

OCR GCSE GATEWAY BIOLOGY A • J247

BIOLOGY



EXAM QUESTION PACK

B1.2 WHAT HAPPENS IN CELLS (AND WHAT DO CELLS NEED?)

SCORE

/171

PERCENTAGE

%

STEMUP

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Gateway Biology A (9-1)

What happens in cells (and what do cells need)?

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname								
Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **171**.
- The total number of marks may take into account some 'either/or' question choices.

1 How many strands are in a DNA molecule?

- A 1
- B 2
- C 3
- D 4

Your answer

[1]

2 In DNA, which base does A (adenine) pair with?

- A A
- B C
- C G
- D T

Your answer

[1]

3 Which molecule is **not** a polymer?

- A DNA
- B lipid
- C protein
- D starch

Your answer

[1]

4(a) A group of students investigate the effect of temperature on the breakdown of the fat in milk by the enzyme lipase.

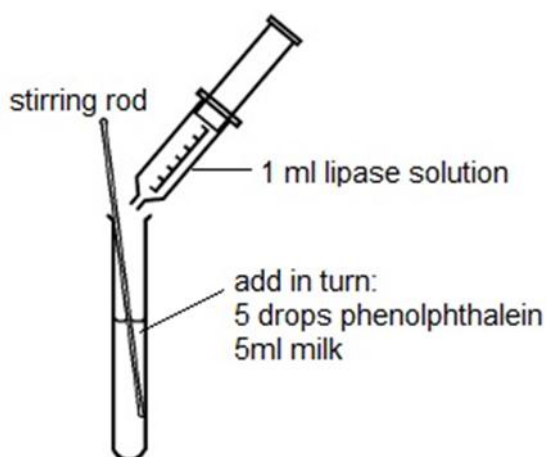
In their investigation they use an indicator called phenolphthalein.

Phenolphthalein is pink in alkali conditions but becomes colourless when the pH falls below pH8.

A student puts 5 drops of phenolphthalein and 5 ml of full fat milk into a test tube.

She adds 1 ml of lipase, stirs the mixture and times how long it takes to lose the pink colour.

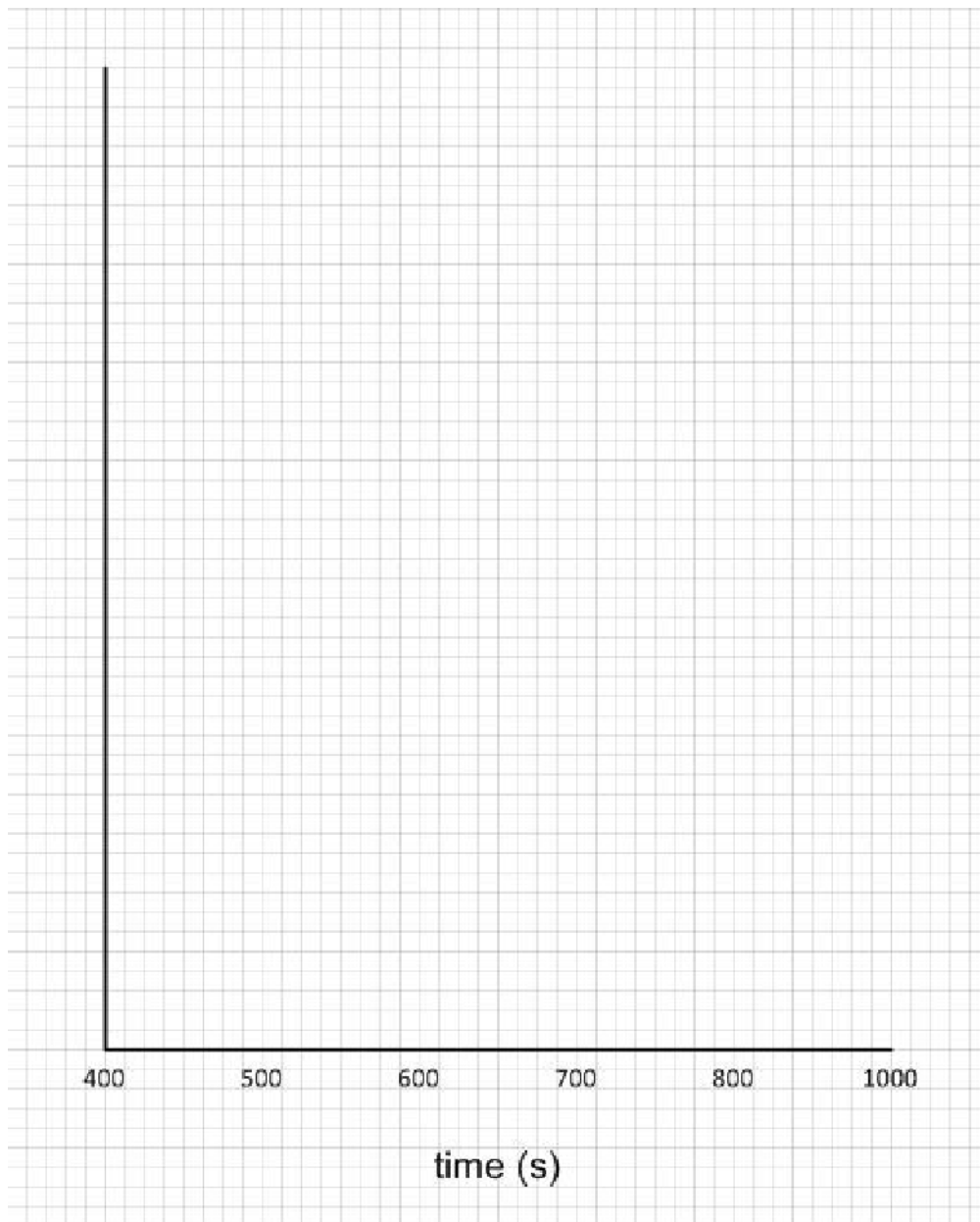
Other students repeat this but at different temperatures.



The table shows the group's results.

Temperature (°C)	Time for pink colour to disappear (s)
20	480
40	240
60	270
80	960

Plot a graph of the results and draw a line of best fit.



[5]

(b) Explain the difference between the results at 20 °C and 40 °C.

[3]

(c) Explain the difference between the results at 80 °C and 40 °C.

[3]

(d)

(i) One student says that the results show that the optimum temperature for the lipase is 40 °C.

The teacher says that she **cannot** say for certain that it is 40 °C.

Explain why.

[1]

(ii) Give **two** reasons how the students could modify their method to find out the optimum temperature more accurately.

[2]

(e) The students rounded their times to the nearest 10 seconds.

They did this because they found it difficult to judge exactly when the pink colour had disappeared.

Describe and explain **two** ways the method could be improved to give more accurate measurements.

1

2

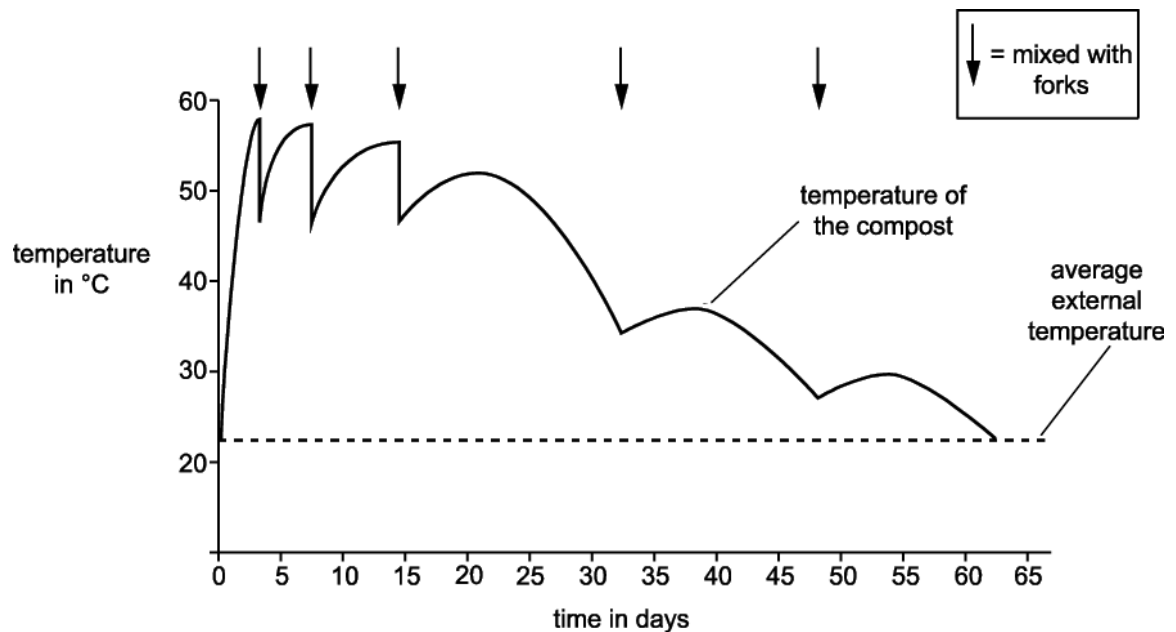
[2]

5 Some students measured the temperature inside a compost heap.

They also measured the external temperature.

On five occasions they mixed up the compost heap with garden forks.

The graph shows their results.



- (i) The compost took 63 days to completely decompose.

Explain how the students could tell this from their graph.

----- [1]

- (ii) The rate of temperature increase is greatest before the compost is mixed for the first time.

Explain how the rate of temperature change can be calculated.

----- [1]

6 In DNA, which base does T (thymine) pair with?

- A T
- B C
- C G
- D A

Your answer

[1]

7 Which molecule is **not** a polymer?

- A DNA
- B lipid
- C protein
- D starch

Your answer

[1]

8 Insulin is a protein made of 51 amino acids.

How many bases are in the length of DNA coding for insulin?

- A 51
- B 102
- C 153
- D 204

Your answer

[1]

9(a) A group of students investigate the effect of temperature on the breakdown of the fat in milk by the enzyme lipase.

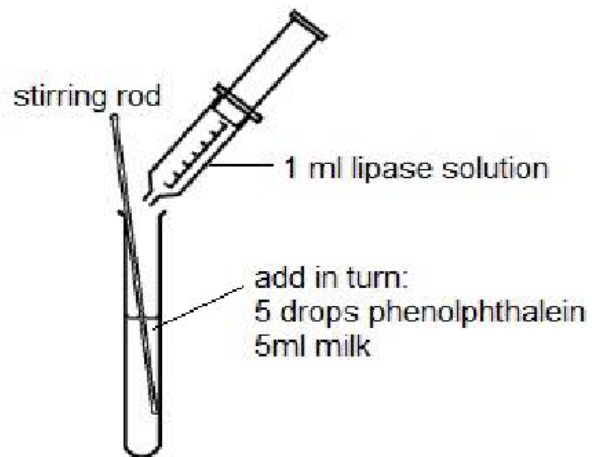
In their investigation they use an indicator called phenolphthalein.

Phenolphthalein is pink in alkali conditions but becomes colourless when the pH falls below pH 8.

A student puts 5 drops of phenolphthalein and 5 ml of full fat milk in to a test tube.

She adds 1 ml of lipase, stirs the mixture and times how long it takes to lose the pink colour.

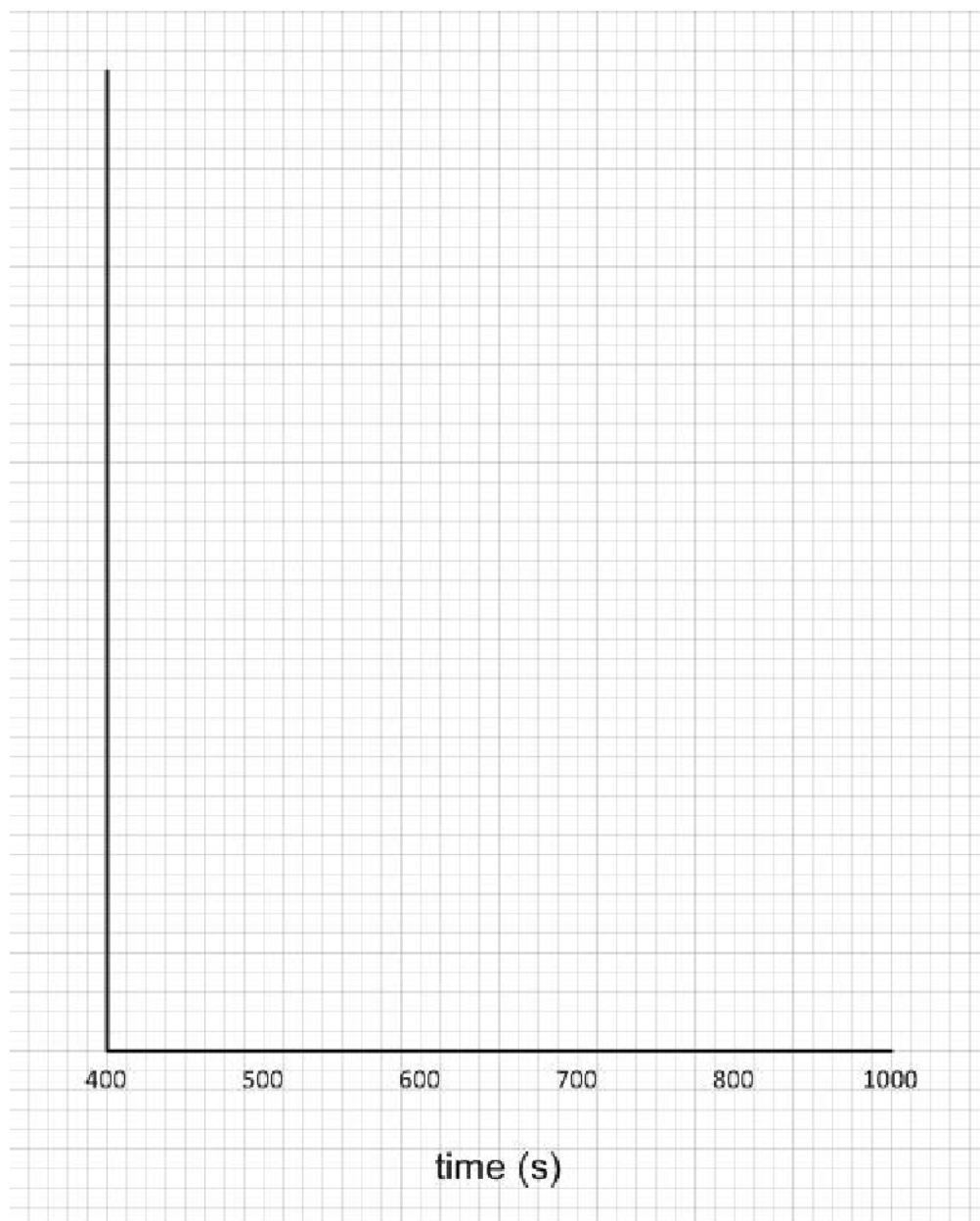
Other students repeat this but at different temperatures.



The table shows the group's results.

Temperature (°C)	Time for pink colour to disappear (s)
20	480
40	240
60	270
80	960

Plot a graph of the results and draw a line of best fit.



[5]

(b) Explain the difference between the results at 20°C and 40°C.

[3]

(c) Explain the difference between the results at 80°C and 40°C.

[3]

(d)

(i) One student says that the results show that the optimum temperature for the lipase is 40°C.

The teacher says that she **cannot** say for certain that it is 40°C.

Explain why.

[1]

(ii) Give **two** reasons how the students could modify their method to find out the optimum temperature more accurately.

[2]

(e) The students rounded their times to the nearest 10 seconds.

They did this because they found it difficult to judge exactly when the pink colour had disappeared.

Describe and explain **two** ways the method could be improved to give more accurate measurements.

1

2

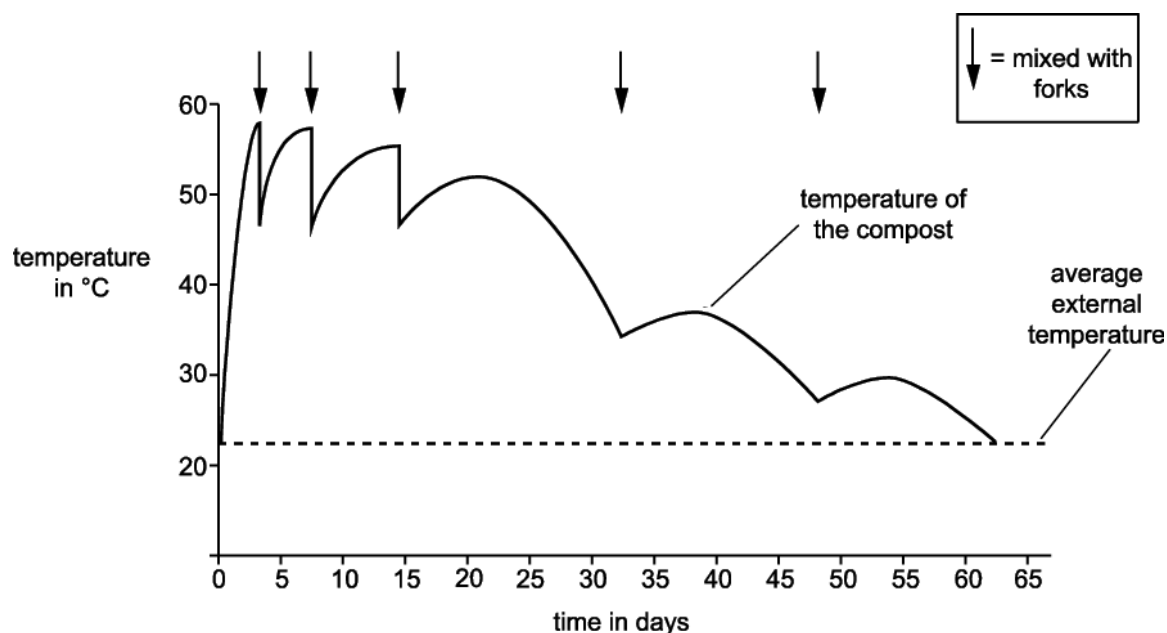
[2]

10 Some students measured the temperature inside a compost heap.

They also measured the external temperature.

On five occasions they mixed up the compost heap with garden forks.

The graph shows their results.



(i) The compost took 63 days to completely decompose.

Explain how the students could tell this from their graph.

----- [1]

- (ii) The rate of temperature increase is greatest before the compost is mixed for the first time.

Explain how the rate of temperature change can be calculated.

----- [1]

11(a) Erythromycin is an antibiotic drug.

It is important to get the dose of erythromycin right.

Too much erythromycin can be harmful.

However, recently some strains of bacteria have developed resistance to low concentrations of erythromycin.

To see how effective erythromycin is, it is tested using bacteria grown on agar plates.

This method is used:

- A petri dish is used that has the bacteria growing evenly over the surface.
- A disc of filter paper is soaked in erythromycin.
- The disc is placed on the agar in the centre of the petri dish using sterile forceps.
- The dish is incubated at 37°C.

(i) Why did the scientists incubate the dish at 37°C rather than at higher or lower temperature?

----- [2]

(ii) Why is the filter paper disc moved using sterile forceps?

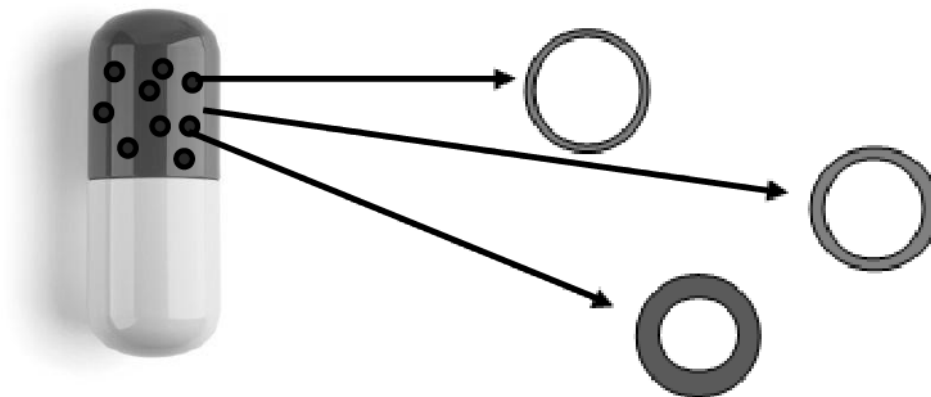
----- [1]

(b) Erythromycin is usually given to patients in a capsule.

The capsule has lots of small spheres containing the drug.

The walls of the spheres are different thicknesses.

They are made of a carbohydrate polymer.



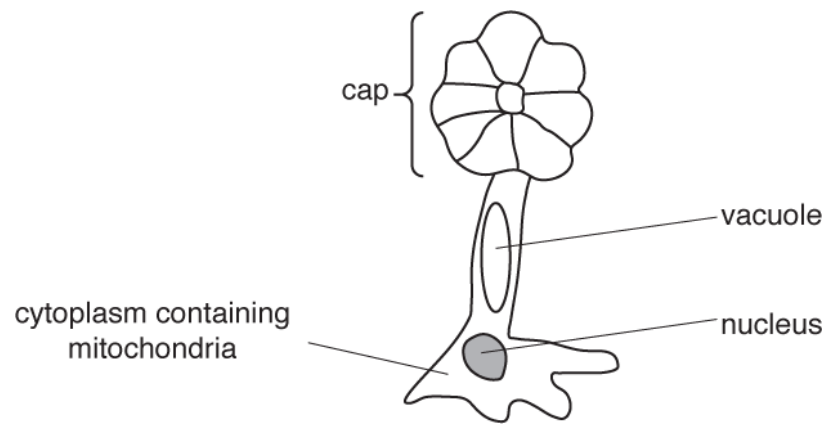
(i) Explain why the drug is released from the spheres in the small intestine.

[2]

(ii) * The graph shows the levels of erythromycin in the blood when given using this capsule and in a normal tablet.

12 *Acetabularia* is a single-celled organism that lives in the sea.

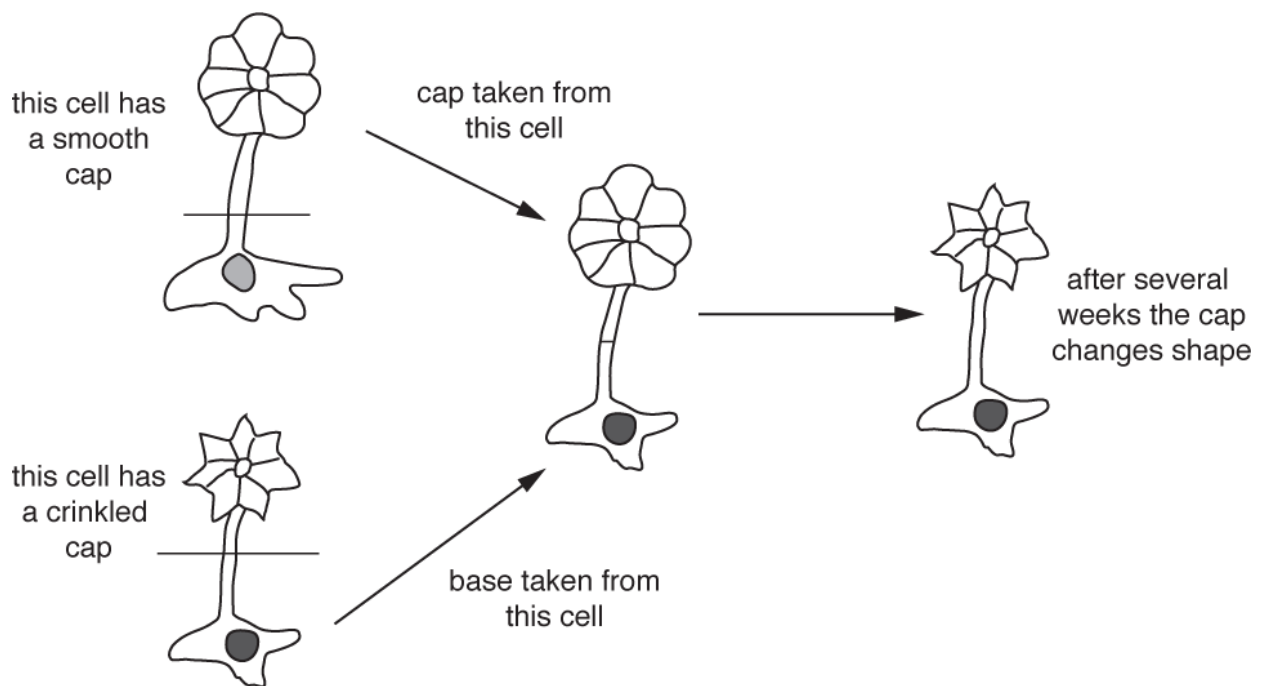
It has rather an unusual shape.



A scientist does an experiment with two types of *Acetabularia*.

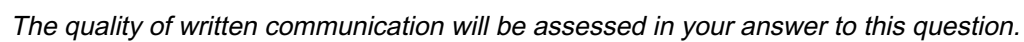
The two cells have different shaped caps.

The scientist takes parts from each cell and joins them together.



The shape of the cap depends on which **proteins** are made by the cell.

Use this idea to explain the results of the scientist's experiment.



[6]

13(a) A student answered some questions in a biology test.

His answers contain mistakes.

Explain what they are.

Question: Write down three examples of proteins.

Student's answer: DNA, collagen, insulin

Student's mistake _____

[1]

(b) Question: Why are sperm cells and egg cells different in size?

Student's answer: Egg cells are bigger because they supply all the chromosomes and genes for the zygote.

Student's mistake _____

[2]

(c) Question: How do enzymes work?

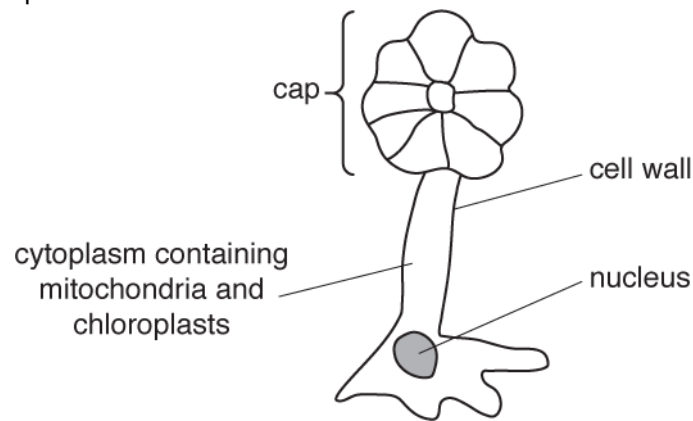
Student's answer: An enzyme is like a key that fits into a substrate's active site.

Student's mistake _____

[2]

14 *Acetabularia* is a unicellular organism that lives in the sea.

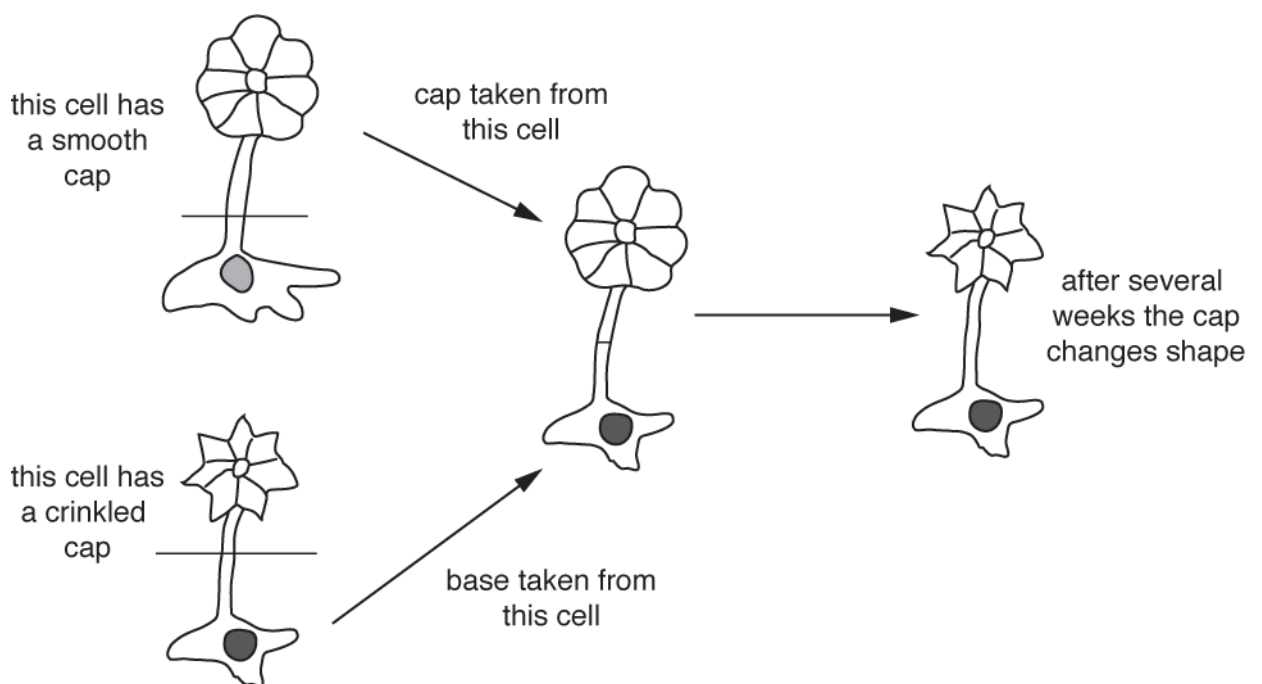
It has rather an unusual shape.



A scientist did an experiment with two types of *Acetabularia*.

The two types of *Acetabularia* had different shaped caps.

The diagram shows the scientists experiment.



*The shape of the cap depends on which **proteins** are made by the cell.*

Explain how the nucleus codes for proteins that are made elsewhere in the cell and suggest why it took several



[6]

15(a) A student answered two questions in a biology test.

Both his answers contain mistakes.

Explain the student's mistakes in each answer.

Question one: Write down three examples of proteins.

Student's answer: amino acids, collagen, insulin

Student's mistake _____

[2]

(b) Question two: How do enzymes work?

Student's answer: An enzyme is like a key that fits into a substrate's active site.

Student's mistake _____

[2]

16 DNA is a polymer.

What is the name of the monomer in DNA?

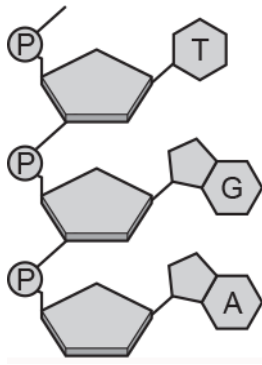
- A Base
- B Deoxyribose sugar
- C Nucleotide
- D Phosphate

Your answer

[1]

17 DNA is made of two complementary strands.

The diagram shows part of one strand of DNA.



Which base sequence would be found on the complementary strand of this DNA?

A A
 C
 T

B C
 A
 G

C G
 A
 C

D T
 G
 A

Your answer

[1]

18(a) Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm³ of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm³ of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm³ of washing-up liquid and swirl to mix.
- Let the mixture settle for 5–10 minutes in a water bath at 60°C.

One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1 -----

2 -----

[2]

- (b) Low temperatures protect DNA by slowing down the activity of enzymes that destroy DNA.
High temperatures break down membranes in the cell.

To extract DNA, some methods use a water bath at 60°C but other methods do not use an increased temperature.

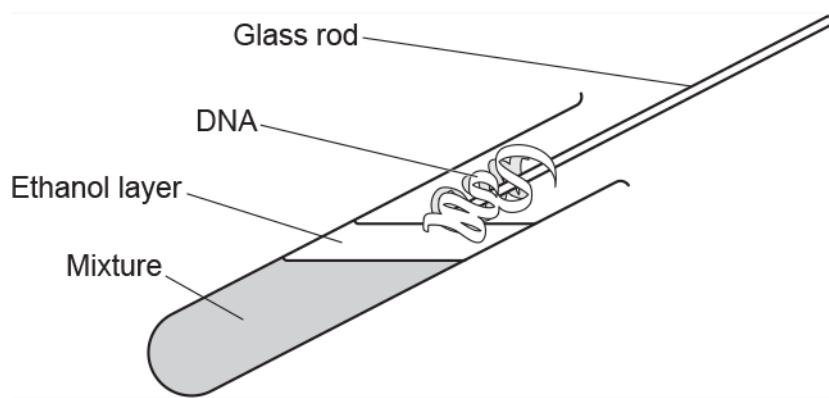
Suggest **two** reasons for the different methods.

[2]

- (c) Students investigate how to extract DNA from peas.

This is a two stage process.

Stage 2 isolates the DNA.



- Pour the mixture collected from stage 1 into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.

- Dry the sample on a pre-weighed filter paper and measure the mass of product.

Suggest **two** safety precautions which should be taken at stage 2.

Explain why each safety precaution is needed.

1 Safety precaution:

Explanation:

2 Safety precaution:

Explanation:[2]

(d) Students investigate how to extract DNA from peas.

Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	Test 2	Test 3	Mean
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	33.3	-----

(i) Calculate the mean mass collected in the investigation using the electric water bath.

Give your answer to 1 decimal place.

Answer = ----- mg [2]

(ii) The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

-----[2]

19 During protein synthesis the DNA that codes for a particular protein is copied. This copy is called mRNA.

The diagram below shows the base sequence for a section of DNA.

G G T G C A T A T

What would be the complementary sequence of mRNA for this section of DNA?

A C C A C G T A T A

B C C A C G U A U A

C G G T G C A T A T

D G G U G C A U A U

Your answer

[1]

20

- (i) An egg develops in a follicle before ovulation. The follicle has a diameter of 25×10^{-3} mm at the start. This follicle grows to 20 mm in diameter just before the egg is released.

Calculate the increase in size of the diameter of the follicle.

Give your answer to 2 decimal places.

Answer = _____ mm [3]

- (ii) The failure of a follicle to increase in size can result in less production of oestrogen.

Explain what effect this may have on the uterus.

-----[1]

(iii) Explain how hormones can be used to treat infertility in women.

[3]

(iv) Infertility can also be caused by problems in the male.

Plasmin is a protease enzyme important in sperm movement.

Explain how changes to the structure of DNA could result in the plasmin enzyme being faulty.

[2]

21(a) Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm³ of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm³ of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm³ of washing-up liquid and swirl to mix.
- Let the mixture settle for 510 minutes in a water bath at 60°C.

One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1

.....

2

.....

[2]

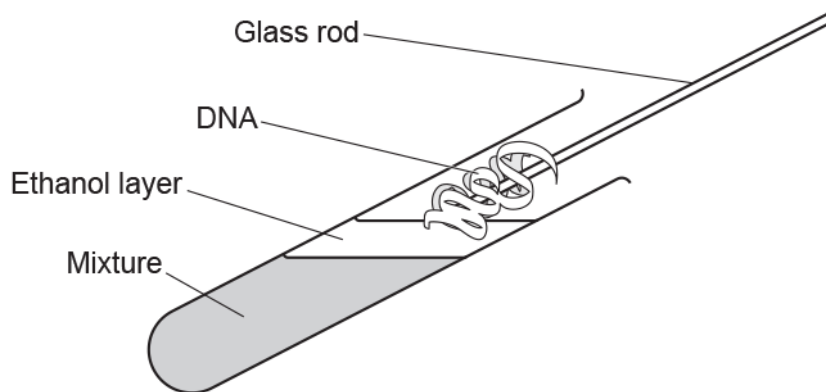
- (b) Low temperatures protect DNA by slowing down the activity of enzymes that destroy DNA.
High temperatures break down membranes in the cell.

To extract DNA, some methods use a water bath at 60°C but other methods do not use an increased temperature.

Suggest **two** reasons for the different methods.

-----[2]

(c) **Stage 2** isolates the DNA.



- Pour the mixture collected from stage 1 into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.
- Dry the sample on a pre-weighed filter paper and measure the mass of product.

Suggest **two** safety precautions which should be taken at stage 2.

Explain why each safety precaution is needed.

1 Safety precaution: -----

Explanation: -----

2 Safety precaution: -----

Explanation: -----

[2]

(d) Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	Test 2	Test 3	Mean
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	32.3	

(i) Calculate the mean mass collected in the investigation using the electric water bath.

Give your answer to 1 decimal place.

Answer = _____ mg [2]

(ii) The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

-----[2]

22 How many different bases are in DNA?

- A 2
- B 4
- C 23
- D 46

Your answer [1]

23 When the enzyme lipase is mixed with a lipid which of the following will increase in concentration?

- A Amino acids
- B Fatty acids and glycerol
- C Glucose and fructose
- D Starch

Your answer

[1]

24 Switching off the protection mechanism described in part (b) involves the plant making a **protein**.

Scientists have put extra copies of the gene for this protein into the plants. This makes the plant make more mRNA molecules.

(i) Explain why making more mRNA will switch off the mechanism faster.

----- [2]

(ii) Scientists have found that the genetically modified plants make 20% more biomass.

Use the agricultural food chain on page 21 to calculate the increase in biomass this would provide for humans.

Answer = -----kg [2]

(iii) Inserting extra copies of a plant's gene into a plant is a type of genetic modification (GM).

Another example of GM involves inserting a bacterial gene into a plant which makes the plant produce an insecticide.

Suggest reasons why.

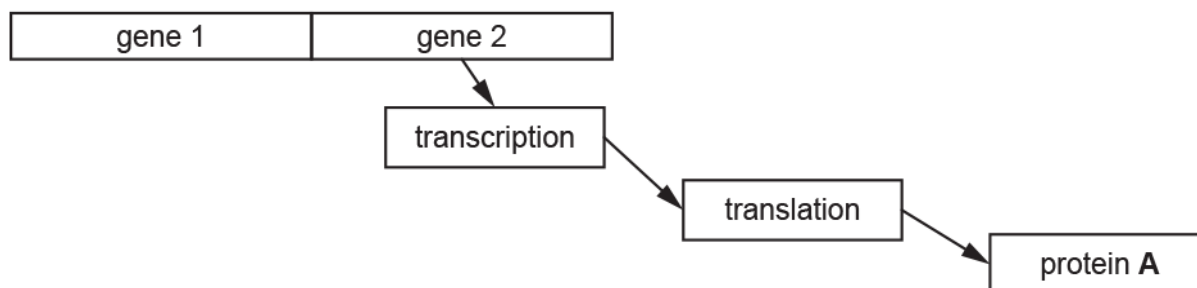
----- [2]

25 Drugs can be used to treat one type of diabetes. One drug prevents an enzyme working properly.

Suggest how a drug can stop an enzyme working.

----- [2]

26 Gene 1 and gene 2 are both needed for the production of protein A.



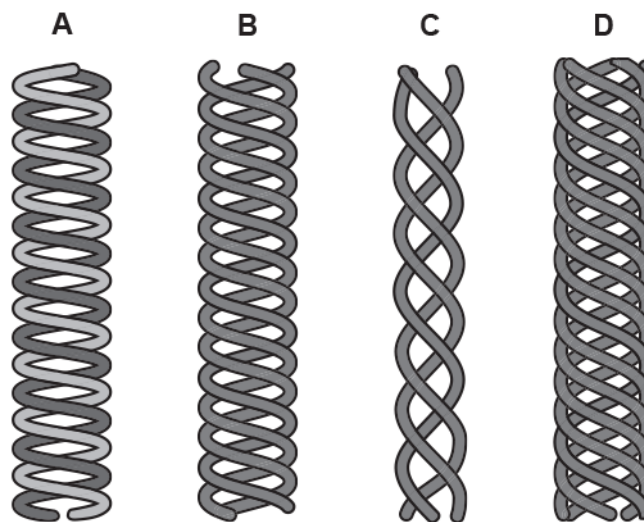
What is the function of **gene 1** in this process?

- A It codes for the amino acids in protein A.
- B It codes for the mRNA needed to make protein A.
- C It acts as the site for protein synthesis.
- D It controls the expression of **gene 2**.

Your answer

[1]

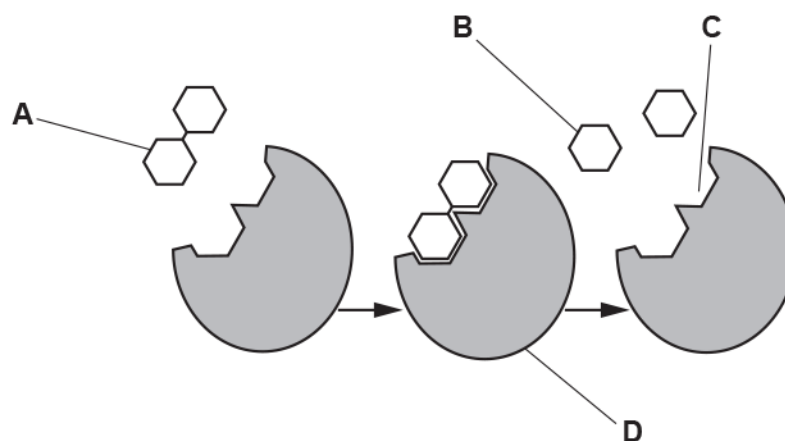
27 Which structure most closely resembles DNA?



Your answer

[1]

28 Look at the model of enzyme activity.



Which label represents the active site of an enzyme?

Your answer

[1]

29 Which biological molecule is **not** a polymer?

- A Amylase
- B DNA
- C Nucleotide
- D Starch

Your answer

[1]

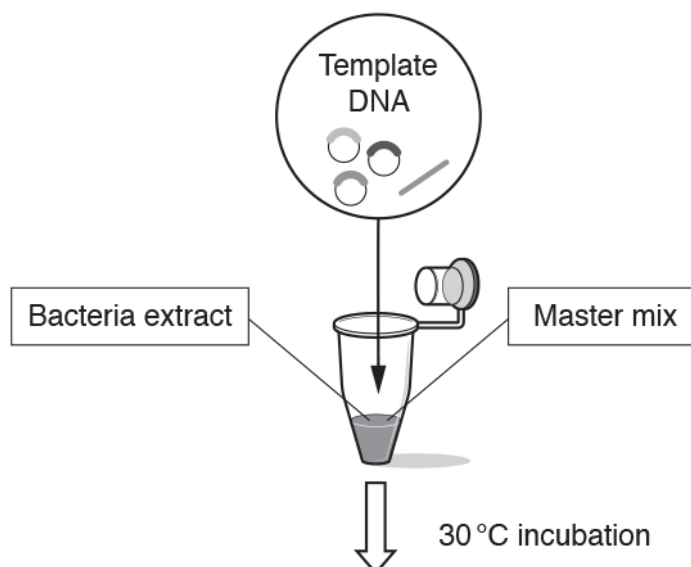
30(a) Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



(i) Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

[2]

(ii) Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

[2]

(b) Thirty years ago, identifying a person from their DNA required a large sample of DNA.

Polymerase chain reaction (PCR) is a technique developed in 1983.

PCR allows a single copy or segments of DNA to quickly make multiple copies of a DNA sequence.

(i) Many crimes committed over 30 years ago can now be solved using PCR.

Explain why.

----- [2]

(ii) Which part of the cell cycle takes place in PCR?

----- [1]

(c)

- (i) DNA databases involve storing a person's individual DNA profile. The DNA profile identifies DNA sequences present in an individual.

DNA databases are used by many different organisations.

Solving crimes is one use of a DNA database.

Suggest **other** reasons why organisations might need a DNA database.

----- [2]

- (ii) Write down **one** reason why people might **not** want to be included on a DNA database.

----- [1]

They use four different colours of round sweets to represent the bases and attach them to two candy laces. Fig. 16.2 shows their model.

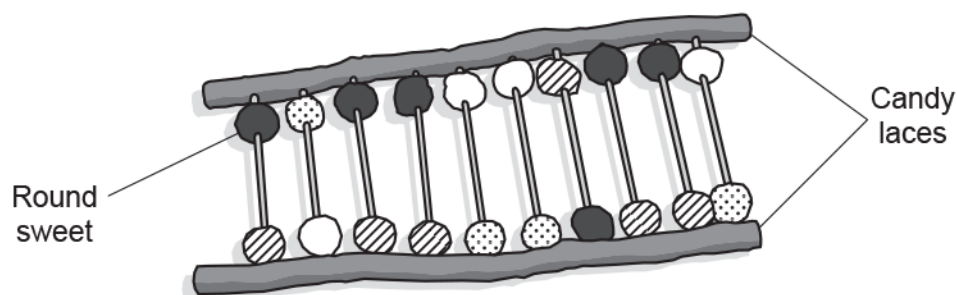


Fig. 16.2

- (i) Why did the students use four different colours of round sweets in their model of DNA?

----- [1]

- (ii) Write down the names of the **two** types of chemical group represented by the candy laces.

1 -----

2 -----

[2]

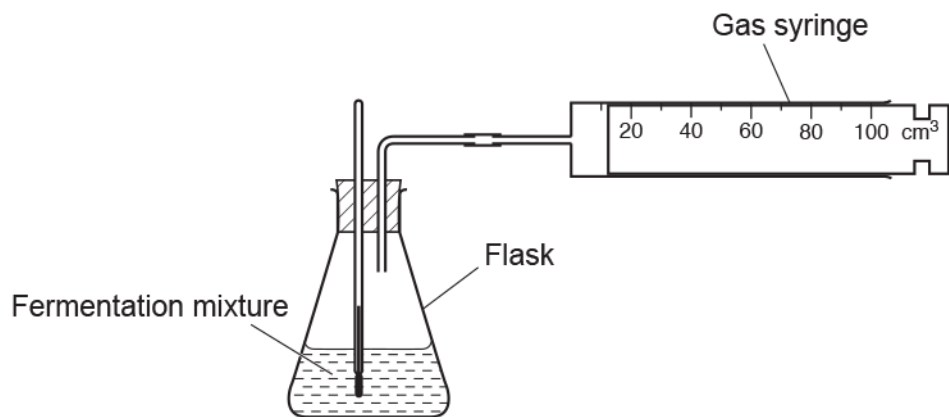
32(a) Fermentation involves enzymes breaking down sugar and releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.

She measures the volume of carbon dioxide released in 10 minutes.

The diagram shows the apparatus she uses.



Using a Bunsen burner to heat a water bath is **one** way the student could keep the flask at a constant temperature.

(i) What other way could be used to keep the flask at a constant temperature?

[1]

(ii) She chooses to use a Bunsen burner and water bath.

Give **one** safety precaution she should take.

[1]

(iii) Explain why using a Bunsen burner and water bath may introduce errors into her results.

[2]

(b) The table shows the student's results.

Temperature (°C)	Volume of carbon dioxide gas released in 10 minutes (cm ³)				
	Trial 1	Trial 2	Trial 3	Mean	Range
25	23	25	22	23	22–25

30	34	29	33		29–34
----	----	----	----	-------	-------

- (i) Calculate the **mean** for the results at 30 °C and **complete the table**.

[2]

- (ii) The student repeated the experiment at two more temperatures, 20 °C and 35 °C, to get enough readings to plot a line graph.

Which measurement should the student plot on the **x-axis**?

[1]

- (iii) Describe **one** way that the range would improve any conclusions made from the graph.

[1]

- (iv) The mean volume at a temperature of 20 °C was 15 cm³ and for a temperature of 35 °C it was 27 cm³.

Describe what the student's results show about the effect of temperature on enzyme activity.

[2]

- (i) Explain why overheating of the body may stop chemical reactions in cells.

[2]

- (ii) * Look at Fig. 20.2 which shows two people riding on boards.

Person A is riding a board on sand in a hot desert. **Person B** is riding a board on snow.

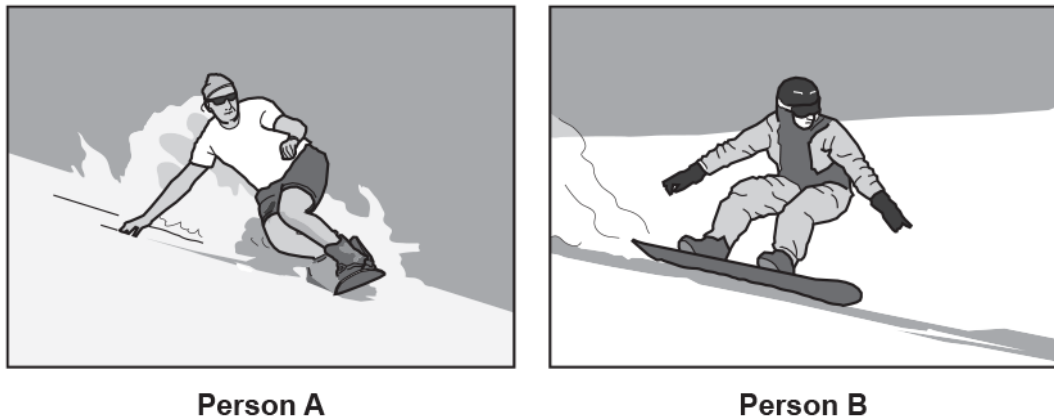


Fig. 20.2

Explain the different problems of temperature regulation for these two people and give examples of the ways their bodies solve these problems.

[6]

34 Hypercholesterolemia (HC) is caused by a dominant allele on chromosome 19. This allele has mutations which cause a change in the order of DNA nucleotides.

Write the words **allele**, **chromosome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature

Largest feature

[1]

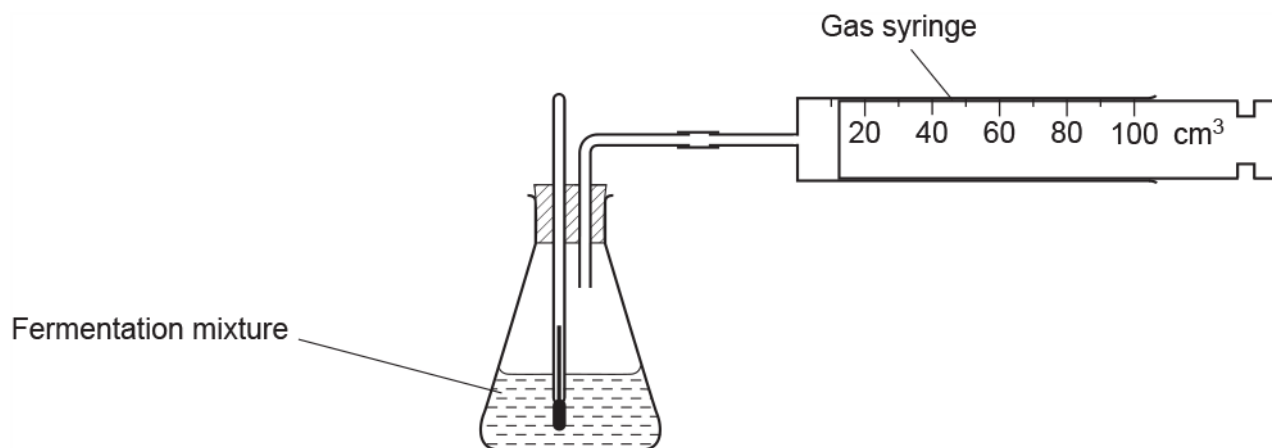
35(a) Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.

She measures the volume of carbon dioxide released in 10 minutes.

The diagram shows the apparatus she uses.



The student could have measured the volume of carbon dioxide by collecting the gas over water in a measuring cylinder.

Why is it better to use a gas syringe?

[1]

(b) The student's results are shown in the table.

Temperature (°C)	Volume of carbon dioxide gas (cm ³) released in 10 minutes		
	Trial 1	Trial 2	Trial 3
25	23	25	22
30	34	27	33

(i) Calculate the **mean** rate of gas produced at **25 °C** in cm³ / minute.

Give your answer to **1** decimal place.

Mean rate of gas produced at 25 °C = ... cm³ / minute [3]

(ii) The rate of gas produced at 30 °C is greater than at 25 °C.

Use ideas about enzymes to explain why.

-----[3]

(c) Phenols are chemicals that inhibit enzymes during fermentation.

They bind to amino acids on enzyme molecules.

Suggest how phenols inhibit enzymes.

[2]

36 Protein synthesis takes place inside cells.

Describe what happens during protein synthesis.

Use terms from the list in your answer.

amino acids DNA mRNA transcription

translation ribosome

[4]

37(a) Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

Write the words **allele**, **chromosome**, **genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature	
Largest feature	

[1]

(b) One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

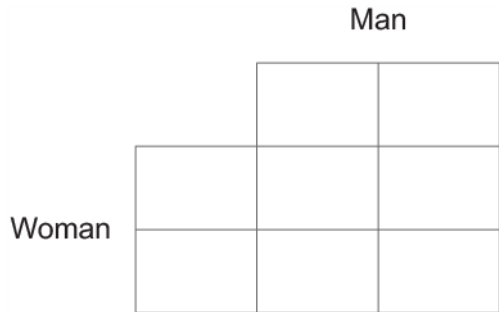
Number of people = ... [1]

(c) A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.



Probability = ... [2]

(d) The allele that is affected by HC codes for a protein called LDL receptor protein.
The faulty allele often has four extra nucleotides, making a total of 2521 nucleotides.

Calculate the number of **amino acids** found in the healthy, **unaffected** protein.

Number of amino acids = ... [2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			B	1	
			Total	1	
2			D	1	
			Total	1	
3			B	1	
			Total	1	
4	a		Y axes correctly labelled, including units (1)	1	
			Y axis even scales occupying more than half of the page (1)	1	
			all points correctly plotted = 2 marks but at least 3 points correctly plotted = 1 mark	2	
			line of best fit (1)	1	
	b		at 20 °C: slower reaction (1)	1	allow reverse argument referring to 40 °C
			particles moving more slowly (1)	1	
			less frequent collisions (1)	1	
	c		At 80 °C: slower reaction (1)	1	allow reverse argument referring to 40 °C
			enzyme denatured (1)	1	
			shape of active site changed / cannot bind to substrate (1)	1	
	d	i	(optimum) could be either side of 40 °C / could be anywhere between 40 °C and 60 °C (1)	1	
		ii	Do more repeats (1)	2	allow 30–50 °C
		ii	Idea of narrower intervals around 40 °C (1)		

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	e		any two from use a colorimeter – so it's objective / AW (1) have the same student doing all observations – so there is a consistent judgement / AW (1) repeat the experiment at each temperature – can take mean / average (1)	2	allow light meter allow colour chart / serial dilution
			Total	16	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		i	the temperature of the heap was the same as the external temperature (1)	1	
		ii	Change in temperature $\div$ time OR Tangent drawn from line and used to calculate rate	1	
			Total	2	
6			D	1	
			Total	1	
7			B	1	
			Total	1	
8			C	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a		Y axes correctly labelled, including units (1)	1	
			Y axis even scales occupying more than half of the page (1)	1	
			all points correctly plotted = (2) but at least 3 points correctly plotted = (1)	2	
			line of best fit (1)	1	
	b		at 20 °C: slower reaction (1)	1	allow reverse argument referring to 40 °C
			particles moving more slowly (1)	1	
			less frequent collisions (1)	1	
	c		At 80 °C: slower reaction (1)	1	allow reverse argument referring to 40 °C
			enzyme denatured (1)	1	
			shape of active site changed / can not bind to substrate (1)	1	
	d	i	(optimum) could be either side of 40 °C / could be anywhere between 40 °C and 60 °C (1)	1	
		ii	do more repeats (1)	1	allow 30–50 °C
		ii	idea of narrower intervals around 40 °C (1)	1	
	e		any two from use a colorimeter – so it's objective / AW (1) have the same student doing all observations – so there is a consistent judgement / AW (1) repeat the experiment at each temperature – can take mean / average (1)	2	allow light meter allow colour chart / serial dilution
			Total	16	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10		i	the temperature of the heap was the same as the external temperature (1)	1	
		ii	change in temperature $\div$ time OR tangent drawn from line and used to calculate rate	1	
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11	a	i	any higher and the bacteria might be killed / bacterial enzymes denatured (1)	1	allow optimum temperature for the bacteria / bacterial enzymes
		i	any lower and the erythromycin would diffuse slower / bacteria would reproduce more slowly so takes longer to get the results (1)	1	allow spread out slower
		ii	prevent contamination by other microbes (1)	1	not germs / bugs
	b	i	coat is digested (1)	1	
		i	by enzymes present in small intestine (1)	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	* Please refer to the marking instructions on point 10 for guidance on how to mark this question. Level 3 (5–6 marks) Explains the shapes of the two graphs in the effectiveness / safety of the drugs delivery system. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Explains the shapes of the two graphs the total dosage of the drugs. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Simply describes the patterns in the graph. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks <i>No response or no response worthy of credit.</i>	6	AO3.2a: Analyse the information and judge the relative effectiveness of the two delivery systems - links this to the advantages / disadvantages of keeping a steady, intermediate level in the blood - with tablet high levels may be toxic - if reduce the dose, then when levels low it may not kill all bacteria - reference to allowing resistant strains to develop AO2.2: Apply knowledge to demonstrate an understanding of how the capsules and tablets work in delivering the drug - any statement regarding the total dosage for the two delivery methods - dosage rises rapidly because of rapid absorption into the blood stream - dosage falls fast because it is rapidly broken down - capsules allow staggered release of drug dosage - this is because walls are different thicknesses of the capsule - therefore different digestion time - conventional tablet releases drug all at once - tablet may not have a coating AO2.1: Apply knowledge and understanding in reading the graphical information - Simple description of the patterns of the two lines on the graph.
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12			[Level 3] Answer includes a correct description of how protein synthesis is controlled and is able to link this to the change in shape of the cap Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer includes a correct description of how protein synthesis is controlled or links change in shape of the cap to the movement of the nucleus Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer includes a correct statement about how protein synthesis is controlled. or Links change in shape of the cap to production of different proteins / presence of different genes. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted up to grade C Indicative scientific points about protein synthesis may include: • Proteins are coded for by genes / DNA • Genes / DNA are kept in the nucleus (on chromosomes) • The genes contain a sequence of bases that code for the protein Indicative scientific points about the experiment include: • The cap changes shape because the cell starts to make different proteins • The different proteins are made because the nucleus has come from the cell with the crinkled cap • Therefore the cell's DNA / genes are now coding for proteins that make the cap crinkle Use the L1, L2, L3 annotations in Scoris; do not use ticks.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13	a		DNA is not a protein (1)	1	ignore just DNA
	b		any two from: egg cells do not supply all the chromosomes / genes (1) BUT (sperm and) eggs (each) supply half of the genetic material / genes / chromosomes (2)	2	egg cells are larger because they do not need to swim / contain food reserves (1)
	c		the substrate is like a key (not the enzyme) (1) the substrate fits into the enzyme's active site (not the other way round) (1)	2	allow: the enzyme is like a lock (not a key) (1) allow: the enzyme has an active site not the substrate (1) allow: 'enzyme and the substrate are the wrong way round' (2)
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14			[Level 3] includes a correct description of protein synthesis AND describes where proteins are made AND correctly links this to the change in shape of the cap over a period of time. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] includes a correct description of protein synthesis AND describes where proteins are made OR correctly links this to the change in shape of the cap over a period of time. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] includes simple description of protein synthesis OR describes where proteins are made OR why it takes several weeks for the change in the cap. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted up to grade A* Indicative scientific points about protein synthesis at level 2/3 may include: - the order of bases codes for the order of amino acids - mRNA carries the code from the DNA - triplet base code read for amino acid Indicative scientific points about where proteins are made may include: - proteins are made on the ribosomes - in the cytoplasm Indicative scientific points about why it takes several weeks for the change in the cap: - time taken for the proteins in the cap to be replaced / make different proteins - mRNA from the old nucleus takes some time to be replaced by mRNA from new nucleus Indicative scientific points about protein synthesis at level 1 may include: - proteins are coded for by DNA / genes - sequence of bases that code for the protein Use the L1, L2, L3 annotations in Scoris; do not use ticks.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15	a		amino acids are not proteins (1) they make up proteins (1)	2	no marks if they haven't identified amino acids not incorrect statements about collagen and insulin allow amino acids make up proteins (2)
	b		the substrate is like a key (not the enzyme) (1) the substrate fits into the enzyme's active site (not the other way round) (1)	2	allow the enzyme is like a lock (not a key) (1) allow the enzyme has an active site not the substrate (1) allow 'enzyme and the substrate are the wrong way round' (2)
			Total	4	
16			C ✓	1 (AO 1.1)	
			Total	1	
17			A ✓	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18	a		can control temperature (easier)/ can be set to a specific / constant temperature ✓ limited fire risk✓	2 (AO 2 x 2.2)	IGNORE reference to ease of measurement ALLOW less risk of burns ALLOW ORA <u>Examiner's Comments</u> This question assesses AO2.2. Candidates were able to identify that the electric water bath was much easier to control the temperature, but it was rare to see any link the limited fire risk compared to the Bunsen and beaker.
	b		for 60°C / high temperatures: idea that (membranes break down) at 60°C releasing more DNA / DNA is extracted easily ✓ against 60°C / high temperatures: increased risk of DNA breaking down at 60°C / more DNA destroyed at 60°C / DNA not preserved at 60°C ✓	2 (AO 2 x 2.2)	ALLOW idea that enzymes destroying DNA are denatured so less DNA destroyed Answers must make it clear which temperature they are referring to. ALLOW ORA

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		wear face mask / goggles to prevent protease/ethanol/chemicals being inhaled / entering eyes✓ gloves / use tongs prevent ethanol/protease/chemicals being in contact with skin✓ turn Bunsen off as ethanol is flammable✓	2 (AO 2 x 2.2)	ALLOW use tongs as solution/ tube may be hot IGNORE reference to lab coats / glass breakages <u>Examiner's Comments</u> This AO2.2 question assessed application of knowledge an understanding to scientific enquiry. Candidates were good at recognising safety precautions. The most common were “gloves to prevent ethanol causing skin irritation” and “goggles to prevent chemicals getting in the eyes”. Where candidates did not gain credit was for generalised explanations such as “goggles, so nothing gets on you”.
	d	i	First check answer on answer line If answer = 33.1 (mg) award 2 marks <u>99.2</u> OR 33.067 / 33.07✓ 3 = 33.1 (mg) ✓	2 (AO 1.2) (AO 2.2)	<u>Examiner's Comments</u> This question assessed mathematical skills in a scientific enquiry context. Many candidates gained both marks. Occasionally rounding errors meant that they only gained 1 mark for correct working out. This is where showing working out can really benefit candidates, as those that didn't but made a rounding error, scored zero. This can be reinforced when candidates are developing their examination technique.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(yes because) idea that there is a greater mean / yield / mass produced (of DNA)✓ there is less range/variation in results✓	2 (AO 2 x 3.1b)	ALLOW ECF ALLOW examples of data from table to indicate less range/variability <u>Examiner's Comments</u> AO3 interpretation and evaluation was assessed in this question. Many candidates identified the increased mass of DNA extracted as indicative that the electric water bath was better to use. Some candidates went on to identify that the range of results was narrower, indicating the variation in results was less and gained 2 marks.
			Total	10	
19			B ✓	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
20		i	First check answer on answer line If answer = 19.98 (mm) award 3 marks 20 - 0.025✓ but 19.975 (mm)✓ 19.98 (mm)✓	3 (AO 2 × 2.2) (AO 1.2)	<u>Examiner's Comments</u> The manipulation of standard form was often correct in this question.
		ii	lining is not repaired correctly✓	1 (AO 1.1)	ALLOW lining will not thicken / not build up IGNORE lining will not be maintained / will become thinner <u>Examiner's Comments</u> There was some confusion in the answers between the roles of progesterone and oestrogen. Common incorrect answers referred to the breaking down of the uterus lining.
		iii	Any three from: gonadotrophins used✓ FSH and LH used✓ FSH lead to ripening of follicle✓ and LH causes ovulation✓ human chorionic gonadotrophin✓ causes egg/ovum to mature inside follicle✓	3 (AO 3 × 1.1)	ALLOW stimulate egg production/development <u>Examiner's Comments</u> Candidates often gave the hormones that might be given to women to treat infertility, i.e. LH and FSH but did not specifically link them to their function. This is illustrated in exemplar 7, which would only gain one mark for naming the two hormones. Exemplar 7 (iii) Explain how hormones can be used to treat infertility in women: <i>Drugs with menstrual hormones in - eg: FSH and LH - complete negative feedback to produce more oestrogen and increase the number of eggs matured & developed.</i>

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iv	order of bases is changed (in gene)✓ order of amino acids changed in protein / change in shape of the enzyme✓	2 (AO 1.1) (AO 2.1)	ALLOW nucleotides ALLOW mutation in base sequence ALLOW different amino acids in protein IGNORE codes for wrong amino acid to be made <u>Examiner's Comments</u> Many candidates correctly linked changes in the DNA base sequence to alterations in the amino acids in the protein or the shape of the protein molecule.
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21	a		can control temperature (easier)/ can be set to a specific / constant temperature ✓✓ limited fire risk✓	2 (AO 2 ×2.2)	IGNORE reference to ease of measurement ALLOW less risk of burns ALLOW ORA <u>Examiner's Comments</u> Many candidates correctly focussed on the fact that an electric water bath will maintain a constant temperature. Fewer candidates stated the need to prevent ethanol from being near a naked flame. Exemplar 1 contains both these points, therefore achieved both marks. Exemplar 1 1. When you use an electric water bath it's easier to set the temperature and maintain the temperature. ✓ 2. Electric water bath is safer than using bunsen burner especially when substance you are heating is flammable. ✓ [2]
	b		for 60°C / high temperatures: idea that (membranes break down) at 60°C releasing more DNA / DNA is extracted easily ✓ against 60°C / high temperatures: increased risk of DNA breaking down at 60°C / more DNA destroyed at 60°C / DNA not preserved at 60°C✓	2 (AO 2 × 2.2)	ALLOW idea that enzymes destroying DNA are denatured so less DNA destroyed Answers must make it clear which temperature they are referring to. ALLOW ORA

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		wear face mask / goggles to prevent protease/ethanol/chemicals being inhaled / entering eyes gloves / use tongs prevent ethanol/protease/chemicals being in contact with skin ✓ turn Bunsen off as ethanol is flammable ✓	2 (AO 2 × 2.2)	ALLOW use tongs as solution/ tube may be hot IGNORE reference to lab coats / glass breakages Examiner's Comments Lower ability candidates did not gain marks in this question as they often gave vague answers such as references to being careful or not dropping equipment. An example of an answer that did not receive credit is seen in exemplar 2. Exemplar 2 1 Safety precaution: Do not shake the test tube. Explanation: This may spill the mixture and DNA. 2 Safety precaution: Do not place the test tube down. Explanation: This may break it. [2]
	d	i	First check answer on answer line If answer = 33.1 (mg) award 2 marks <u>99.2</u> OR 33.067 / 33.07✓ 3	2 (AO 1.2) (AO 2.2)	Examiner's Comments The majority of candidates could correctly calculate the mean mass and give the answer to one decimal place. A small but significant number only gained one mark as they quoted too many decimal places.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(yes because) idea that there is a greater mean / yield / mass produced (of DNA) ✓ there is less range/variation in results ✓	2 (AO 2 × 3.1b)	ALLOW ECF ALLOW examples of data from table to indicate less range/variability <u>Examiner's Comments</u> There were many correct references to the differences in the ranges of readings, although in some cases the range for the water bath was incorrectly calculated. Fewer candidates commented on the differences between the mean mass of DNA obtained.
			Total	10	
22			B	1 (AO 1.1)	<u>Examiner's Comments</u>  AfL Although many candidates answered this correctly, several did so by writing the number in the answer box rather than the correct letter. Candidates who wrote 4 were credited but it is something they should be encouraged to avoid and to only use letters A, B, C or D.
			Total	1	
23			B	1 (AO 2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
24		i	mRNA carries the code for proteins ✓ more protein will be made ✓	2 (AO 2 × 2.1)	ALLOW protein will be made faster <u>Examiner's Comments</u> This question assessed AO2.1. Many candidates were able to link mRNA to either more or faster protein synthesis, but very few referred to the term 'code' to link mRNA and protein synthesis.
		ii	First check answer on answer line If answer = 40 award 2 marks $\frac{20 \times 200}{100}$ ✓ = 40 ✓	2 (AO 2 × 2.2)	<u>Examiner's Comments</u> Candidates found this AO2.2 mathematics skills question quite challenging. 240 was a common incorrect response. Candidates need to have more practice at similar questions using percentages to develop their mathematical skills in this area.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	new method uses the plants own genes ✓ concern that plants with the insecticide/gene might be harmful to humans / might impact on food chains / might kill useful insects ✓	2 (AO 2.2) (AO3.2a)	ALLOW might have side-effects IGNORE ideas about cultural or religious or ethical objections or that it is playing God <u>Examiner's Comments</u> This question assesses both AO2 and AO3. Candidates were most likely to score a mark for the AO3 marking point, but it was rare for them to gain the AO2 mark. Many candidates described the effect of the gene on the plant, not consumers, or did not pick up on the possible problems of the insecticide itself. There were several responses written about the concern about genetic modification not being a natural process. This is an idea that mark schemes are unlikely to credit, preferring instead to focus on the effects of GM food on all consumers. Candidates also frequently missed out writing about the plants own genes and just focused on the AO3 marking point of the bacterial gene so missed the AO2 marking point. It was common for candidates to write about general dangers of bacteria and infections and not specifically the gene.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25			Any two from: drugs shape is same as substrate ✓ blocks the active site ✓ denature the enzyme ✓ change (shape of) active site ✓	2 (AO 2.1)	ALLOW drug is competitive/non-competitive inhibitor ALLOW competes with enzyme for active site NOT kill the enzyme ALLOW drug deforms enzyme/active site ALLOW substrate doesn't fit the active site/not complimentary ALLOW key doesn't fit the lock <u>Examiner's Comments</u> This AO2.1 question was answered well by higher ability candidates. Most candidates realised the enzyme could denature. Some went further to describe what this meant in terms of the shape of the enzyme.
			Total	2	
26			D	1 (AO 1.1)	<u>Examiner's Comments</u> Recalling their knowledge in this AO1.1 question was answered well by higher ability candidates, less so by others. Lower ability candidates were frequently distracted by A.
			Total	1	
27			A	1 (AO 1.1)	<u>Examiner's Comments</u> A very accessible question with the majority of candidates realising that DNA has a double helical structure.
			Total	1	
28			C	1 (AO 1.1)	<u>Examiner's Comments</u> Another very accessible question which was answered correctly by most candidates.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
29			C	1 (AO 1.1)	<u>Examiner's Comments</u> This question proved to be challenging with a number of candidates choosing distractor A as the answer.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30	a	i	Any two from: <u>transcription</u> ✓ DNA (template) used to code for/make mRNA ✓ mRNA nucleotides/bases used to synthesis a mRNA molecule / mRNA nucleotides/bases pair with DNA nucleotides/bases ✓	2 (AO 1.1)	<u>Examiner's Comments</u> There were some correct references to transcription, but this question was intended as a high demand question and did prove to be quite challenging. Exemplar 8 shows an answer that does gain credit for referring to the pairing of DNA bases with mRNA bases. Exemplar 8 <i>The DNA is unzipped to be read by the mRNA. The mRNA then reads the DNA template, matching each base with its complimentary base pairing.</i> [2]
		ii	Any two from: <u>translation</u> ✓ mRNA attaches to ribosome✓ tRNA is a carrier molecule for amino acids / tRNA/carrier molecule brings (correct) amino acids into place / tRNA reads the triplets on the mRNA✓	2 (AO 1.1)	ALLOW each triplet code on tRNA/carrier molecule is specific for an amino acid. DO NOT ALLOW amino acids are made <u>Examiner's Comments</u> Again, there were some correct references to translation, but many answers confused the roles of ribosomes, mRNA and tRNA. Another common error was to refer to the making of amino acids, rather than proteins.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	small traces of DNA can now be replicated (using PCR) ✓ PCR makes enough DNA to profile / PCR makes enough DNA to match with suspects ✓	2 (AO 2.1)	IGNORE single copy of DNA Small traces of DNA can be replicated using PCR so that it can match to suspects = 2 marks DNA can be replicated using PCR so that there is enough to match to suspects = 2 marks <u>Examiner's Comments</u> A number of candidates thought that the PCR process actually matched the DNA samples. Often the ability to copy small amounts of DNA to make enough for testing was not appreciated.
		ii	S phase / DNA replication ✓	1 (AO 2.1)	ALLOW DNA duplication / IGNORE synthesis unless qualified <u>Examiner's Comments</u> S phase or DNA replication was stated by a number of candidates but more commonly there were references to mitosis or one of the stages of mitosis.
	c	i	Any two from: check on heredity ✓ look for genetic disorders / identify health risk factors ✓ idea of choosing correct medication / genomics ✓ to confirm a person's identity ✓	2 (AO 2.1)	ALLOW establish family tree / find relatives ALLOW specified health risk factor <u>Examiner's Comments</u> There were many correct references to genetic conditions, making ancestral links or the identification of individuals.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	avoid being identified for a crime / avoid high insurance costs / reluctance of employers to offer jobs / remain unaware of family history/genetic disorders / idea of dislike of sharing personal details / privacy (reasons) ✓	1 (AO 3.1a)	ALLOW do not want to be found by lost relatives ALLOW against the Human Rights Act <u>Examiner's Comments</u> A number of candidates seemed to think that the database actually stored physical samples of DNA that could be used for cloning. The most common creditable answers referred to protection of privacy.
			Total	10	
31		i	there are four different bases in DNA ✓	1 (AO1.1)	ALLOW nitrogenous bases ALLOW names of the four bases / represents ATCG
		ii	phosphate (groups) ✓ sugars ✓	2 (AO2 x 1.1)	ALLOW correct answers in either order ALLOW deoxyribose
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
32	a	i	electric heater ✓	1 (AO2.2)	ALLOW electric incubator / <u>electric</u> (water) bath
		ii	wear goggles / tie (long) hair back / secure loose clothing ✓	1 (AO1.2)	ALLOW wear gloves / use gauze under flask / use heatproof mat IGNORE face mask / do not touch hot equipment
		iii	Any two from: difficult to keep constant/regulate temperature ✓ uneven heating of flask creating hot/cold spots ✓ human error in reading thermometer ✓	2 (AO2.2)	ALLOW water may overheat ALLOW may become hot and denature enzyme ALLOW flask may have slightly raised temperature ALLOW temperature in water bath may not reflect temperature in the flask
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 32 award 2 marks $34 + 29 + 33 = 96$ ✓ $96 \div 3 = 32$ ✓	2 (AO2.2)	ALLOW answer in the space under the table but answer on answer line in table takes preference ALLOW ECF for mean calculation
		ii	temperature ✓	1 (AO2.1)	
		iii	identifies variability in each point plot / gives an estimate of level of uncertainty ✓	1 (AO1.2)	ALLOW can plot range/error bars ALLOW large error bars variability is high/ORA ALLOW high variability then reliability is low/ORA ALLOW idea of the spread of data at each point and possibly identify/eliminate outlier/anomaly ALLOW ranges overlap the data at those 2 points isn't significantly different

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iv	Any two from: as temperature increases enzyme activity increases ✓ optimum enzyme activity between 25⁰C and 35⁰C enzyme activity ✓ but somewhere between 30⁰C and 35⁰C enzyme activity starts to decrease ✓ idea decrease in rate (after 35⁰C) due to denaturing ✓	2 (AO3.1a)	ALLOW idea that as temperature increases/gets higher so does rate of (enzyme) reaction / gas release / ORA ALLOW higher temperature the faster the enzyme activity ALLOW enzyme starts to denature above 30⁰C/between 30⁰C and 35⁰C
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
33		i	Any two from: idea it affects enzymes (action/structure) ✓ high temperature causes active site to change shape / active site denatures ✓ stops them working ✓	2 (AO1.1)	ALLOW enzymes are heat sensitive/denature ALLOW enzymes cannot bind to substrate molecules IGNORE cells denature ALLOW enzymes no longer catalyse reaction

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Demonstrates knowledge of homeostasis. AND Applies knowledge of a skin mechanism for maintaining body temperature in different environments. AND Analyses information to comment on the effect of exposing skin. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Demonstrates knowledge of homeostasis and applies knowledge of a skin mechanism for maintaining body temperature in different environments. OR Demonstrates knowledge of homeostasis and analyses information to comment on the effect of exposing the skin. OR Applies knowledge of a skin mechanism for maintaining body temperature in different environments and analyses information to comment on the effect of exposing skin. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Demonstrates knowledge of homeostasis. OR Applies knowledge of a skin mechanism for maintaining body temperature in different environments. OR Analyses information to comment on the effect of exposing skin.	6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)	AO1.1 Demonstrate knowledge and understanding of skin and homeostasis • need to keep constant internal temperature, despite the different external temperatures • person A needs to lose heat to the environment / person B needs to reduce heat lost to the environment • person A gains heat from the environment / person B loses heat to the environment • person A will be in danger of overheating / person B will be in danger of becoming too cold. AO2.1 Apply knowledge and understanding of the mechanisms in skin for maintaining body temperature in different environments • cold environment reduces sweating /decreases blood flow to the skin (vasoconstriction) / shivering / body hairs rise • warm environment increases sweating / increases blood flow to the skin (vasodilation) / body hairs on skin lie flat AO3.1a Analyse information and ideas to interpret the effect of exposing / covering skin in different environments • person A body less covered/more exposed skin in warmer conditions increases heat loss/allows sweat to evaporate • person B body covered/less exposed skin in colder conditions reduces heat loss/stops sweat evaporating

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		
			Total	8	
34			smallest largest ✓ nucleotide allele chromosome	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
35	a		more accurate/precise measurement (of volume/amount of gas) ✓	1 (AO3.3b)	ALLOW gas could dissolve in water / less gas can escape IGNORE gives exact measurement of gas release
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.3 (cm ³ / min) award 3 marks $\frac{25+23+22}{3} = 23.3333333 \quad \checkmark$ $\frac{23.3}{10} = 2.3333333 \quad \checkmark$ = 2.3 (cm ³ / min) ✓	3 (AO1 x 1.2) (AO2 x 2.2)	 ALLOW one mark for clear evidence of rounding incorrect answer correctly to one dp.
		ii	increased movement of molecules / increased kinetic energy ✓ therefore, more chance of substrate colliding with enzymes/active sites ✓ more chance of substrate entering active site ✓	3 (AO2 x2.1)	 increased KE of enzymes and substrates leads to more collisions = 2 marks ALLOW more enzyme-substrate complexes forming
	c		(phenols) alter the shape of the active site/enzyme / block active site/enzyme ✓ so substrate no longer fits/binds with active site/enzyme ✓	2 (AO2.1)	IGNORE reference to denaturing need reference to active site once only for 2 marks
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance												
36			Any four from: DNA unwinds/unzips ✓ during transcription mRNA is made ✓ mRNA moves from the nucleus to the cytoplasm/ribosomes ✓ translation on the ribosomes ✓ carrier molecules/tRNA bring specific amino acids ✓ amino acids joined to form a protein ✓	4 (AO4 x 1.1)	DO NOT ALLOW amino acids are produced												
			Total	4													
37	a		<table><tr><td rowspan="3">smallest</td><td>nucleotide</td></tr><tr><td>allele</td></tr><tr><td>chromosome</td></tr><tr><td rowspan="2">largest</td><td>genome</td></tr></table>	smallest	nucleotide	allele	chromosome	largest	genome	1 (AO1.1)							
smallest	nucleotide																
	allele																
	chromosome																
largest	genome																
		b		66000000 ÷ 500 = 132 000 ✓	1 (AO2.2)	ALLOW 0.132 million or 132 thousand											
	c		<table><tr><td rowspan="3">woman</td><td colspan="2">man</td></tr><tr><td>D</td><td>d</td></tr><tr><td>d</td><td>Dd</td><td>dd</td></tr><tr><td></td><td>d</td><td>Dd</td><td>dd</td></tr></table> ✓ 0.5 / 50(%)✓	woman	man		D	d	d	Dd	dd		d	Dd	dd	2 (AO2.2) (AO3.1a)	ALLOW appropriate use of other lower/upper case letters ALLOW ECF ALLOW 1 in 2 / ½ / 1:1 ✓ DO NOT ALLOW 1:2
woman	man																
	D	d															
	d	Dd	dd														
	d	Dd	dd														
	d		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 839 award 2 marks 2517/3 ✓ = 839 ✓	2 (AO2 x 1.2)	ALLOW 840 or 2521/3 ✓												
			Total	6													