OCR
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GCSE (9–1) Biology B (Twenty First Century Science)

H

J257/04 Depth in biology (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2

Time allowed: 1 hour 45 minutes

You may use:
- a scientific or graphical calculator
- a ruler

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **32** pages.

Answer **all** the questions.

1 A student did an experiment to find out more about the process of osmosis.

(a) The student was provided with ten pieces of potato, each about 5 cm long.

She was also given five dishes each containing a different **unknown** concentration of sugar solution.

The student put two pieces of potato in each dish and left them for 30 minutes. She then removed the potato pieces and re-measured their length.

The student recorded the results in Table 1.1.

Dish of sugar solution	Length of potato (cm)				Change in mean length (cm)	Percentage change (%)
	Original	After 30 minutes in sugar solution				
		Piece 1	Piece 2	Mean		
1	4.9	5.0	5.4	5.2	+0.3	.....
2	5.1	4.3	4.1	4.2	–0.9	–18.4
3	5.0	4.8	4.4	4.6	–0.4	–8.0
4	5.2	5.7	5.9	5.8	+0.6	+11.5
5	4.9	4.8	4.8	4.8	–0.1	–2.0

Table 1.1

(i) The student has not finished working out the results.

Calculate the missing value and write it in the table. **[2]**

(ii) The table below shows the concentration of sugar solution in each of the five dishes.

Use the results from the student's experiment to show which solution was in each dish.

Write down the correct dish numbers from Table 1.1 in the column headed **'Dish'**.

Sugar solution concentration (mol/dm^3)	Dish
0.2	
0.4	
0.6	
0.8	
1.0	

(iii) The student measured the length of the pieces of potato as a quick way to obtain results.

Why does this method not measure the total change to the pieces of potato?

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(iv) How could the student modify the experiment to show the rate of water movement by osmosis in pieces of potato?

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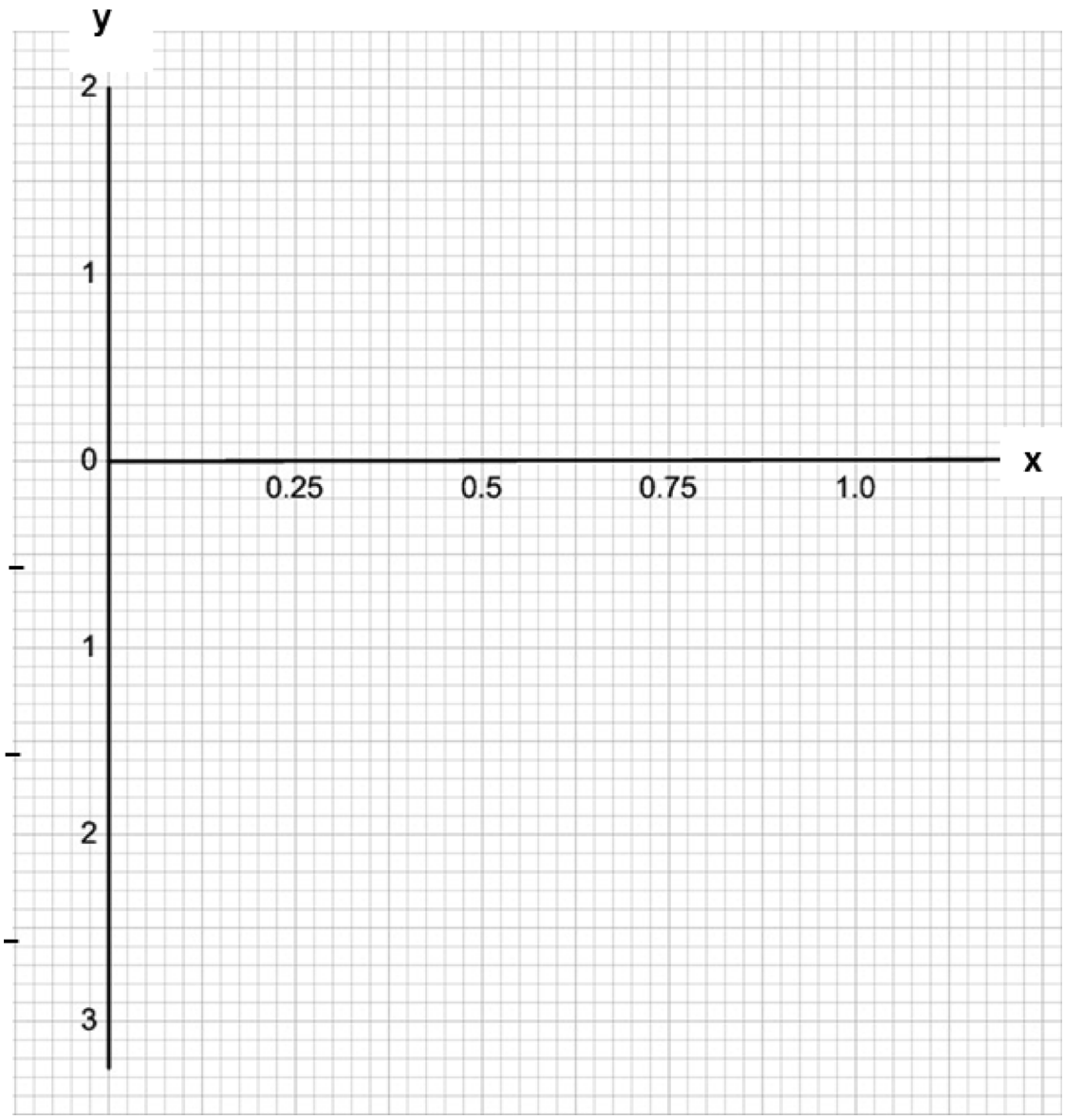
(b) Another student did a similar experiment.

These are his results in Table 1.2.

Sugar solution concentration (mol/dm^3)	Change in mean length (mm)
1.00	–1.9
0.75	–1.2
0.50	–0.5
0.25	+0.3
0.00	+1.0

Table 1.2

(i) Using the information in Table 1.2, label the x and y axis on the grid below. **[1]**



(ii) Plot the student's results on the grid. **[2]**

(iii) Draw a line of best fit on the grid. **[1]**

(iv) Use your graph to find the concentration of sugar solution where the potato pieces do not change in length.

Sugar solution concentration = ... mol/dm^3 **[1]**

(v) What can you conclude, in terms of osmosis, at this concentration?

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2 A group of students do an enzyme investigation.

Catalase is the name of the enzyme.

The word equation below shows the reaction.

$$\text{Hydrogen peroxide} \xrightarrow{\text{catalase}} \text{oxygen and water}$$

(a) Name the substrate and the enzyme in this reaction.

Substrate: .....

Enzyme: ..... **[1]**

(b)* The students investigated the effect of temperature on the rate of this enzyme-controlled reaction.

Fig 2.1 shows a graph of their results.

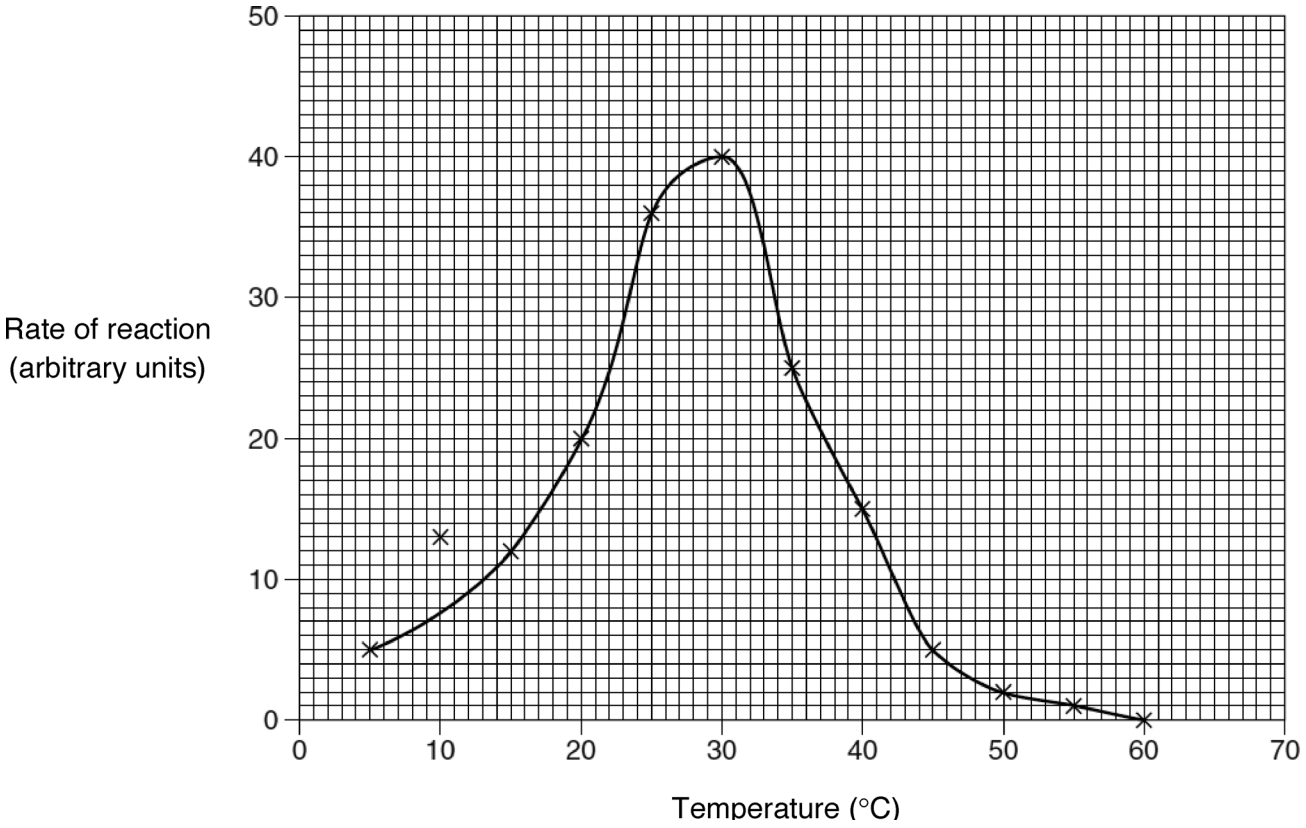

Fig 2.1

Using the graph in Fig 2.1, describe and explain the effect of temperature on this enzyme.

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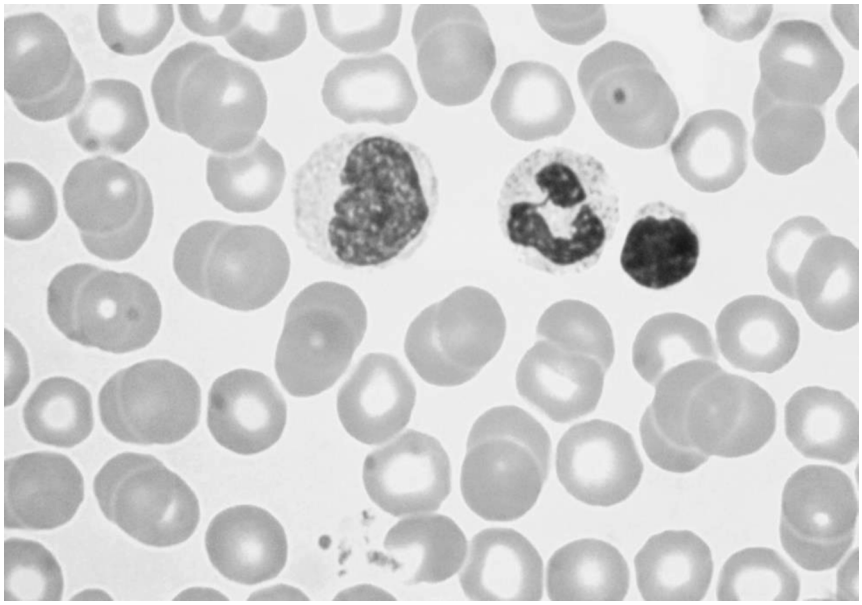
3 **(a)** Blood is made up of cells, plasma and platelets.

The picture shows blood cells as seen down a microscope.



Draw a labelled scientific drawing of a white blood cell in the space below.

Label the nucleus and the cell membrane.

[4]

(b) The function of the heart is to pump blood round the circulatory system.

The coronary arteries provide a blood supply to the cardiac muscle of the heart, although the heart is already full of blood.

Explain why coronary arteries are still needed.

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(c) James carries out a heart dissection of a heart from a lamb.

(i) He discovers that the wall of the left ventricle of the heart is made from thicker cardiac muscle than the wall of the right ventricle.

Explain the difference in thickness of the two ventricle walls.

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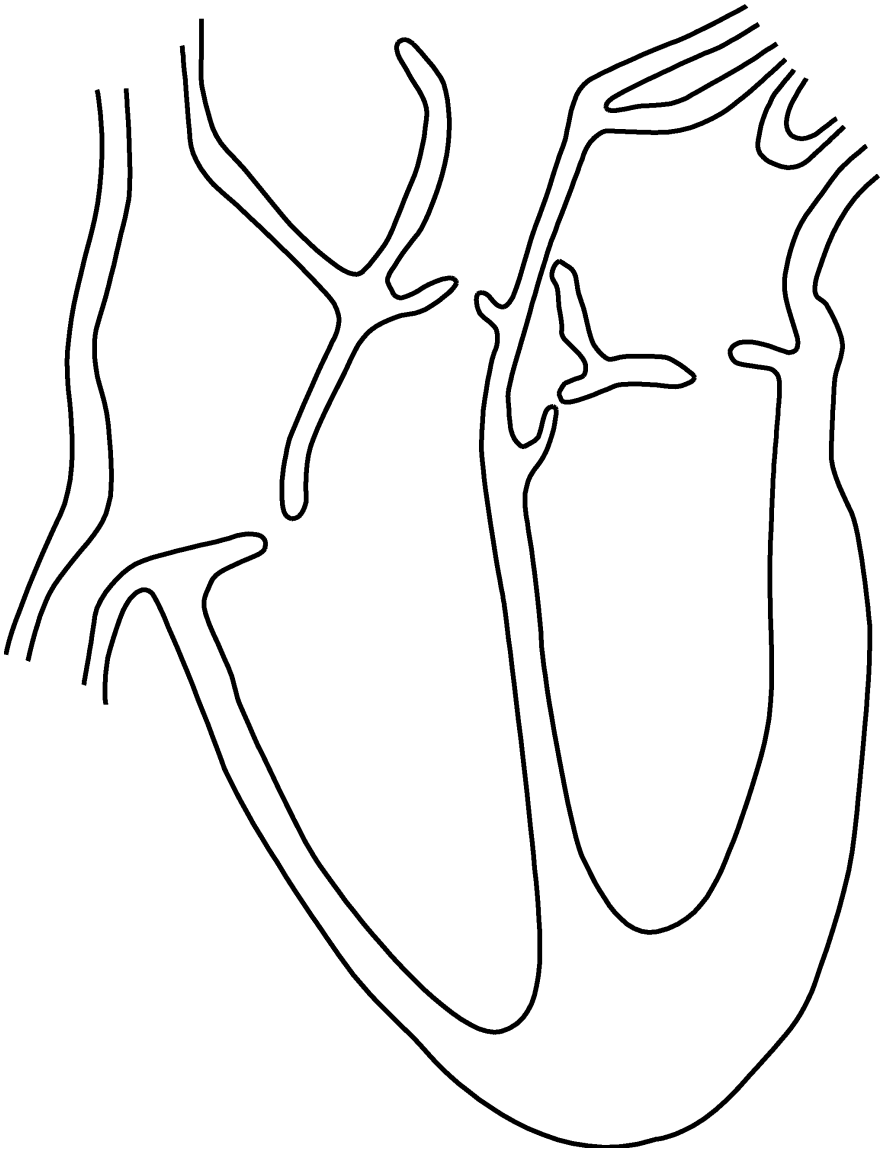
(ii) The diagram shows a line drawing that Jon does of his dissection.

Label the left ventricle with a straight line.



[1]

(iii) Place arrows on the diagram above to show the direction of blood flow out of the heart through the left **and** right sides of the heart. **[2]**

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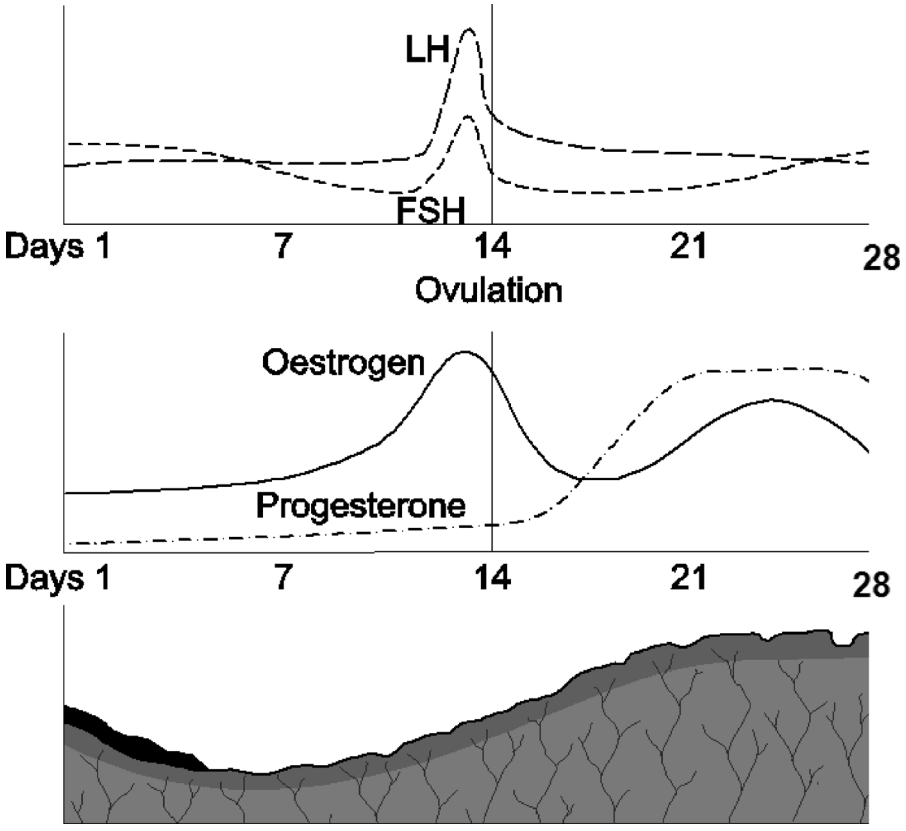
TURN OVER FOR THE NEXT QUESTION

4 The menstrual cycle is controlled by four hormones.

These hormones have an effect on target organs such as the ovaries and the uterus.

The graphs and diagram below show the hormone levels of the four hormones and the relative thickness of the uterus lining during a typical 28 day menstrual cycle.



(a)* Explain the changes that occur to prepare a woman's body to receive a fertilised egg and then allow it to grow and develop.

In your answer, use the graphs and diagram and your own knowledge.

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(b) Ali and Layla are recently married and wish to delay starting a family.

Consider the data in the table below about the effectiveness of various methods of contraception.

Method of contraception	Percentage of pregnancies that occurred despite using contraception
Birth control pill	7.6
Condom	13.9
Hormone implants	0.2
Hormone injections	3.1
Diaphragm	12.1

Suggest the most appropriate method of contraception for Ali and Layla to use by evaluating the data above.

Give reasons for your answer.

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5 The use of microscopes has greatly increased our understanding of the cell.

(a) Cells come in different shapes and sizes.

Look at the diagrams of two **spherical** cells **A** and **B**.

Cell A

Cell B

Estimate how many times larger cell **B** is than cell **A**.

Describe the method you used to make your estimation.

Estimate ..... × larger

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(b) **(i)** A group of students decide to look at human egg cells and human red blood cells using a light microscope.

Name a structure that would be visible in the human egg cell but **not** in the human red blood cell.

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(ii) A human egg cell is approximately 10^2 μm in diameter.

A human red blood cell is approximately 10 μm in diameter.

How many times larger is an egg cell compared to a red blood cell?

..... × larger **[1]**

(iii) Suggest an advantage of both cells being the size they are.

Human egg cell .....

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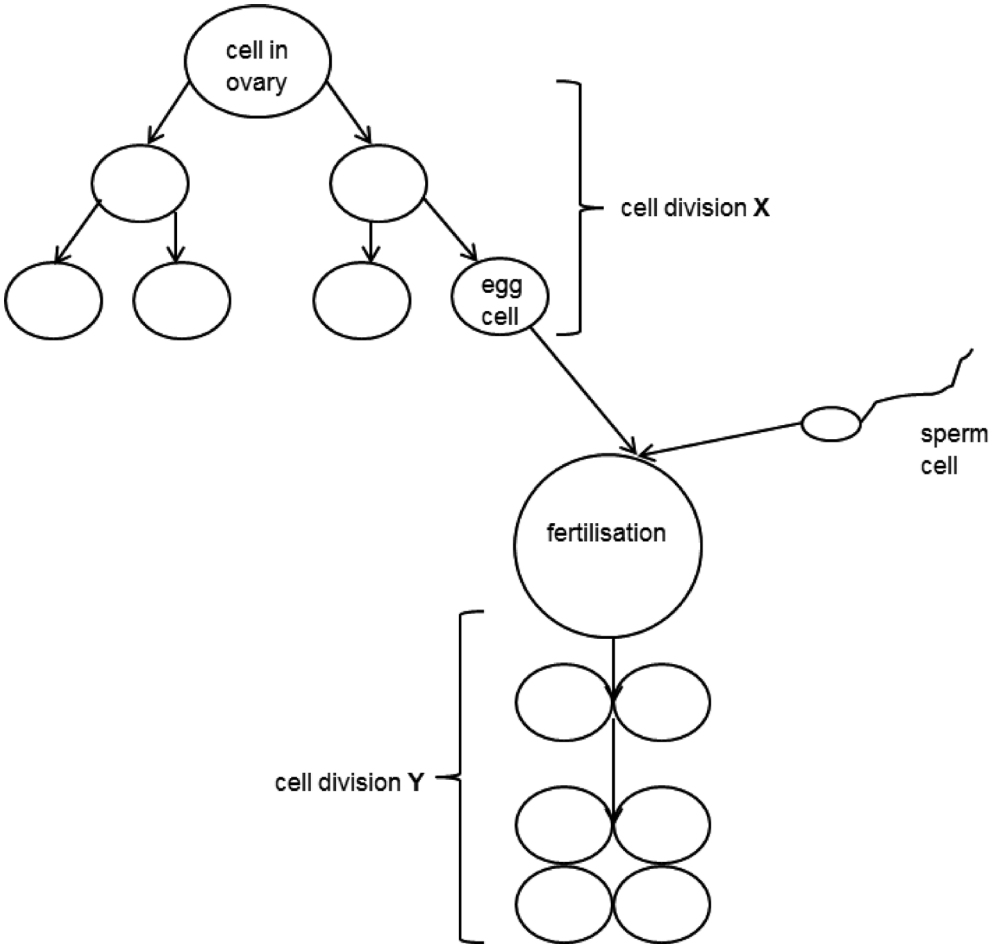
Red blood cell .....

..... **[2]**.

(c) There are two types of cell division.

Human egg cells are produced by one type of cell division. The other type is used for growth of new cells.



Identify the two types of cell division shown in the diagram above.

Cell division **X** .....

Cell division **Y** ..... **[2]**

(d) After cells divide they become specialised to form tissues with different functions.

Explain what happens during this process of specialisation.

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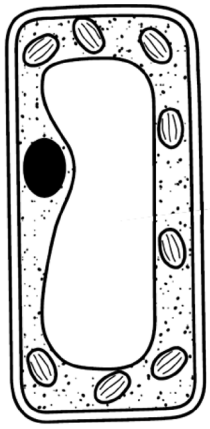
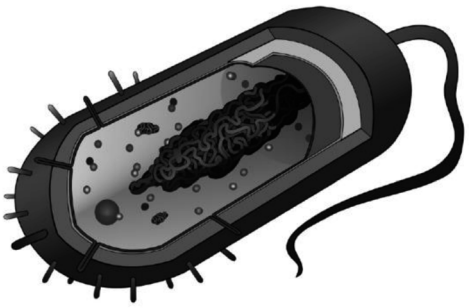
6 **(a)** Cells of living organisms carry out their functions in a variety of ways.

Cell A and **Cell B** are cells from different types of living organism.



Cell A



Cell B

Explain one **similarity** and one **difference** in the genetic material of the two cells.

Similarity	Difference

[2]

(b) Patients in hospital can be at risk from infections such as MRSA. The bacteria that cause MRSA are resistant to a variety of antibiotics.

New antibiotics need to be developed as a result of infections such as MRSA.

Use the theory of natural selection to describe how antibiotic resistance in bacteria is increasing.

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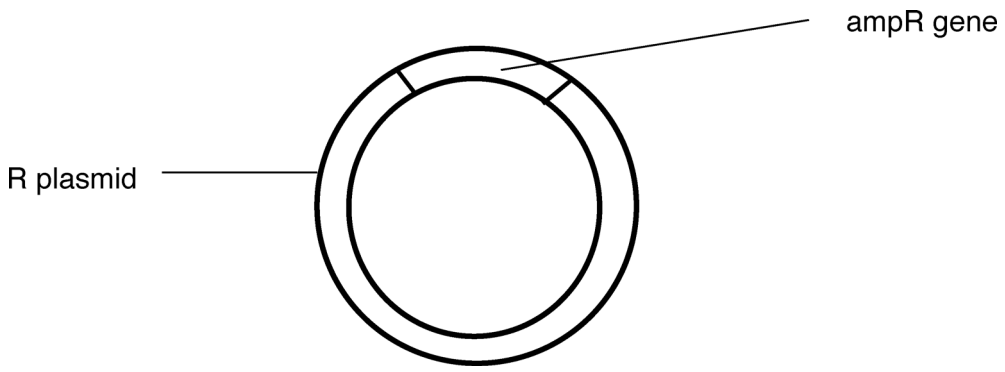
(c) Plasmids, such as the R plasmid shown below, may be found in bacteria.



What features of the R plasmid make it suitable as a **vector** in genetic engineering?

Use information in the diagram to help in your answer.

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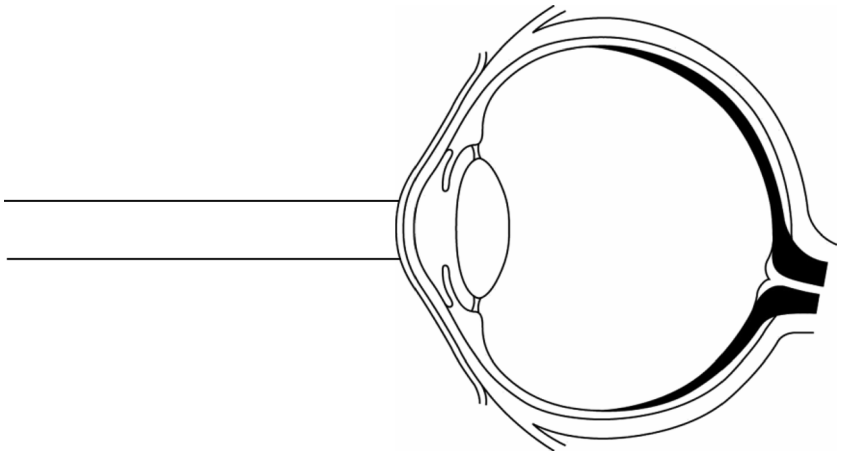
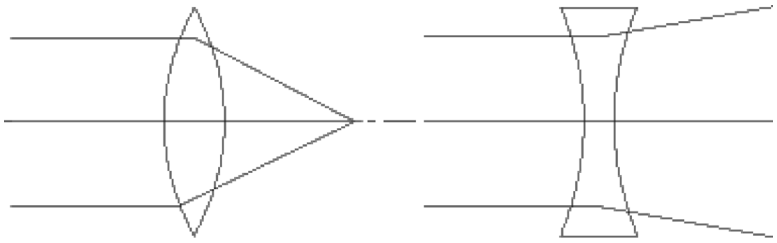
7 Sarah visits her optician who tells her she is **long sighted**.

(a) Complete the ray diagram to show what happens to the rays of light when they enter Sarah's eye.



[2]

(b) Sarah draws ray diagrams for two lenses, **A** and **B**.



Lens A **Lens B**

(i) Suggest which lens, **A** or **B**, would improve Sarah's vision.

Explain your answer.

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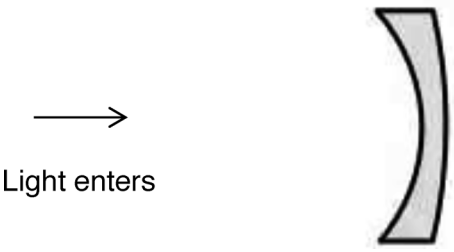
(ii) Sarah investigates other lenses. One is shown below.



Use the ray diagrams from part **(b)** to suggest the type of visual impairment that a pair of glasses with this lens would correct.

Explain your answer.

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(c) Failure of vision can sometimes be caused by brain damage and disease.

Describe and explain the limitations of treating damage to the brain.

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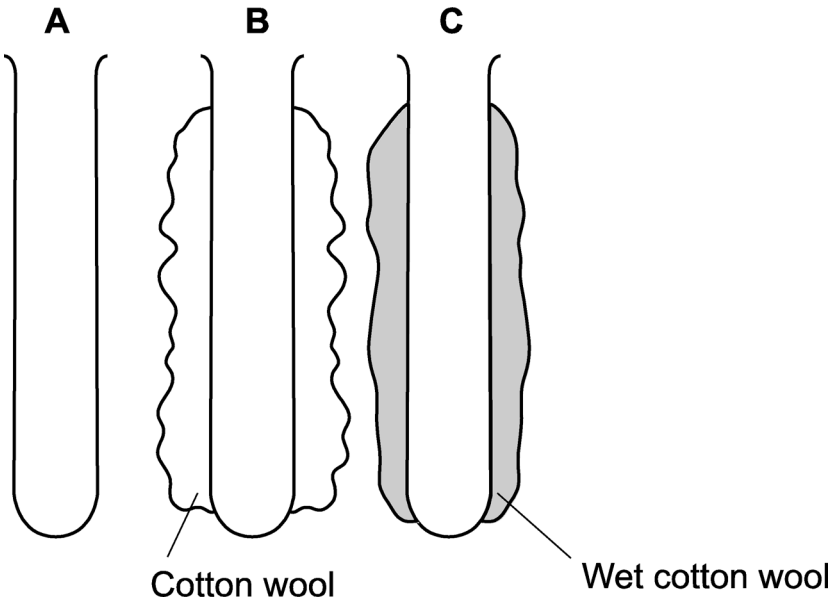
8 Kai is investigating the most effective method for staying warm on a mountain.

He sets up test tubes as below.



- Test tube **A** has no insulation.
- Test tube **B** is wrapped in cotton wool.
- Test tube **C** is wrapped in wet cotton wool.

(a) Describe an investigation that would allow Kai to find the most effective conditions for staying warm on a mountain.

- In addition to the test tubes above, Kai has access to thermometers, hot water and stopwatches.
- Include information about the results that will be collected, how they will be recorded and how they will be made valid.

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(b) Kai's results suggest that being wrapped in wet clothes would be the least effective way of staying warm on a mountain.

Explain what could happen in this situation.

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(c) **(i)** If a person was wrapped in wet clothes on a mountain, their skin would appear pale.

Explain why.

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(ii) If a person has an infection, caused by bacteria or a virus, they may have a fever. This means the internal temperature control mechanisms are no longer working correctly.

Suggest why this might be an advantage to a person suffering from a bacterial or viral infection.

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9 Read the article about classification.

Scientists use amino acid sequences to classify living things.

Scientists know that DNA codes for amino acids. They also know that amino acids are joined together to make proteins. By examining the sequence of amino acids in the same proteins in different animals, scientists can work out how closely related the animals are. The more similar the sequence, the more closely related organisms are. This technique is now being used to classify organisms in a completely new and more reliable way than in the past.

The table shows the sequence for 11 amino acids in humans and four other organisms: **A**, **B**, **C** and **D**.

Organism	Sequence of amino acids in a protein											Number of differences
	1	2	3	4	5	6	7	8	9	10	11	
Human	Gly	Asp	Val	Glu	Lys	Gly	Lys	Lys	Ile	Phe	Ile	
A	Gly	Asp	Ile	Glu	Lys	Gly	Lys	Lys	Val	Phe	Val	3
B	Gly	Asp	Val	Glu	Lys	Gly	Lys	Lys	Ile	Phe	Val	1
C	Gly	Asp	Ile	Glu	Lys	Gly	Lys	Lys	Ile	Phe	Val	2
D	Gly	Asn	Pro	Asp	Ala	Gly	Ala	Lys	Leu	Phe	Lys	7

Look at organisms **A**, **B**, **C** and **D**. The shaded boxes show where the sequence of amino acids differs from that found in humans.

The column on the right shows the total number of these differences.

(a) Describe and explain the conclusions that can be made from the data in the table.

Use the information in the article to help you.

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(b) Suggest how the data could be improved to make scientists more confident in their conclusions.

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(c) Look at the statements about the classification and identification of different organisms.

Put a tick (✓) in the boxes next to the **two** statements that describe advantages of using DNA technology.

Can be done without specialised laboratory equipment. ☐

Can be used to compare anatomical features. ☐

Can distinguish between species that look very similar. ☐ **[2]**

Can identify organisms from photographic evidence. ☐

Can identify species from small parts of the organism. ☐

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