PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 2: STRUCTURE AND FUNCTIONS IN LIVING ORGANISMS (PACK 1)

SCORE	PERCENTAGE
/223	%

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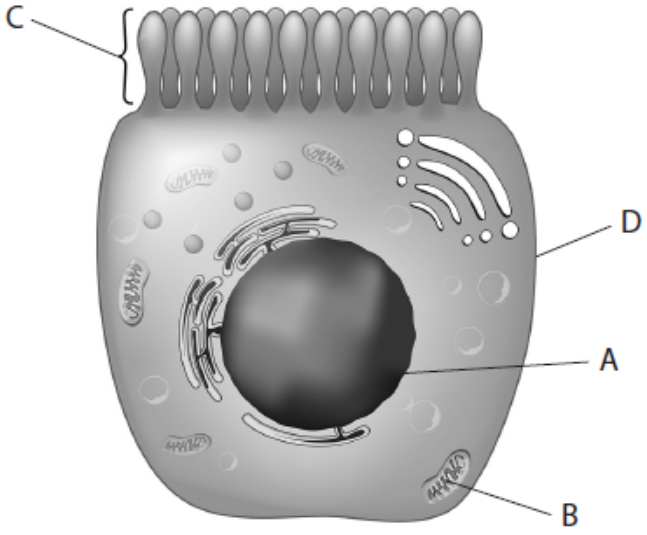
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Q1.

The diagram shows a cell found in the lining of the human small intestine.



(Source: © Designua / Shutterstock)

(a) (i) Which of the labelled structures is a microvillus?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Which of the labelled structures produces ATP?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) These cells form the lining of the small intestine.

Explain how the structure of the small intestine is adapted for absorption.

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(c) Cells in the human placenta also have microvilli.

Describe the role of the human placenta.

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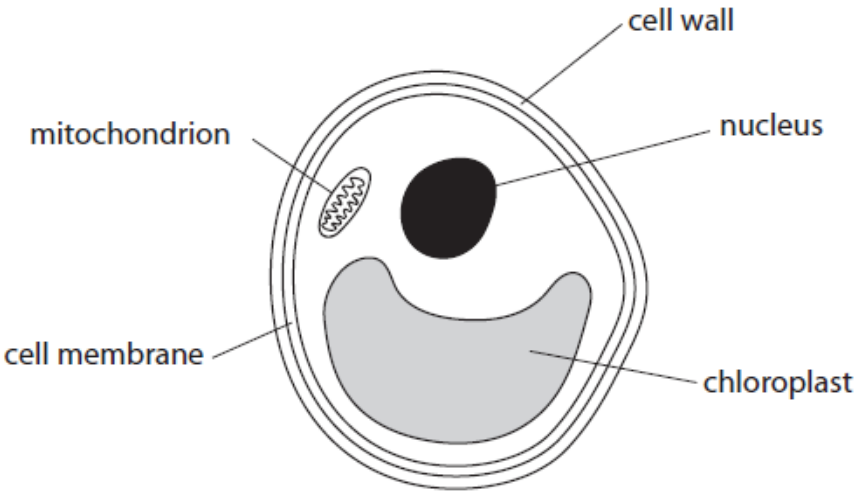
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(Total for question = 9 marks)

Q2.

The diagram shows a single-celled organism called *Chlorella* that lives in fresh water.

Chlorella has a chloroplast and can photosynthesise.



(a) (i) Which of these groups of organisms contains *Chlorella*?

(1)

☒ **A** animals

☒ **B** bacteria

☒ **C** plants

☒ **D** protoctists

(ii) Which of these labelled structures would also be present in an animal cell?

(1)

☒ **A** cell membrane and chloroplast

☒ **B** cell membrane and mitochondrion

☒ **C** cell wall and chloroplast

☒ **D** cell wall and mitochondrion

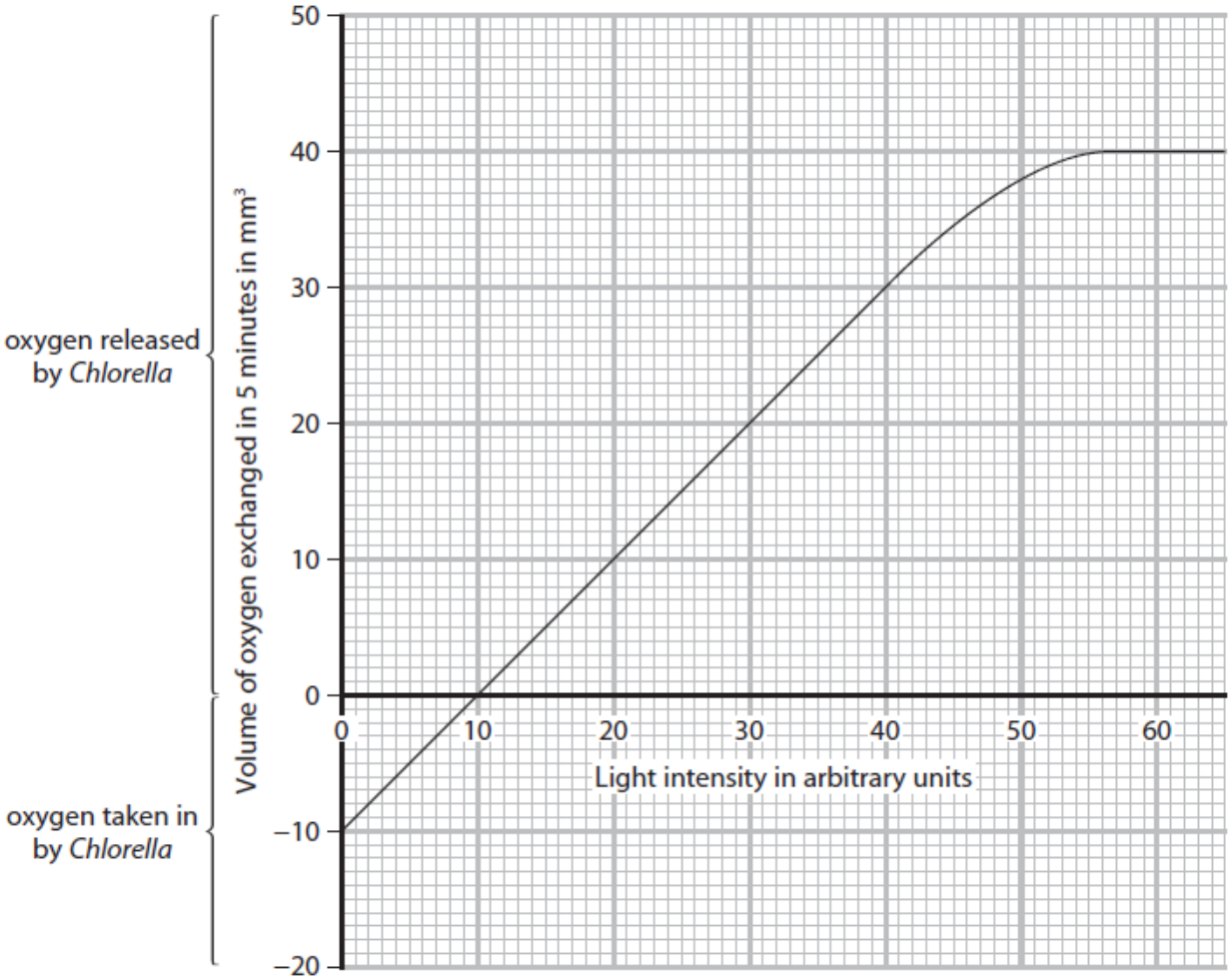
(b) Complete the balanced chemical symbol equation for photosynthesis.

(2)

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..... ⟶ ..... + $6O_2$

(c) The graph shows the effect of light intensity on gas exchange by *Chlorella*.



(i) Explain why *Chlorella* takes in oxygen at light intensities below 10 arbitrary units.

(2)

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(ii) Explain the changes in the volume of oxygen released as the light intensity increases from 10 arbitrary units.

(3)

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(iii) The volume of oxygen released by *Chlorella* is the difference between the oxygen produced by photosynthesis and the oxygen taken in.

Use the graph to calculate the volume of oxygen produced in five minutes by photosynthesis at a light intensity of 50 arbitrary units.

(2)

volume of oxygen = ... mm^3

(d) Describe how hydrogen-carbonate indicator could be used to investigate the effect of light intensity on carbon dioxide exchange by *Chlorella*.

(3)

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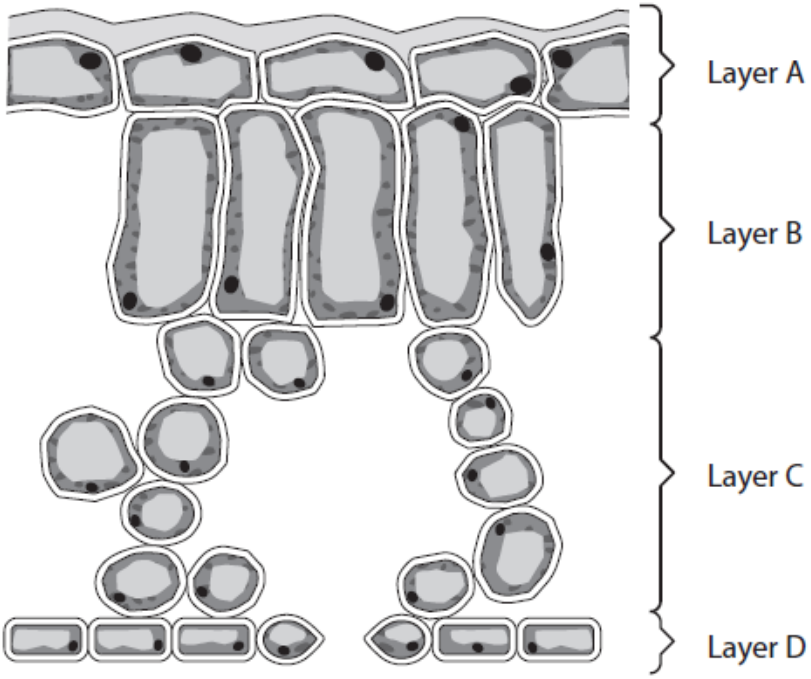
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(Total for question = 14 marks)

Q3.

The diagram shows a transverse section through a leaf.



(a) Explain how layer A is adapted for its role.

(2)

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(b) Explain how layers B and C are adapted for photosynthesis and gas exchange.

(4)

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(c) Explain how layer D is able to regulate gas exchange.

(2)

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(d) Gardeners sometimes apply a spray called an anti-transpirant to plant leaves.



The spray is impermeable to water vapour but allows other gases to pass through.

Discuss whether an anti-transpirant spray will promote plant growth.

(4)

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(Total for question = 12 marks)

Q4.

Read the passage below.

Use the information in the passage and your own knowledge to answer the questions that follow.

Toystory

Toystory is a bull who was born in 2001. The photograph shows Toystory.



In the world of dairy farming Toystory is a famous bull. He fathered 500 000 offspring but did not mate with any cows. He was able to father so many offspring because his semen was collected and then used to fertilise cows using artificial insemination.

Toystory's mother was a high milk producer and his father was a popular bull. He was sold for $4 000 by his owner to a specialist breeding company called Genex.

Genex started to collect semen from Toystory when he was four years old. The semen is carefully collected, using a teaser animal and an artificial rubber vagina.

The semen is divided into many separate samples. These samples are put in small straws and frozen in liquid nitrogen. The straws can then be sold and sent to dairy farmers around the world to inseminate their cows. A total of 2.4 million samples of semen from Toystory was sold in more than 50 countries around the world.

Toystory's reputation grew as the offspring he fathered went on to be high milk producers. His semen straws sold for over $60 each. Bull semen can now be sold as sexed or unsexed samples, with sexed samples being more expensive to purchase.

Toystory was highly valued because his offspring produced large quantities of milk of a desired composition. His semen was effective at getting cows pregnant, his daughters gave birth easily and were strong. He had a rare mix of fertility, genetics and appearance.

One of his daughters sold for $300 000 in 2009. His record number of offspring is unlikely to be beaten. This is because bulls are often retired earlier as new genetic advances are discovered.

(a) Suggest why Genex waited until Toystory was four years old before beginning to collect his semen (line 9).

(1)

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(b) Explain how the semen from the bull is used to fertilise cows using artificial insemination.

(2)

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(c) (i) Suggest why the semen is stored in liquid nitrogen (line 13).

(1)

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(ii) Sexed semen is guaranteed to produce offspring of one sex.

Suggest why dairy farmers would prefer to used sexed semen (line 19).

(1)

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(d) Determine the percentage success of Toystory's semen samples in producing offspring (line 2 and line 15).

(2)

percentage success = ... %

(e) Describe how scientists could investigate which of two bulls is the best to use as a father in dairy farming.

(3)

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(f) Explain why the composition of milk is important to consumers (line 22).

(2)

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(g) (i) Scientists are now using cloning to produce animals.

Describe the stages that are required to clone a bull.

(4)

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(ii) Give two advantages of using cloning rather than selective breeding to produce offspring.

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(Total for question = 18 marks)

Q5.

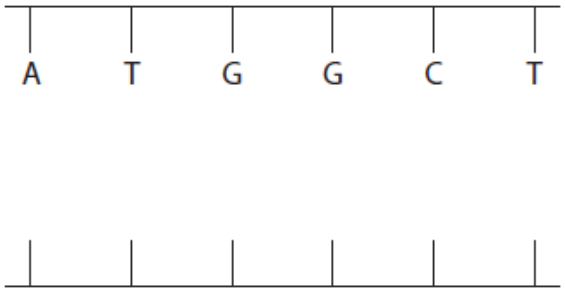
Decomposer bacteria are involved in the nitrogen cycle.

The bacteria release an enzyme called urease.

(a) The diagram shows part of one strand of DNA used to make urease.

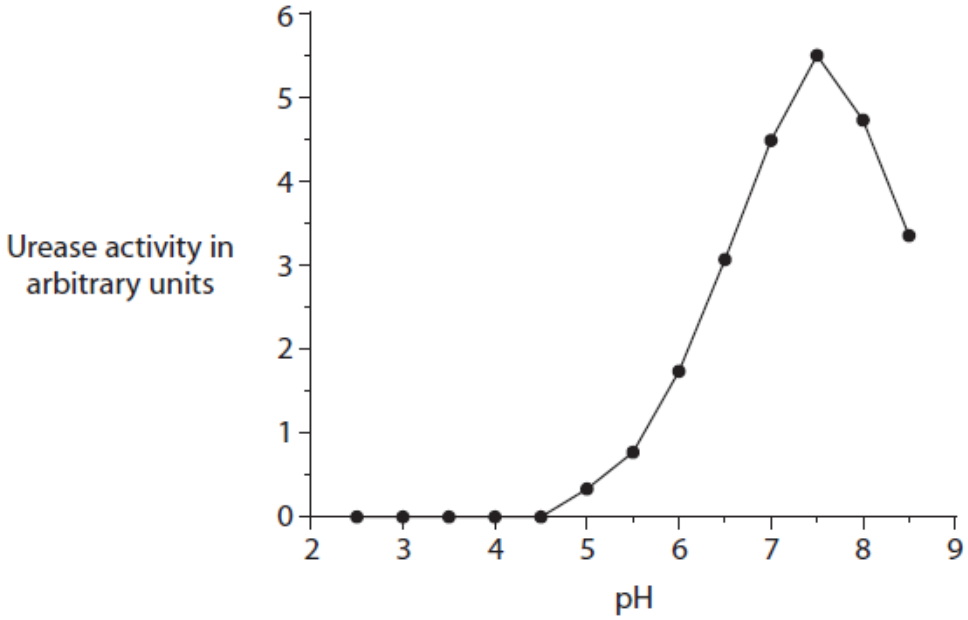
Complete the diagram by giving the missing bases on the other strand of DNA.

(1)



(b) Urease acts on urine to produce ammonia.

The graph shows how pH affects the activity of urease.



(i) Which of these is the optimum pH for urease?

(1)

- ☒ **A** 2.5
- ☒ **B** 4.5
- ☒ **C** 7.5
- ☒ **D** 8.5

(ii) Explain the activity of urease at pH 8.5

(2)

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(c) Describe the role of the other bacteria involved in the nitrogen cycle.

(5)

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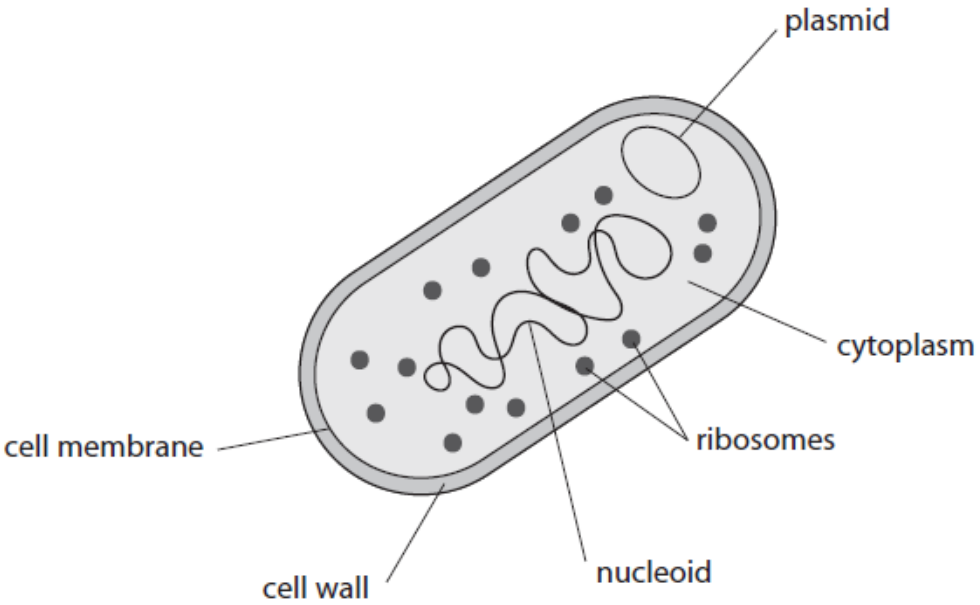
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(Total for question = 9 marks)

Q6.

P. multocida is a bacterium that causes cholera in chickens.

The diagram shows the bacterium.



(a) Give two structures in this bacterium that are also found in all eukaryotic cells.

(2)

1 .....

2 .....

(b) Scientists investigated the survival of chickens injected with normal *P. multocida* or with weakened *P. multocida*.

The table shows the scientists' results.

Type of injection	Result
normal *P. multocida*	chickens die
weakened *P. multocida*	chickens stay alive

(i) What is a correct conclusion about *P. multocida* from these results?

(1)

☒ **A** they are decomposers

☒ **B** they are pathogens

☒ **C** they are microscopic

☒ **D** they are non-living

(ii) The scientists took the living chickens that had been injected with weakened *P. multocida* and then injected them with normal *P. multocida*.

The chickens did not die, as they were now immune.

Explain why these chickens did not die.

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(Total for question = 7 marks)

Q7.

Beta thalassaemia is a genetic condition caused by a mutation in a gene for haemoglobin.

People with beta thalassaemia produce less haemoglobin and fewer red blood cells than people without the condition.

(a) Explain why people with beta thalassaemia may experience severe tiredness.

(2)

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(b) A new treatment for beta thalassaemia has been developed that edits the haemoglobin gene. These are the steps in the treatment.

• remove blood stem cells from a patient's bone marrow

• put a strand of RNA and an enzyme into the blood stem cells to correct the haemoglobin gene

• use drugs to destroy the patient's remaining bone marrow cells

• replace the patient's bone marrow cells with the modified stem cells

The modified stem cells that are in the bone marrow now produce red blood cells containing sufficient haemoglobin.

(i) The strand of RNA used in this treatment is complementary to one strand of the DNA in the haemoglobin gene.

Give the base sequence of RNA that is complementary to this sequence of DNA.

(2)

DNA strand A A T G G C G G C T C A

RNA strand
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(ii) Protein synthesis of the modified gene will produce haemoglobin.

Describe the stages of this protein synthesis.

(4)

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(iii) The standard treatment for beta thalassaemia is a weekly blood transfusion.

The new treatment has so far been tested on two patients, with these results.

• both patients started making large numbers of red blood cells with sufficient haemoglobin

• both patients experienced serious side effects from the drugs used, needing to spend several months in isolation in hospital before recovering

• 15 months after the treatment, neither patient required further blood transfusions

• both patients were able to exercise normally without feeling tired

Evaluate the use of the new treatment compared to weekly blood transfusions.

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(Total for question = 12 marks)

Q8.

The biodiversity in an ecosystem can be determined by counting the number of different species present and the number of individuals of each species present.

(a) Give the term that describes the number of individuals of one species present in a habitat at one time.

(1)

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(b) Students compared the biodiversity of two fields, A and B.

They determined the number of individual plants of three species in each field.

They also calculated the percentage of each species of plant compared to the total number of plants of all three species for each field.

The table shows the results.

Species	Field A		Field B	
	Number of each plant	Percentage (%) of each species	Number of each plant	Percentage (%) of each species
daisy	19	76	15	
dandelion		16	18	38
buttercup		8	14	30
total	25	100	47	100

(i) Complete the table by calculating the missing values.

(2)

(ii) Explain which field has the greater biodiversity.

(2)

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(c) Explain how a shortage of one named mineral could affect the size of plants in the fields.

(2)

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(Total for question = 7 marks)

Q9.

Blood clotting is an important process in humans.

The process is controlled by enzymes.

(a) (i) Give two reasons why blood clotting is important.

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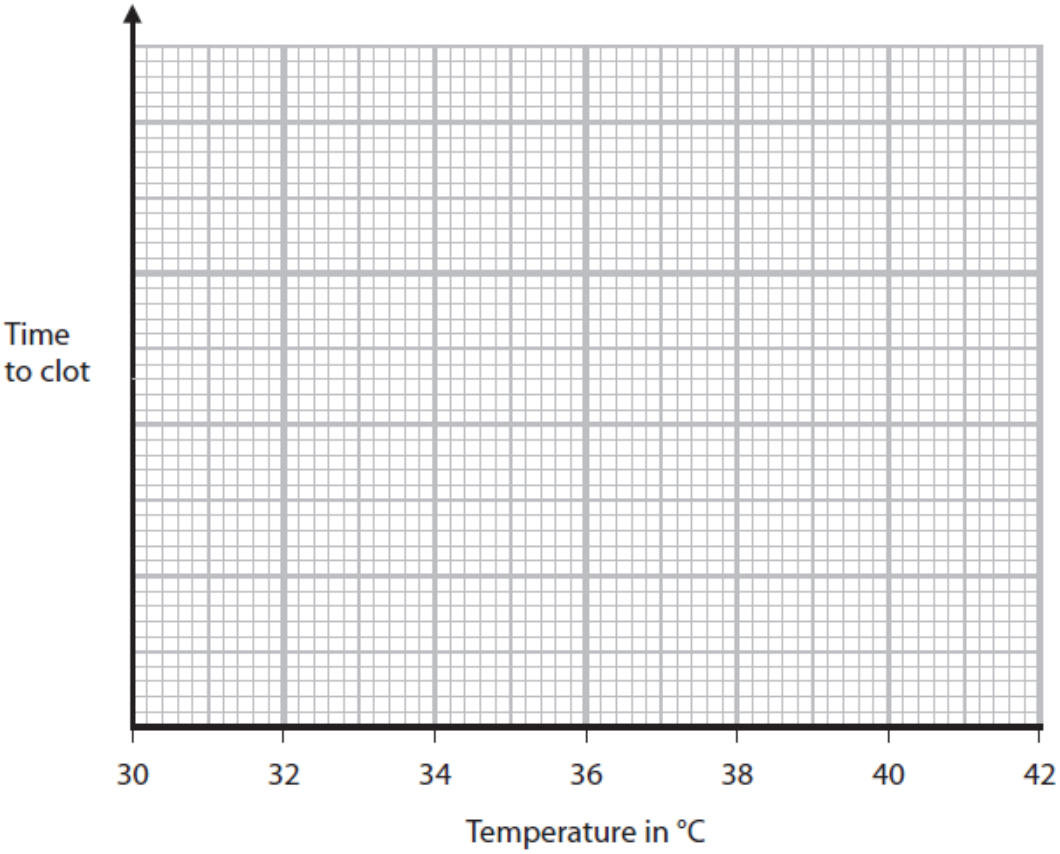
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(ii) The optimum temperature for the enzymes involved in blood clotting is 37 °C.

Sketch a graph to show how temperature affects the time taken for blood to clot.

(1)



(b) Some people cannot make the proteins needed for blood clotting.

Cloning is used to produce large numbers of transgenic mammals.

These transgenic mammals can make the human blood-clotting proteins. The human blood-clotting proteins can then be removed from the mammals' milk and injected into people who cannot make the proteins.

(i) Explain why these mammals are described as transgenic.

(2)

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(ii) Describe how a mammal is cloned.

(6)

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(Total for question = 11 marks)

Q10.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Making Enough Blood for the World

A blood transfusion is the transfer of blood from a donor into a patient. Blood transfusions are routine medical procedures that save the lives of millions of people every year.



(Source: beerkoff/Shutterstock)

The first successful blood transfusions were performed in the early twentieth century after scientists discovered that there are four main blood groups, A, B, AB and O. The blood groups are due to the presence of proteins, called antigens, on the surface of red blood cells. There are two main protein antigens called A and B. If a patient is given blood with antigens different to their own cells, their immune system will make antibodies against that antigen. The antigens present on the surface of red blood cells for each blood group are shown in the table.

Blood group	Antigens present
A	A
B	B
AB	A and B
O	neither A nor B

Currently, blood transfusions are carried out with blood that has been donated by healthy people. The World Health Organisation calculates that there are 118.5 million blood donations collected globally every year. Of these donations, 40% are collected from a small group of high-income countries. This means that there is a shortage of blood in many countries so the hunt is on to find an alternative.

Scientists have found a way to make artificial red blood cells. They made spheres of cell membranes filled with haemoglobin. These artificial cells are then suspended in sodium chloride solution. These artificial red blood cells have no proteins on their surface. Another way of making red blood cells is being developed in the United Kingdom. A research team has used stem cells to produce red blood cells with blood group O. The red blood cells produced are then suspended in sodium chloride solution.

Both methods produce large quantities of safe red blood cells. There may be other advantages as well, artificial blood would always have the same concentration of solutes and will not clot when stored. Critics have pointed out that the artificial blood will only transport oxygen and that blood has many more functions.

(a) Name the type of cell that produces antibodies. (Lines 8 and 9)

(1)

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(b) Human blood groups are controlled by three alleles, I^A, I^B and I^O.
The I^A and I^B alleles are codominant and the I^O allele is recessive.

(i) State what is meant by the term **codominant**.

(1)

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(ii) Two parents have genotypes of I^AI^O and I^BI^O.

Which of these are all the possible blood groups of their children?

(1)

☒ **A** A and B

☒ **B** A, B and O

☒ **C** AB and O

☒ **D** A, B, AB and O

(c) Calculate the number of blood donations collected per year from the high-income countries. (Lines 14 and 15)

Give your answer in standard form.

(2)

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(d) Some scientists have suggested that spherical artificial red blood cells transport oxygen less

efficiently than normal human red blood cells.

Explain why the shape of the artificial red blood cells reduces the efficiency of oxygen transport compared to normal human red blood cells. (Lines 18 and 19)

(3)

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(e) Suggest why artificial blood does not clot when stored. (Lines 26 and 27)

(1)

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(f) Explain why the artificial red blood cells are suspended in sodium chloride solution instead of in water. (Line 20)

(2)

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(g) (i) Explain why stem cells can be used to make large quantities of red blood cells. (Lines 22 and 23)

(2)

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(ii) Suggest why the scientists made red blood cells with blood group O. (Lines 22 and 23)

(2)

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(h) Give two substances found in blood plasma that are not present in the artificial blood. (Lines 28 and 29)

(2)

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2 .....

(Total for question = 17 marks)

Q11.

As an embryo develops, its cells differentiate.

(a) Explain the importance of cell differentiation in the development of the growing embryo.

(2)

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(b) (i) Which of these is a feature of adult stem cells?

(1)

☒ **A** they do not divide

☒ **B** they divide by meiosis

☒ **C** they can become all cell types

☒ **D** they are found in some tissues and organs

(ii) Adult stem cells or embryonic stem cells can be used in medical treatments.

Explain why the choice between these two types of stem cells can cause issues for doctors.

(2)

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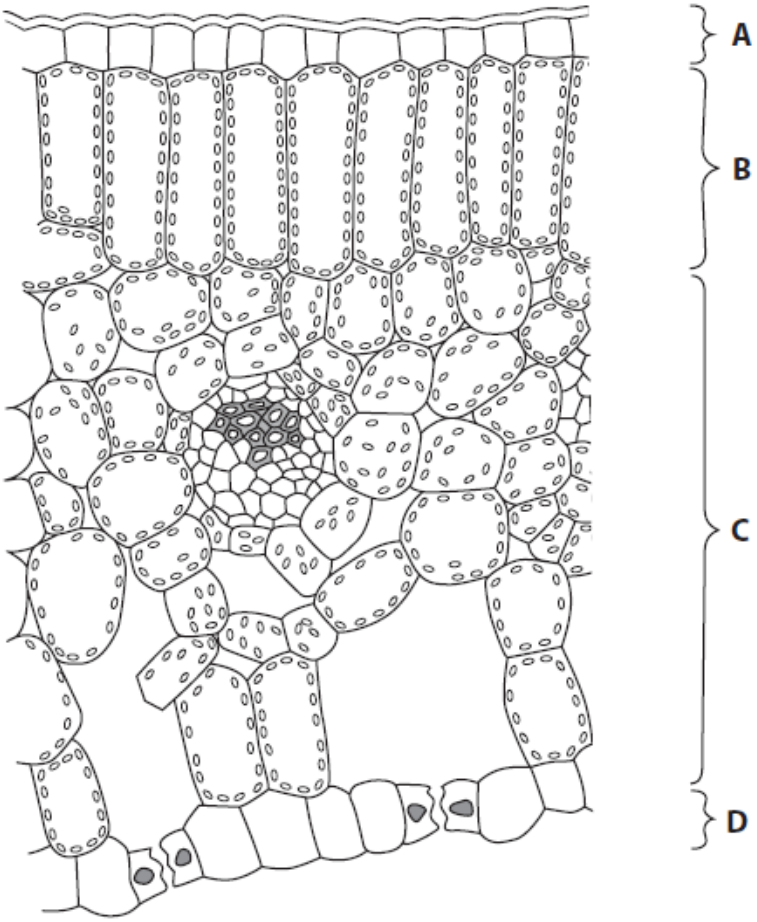
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(Total for question = 5 marks)

Q12.

The diagram shows a cross-section through a leaf.



(a) (i) Which layer contains palisade mesophyll cells?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Which set of environmental conditions would produce the fastest rate of transpiration from this leaf?

(1)

	Humidity	Temperature
☒ **A**	High	High
☒ **B**	High	Low
☒ **C**	Low	High
☒ **D**	Low	Low

(b) Scientists investigate the effect of changing carbon dioxide concentration on the density of stomata of wheat plants.

They grow wheat plants from seed in different concentrations of carbon dioxide.

After three weeks, they take a leaf from each plant and calculate the mean density of stomata.

(i) State the independent variable in this investigation.

(1)

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(ii) Give two abiotic variables that the scientists could control.

(2)

1 .....

2 .....

(iii) To calculate the mean density of stomata, leaf sections are viewed with a microscope.

The number of stomata within six circular areas of the leaf are counted.

The results for one leaf are shown in the table.

Leaf area number	Per number of stomata
1	68
2	72
3	66
4	75
5	76
6	63

The radius of each circular area is 0.40 mm.

area of circle = $\pi r2$

[π = 3.14]

Calculate the mean density of stomata on the leaf surface.

(3)

mean density = ... stomata per mm^2

(iv) The investigation shows that in increased carbon dioxide concentrations there is a lower mean density of stomata.

The scientist concludes that in hot dry areas, with increased carbon dioxide concentrations, it would be an advantage for wheat to have a lower mean density of stomata.

Discuss the scientist's conclusion.

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(Total for question = 12 marks)

Q13.

The brain is part of the central nervous system.

(a) Name the other part of the central nervous system.

(1)

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(b) Huntington's disease (HD) is caused by a mutation in the gene for making a protein called huntingtin.

This protein damages nerve cells in the brain.

HD is caused by a dominant allele.

A heterozygous parent and a homozygous recessive parent have a child.

(i) What is the probability of this child having HD?

(1)

☒ **A** 0.0

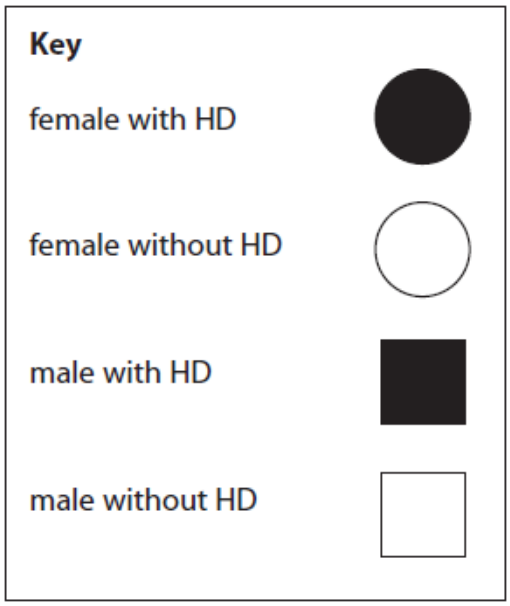
☒ **B** 0.25

☒ **C** 0.5

☒ **D** 1.0

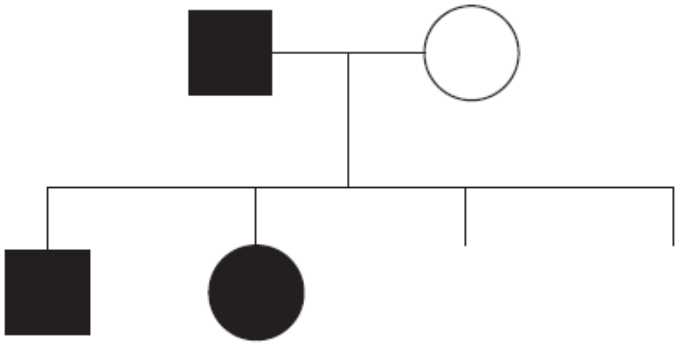
(ii) These parents have three more children.

The key shows the possible sex and phenotype of the individuals with or without HD.



The family pedigree gives the predicted sex ratio and the predicted phenotype ratio for two of the children. Complete the family pedigree by giving the predicted sex ratio and predicted phenotype ratio for the other two children.

(2)



(c) A drug can reduce the damage to nerve cells in the brains of people with HD.

The drug binds to messenger RNA produced by the mutated gene for huntingtin protein.

Suggest ways that this drug reduces damage to nerve cells in people with HD.

(3)

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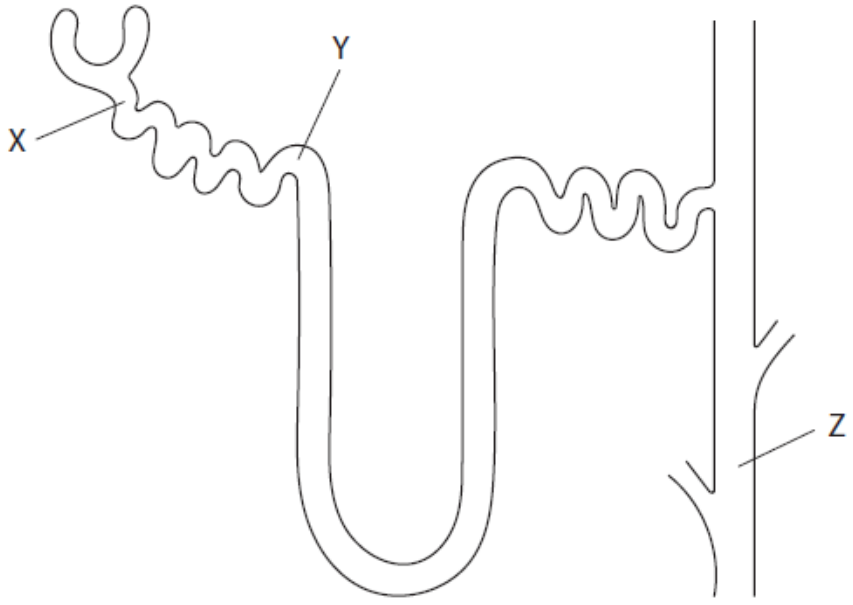
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(Total for question = 7 marks)

Q14.

The diagram shows a nephron from a kidney with three different areas, X, Y and Z.



The table gives the concentration of glucose and urea at X, Y and Z.

Area of nephron	Concentration of glucose in mg per 100 cm^3	Concentration of urea in mg per 100 cm^3
X	90	32
Y	0	440
Z	0	1700

(a) Explain the difference in concentration of glucose between X and Y.

(3)

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(b) (i) Calculate how many times more concentrated the urea is in area Z compared to area Y.

Give your answer to two significant figures.

(2)

answer = ...

(ii) Explain the difference in urea concentration in the filtrate found in Y and Z.

(2)

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(c) High blood pressure during pregnancy can result in the production of urine that contains

protein.

(i) Describe how a sample of urine could be tested to see if it contains protein.

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(ii) Protein is not normally found in urine.

Suggest why high blood pressure could cause protein to be present in urine.

(2)

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(Total for question = 11 marks)

Q15.

A teacher carries out a demonstration to show the effect of different concentrations of salt solution on red blood cells.

This is the teacher's method.

- dilute a sample of blood using a salt solution that has the same concentration as blood plasma
- place 1 cm^3 of the diluted blood into each of three test tubes labelled A, B and C
- add 10 cm^3 of water to tube A

- add 10 cm^3 of 1% sodium chloride solution to tube B
- add 10 cm^3 of 5% sodium chloride solution to tube C
- leave each tube for 5 minutes
- compare the cloudiness of the solutions in the three test tubes
- take a drop of liquid from each tube and put on separate microscope slides
- observe each slide under a microscope

(a) State the independent variable in this investigation.

(1)

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(b) Give one variable that the teacher controls in this investigation.

(1)

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(c) After 5 minutes, these are the teacher's observations.

- tube A – a clear red solution
- tube B – a cloudy red suspension
- tube C – a cloudy red suspension

(i) Explain the differences in the teacher's observations.

(2)

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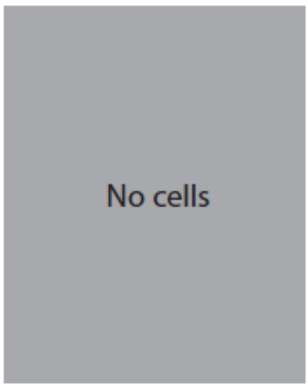
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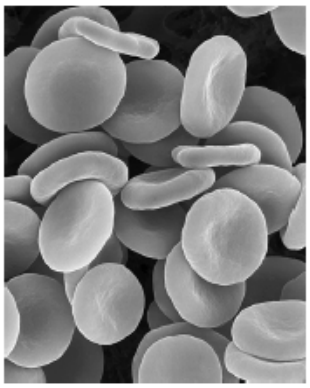
(ii) When the teacher looks down a microscope for cells on each slide, these are the teacher's observations.

- slide from tube A – no cells are seen
- slide from tube B – normal biconcave red cells are seen
- slide from tube C – red cells are seen but the cells have shrunken edges

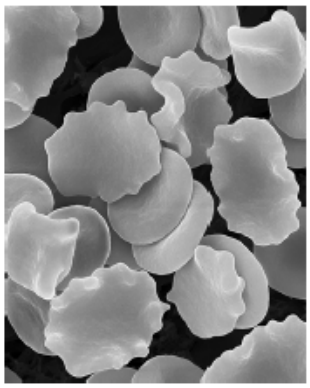
The photographs show the teacher's observations.



Tube A



Tube B



Tube C

(Source: © Dennis Kunkel Microscopy / Science Photo Library)

Explain the differences between the teacher's observations of the slides from each tube.

(2)

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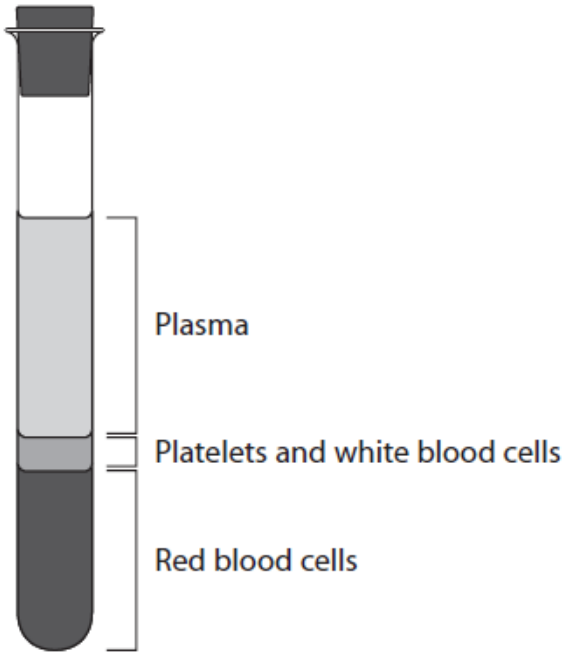
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(d) Blood samples can be separated into different layers using a centrifuge.

This is a machine that spins blood at a high speed.

A new sample of blood is shown after it has been spun in a centrifuge.



Describe how the blood in tubes A, B and C from the teacher's demonstration would look after they had been spun in a centrifuge.

(2)

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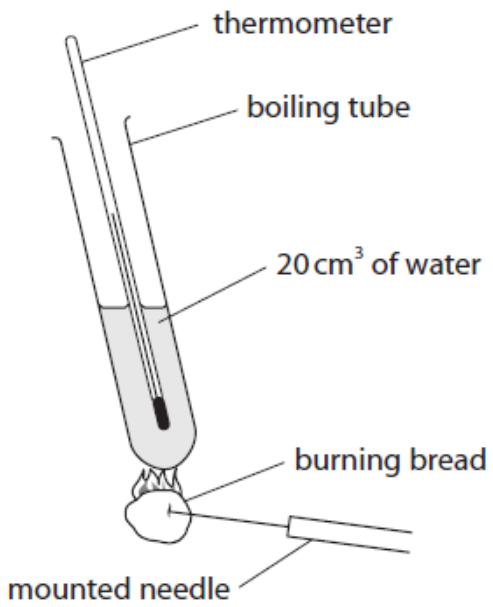
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(Total for question = 8 marks)

Q16.

A student uses this method to measure the energy value of a sample of bread.

- measure the mass of a sample of bread
- put 20 cm^3 of water in a boiling tube
- place a thermometer in the boiling tube and record the initial temperature of the water
- place the sample of bread on a mounted needle
- light the bread sample in a Bunsen flame
- quickly move the burning bread sample and place it directly under the boiling tube
- if the bread stops burning, relight the bread in the Bunsen flame
- place it back under the boiling tube
- repeat until the bread does not burn
- record the final temperature of the water in the boiling tube



The student repeats the experiment 3 times.

The table shows some of the student's results.

Initial temperature of water in °C	Final temperature of water in °C	Increase in water temperature in °C	Energy released in J	Mass of bread sample in g	Energy released by 1 g of bread in J
20	33	13	1092	0.25	4368
20	34	14	1176	0.30	3920
21	36			0.20	

(a) To calculate the energy released from the burning bread the student uses this formula.

energy (in J) = mass of water (in g) × 4.2 × increase in temperature (in °C)

They then calculate the energy in joules released by 1 g of bread.

(i) Calculate the increase in water temperature for the third sample of bread.

(1)

temperature increase = ... °C

(ii) Calculate the energy released in joules by the third sample of bread.

[1 cm^3 of water has a mass of 1 g]

(1)

energy released = ... J

(iii) Calculate the energy released in joules by 1g of bread for the third sample of bread.

(1)

energy released by 1g = ... J

(b) The energy value given on the packaging of the bread is 10 400 J for 1 g of bread.

Comment on why the student's method gives a different value.

(5)

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(c) Give two ways that the student could modify this apparatus to achieve an answer nearer to the energy value given on the packaging of the bread.

(2)

1 .....

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2 .....

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(Total for question = 10 marks)

Q17.

Gas exchange in a flowering plant changes depending on conditions.

(a) Complete the passage by writing a suitable word or words in each blank space.

(5)

Plants carry out photosynthesis to produce ..... . To enable this process to occur the leaf cells absorb carbon dioxide and release oxygen.

At the same time the cells in the leaves are respiring. This means that they are using ..... and producing carbon dioxide. If the leaves are in bright sunlight, then the rate of photosynthesis will be ..... than the rate of respiration.

If the leaves are in dim light, then the rate of respiration will be greater than the rate of photosynthesis and there will be a net production of ..... .

In conditions when there is no net absorption or release of carbon dioxide the rate of photosynthesis and respiration are ..... and the plant is at its compensation point.

(b) Describe how you could use hydrogen-carbonate indicator to investigate the effect of light intensity on net gas exchange in a leaf.

(3)

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(Total for question = 8 marks)

Q18.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Badgers and bovine tuberculosis

The bacterium *Mycobacterium bovis* causes the lung disease bovine tuberculosis (TB) in cattle. Infected cattle have damaged lungs, which causes gas exchange problems and makes them cough into the air. The pathogen spreads to humans if they inhale air containing the bacterium. Humans also become infected if they drink unpasteurised milk from infected cattle. Milk is usually pasteurised by heating it for a period of time at a high temperature.

Bovine TB can kill humans. In one year, 13 400 people died from a total of 149 000 reported cases of TB. Some of these cases were from Europe, where 103 people died from 1290 reported cases. The rest of the cases were from outside Europe.

Some farmers in the United Kingdom are concerned that badgers spread the TB pathogen to cattle.

The photograph shows a badger.



Badgers act as a reservoir for the TB pathogen and can live for several years without showing any signs of TB. Some farmers want badgers to be culled (killed) to stop the spread of bovine TB to cattle.

However, some scientists claim that only a fraction of cattle catch TB from badgers, and that culling badgers could spread the disease to new areas. This is because badger culling changes the behaviour of the badgers that survive. Normally, badgers live in social groups and will defend their territory from other badgers by being aggressive. This territorial behaviour reduces the spread of disease between groups. If badgers are culled, then their territories cannot be defended. Surviving badgers could move in to occupy the undefended territory, bringing TB with them. This could spread TB to new animals and new areas.

Some people believe that badgers should be vaccinated to stop the spread of TB. However, there is some concern that vaccination may increase the spread of TB because it might also change badger behaviour.

An investigation is needed to find out if badger vaccination can reduce TB both in badgers and in cattle.

(a) Explain why cattle with damaged lungs have gas exchange problems (lines 2 to 3).

(2)

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(b) Explain the advantage of drinking pasteurised milk rather than unpasteurised milk (lines 4 to 5).

(2)

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(c) Suggest two reasons why there were fewer cases of bovine TB in Europe compared with outside Europe (lines 7 to 9).

(2)

1 .....

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2 .....

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(d) The case to death ratio in Europe is 12.5 : 1 (lines 7 to 9).

Calculate the case to death ratio from outside Europe.

(2)

case to death ratio = ...

(e) Territorial behaviour reduces the spread of disease between badger groups (lines 19 to 20).

Suggest two other ways that badgers benefit from territorial behaviour.

(2)

1 .....

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2 .....

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(f) Explain how vaccination reduces the risk of infection in badgers (line 24).

(3)

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(g) Describe how scientists could find out if badger vaccination reduces TB in cattle (lines 27 to 28).

(3)

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(Total for question = 16 marks)

Q19.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Global warming and the Great Barrier Reef

The Great Barrier Reef is found in the sea off the North-East coast of Australia. It is the largest coral reef in the world.



Coral reefs are underwater ecosystems. Coral grows best on rock found in shallow, clear moving water. The coral is made from a hard calcium shell that contains small animals. Inside the bodies of these animals there are microscopic organisms called algae. These animals and algae have a mutualistic relationship. In a mutualistic relationship, both species benefit by living together.

A scientific study found that higher sea temperatures in 2016 caused the worst destruction of corals ever recorded on Australia's Great Barrier Reef. Many scientists believe that the increase in sea temperature is the result of an increase in carbon dioxide in the atmosphere.

About 70% of coral died in the northern section of the reef. One of the worst-hit areas was around Lizard Island in North Queensland, where almost 90% of the coral died. The situation was better in the central section, where only about 5% died. The southern section of the reef was healthy. Scientists warn that recovery of the coral reefs will be difficult if climate change continues.

Some coral death is the result of overheating. However, far more coral has been lost through bleaching. Coral bleaching happens when sea temperatures rise for a long period of time. The algae cannot survive so the coral starves. The pigments in the algae give coral its colour. After bleaching, the coral appears white because it is now without the colourful algae that provide its main source of energy.

Some coral survives the higher sea temperatures. However, another study has found that this coral has now come under increased threat from predators such as snails and the crown-of-thorns starfish.

Scientists are hopeful that the reef is capable of recovery, but fear it may not have an opportunity as sea temperatures continue to rise. The Australian Government has published recommendations in a long-term sustainability plan for the coral reef.

(a) What is meant by the term **ecosystem** (line 3)?

(2)

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(b) Suggest how the mutualistic relationship between the small animals and the algae inside them is of benefit to both species (lines 6 and 7).

(2)

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(c) (i) Explain why coral grows best in shallow, clear water (lines 3 and 4).

(2)

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(ii) Suggest why coral grows best in moving water (lines 3 and 4).

(2)

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(d) Suggest how scientists are able to find the percentage of coral that has died in a section of the reef.

(3)

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(e) Give one reason why coral that survives higher sea temperatures is under increased threat from predators (lines 22 to 24).

(1)

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(f) Suggest what recommendations should be included in the sustainability plan for the coral reef (lines 26 and 27).

(3)

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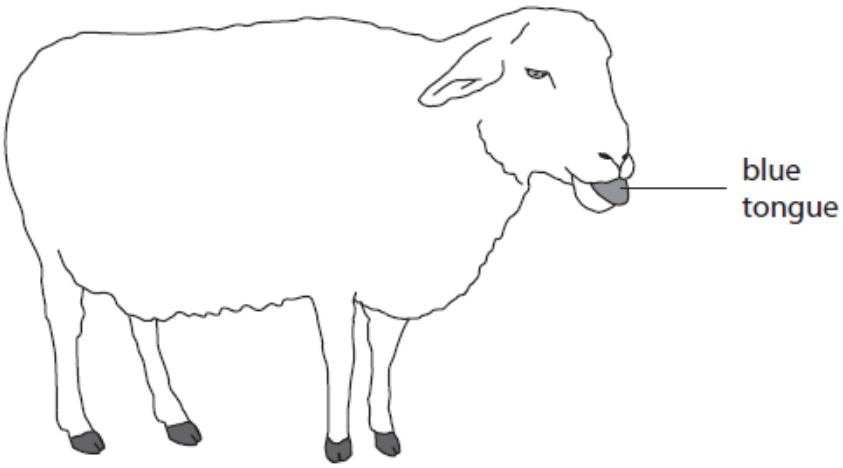
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(Total for question = 15 marks)

Q20.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Bluetongue disease in sheep



Global warming can lead to biological consequences. Some insects are vectors for disease. These insects can move to habitats that were previously too cold for their survival. These insects spread diseases, such as malaria, when they feed on the blood of animals that they bite. Warmer air temperatures increase the rate at which insects reproduce, as well as increasing the number of times that the insects bite animals to feed on their blood.

Bluetongue is a disease that affects sheep. It is common in countries in southern Europe, but was not found in the UK until 2007. The disease has been found in sheep further north in the UK since 2007. Bluetongue is caused by a virus that is spread by a small insect, called a midge. Although there are about 995 species of midge, only 20 species are vectors for the bluetongue virus.

One symptom of bluetongue is fever. When a sheep has a fever, its body temperature rises. If the sheep's temperature becomes very high, it can affect enzymes in sheep cells, which can lead to the death of the sheep. Sheep do not sweat, but can lower their body temperature by panting. Panting involves blowing air out of the lungs over the tongue. Another symptom is swelling of the lips and the tongue, which change colour from pink to blue. The blue colour is caused by reduced blood circulation, and it gives the disease its name.

Bluetongue is difficult to treat. It is possible to prevent the disease by vaccination or by controlling the midge vector. The disease can also be controlled by quarantining infected sheep. This involves keeping the infected sheep indoors, away from other sheep.

The cabins of aircraft arriving from other countries are often sprayed with insecticide to kill any insects that may have been present.

(a) The spread of bluetongue may be one consequence of global warming (line 1).

Explain one other biological consequence of global warming.

(2)

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(b) Suggest how the midge acts as a vector (line 1).

(1)

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(c) Explain why sheep with bluetongue need to pant (line 14).

(2)

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(d) Give **one** reason why bluetongue was not found in the UK before 2007 (line 7).

(1)

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(e) Calculate the percentage of midge species that are vectors of the bluetongue virus (line 10).

(2)

percentage = ... %

(f) Explain why the lips of sheep with bluetongue turn blue (line 16).

(2)

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(g) Explain how vaccination could protect a sheep from bluetongue (line 19).

(3)

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(h) Explain how quarantine could protect sheep from bluetongue (line 20).

(2)

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(Total for question = 15 marks)

D is not correct as it is not the microvilli