an enzyme.

Results Plus: Examiner Comments

One mark awarded for naming bonds.

This response scored two of the three marks available.

(b) (i) Describe the three-dimensional (tertiary) structure of an enzyme.

(3)

The tertiary structure of an enzyme can be globular or fibrous. Globular proteins are round and compact. They are ~~the~~ soluble as hydrophilic molecules remain on the outside while hydrophobic molecules clump together on the inside. Fibrous proteins are straight, helical chains so they are strong. ~~Pepti~~ The tertiary structure of proteins has disulfide bonds (between 2 sulfurs), ionic bonds (between charged parts), hydrophilic and hydrophobic interactions and H-bonds (between e groups). The tertiary structure ~~depends on the primary structure~~ makes the enzyme very specific due to its bonds and the way it interacts.

Results Plus: Examiner Comments

This candidate correctly names some bonds in the tertiary structure and recognises that they are bonds between R groups. However, they do not mention an active site and they do not get the mark for recognising that enzymes are globular proteins because they say that they could be globular or fibrous.

Results Plus: Examiner Tip

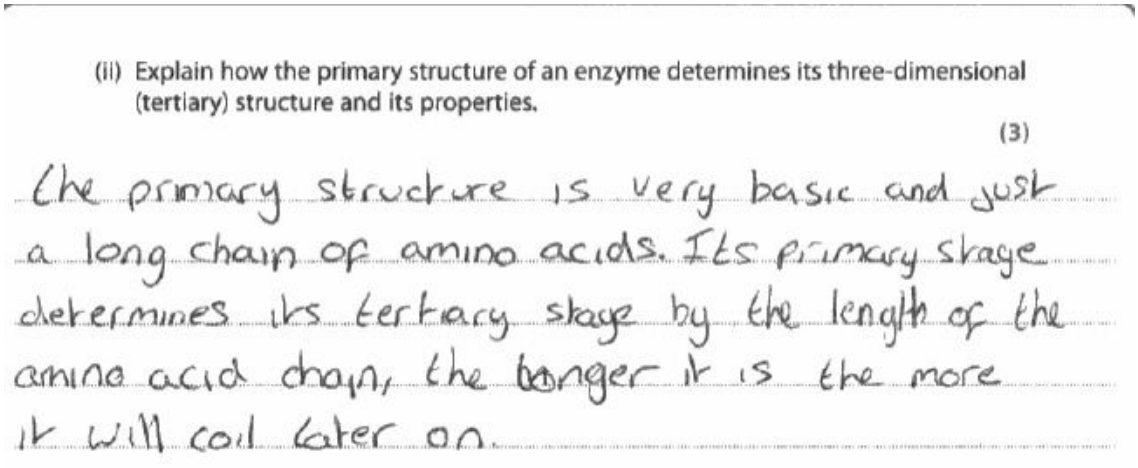
Read the context of the question carefully to make sure you include relevant details. In this example write about enzymes and not just proteins in general.

(ii) This question asked candidates to explain how the primary structure of an enzyme determines its tertiary structure and properties.

Some candidates gave very good responses explaining how the sequence of amino acids (the primary structure) determined the position and type of bonds in the tertiary (and secondary) structure which determined the shape of the active site and the way it could interact with specific substrates to catalyse the reaction. Many also explained the significance of hydrophilic and hydrophobic groups in determining the shape of the enzyme and the way it could interact in an aqueous environment.

Unfortunately, some candidates repeated their descriptions from (i) and ignored the enzymes context, and the request to explain its properties.

This is a typical example of a response that did not score any marks.



(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

The primary structure is very basic and just a long chain of amino acids. Its primary stage determines its tertiary stage by the length of the amino acid chain, the longer it is the more it will coil later on.

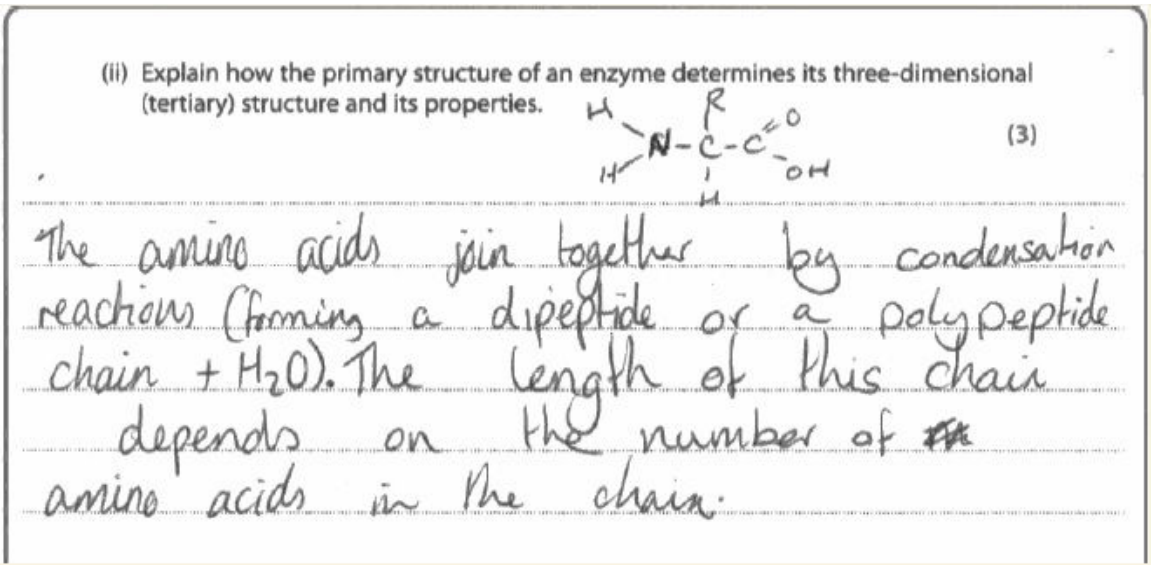
Results Plus: Examiner Comments

This candidate does not relate their answer to enzymes and does not successfully explain how the primary structure determines the tertiary structure.

Results Plus: Examiner Tip

Make sure your answers relate to the context of the question - in this case the structure and properties of an enzyme.

This is an example of a response that scored no marks.



(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

The amino acids join together by condensation reactions (forming a dipeptide or a polypeptide chain + H_2O). The length of this chain depends on the number of ~~the~~ amino acids in the chain.

Results Plus: Examiner Comments

Several candidates interpreted this question as asking how the polypeptide chain is formed.

Results Plus: Examiner Tip

Make sure you read the question carefully and answer the question asked, rather than answering the question you hoped that we asked.

This is also an example of a response that scored all three marks.

(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

the primary structure is the basic sequence of amino acids in a polypeptide chain. The structure of the R-Group determines how the chain is folded. The hydrophobic R-Groups point inwards and are protected by the hydrophillic side-chains. This makes the enzyme soluble ~~with~~ which is useful as it speeds up enzymes metabollic reactions. They chain of amino acids also decide the depression on the enzyme called an active sight which is specific for a certain substrate.

(Total for Question 1 = 11 marks)

Results Plus: Examiner Comments

This response explains what the primary structure of the enzyme is and how it determines the shape. They also explain how the hydrophobic and hydrophilic groups determine folding and solubility of the enzyme.

Please note 'active sight' was deemed acceptable in this case as it is phonetically correct and clearly in the correct context.

This is a good example of a response scoring all three marks available.

(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

The primary structure of an enzyme is a polypeptide chain, and the order of the amino acids making this up determines its structure as they determine how it folds up to form the 3D structure. Bonds form between the R groups of the amino acid & if they were in a different order they would form in different places. As the polypeptide chain determines the shape of the protein, it also determines which amino acids will be involved in the active sites - so it determines which R-groups the substrate molecules will form bonds with - allowing them to be held in position. It also determines which amino acids will be on the inside and outside - affecting the solubility of the enzyme.

(Total for Question 1 = 11 marks)

Results Plus: Examiner Comments

This candidate recognises what the primary structure explains how it determines the bonding and shape of the enzyme, including the active site, and how it interacts with the substrate.

Results Plus: Examiner Tip

This is a very good response, covering more than is needed for the three marks available. If it was to be improved it would have been useful to explain how amino acids would be positioned inside or outside the enzyme and how they would affect the solubility.

This is typical of the type of response that frequently only scored one mark.

(ii) Explain how the primary structure of an enzyme determines its three-dimensional (tertiary) structure and its properties.

(3)

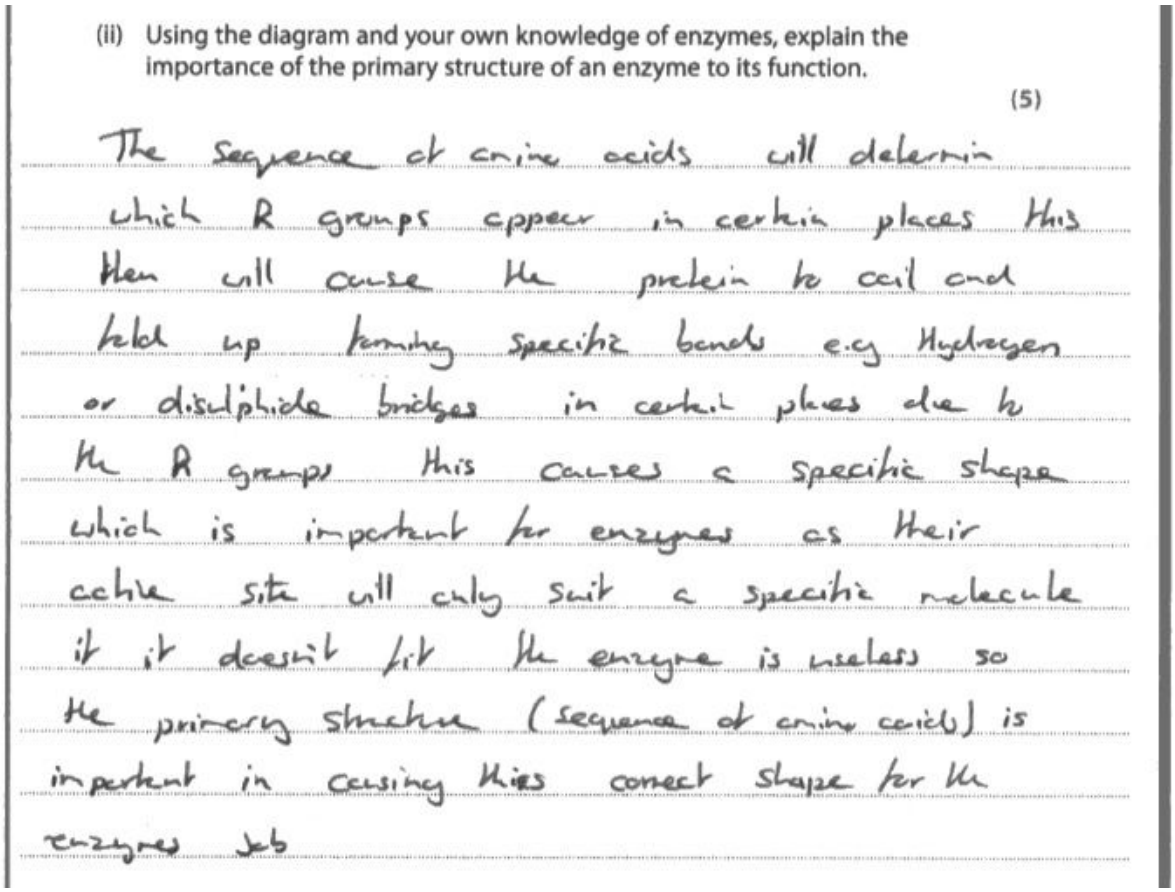
Primary structure is a specific sequence of amino acids. If the sequence is changed then the tertiary structure is changed. It is a long chain of peptide bonds

Results Plus: Examiner Comments

Many candidates only described what the primary structure is and failed to go on to explain how it determined the tertiary structure and properties of an enzyme.

Q21.

(a) (ii) This particular question addressed one of the few remaining specification points that we have not directly addressed yet. The mark scheme indicates exactly what we are expecting candidates to appreciate about the primary structure and its influence on the structure and therefore the functioning of a protein.



(ii) Using the diagram and your own knowledge of enzymes, explain the importance of the primary structure of an enzyme to its function.

(5)

The sequence of amino acids will determin which R groups appear in certain places this then will cause the protein to coil and fold up forming specific bonds e.g Hydrogen or disulphide bridges in certain places due to the R groups this causes a specific shape which is important for enzymes as their active site will only suit a specific molecule if it doesn't fit the enzyme is useless so the primary structure (sequence of amino acids) is important in causing this correct shape for the enzymes job

Results Plus: Examiner Comments

This illustrates a particularly good answer. This candidate was awarded mark points 1.2.3.5 and 6, in that order.

Results Plus: Examiner Tip

When referring to the structure and functioning of an enzyme, always write about the *shape* of the active site.

(b) (i) Question (b) parts (i) and (ii) seemed to throw candidates completely, even though we have often asked questions about transcription and translation. Candidates were not being asked to recall anything extra, but to apply their answer such that the context answered the question.

(b) Describe the roles of messenger RNA (mRNA) and transfer RNA (tRNA) in protein synthesis.

(i) Messenger RNA

(3)

mRNA attaches to the antisense strand of DNA, and with base pairing, creates a template of a DNA strand. However, Thymine is replaced with Uracil. This all happens in the nucleus. The mRNA then leaves the nucleus through pores to the cytoplasm and attaches to the ribosome.

Results Plus: Examiner Comments

This candidate described the process of transcription and did not emphasise the role of mRNA.

Results Plus: Examiner Tip

Try to apply your knowledge to the question; do not simply write everything you know about a topic.

(b) (ii)

(ii) Transfer RNA

(3)

The tRNA is made in the ribosomes. It is involved in translation. It is attached to a specific amino acid. It has three anti-codons on them which code for the amino acid at the other end. The anti-codons pair up with the codons during translation to form a sequence of amino acids joined together by peptide bonds.

Results Plus: Examiner Comments

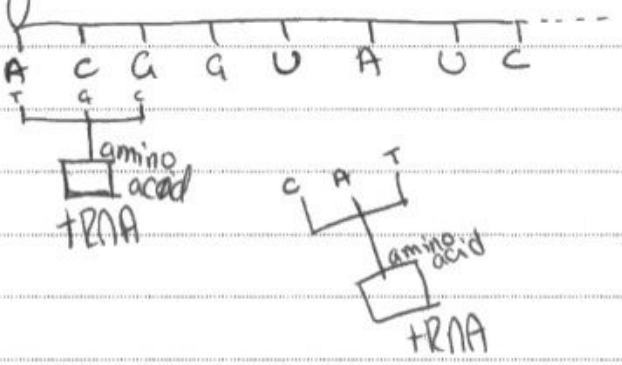
A good, clear answer.

(ii) Transfer RNA

(3)

Translation

* tRNA, using mRNA, completes the [redacted] chain, using amino acids.



Results Plus: Examiner Comments

This illustrates our bottom line for accepting marks from a diagram. We did award mark point 2, although it would have been clearer if the candidate has bracketed the top part as the tRNA .

Results Plus: Examiner Tip

Be very cautious about trying to answer questions using diagrams, unless being specifically asked to. If you do, then make your labels very clear and accurate.

(ii) Transfer RNA

(3)

tRNA is what is used to make up polypeptides, and in turn proteins. ~~the tRNA joins onto amino acids~~ amino acids join onto the tRNA, for specific sequencing to make specific poly peptides

Results Plus: Examiner Comments

Unfortunately, although the candidate has the jist of translation, the expression is not clear enough to award any marks. The answer clearly states that more than one amino acid is

attached to a tRNA molecule which is simply untrue. Mark point 2 cannot be awarded for wrong Biology.

Results Plus: Examiner Tip

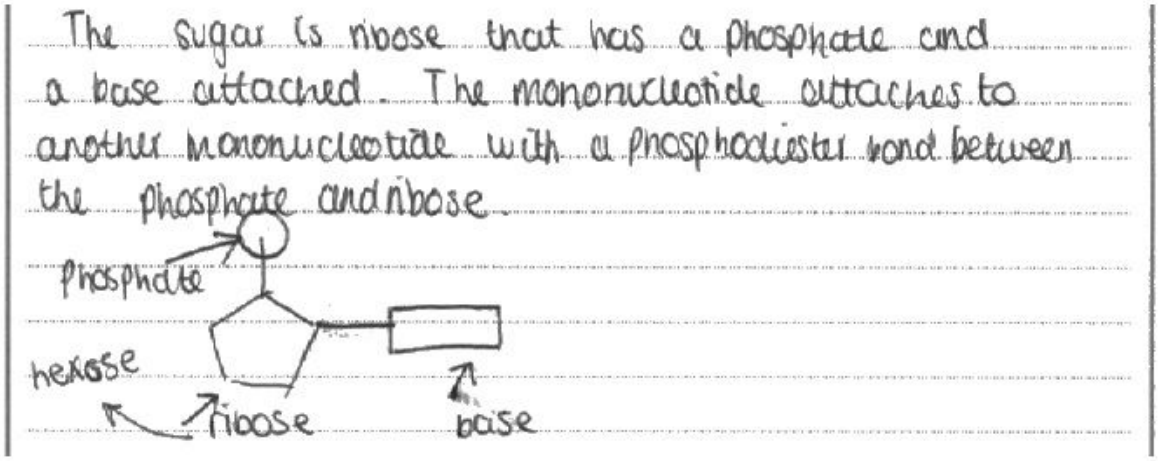
Read through every single word of your answer to check that you have actually said what you mean.

Q22.

Question (b)

Most candidates did well on this question. Where errors were made they confused the structure of a DNA nucleotide with an RNA nucleotide e.g. by naming deoxyribose and/or including thymine as a possible base. A few candidates implied that one nucleotide had several bases attached to it, others described a base pair rather than the structure of a single base.

This response gains both marks available.



Results Plus: Examiner Comments

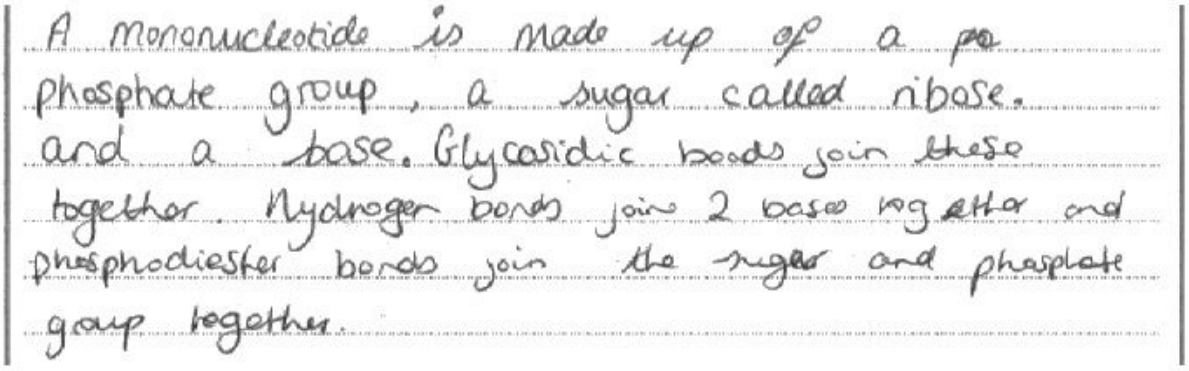
Although the diagram was not needed as both marks have been gained by the written response, the annotated diagram would also have gained the marks.

Results Plus: Examiner Tip

If you include a diagram in your response make sure you annotate it clearly or it will not gain any credit.

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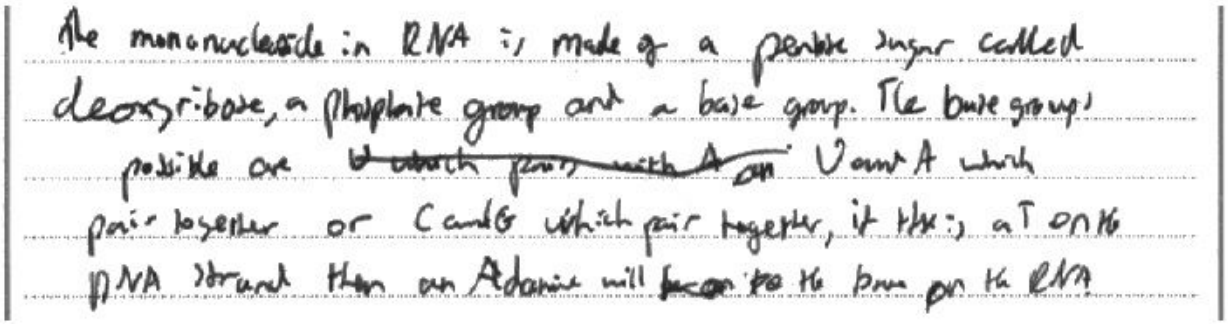
This response gains both marks available, but also shows some errors with the bonding.


A mononucleotide is made up of a pe phosphate group, a sugar called ribose. and a base. Glycosidic bonds join these together. Hydrogen bonds join 2 bases together and phosphodiester bonds join the sugar and phosphate group together.

Results Plus: Examiner Comments

One mark gained for the phosphate and ribose and the other mark for the base. Glycosidic bonds are not involved, but this has not been penalised here.

This response gained one mark.


The mononucleotide in RNA is made of a pentose sugar called deoxyribose, a Phosphate group and a base group. The base groups possible are ~~U which pairs with A or~~ U and A which pair together or C and G which pair together, it the is a T on the DNA strand then an Adenine will ~~become~~ be the base pair to the RNA

Results Plus: Examiner Comments

This response gained the mark for the base, but is an example of a common error where the structure of an RNA nucleotide and a DNA nucleotide has been muddled and they have included deoxyribose instead of ribose.

Question (c)

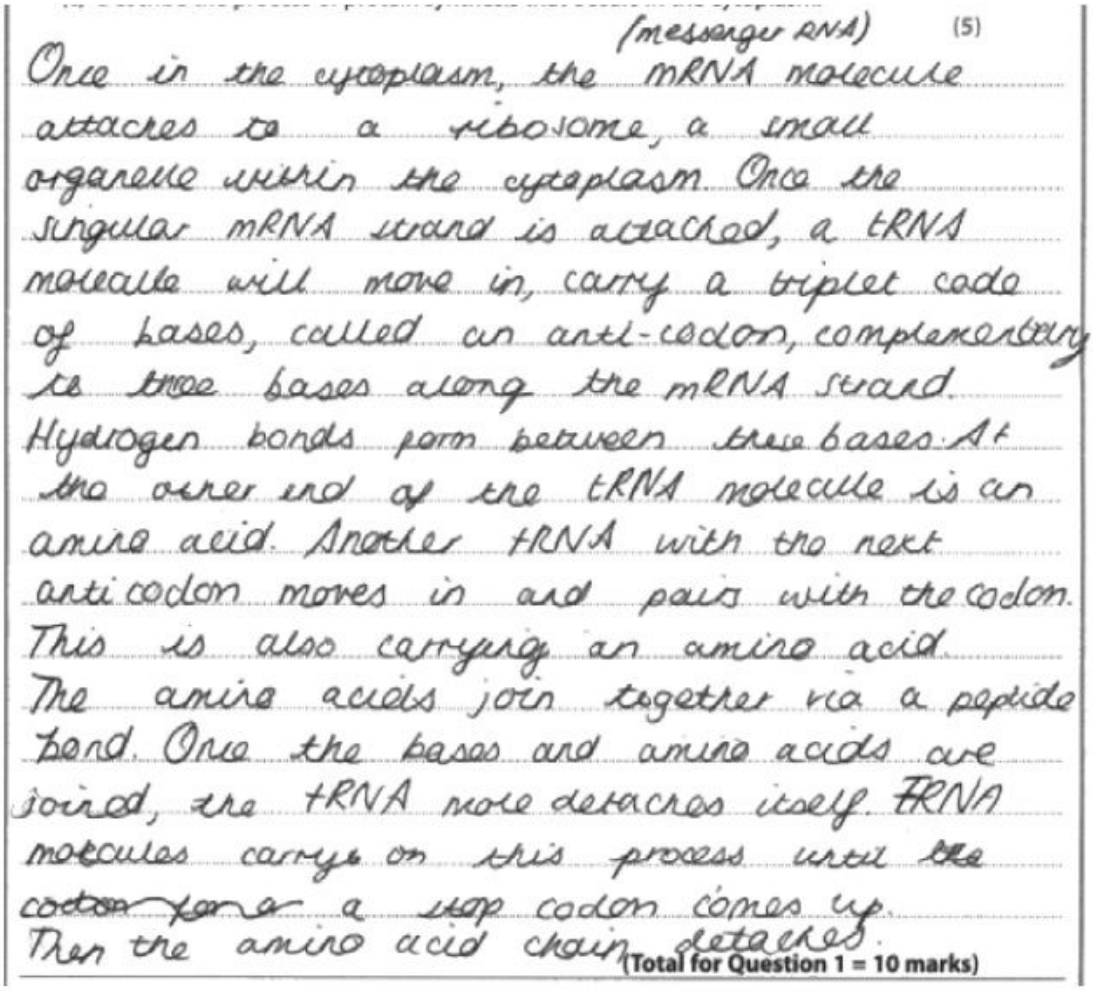
This question achieved the full range of marks from 0 to 5, with equal proportions of candidates on each mark. Many candidates demonstrated a detailed and sound understanding of the process of translation writing a logical account with plenty of specific details e.g. the complementary base pairing between the codon and anticodon. Several candidates even managed to match all points on the mark scheme in the same sequence. The majority of candidates gained credit for recognising the role of ribosomes and that peptide bonds form between the amino acids, but several lost marks for careless wording e.g. a tRNA carries amino acid**s** (rather than just one).

Unfortunately, many candidates ignored the context stated in the question '*in the cytoplasm*' and therefore wrote in detail about transcription and only wrote a few comments about translation at the end such as the mRNA goes to the ribosome. Some other candidates included a significant amount of unnecessary detail about the structure and folding of proteins rather

than how they were synthesised.

Some candidates appear confused about the relationship between tRNA, mRNA and amino acids and have tRNA being formed by replication of the mRNA and several candidates describe amino acids being formed/produced by the tRNA. A few candidates even described reverse transcription and had the mRNA making new DNA molecules in the ribosomes without mentioning proteins at all. There was some confusion with a few candidates over the types of bonds between bases, and those between amino acids. Some candidates stated that amino acids were bases.

This response gained all five marks available.



(messenger RNA) (5)

Once in the cytoplasm, the mRNA molecule attaches to a ribosome, a small organelle within the cytoplasm. Once the singular mRNA strand is attached, a tRNA molecule will move in, carry a triplet code of bases, called an anti-codon, complementary to three bases along the mRNA strand. Hydrogen bonds form between these bases. At the other end of the tRNA molecule is an amino acid. Another tRNA with the next anticodon moves in and pairs with the codon. This is also carrying an amino acid. The amino acids join together via a peptide bond. Once the bases and amino acids are joined, the tRNA now detaches itself. tRNA molecules carry on this process until the ~~codon for~~ a stop codon comes up. Then the amino acid chain detaches.

(Total for Question 1 = 10 marks)

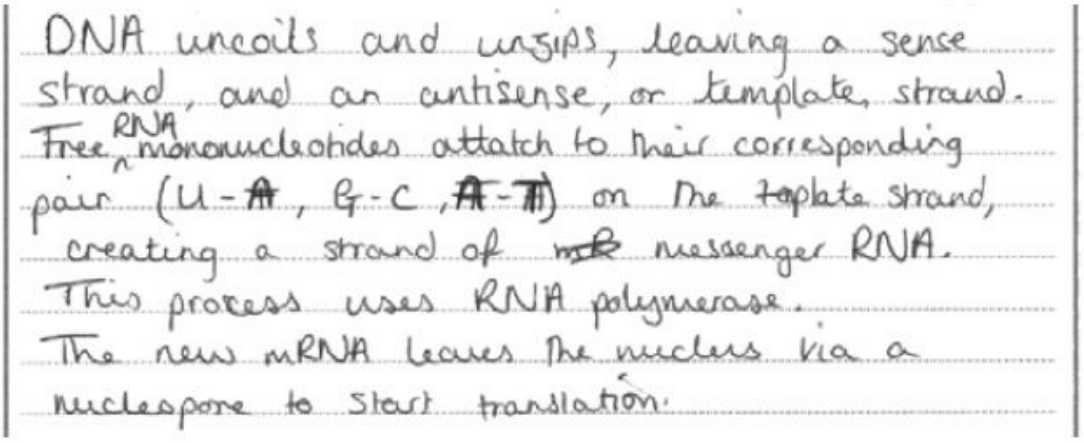
Results Plus: Examiner Comments

Marks were awarded for:
mRNA attaching to the ribosome;
anticodon and codon pairing between the tRNA and mRNA;
correct reference to the hydrogen bonding;
tRNA carrying an amino acid;
correct reference to the peptide bond;
tRNA being released;
correct reference to a stop codon.

Results Plus: Examiner Tip

For an extended description like this it helps clarity (and credit) if your response is written in a clear logical sequence like this response.

This response gained no marks.


DNA uncoils and unzips, leaving a sense strand, and an antisense, or template, strand. Free RNA mononucleotides attatch to their corresponding pair (U-~~A~~, G-C, ~~A~~-~~T~~) on the ~~t~~oplate strand, creating a strand of ~~m~~messenger RNA. This process uses RNA polymerase. The new mRNA leaves the nucleus via a nucleopore to start translation.

Results Plus: Examiner Comments

This is a typical response of the candidates who did not read the question and just described transcription and gave up just as they reached the description of translation.

Results Plus: Examiner Tip

Always read the question carefully to avoid silly mistakes. If the question asks you to describe what happens in the cytoplasm, don't just describe what happens in the nucleus.

This response gained two of the five available marks.

The DNA double helix unwinds, breaking the hydrogen bonds in the process. This is caused by DNA helicase.

One of the strands is used, called the antisence or ~~coding~~ template strand.

Free nucleotides line up, alongside, following complementary base pairings, forming MRNA.

mRNA then moves into the cytoplasm via ~~nuclear~~ nuclear pores.

The mRNA binds with a ribosome, either on a rough E.R or seperated in the cytoplasm. Then ~~RNA~~ translation occurs forming a protein.

tRNA anti-codon matches up with triplet (easy) code on the mRNA, following complementary base pairing rules.

Then amino acids are formed.

Results Plus: Examiner Comments

This response gained marks for the reference to the ribosome and the pairing of the mRNA and tRNA. This candidate is typical of many who think that amino acids are formed rather than arranged by the process of translation.

Q23.

Results Plus: Examiner Tip

Candidates need to be as specific as they can; answers should always double checked to ensure that appropriate detail has been included.

2 Read through the following passage on protein synthesis, then write on the dotted lines the most appropriate word or words to complete the passage.

(6)

Protein synthesis involves two stages. The first stage is Transcription and takes place in the nucleus of the cell. During this stage, a molecule called RNA is made using the antisense DNA strand as a template.

The second stage, known as Translation, takes place in the cytoplasm of the cell on structures called Ribosomes. During this stage, MRNA molecules enable the amino acids attached to them to line up in the correct order. The amino acids are joined together by the formation of peptide bonds.

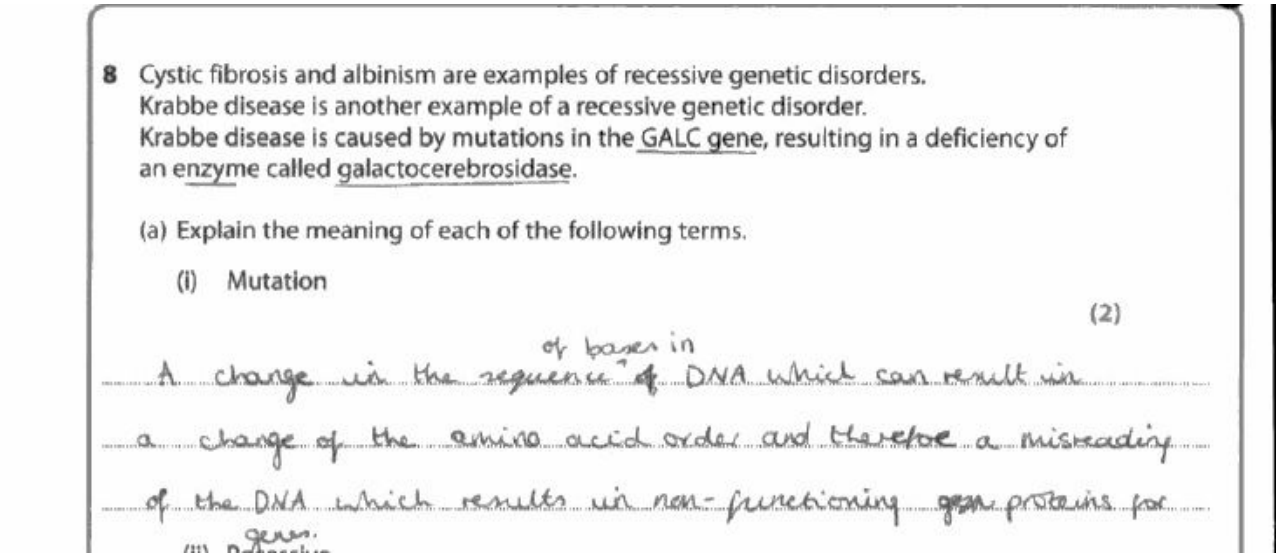
Results Plus: Examiner Comments

On the third line of this passage the reference to 'RNA' is too vague. Candidates are supposed to know about the roles of mRNA and tRNA and therefore this degree of specificity is expected in their answers.

Q24.

(a) (i) A common error here was not to refer to DNA in the answer related to a specific gene mutation. The better candidates did refer to this and clearly explained the change in base sequence or quantity of DNA. There were a few responses referring to insertion, deletion etc, but a significant number of candidates spoiled answers with references to changes in amino acid sequence in genes/DNA or alteration of cells.

This response scores both marks available.



8 Cystic fibrosis and albinism are examples of recessive genetic disorders.
Krabbe disease is another example of a recessive genetic disorder.
Krabbe disease is caused by mutations in the GALC gene, resulting in a deficiency of an enzyme called galactocerebrosidase.

(a) Explain the meaning of each of the following terms.

(i) Mutation

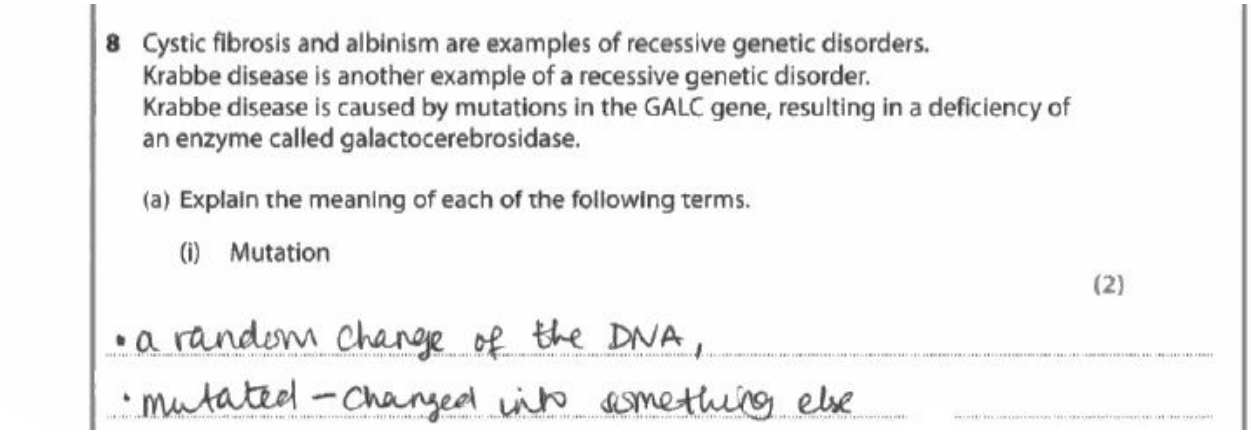
(2)

A change in the sequence of bases in DNA which can result in a change of the amino acid order and therefore a misreading of the DNA which results in non-functioning gene proteins for gene.

Results Plus: Examiner Comments

The candidate has described what is changed in the DNA for both marks.

This response gains one of the two marks available.



8 Cystic fibrosis and albinism are examples of recessive genetic disorders.
Krabbe disease is another example of a recessive genetic disorder.
Krabbe disease is caused by mutations in the GALC gene, resulting in a deficiency of an enzyme called galactocerebrosidase.

(a) Explain the meaning of each of the following terms.

(i) Mutation

(2)

- a random change of the DNA,
- mutated - changed into something else

Results Plus: Examiner Comments

The candidate has recognised what is altered, the DNA, but has not described what the nature of the change is.

Results Plus: Examiner Tip

Remember if a question is worth two marks more detail or two clear statements are often required.

This response gains one of the two marks available.

8 Cystic fibrosis and albinism are examples of recessive genetic disorders.
Krabbe disease is another example of a recessive genetic disorder.
Krabbe disease is caused by mutations in the GALC gene, resulting in a deficiency of an enzyme called galactocerebrosidase.

(a) Explain the meaning of each of the following terms.

(i) Mutation

(2)

A mutation is when there is a change in the sequence of base pairs. There are 5 types of mutation: substitution, duplication, inversion, deletion and insertion

Results Plus: Examiner Comments

This candidate has explained what the change is, but has not stated which molecule is altered.

(a) (ii) It was pleasing to see the large number of candidates who were able to express themselves very clearly here, demonstrating a good understanding of the term recessive. However, there were a few candidates that simply referred to 'not dominant' or 'never expressed' or 'not expressed' or 'carry disease'. There were also several irrelevant references to inheritance in answers.

(ii) Recessive

(1)

A gene or allele that is not expressed in the phenotype unless two recessive alleles are present.

Results Plus: Examiner Comments

This is an example of the common correct response.

(ii) Recessive

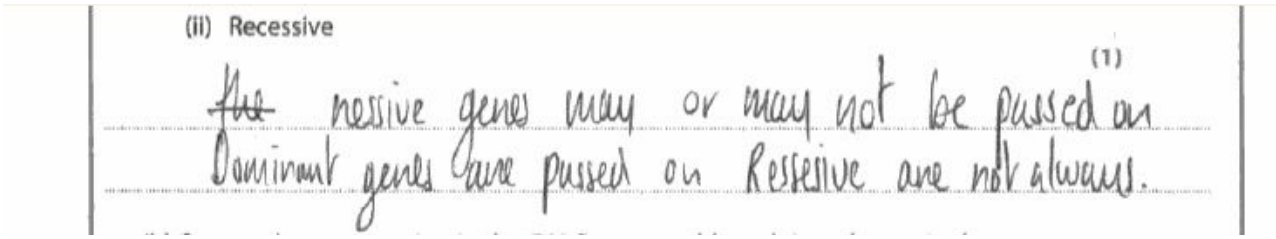
(1)

Not shown in phenotype if a dominant allele is present.

Results Plus: Examiner Comments

This response illustrates another common way of acceptably expressing what recessive means.

This response scores no marks.

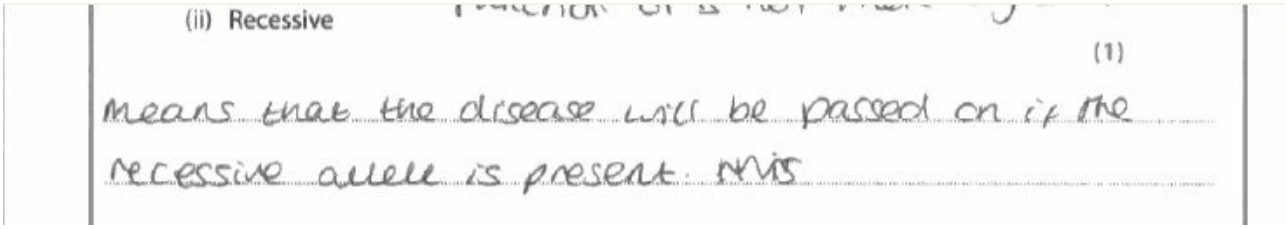

(ii) Recessive

~~the~~ nessive genes may or may not be passed on (1)
Dominant genes are passed on Ressesive are not always.

Results Plus: Examiner Comments

Many candidates who failed to score the mark concentrated on inheritance rather than expression of the characteristic.

This response scores no marks.


(ii) Recessive

(1)

means that the disease will be passed on if the recessive allele is present. MMS

Results Plus: Examiner Comments

Many candidates associate recessive genes with disease and disorders.

Results Plus: Examiner Tip

A genetic disorder could be caused by a recessive or dominant allele. It is also important to remember that genes are not only associated with diseases and disorders - they do a lot more as well.

(b) This was generally well answered with many candidates correctly describing the effects of a mutation on primary structure, the shape of protein/enzyme (3D/tertiary structure) and on the active site, thus gaining all 3 marks. There were only a few candidates who identified the potential effect of incorrect stop codons and only a few on no synthesis or incomplete synthesis of the enzyme. A number of candidates vaguely referred to the enzyme not functioning.

This response scores all three marks available.

(b) Suggest how a mutation in the GALC gene could result in a change in the enzyme galactocerebrosidase.

(3)

A mutation in GALC gene leads to a change in the primary structure of the enzyme. This leads to different amino acids being joined and so are bonded differently. This can change the shape of the enzyme and so the enzyme may no longer be specific to carry out its function. The active site of the enzyme will be different and so will not be able to catalyse any ~~substrate~~ Substrate

Results Plus: Examiner Comments

This candidate has correctly identified that the mutation will affect the primary structure of the protein that will change the 3D shape and therefore the active site of the enzyme will be changed.

This response scores one of the three marks available.

(b) Suggest how a mutation in the GALC gene could result in a change in the enzyme galactocerebrosidase.

(3)

The mutation in the gene could lead to an enzyme diffraency if the mutation changes ~~the ^ blocks~~ the active sites of the enzyme. the enzyme would then not be able to bind with a substrate

Results Plus: Examiner Comments

This candidate has correctly identified what will happen to the enzyme for a mark, but has not answered the question which asks them how the mutation results in the change.

Results Plus: Examiner Tip

Read the question carefully and answer the question asked!

This response scores no marks.

(b) Suggest how a mutation in the GALC gene could result in a change in the enzyme galactocerebrosidase.

(3)

If there is a mutation in the GALC gene the enzyme therefore may not function properly so it will need to be replaced by a healthy gene in order for it to work again. The enzyme galactocerebrosidase could be ~~made~~ found in another section of chromosome and may have a different function the person with the GALC gene will have a disorder in the making of the enzyme.

Results Plus: Examiner Comments

This is an example of a candidate who has failed to focus on what has been asked by the question.

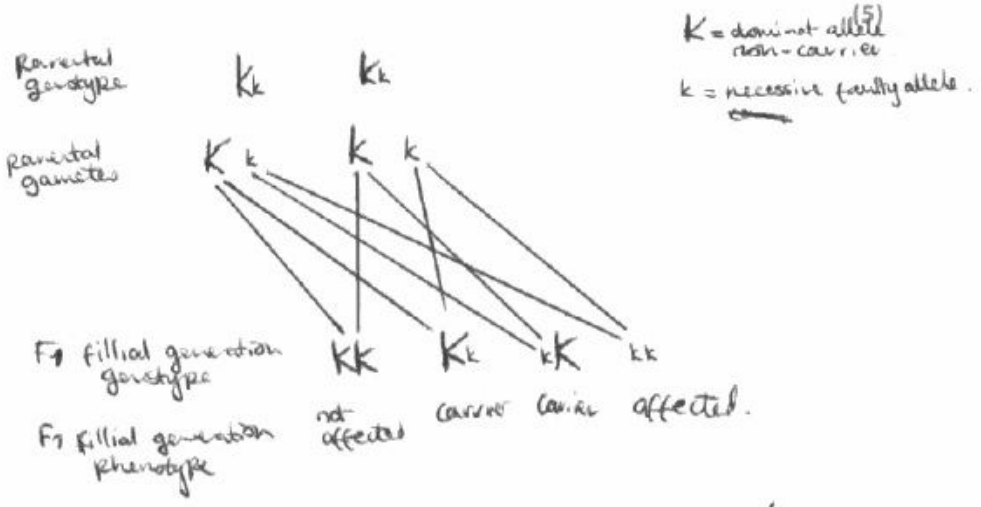
(c) This was well answered by most candidates and most candidates made use of a Punnett square to support their answer. However, by jumping straight into the Punnett square, candidates often lost some of the available marks by not giving parental genotypes clearly and/or the corresponding phenotypes for the possible children's genotypes. Pleasingly, there were very few answers which quoted ratios.

This response scored all five marks available.

(c) Two parents are both carriers of the recessive allele for Krabbe disease.

In the space below, draw a genetic diagram to show the possible genotypes and phenotypes of their children.

Use the genetic diagram to find the probability of these parents having a child with Krabbe disease.



(5)

Probability 1/4

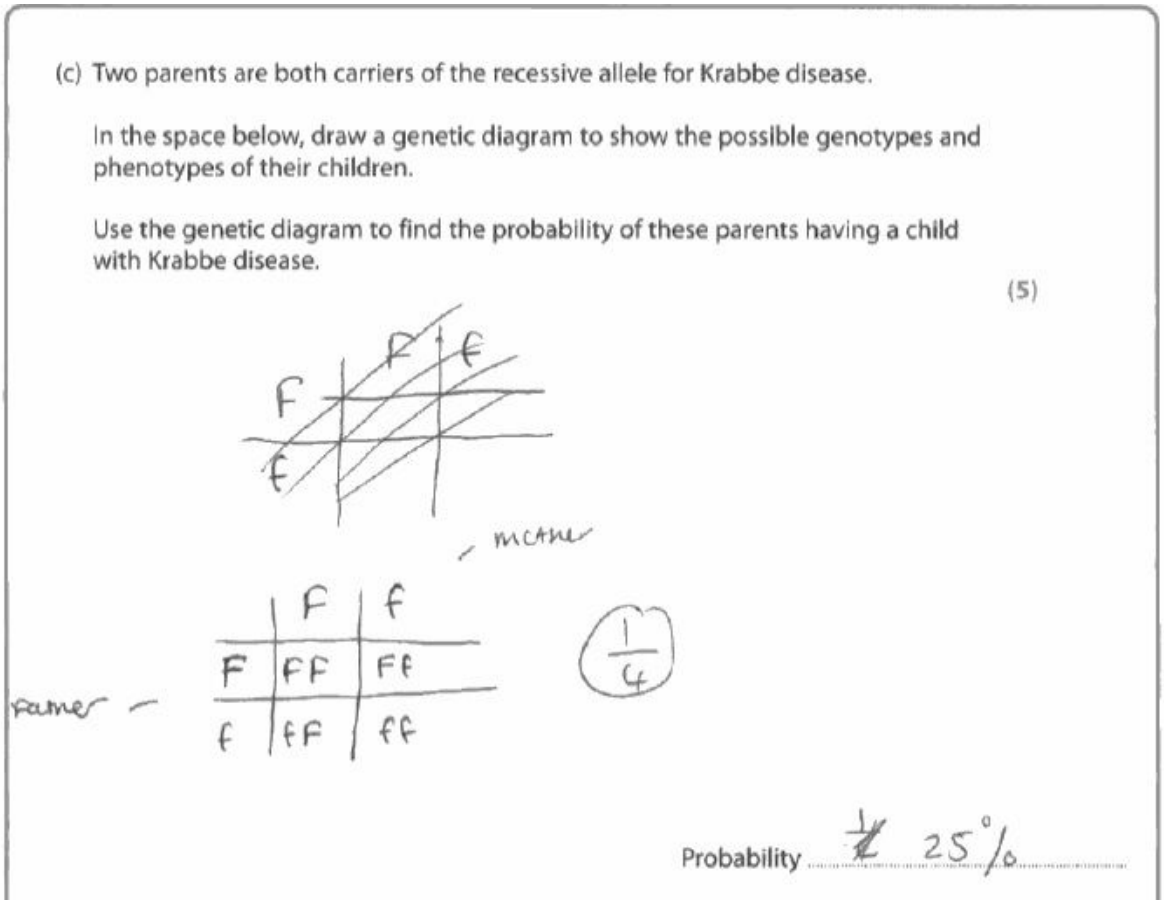
Results Plus: Examiner Comments

This candidate has not used the more common Punnett square, but has managed to clearly label and set out their diagram so that all the required information is clear.

Results Plus: Examiner Tip

Please note: Carrier is not a good description of a phenotype, but was decided that it was acceptable in this context. Ideally the phenotype for the Kk should also have been not affected (or similar).

This response scored three of the available five marks.



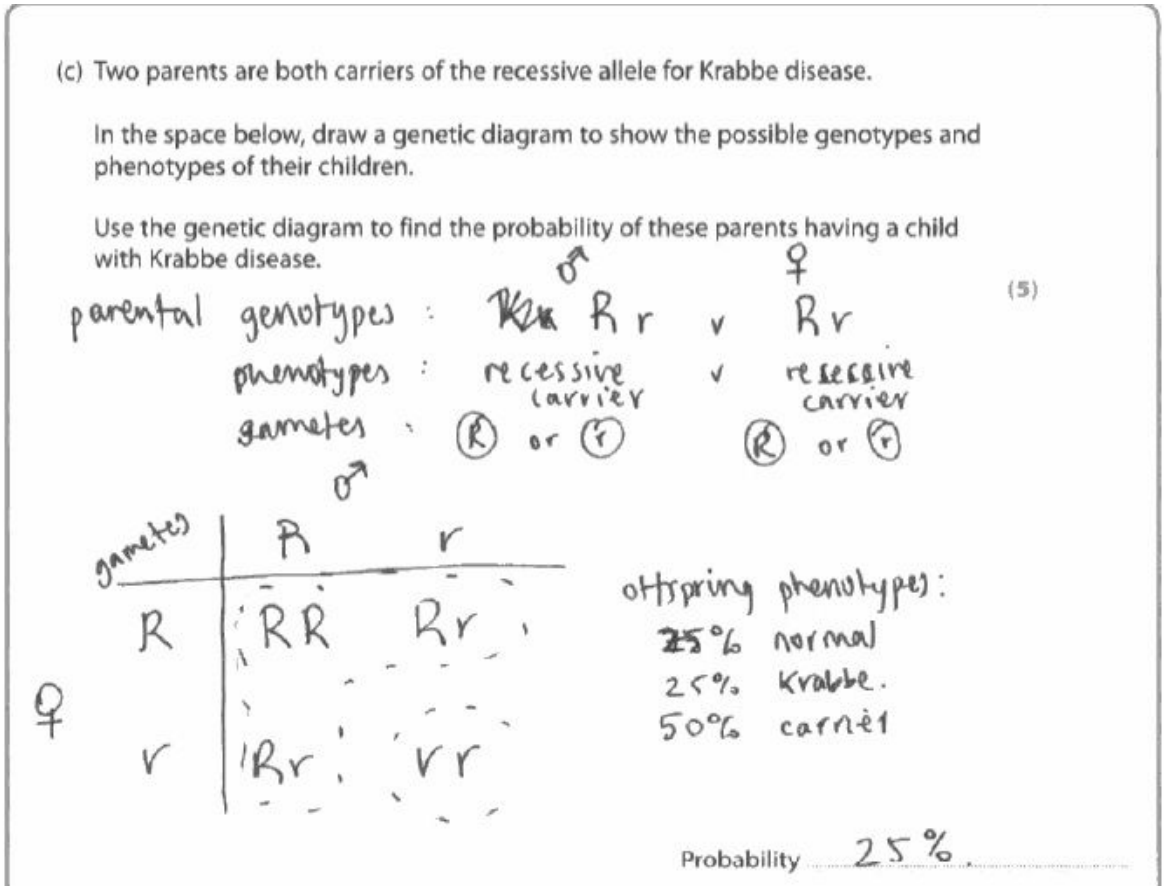
Results Plus: Examiner Comments

By using the Punnett square the candidate has correctly identified the gametes and potential F1 genotypes and gone on to calculate the correct probability. However, they have not made the parental genotypes clear and have not linked the F1 genotypes to the potential phenotypes.

Results Plus: Examiner Tip

Punnett squares are useful tools, but don't forget to make sure you clearly express the information requested in the question.

This response scores four of the five marks available.



(c) Two parents are both carriers of the recessive allele for Krabbe disease.

In the space below, draw a genetic diagram to show the possible genotypes and phenotypes of their children.

Use the genetic diagram to find the probability of these parents having a child with Krabbe disease.

(5)

♂ ♀

parental genotypes : Rr v Rr

phenotypes : recessive carrier v recessive carrier

gametes : (R) or (r) (R) or (r)

♂

gametes	R	r
R	RR	Rr
r	Rr	rr

♀

offspring phenotypes:
25% normal
25% krabbe.
50% carrier

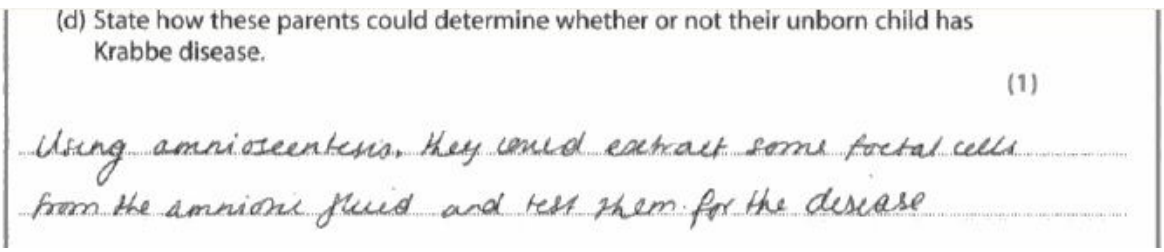
Probability 25%.

Results Plus: Examiner Comments

This candidate has covered all the required information - unfortunately the offspring phenotypes are not clearly linked to the corresponding genotype. This was quite a common mistake.

(d) Many candidates correctly referred to amniocentesis or chorionic villus sampling, with the usual incorrect spellings sometimes appearing (aminocentesis and chronic villus sampling). A small number of answers had correct descriptions of the processes. However, there were plenty of answers which were vague and referred to genetic screening or even gene therapy, etc.

This response gains the mark.



(d) State how these parents could determine whether or not their unborn child has Krabbe disease.

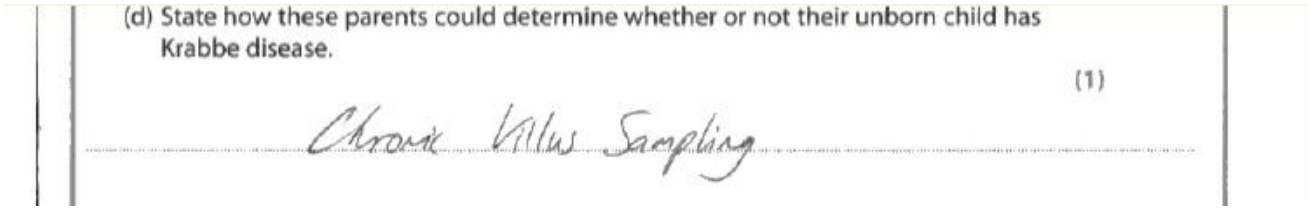
(1)

Using amnioscentesis, they could extract some foetal cells from the amniotic fluid and test them for the disease

Results Plus: Examiner Comments

As well as naming a suitable technique, this candidate has also provided a partial description of the technique.

This response scores no marks.


(d) State how these parents could determine whether or not their unborn child has Krabbe disease.

(1)

Chorionic Villus Sampling

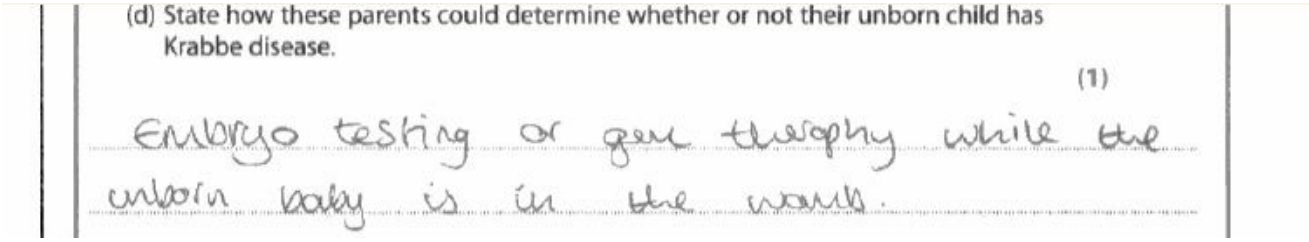
Results Plus: Examiner Comments

Thankfully this spelling mistake is becoming slightly less frequent.

Results Plus: Examiner Tip

When a spelling mistake changes the meaning of the word you will not gain credit. Read back your answers to yourself and make sure it is at least spelt phonetically to avoid mistakes.

This response scores no marks.


(d) State how these parents could determine whether or not their unborn child has Krabbe disease.

(1)

Embryo testing or gene therapy while the unborn baby is in the womb.

Results Plus: Examiner Comments

This example illustrates two common mistakes: 1. embryo testing is too vague for an answer to how the parents could determine if the unborn child has the disease; 2. gene therapy was a common incorrect response.

Results Plus: Examiner Tip

Remember gene therapy is designed to provide working copies of genes into the body and is not a screening technique.

Q25.

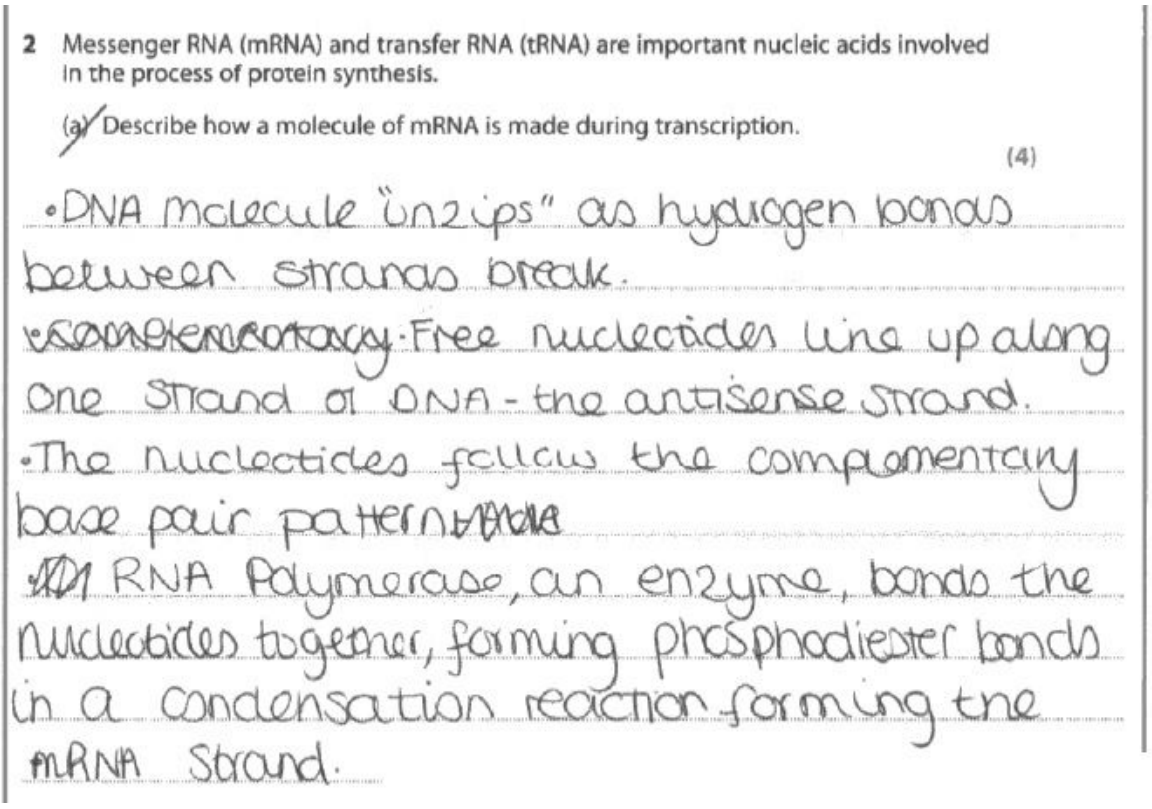
(a) There were a good number of excellent responses from candidates describing the process in detail with correct reference to the specific enzymes and bonds involved. The majority of candidates recognised the need for the DNA double helix to be unwound and that complementary base pairing is involved in the formation of an mRNA molecule.

A significant number of candidates describe the mRNA molecule lining up by complementary base pairing as though it has already been made before transcription starts, or that nucleotides pair up with base pairs. Some candidates are confused about the enzymes involved and many referred to DNA polymerase. Other candidates named peptide bonds joining the nucleotides or strands together.

Only the better accounts clearly recognised that phosphodiester bonds are made via condensation reactions.

Few candidates recognised that mRNA needs to split from the DNA at the end of transcription, although many went onto describe the mRNA leaving the nucleus and the process of protein synthesis which was not relevant to the question asked.

This response gains all four marks available.



2 Messenger RNA (mRNA) and transfer RNA (tRNA) are important nucleic acids involved in the process of protein synthesis.

(a) Describe how a molecule of mRNA is made during transcription.

(4)

- DNA molecule "unzips" as hydrogen bonds between strands break.
- ~~complementary~~ Free nucleotides line up along one strand of DNA - the antisense strand.
- The nucleotides follow the complementary base pair pattern
- RNA Polymerase, an enzyme, bonds the nucleotides together, forming phosphodiester bonds in a condensation reaction forming the mRNA strand.

Results Plus: Examiner Comments

This response gains credit for: - the DNA strands separating; - free nucleotides lining up against the antisense DNA strand; - complementary base pairing; - the reference to the named enzyme RNA polymerase; - phosphodiester bonds forming; - by condensation reactions.

2 Messenger RNA (mRNA) and transfer RNA (tRNA) are important nucleic acids involved in the process of protein synthesis.

(a) Describe how a molecule of mRNA is made during transcription.

(4)

Transcription takes place in the nucleus. A ~~g~~ strand of DNA from the gene is unwound from its double helix shape. The bases are exposed ~~and~~ as the strand becomes separated from it's other half. These bases are then free to join with any ~~oth~~- free floating bases in the nucleus.

Results Plus: Examiner Comments

This response just gains one of the four marks available for the DNA unwinding. The rest is not specific enough for credit.

Results Plus: Examiner Tip

When asked to describe a process worth multiple marks aim to make at least as many clear separate points to the number of marks available.

(c) Q(b) The majority of candidates recognised that it was hydrogen bonds holding the shape of the tRNA molecule together, although a significant number got the amino acid binding site and anticodon confused, together with transcription and translation.

Q(c) A number of candidates did not read the question properly and described differences in function rather than structure. Many said that tRNA carried amino acids or that there was an amino acid on the tRNA, without reference to the binding site. Some answers referred to tRNA being double stranded rather than having double stranded sections and a number of candidates referred to tRNA being branched. However, there were some really good, clear answers and the better candidates tended to score more points than needed for a maximum mark of 2. Few candidates recognised that tRNA has a fixed size compared to the variable size of mRNA.

A few candidates thought that a tRNA molecule has anticodon**s** and several candidates thought that tRNA only has three bases in its structure.

This response gains all four marks available.

(c) Using the information shown in the diagram, describe **two** ways in which the structure of a tRNA molecule differs from the structure of a mRNA molecule.

(2)

1 ~~tRNA has a single strand and mRNA has a double strand~~ there is no hydrogen bonding in mRNA, whereas there is hydrogen bonding in tRNA.

2 ~~tRNA has a tertiary structure whereas mRNA has a primary structure~~ tRNA has a site for bonding to specific amino acids whereas mRNA cannot bond to amino acids

Results Plus: Examiner Comments

This is a typical example of a response that gained both marks available for identifying clear differences between tRNA and mRNA.

(c) Using the information shown in the diagram, describe **two** ways in which the structure of a tRNA molecule differs from the structure of a mRNA molecule.

(2)

1 tRNA consists of an amino acid as well as three bases, whereas mRNA is a small strand of bases, sugars and phosphates.

2 tRNA consists of only three bases, which is an anti-codon, and mRNA consists of multiple codons.

Results Plus: Examiner Comments

This is an example of a response that did not gain any marks. tRNA does not consist of an amino acid and only three bases. Candidates are asked to use the information on the diagram and tRNA may be a fixed size but it is certainly bigger than just 3 bases.

Results Plus: Examiner Tip

When asked to use the information shown in the diagram make sure you look at the diagram carefully and check that your answer makes sense by comparing it back to the diagram.

Q26.

This question gained a full spread of marks with similar numbers scoring 0, 1, 2 or 3 marks.

Many candidates appreciated that folding of the primary structure or the formation of the secondary and tertiary structures was relevant to bring the amino acids closer together. Correct mention of the bonds involved in this process was often seen. However, this was occasionally penalised with the mention of peptide bonds between the relevant two amino acids.

Only approximately 20% of candidates appreciated and described the idea of bonding between R groups. This meant that most candidates effectively limited themselves to a maximum of two marks.

A significant number of candidates approached this question from the point of view that a change in the amino acid sequence was brought about by deletion, substitution or hydrolysis (by mutation or genetic engineering), so bringing the amino acids closer together. This gained no credit.

This response gained all three available marks.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

The primary structure of lysozyme is a specific sequence of 129 amino acids.

Two of the amino acids that make up the active site are in positions 35 and 52 in the primary structure.

Suggest how these two amino acids could be brought closer together to form part of the active site of this enzyme.

(3)

Folding of the primary structure, the sequence of amino acids, held by hydrogen bonds can cause the two amino acids to be brought closer together. Further interaction of the R groups for example formation of ionic bonds and disulphide bridges can cause the two amino acids to be even brought closer together.

Results Plus: Examiner Comments

Credit was given for:

- recognition of the folding of the primary structure
- naming bonds involved
- recognising that bonds form between the R groups of the amino acids.

This response failed to score any marks.

Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

The primary structure of lysozyme is a specific sequence of 129 amino acids.

Two of the amino acids that make up the active site are in positions 35 and 52 in the primary structure.

Suggest how these two amino acids could be brought closer together to form part of the active site of this enzyme.

(3)

A mutation could occur, meaning that insertion of amino acid at position 35 moves to 51, so that it's next to 52. As the lysozyme folds into a secondary structure, they may be brought closer together, being able to form peptide bonds in a condensation reaction.

Results Plus: Examiner Comments

This is an example of the common error of thinking that a mutation (or genetic engineering) would be the cause of bringing the amino acids close together in the final structure of the enzyme.

Q27.

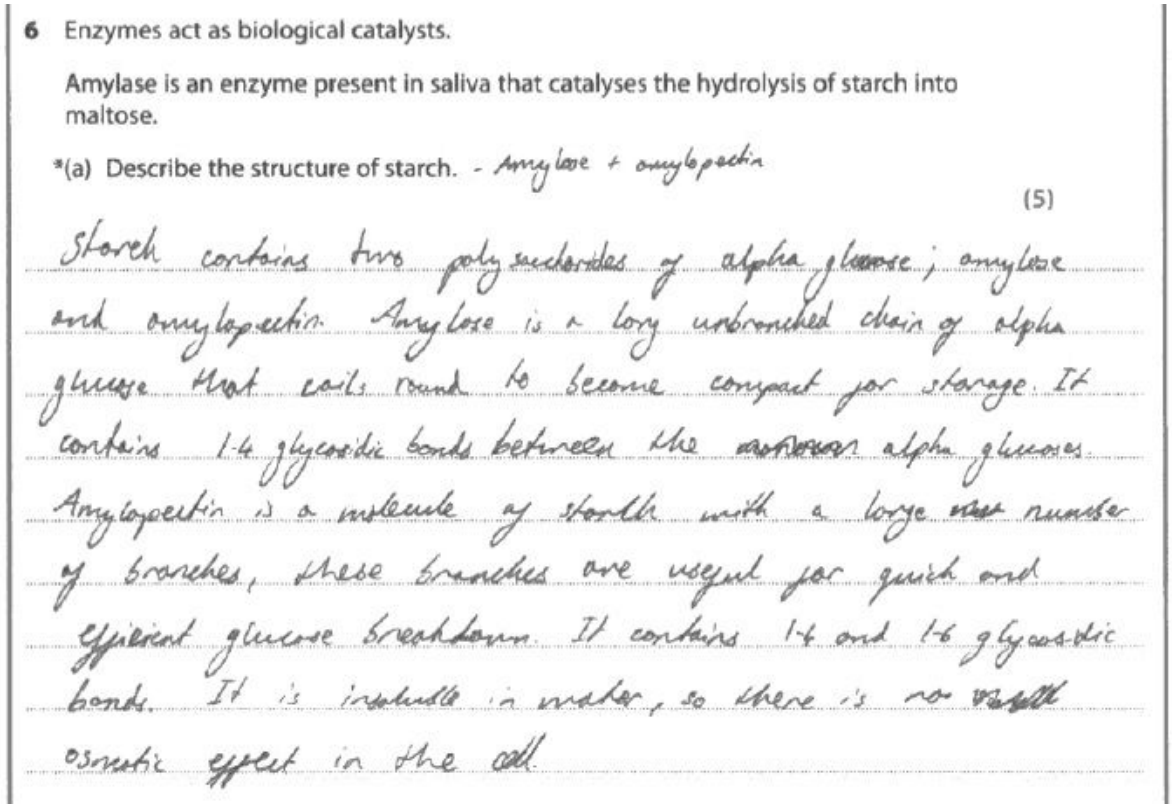
Similar comments apply to this question as to the previous one, although some very good descriptions in (a) were seen. More care needs to be taken by candidates when quoting values from a graph; many values quoted were either vague or inaccurate. There were references to the mid-twenties instead of to 1924 (marking points 1 and 2); and to the drop in number of deaths in 1970 instead of 1969 (marking point 5). In (b), correlation was confused with causation (not surprisingly) and there were few references to the consistent time lag between the changes in numbers of cigarettes smoked and the corresponding changes to the number of deaths from lung cancer. The responses to (b)(iii) indicated that candidates have a good understanding of the validity of surveys. A range of responses was seen in (c), with some good answers.

A number of candidates wasted valuable time by describing the attributes of a healthy lung before eventually answering the question. Command of the English language let other candidates down; a common ambiguity was a reference to the movement of 'carbon dioxide and oxygen into and out of the lung'. Again, the advice is to put one fact in one clause to remove any ambiguity: 'the movement of oxygen into the lung and carbon dioxide out of the lung'.

Q28.

(a) This question was assessed for quality of written communication with examiners specifically checking the spelling of technical terms. Very few candidates were penalised for poor spelling. Where mistakes were made it was with the words glycosidic, amylopectin or accidentally writing amylase instead of amylose. Many candidates scored very highly with this question providing a high level of specific structural detail demonstrating that this area of the specification has been well covered and understood by most candidates. A few candidates did confuse the structure of starch and protein and surprisingly a lot of candidates did not mention that starch is made up of α-glucose.

This response scores all five marks available.



6 Enzymes act as biological catalysts.

Amylase is an enzyme present in saliva that catalyses the hydrolysis of starch into maltose.

*(a) Describe the structure of starch. - amylose + amylopectin

(5)

Starch contains two polysaccharides of alpha glucose; amylose and amylopectin. Amylose is a long unbranched chain of alpha glucose that coils round to become compact for storage. It contains 1-4 glycosidic bonds between the ~~monomers~~ alpha glucoses. Amylopectin is a molecule of starch with a large ~~mass~~ number of branches, these branches are useful for quick and efficient glucose breakdown. It contains 1-4 and 1-6 glycosidic bonds. It is insoluble in water, so there is no ~~water~~ osmotic effect in the cell.

Results Plus: Examiner Comments

Credit was gained for recognising:

- starch is made from alpha glucose;

- amylose is coiled;

- amylose and amylopectin;

- glycosidic bonds;

- comparing the difference in bonding between amylose and amylopectin;

- amylopectin is branched.

This response gained three of the five available marks.

6 Enzymes act as biological catalysts.

Amylase is an enzyme present in saliva that catalyses the hydrolysis of starch into maltose.

*(a) Describe the structure of starch.

(5)

Starch is a polysaccharide mainly used as energy stores. It is made of amylose and amylopectin. Amylose is a straight chain molecule and Amylopectin is a branched chain molecule. Both of these have very compact structures which helps them be such good energy stores.

Results Plus: Examiner Comments

This response gained credit for:

- amylose and amylopectin;

- amylopectin is branched;

- both are compact molecules.

Results Plus: Examiner Tip

When describing the structure of polymers try to include the names of the monomers and bonds involved.

(b) (i) Few candidates struggled with explaining what is meant by a catalyst. The most common responses covered the idea that they speed up reactions by lowering the activation energy. There were some excellent responses that recognised that catalysts do not change the products or equilibrium of a reaction.

(b) Explain the meaning of the following terms.

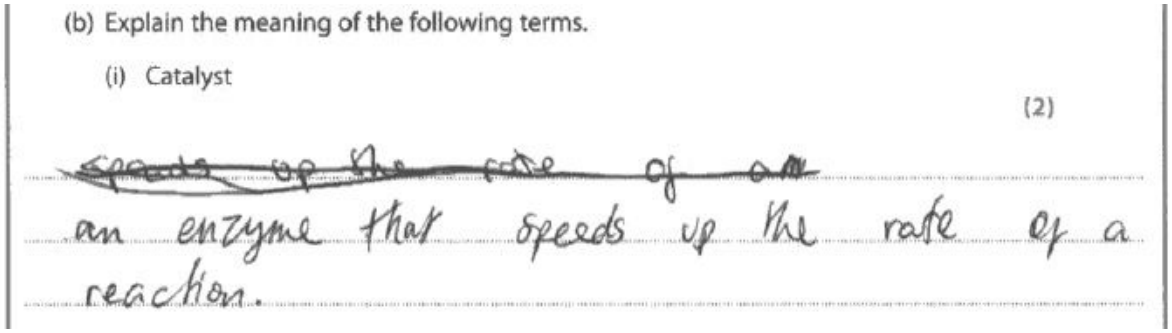
(i) Catalyst

(2)

A catalyst speeds up the rate of reaction by lowering the activation energy without being used up or diminished.

Results Plus: Examiner Comments

This response gains both available marks having made three clear points about catalysts.



(b) Explain the meaning of the following terms.

(i) Catalyst

(2)

~~speeds up the rate of a~~ an enzyme that speeds up the rate of a reaction.

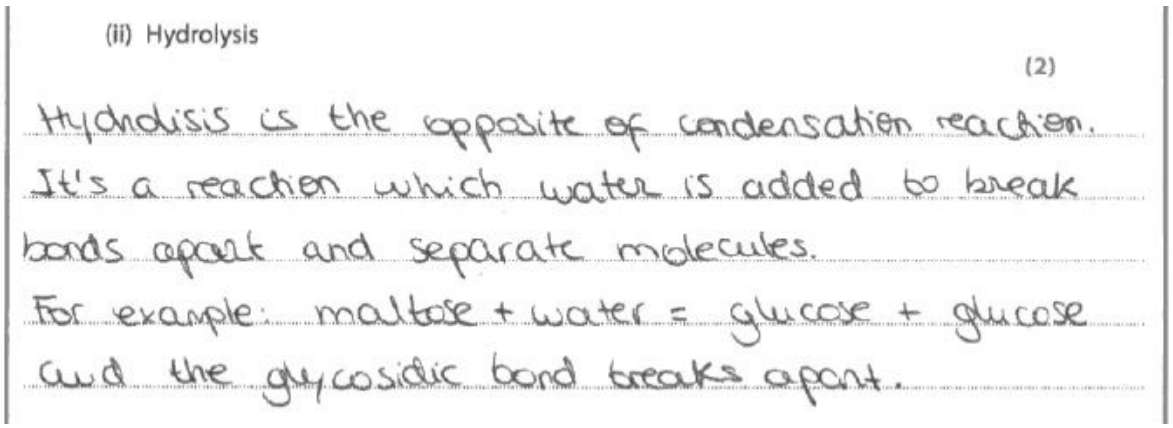
Results Plus: Examiner Comments

This response gained one mark for speeding up the rate of reaction.

Results Plus: Examiner Tip

Remember enzymes are catalysts, but not all catalysts are enzymes. When a question carries two or more marks you should include two or more clear points.

(b) (ii) Most candidates had a good grasp of what a hydrolysis reaction involves. Some candidates referred to 'breaking large molecule into small molecules' rather than specifically mentioning bonds. Most candidates recognised that water is used, although a few did state that water was produced and a small minority hedged their bets and stated that water was used or produced and therefore did not gain the mark.



(ii) Hydrolysis

(2)

Hydrolisis is the opposite of condensation reaction. It's a reaction which water is added to break bonds apart and separate molecules. For example: maltose + water = glucose + glucose and the glycosidic bond breaks apart.

Results Plus: Examiner Comments

This response is typical of the many that gained both marks available.

Results Plus: Examiner Tip

Don't forget to avoid using = in a chemical equation.

(ii) Hydrolysis

(2)

Hydrolysis is the breakdown of molecules, formed in condensation reactions, by the addition of water

Results Plus: Examiner Comments

This response gains one mark for the use of water, but it does not mention bonds being broken.

(ii) Hydrolysis

(2)

hydrolysis is a catabolic reaction, the opposite of condensation, when two subunits are broken down to produce two distinct molecules plus H_2O.

eg maltose → glucose + glucose + water

Results Plus: Examiner Comments

This response gained no marks. It does not mention bonds and has water being produced rather than used.

(ii) Hydrolysis

(2)

Hydrolysis is the name of the reaction in which the glycosidic bonds of joining two sugars are broken.

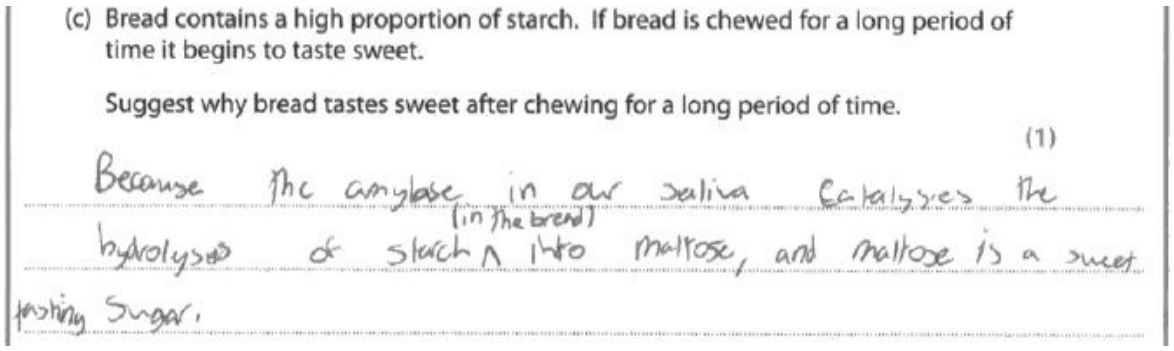
Results Plus: Examiner Comments

This response gained one mark for recognising that bonds are broken in hydrolysis reactions.

Results Plus: Examiner Tip

Don't forget that hydrolysis involves water.

(c) There were some excellent responses recognising that amylase in saliva breaks down starch into maltose that tastes sweeter than starch, but most candidates gained the mark available for recognising that a sugar is produced.



(c) Bread contains a high proportion of starch. If bread is chewed for a long period of time it begins to taste sweet.

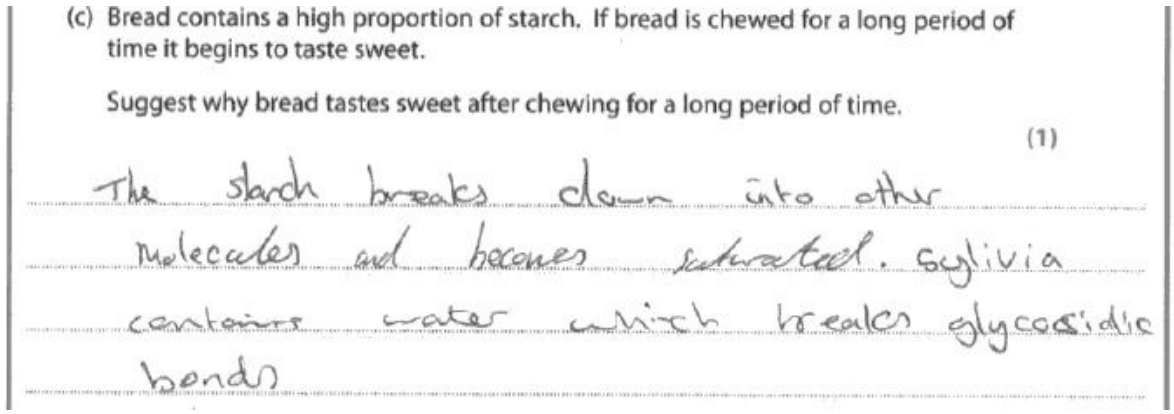
Suggest why bread tastes sweet after chewing for a long period of time.

(1)

Because the amylase in our saliva (in the bread) catalyses the hydrolysis of starch into maltose, and maltose is a sweet tasting sugar.

Results Plus: Examiner Comments

This is a good example of a response that gained the available mark.



(c) Bread contains a high proportion of starch. If bread is chewed for a long period of time it begins to taste sweet.

Suggest why bread tastes sweet after chewing for a long period of time.

(1)

The starch breaks down into other molecules and becomes saturated. Sylivia contains water which breaks glycosidic bonds

Results Plus: Examiner Comments

This is an example of a response that failed to gain the mark.

Results Plus: Examiner Tip

Although water is needed in hydrolysis reactions, thankfully water is not enough to break glycosidic bonds by itself.

Q29.

Most candidates understood the context of what a template is, but often struggled to express what is meant by a template. Some just restated the question and others referred to copying and making an identical strand. However, many did express the idea of nucleotides lining up along one strand of DNA by complementary base pairing to gain credit.

This response gained the mark.

One function of DNA is to act as a template for the synthesis of messenger RNA.

State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

The template DNA acts as a guide for the RNA nucleotides to bind by complementary base pairing to form a strand of mRNA.

Results Plus: Examiner Comments

This is an example of the type of definition we accepted.

This response gained no marks.

One function of DNA is to act as a template for the synthesis of messenger RNA.

State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

The term template for the synthesis of messenger RNA is a strand which acts like a template where RNA copies the exact strand and makes a brand new identical one.

Results Plus: Examiner Comments

This is a typical example of a response that gained no credit as the candidate describes the process of using the template to make an identical copy rather than a complementary strand.

This response gained no marks.

One function of DNA is to act as a template for the synthesis of messenger RNA.

State what is meant by the term **template** for the synthesis of messenger RNA.

(1)

The sequence of bases that are identical to the DNA molecule which is used to find the complementary base for RNA where U replaces T.

Results Plus: Examiner Comments

The sequence is complementary not identical to the DNA so no credit for this response. This response also implies that the template is something other than the DNA strand.

Q30. No Examiner's Report available for this question

Q31.

This was expected to be a relatively straightforward question, but actually resulted in some very poor answers due to poor wording of answers and bad exam technique. In (a), many of the diagrams were sloppily drawn and the label lines carelessly positioned. Although we did not expect three-dimensional drawings, we did expect the drawings to be representative of the biology so that, for example, the vessel wall would be wider than the diameter of the lumen and the diagram would indicate the number of layers present. Part (b) was poorly done by many candidates who failed to appreciate that each component of the vessel wall is present for a different reason. Every structure and function came across as being interchangeable. For example, there were many descriptions of the elastic fibres and smooth muscle cells 'contracting and relaxing' to increase and maintain the pressure of the blood. Candidates need to learn to write one fact in one statement to avoid such ambiguities. In (c), many responses did not actually state differences between the vessels but instead stated facts about one vessel or the other. A surprisingly high number of responses compared veins with arteries. Only the more able candidates scored well in this part and the previous part of the question.

Q32. No Examiner's Report available for this question

Q33. No Examiner's Report available for this question

Q34.

(i)

90% of candidates correctly identified the arrangement of components in a mononucleotide. Of the incorrect responses B was chosen most frequently.

(ii)

52% of candidates correctly identified B as the mRNA with a single mistake. The most common incorrect response was to choose C – the sequence with no mistakes, perhaps showing that they had not all read the question carefully enough.

(iii)

Over 80% of candidates identified the correct sequence events for protein synthesis.

Q35. No Examiner's Report available for this question

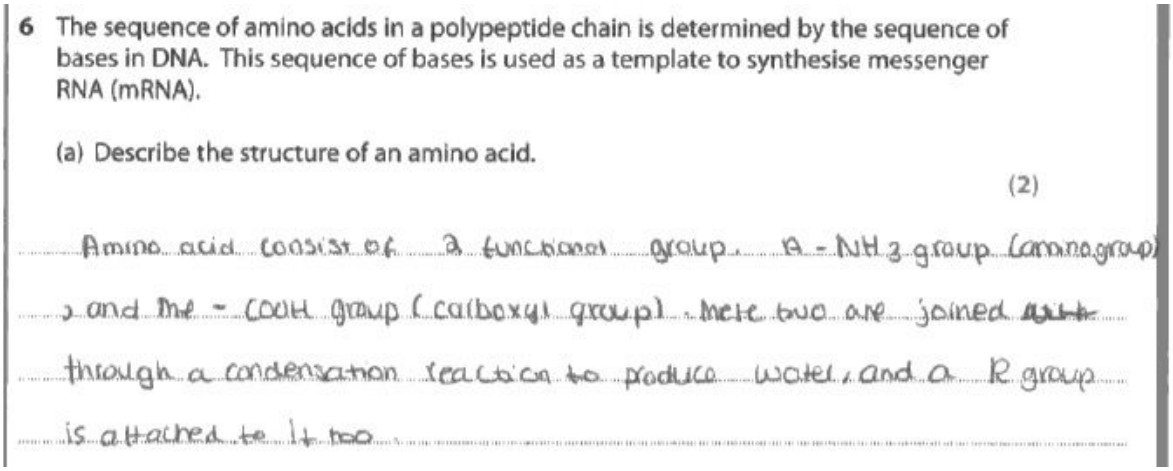
Q36. No Examiner's Report available for this question

Q37. No Examiner's Report available for this question

Q38. No Examiner's Report available for this question

Q39.

(a) Candidates predominantly scored either zero or two marks for this question, depending on the description being of a mononucleotide or of an amino acid.



6 The sequence of amino acids in a polypeptide chain is determined by the sequence of bases in DNA. This sequence of bases is used as a template to synthesise messenger RNA (mRNA).

(a) Describe the structure of an amino acid.

(2)

Amino acid consist of a functional group. A - NH_2 group (amino group) and the - COOH group (carboxyl group). here two are joined through a condensation reaction to produce water, and a R group is attached to it too.

Results Plus: Examiner Comments

This response was awarded 2 marks for the reference to the carboxyl group and to the R group. If candidates are going to use chemical formulae, they must be correct.

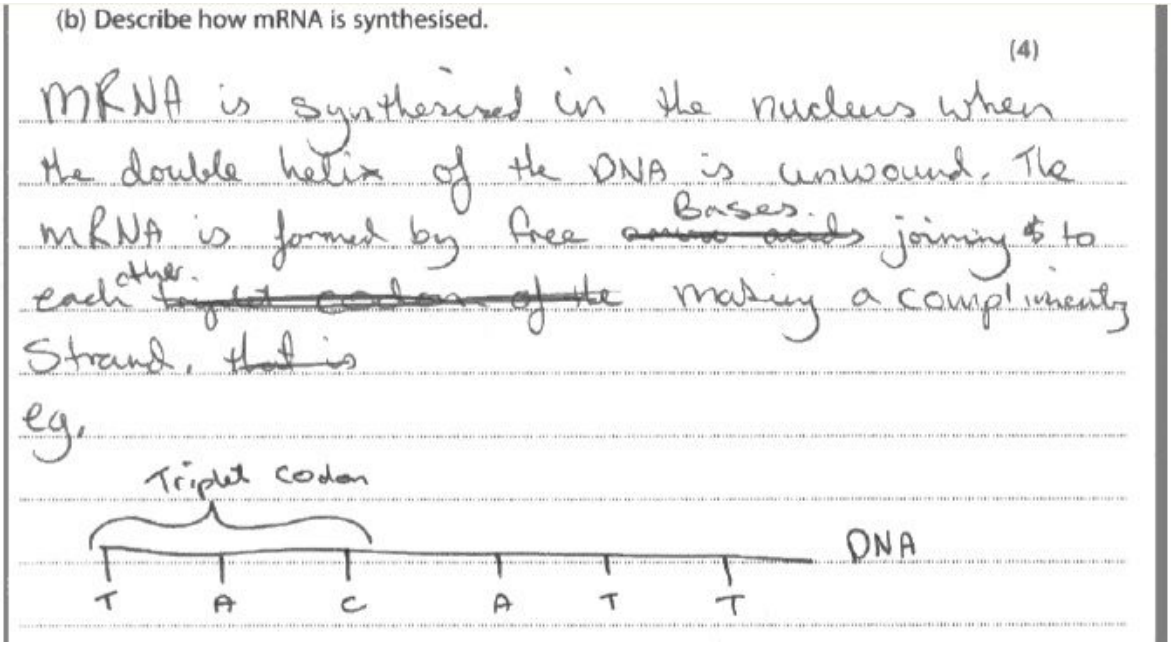
Results Plus: Examiner Tip

Unless specifically asked, it is safer to write out the name of a chemical as opposed to writing out its formula. If the formula is used then it must be correct, including any negative or positive charge it may have.

(b) Many good responses, scoring max four marks were seen; candidates are clearly being prepared for the exam using previous mark schemes. There were still some common errors seen from the weaker students.

(b) Describe how mRNA is synthesised.

(4)



Results Plus: Examiner Comments

One common error is seen in this response. Instead of refering to mononucleotides, the candidate has stated that the bases join to each other.

Results Plus: Examiner Tip

For questions that frequently come up, such as transcription and translation, use previous mark schemes to learn the correct terminology.

There are candidates that lose marks by not being sufficiently precise in their answer.

(b) Describe how mRNA is synthesised.

(4)

mRNA is made in the nucleus of the cell in transcription. The DNA strand unwinds and free nucleotides line up with their complementary bases. The nucleotides are then bonded adjacently forming a strand of mRNA. In mRNA, thymine is replaced by uracil. The mRNA then leaves the ~~cell~~ nucleus and goes into the cytoplasm and the DNA returns to normal.

Results Plus: Examiner Comments

In this response the candidate clearly understands the process and has scored three marks. However they have not been precise enough in stating where the nucleotides line up and what their bases are complementary to.

Results Plus: Examiner Tip

Make sure in your answers involving DNA and mRNA synthesis that it is very clear that mononucleotides line up against the existing DNA strand and that the bases on the nucleotides bind to their complementary bases on the DNA. You must use the term 'complementary' in your response and not just give an example.

Q40.

(i)

Approximately 2/3rds of candidates recognised that osmosis is an example of passive transport. Most of the rest incorrectly thought it involved the movement of a solute down a concentration gradient.

(ii)

The majority of candidates recognised that facilitated diffusion involves ions moving down a concentration gradient. A few thought they move against a concentration gradient or used ATP.

(iii)

The majority of candidates recognised that endocytosis involves the production of a vacuole or vesicle. A, C and D were all seen as incorrect responses.

Q41. No Examiner's Report available for this question

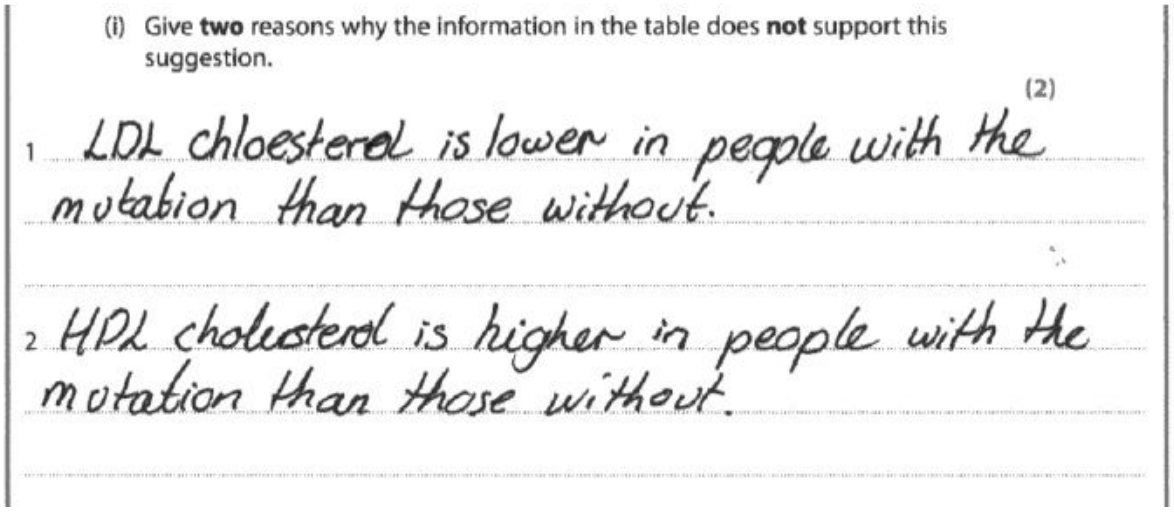
Q42. No Examiner's Report available for this question

Q43. ***Question (b)(i)***

(a): Most candidates had few difficulties with the multiple choice questions about lipid hydrolysis with between 70 and 90% correct response rates for each item. The most common errors were to think that catalysts increase the rate of reaction by increasing the activation energy; water is formed in a hydrolysis reaction; and glycosidic bonds are found in triglycerides.

(b)(i): This question was well answered with most candidates interpreting the data well and relating it to which components are associated with risks of developing CVD.

This response gains both of the available marks.



(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

1 LDL chloesterol is lower in people with the mutation than those without.

2 HDL cholesterol is higher in people with the mutation than those without.

Results Plus: Examiner Comments

Correct comparisons have been made with LDL and HDL levels, both of which have an influence on the risk of developing CVD.

This response gains both available marks.

(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

1 because the number of HDL cholesterol is a very small difference, by 1.48 to 4.9 people without mutation, to people with mutation.

2 Total cholesterol is lower in people with the mutation which would lower there chance of CVD.

Results Plus: Examiner Comments

As well as the correct statement about total cholesterol, they recognise that the key factor is that the differences are very small (particularly for HDL).

This response did not gain any marks.

(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

1 There are more people without the mutation of the gene that have a higher total cholesterol than those with the mutation.

2

Results Plus: Examiner Comments

The statement made is not possible to conclude from the data in the table as there is no indication about the cholesterol levels of individuals within the groups.

Results Plus: Examiner Tip

Take care about over interpreting data.

This response failed to gain any marks.

(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

1 LDL chloesterol is lower in people with the mutation than those without.

2 HDL cholesterol is higher in people with the mutation than those without.

Results Plus: Examiner Comments

The first statement is wrong from the data in the table. The second statement is not worthy of credit as they have said that total cholesterol is reduced. This is not a clear comparative statement with those without the mutation and we have no indication in the data about changes in the lipid levels within the populations, just comparative mean values.

Results Plus: Examiner Tip

Make sure statements are comparative and think carefully over the appropriate use of words such as lower and reduced as they have different meanings and suit different contexts.

Question (b)(ii)

The majority of candidates recognised that statins would be the suitable drug type to use in the context of this mutation. However, a significant number of candidates did mention anticoagulants.

This is an example of the correct response.

(ii) Name the type of drug that could be given to people with this mutation, to reduce the risk of developing CVD.

(1)

Statins

This is an example of an incorrect response that did not gain the mark.

(ii) Name the type of drug that could be given to people with this mutation, to reduce the risk of developing CVD.

(1)

Beta blockers.

Results Plus: Examiner Comments

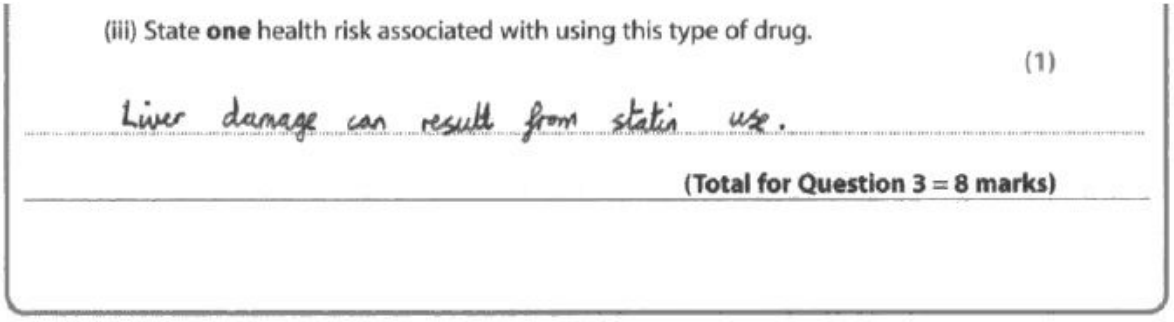
Check the context of the question carefully. The mutation in this question is linked to lipid levels in the blood so the most appropriate drugs will be those that might help reduce cholesterol levels in the blood.

Question (b)(iii)

With such a long list of possible side effects of statin use most candidates were able to gain credit, most for liver, kidney or muscle issues. The most common errors were to state that statins increase the risk of cancer or reduce the absorption of vitamins from the digestive system.

Candidates were asked to state **one** health risk, but many provided a list of risks instead.

This response gained the mark.


(iii) State **one** health risk associated with using this type of drug.

(1)

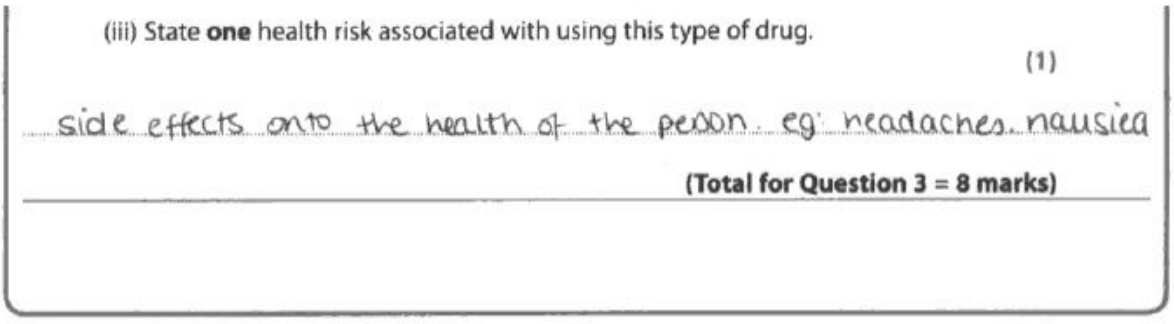
Liver damage can result from statin use.

(Total for Question 3 = 8 marks)

Results Plus: Examiner Comments

This is an example of one of the most common correct responses.

This response gained the mark.


(iii) State **one** health risk associated with using this type of drug.

(1)

side effects onto the health of the person. eg: headaches. nausiea

(Total for Question 3 = 8 marks)

Results Plus: Examiner Comments

This candidate has recognised some side effects as risks and gained credit. However, the question did ask for **one** health risk and not two.

Results Plus: Examiner Tip

If a word is in bold in a question stem take careful note.

(iii) State **one** health risk associated with using this type of drug.

(1)

Could prevent vitamins being absorbed by liver.

(Total for Question 3 = 8 marks)

Results Plus: Examiner Comments

This is an example of one of the most common responses that did not gain the mark.

Q44.

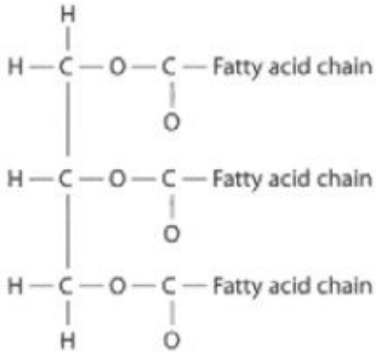
Question (a)

A significant number of candidates drew the products accurately and gained all three marks. A significant number also scored no marks, by either leaving the answer blank, copying the full triglyceride, drawing some random products or even including completely different molecules such as attempts at glucose or amino acids as a product.

Common errors that prevented all three marks being awarded included:

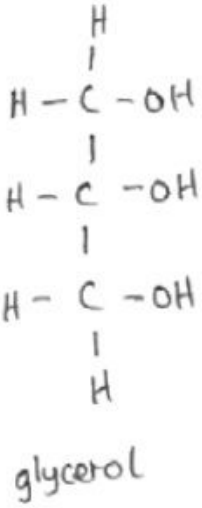
a lack of the 3 OHs on glycerol the incomplete or total lack of COOH at the end of the fatty acids.

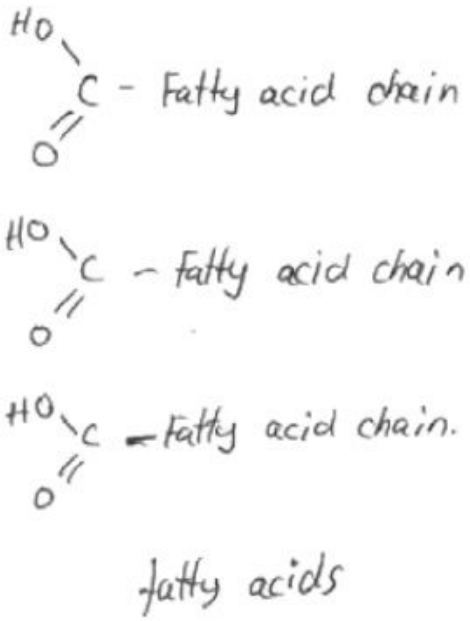
This response gained all three available marks.



In the space below, draw a diagram to show the molecules produced from the complete hydrolysis of the triglyceride.

(3)

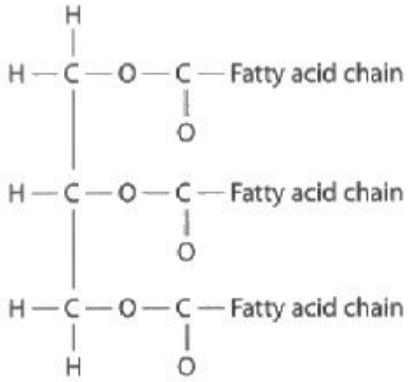




Results Plus: Examiner Comments

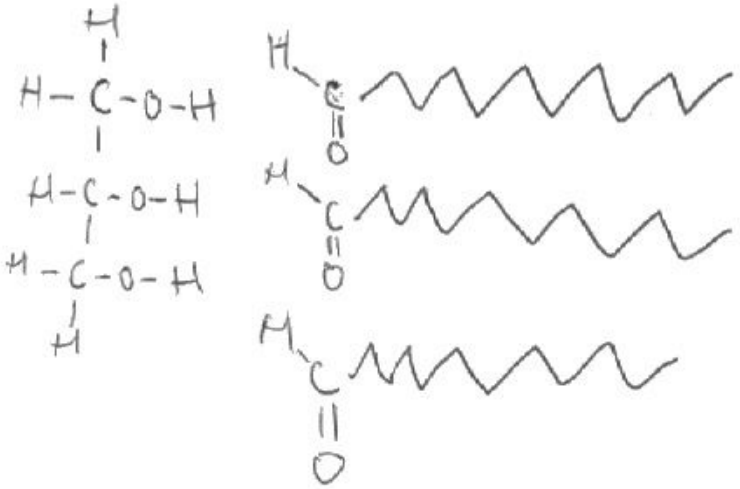
All products have been correctly drawn for maximum credit.

This response gained two of the three marks.



In the space below, draw a diagram to show the molecules produced from the complete hydrolysis of the triglyceride.

(3)



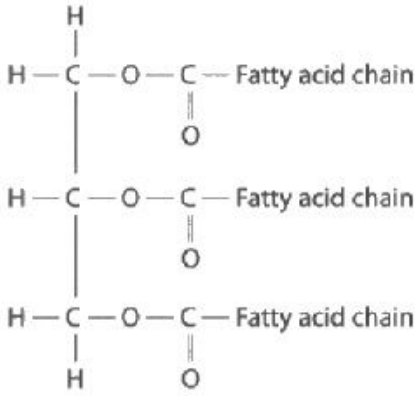
Results Plus: Examiner Comments

The products have been identified and drawn, but one mark has been lost as each fatty acid has been drawn with an H rather than OH group.

Results Plus: Examiner Tip

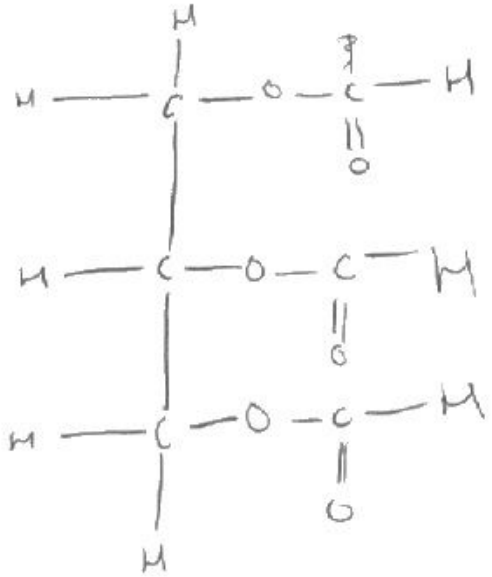
Remember that hydrolysis involves H_2O, double check your molecules drawn to make sure you have not lost any atoms. In this case H_2 has been added to each bond split by hydrolysis instead of H_2O.

This response gained no marks.



In the space below, draw a diagram to show the molecules produced from the complete hydrolysis of the triglyceride.

(3)



Results Plus: Examiner Comments

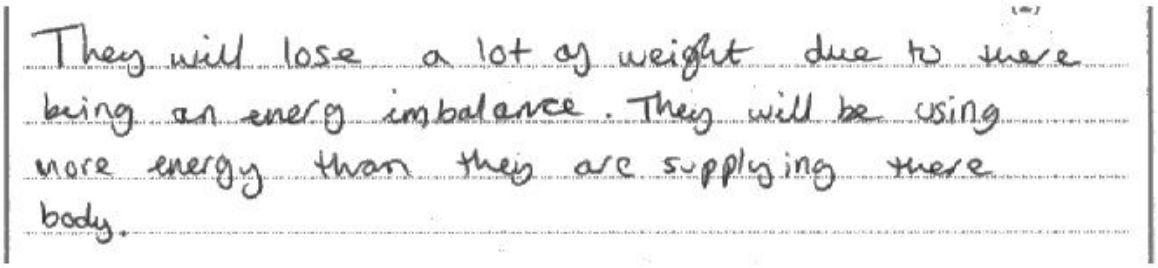
Just changing the fatty acid chain into a hydrogen is not an accurate hydrolysis reaction and only one product is shown which is not a correct glycerol molecule.
If you are asked to show the molecule**s** produced make sure you include more than just one product as things don't disappear.

Question (b)

Many candidates were able to link the diet and lifestyle to the idea that the person would lose weight but many were unable to go on and explain why for a further mark, mainly because they did not mention it in terms of an energy imbalance. Some candidates referred to fatigue and muscle wastage, but rarely mentioned the necessity for eating more carbohydrate/protein for energy balance. A few candidates looked for extreme consequences and thought that the person was likely to die as a direct result.

Some candidates referred to saturated and unsaturated fats or HDLs and LDLs, producing answers that made no sense at all in relation to the question asked.

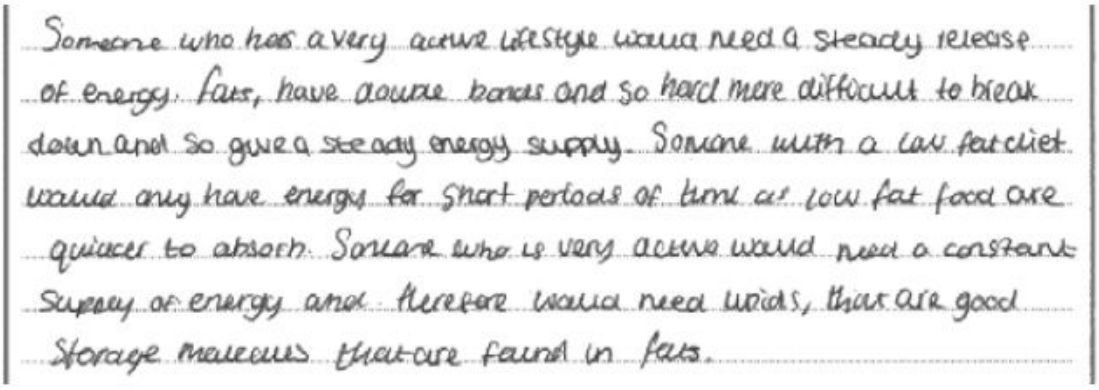
This response gained both available marks.


They will lose a lot of weight due to there being an energy imbalance. They will be using more energy than they are supplying there body.

Results Plus: Examiner Comments

This is an example of a concise response that clearly identifies a consequence (loss of weight) with the energy imbalance resulting from the situation described.

This response gained no credit.


Someone who has a very active lifestyle would need a steady release of energy. Fats, have double bonds and so hard more difficult to break down and so give a steady energy supply. Someone with a low fat diet would only have energy for short periods of time as low fat food are quicker to absorb. Someone who is very active would need a constant supply of energy and therefore would need lipids, that are good storage molecules that are found in fats.

Results Plus: Examiner Comments

This response is typical of some that described what is needed from the diet rather than the consequences of the energy imbalance.

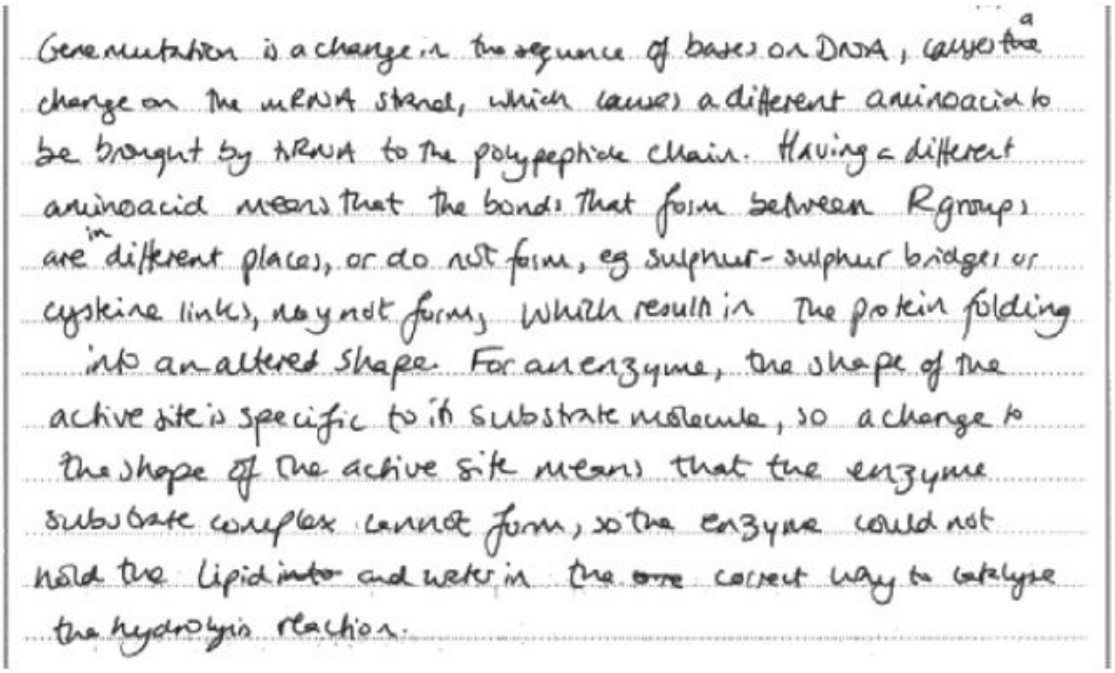
Question (c)

There was a perfect spread of marks for this question with equal numbers of candidates gaining 0, 1, 2, 3, 4, or 5 marks; with most candidates demonstrating an understanding of the relationship between genetic change and an alteration to the enzyme. Candidates who gained the higher marks in the question told a clear and detailed story of how a gene mutation leads to the non-functioning of an enzyme.

Many responses lacked detail for describing a mutation in terms of a change to the DNA sequence or a change in the base sequence of a gene. There were vague references to changes in base sequence but this was rarely qualified by the gene, and often was described with reference to the amino acid base sequence. Most were able to recognise that a mutation would lead to a change in amino acids but few linked this to a change in R groups. Candidates were able to recognise that folding changed but some vaguely mentioned that this would change the active site but did not describe what this change would be (shape or properties).

Some candidates described the normal process of protein synthesis without specifying how this would be different due to mutation, e.g. that the bonds would be in different positions, that the 3D structure would be different, therefore they were not addressing the question.

This response gained all five marks available.


Gene mutation is a change in the sequence of bases on DNA, a
cause the change on the mRNA strand, which causes a different amino acid to be brought by tRNA to the polypeptide chain. Having a different amino acid means that the bonds that form between R groups are in different places, or do not form, eg sulphur-sulphur bridges or cystine links, may not form, which result in the protein folding into an altered shape. For an enzyme, the shape of the active site is specific to it substrate molecule, so a change to the shape of the active site means that the enzyme substrate complex cannot form, so the enzyme could not hold the lipid into and water in the correct way to catalyse the hydrolysis reaction.

Results Plus: Examiner Comments

This is a typical example of the many clear and concise responses seen.
Credit was given for:
description of what a gene mutation is;
change in the amino acids;
different bonds between the R groups;
change to the folding of the protein;
the shape of the active site is changed;
enzyme-substrate complex can't form.

This response gained three of the five marks available.

A gene mutation will change the base sequence of amino acids (primary structure), therefore altering the 3D structure of the enzyme. If a different sequence is produced, the folding of the polypeptide chain will be altered and the bonds formed between the R groups will be changed. The bonds and interactions between the R group maintain the 3D shape. The lipid will not fit into the enzymes active site as the active site has a specific shape for each substrate. There will be no enzyme-substrate complexes so lipids cannot be broken down.

Results Plus: Examiner Comments

Marks were given for:
change in the 3D structure of the enzyme;
change in the bonds between R groups;
idea that the lipid does not fit the enzyme's active site.
As this is a question that assesses the quality for written communication, points must be made clearly. For example in this case changing the base sequence of amino acids has confused DNA and the primary structure of the protein so this was not given credit.

This response gained no marks.

The mutation causes a change in the gene that codes for an enzyme. This will prevent the enzyme from doing its job (breaking down lipids) resulting in a build up of these lipids. The mutation may have caused the gene that codes for the enzyme to change resulting in the creation of a different enzyme. This means the enzyme will be unable to break down lipids but may instead have the opposite function causing them to build up

Results Plus: Examiner Comments

Although this candidate has got the general idea of what is happening they have not gone much beyond restating the information in the question and have therefore not included the biological

detail and clarity needed to explain why the gene mutation results in an enzyme that can't break down lipids.
The nature of the gene mutation is not explained, neither is the change to the enzyme.

Q45.

The multiple choice questions were reasonably discriminating, for example with only about 65% of candidates correctly calculating the percentage of adenine in the sample.

"Contain ribose" and "transcription and replication can occur at the same time" were the most common incorrect responses for (i) and (ii).

Q46.

The majority of candidates gained 2, 3 ir 4 marks for this question. Most candidates understood and described the nature of the changing primary and tertiary structures and the changing bonds. However, in a number of cases these descriptions were not in a logical order and so candidates were penalised as a result.

Many candidates did not describe the possible changes in the haemoglobin properties, those that did attempt to try and describe what might happen to the properties they often described an enzyme and its active site rather than haemoglobin.

Some candidates described changes to peptide bonds.

In addition, a significant number of candidates wasted time (and space) by giving details of transcription and translation, which was not required by the question.

Q47.

Most candidates identified that water was moving into the cell by osmosis, so gaining two of the three marks available. However, many failed to explain this in terms of a solute or water potential gradient (or a description of such). Where they did most described a water concentration gradient with few describing water potential or solute concentration gradients. Surprisingly relatively few candidates went onto describe that the membrane ruptures to explain why some of the cells had burst.

The worst responses ignored water and osmosis and described the events in terms of what had happened due to the uptake of molecule W.