National Qualifications 2015

X707/75/02

Biology
Section 1—Questions

WEDNESDAY, 13 MAY

9:00 AM – 11:00 AM

Instructions for the completion of Section 1 are given on Page two of your question and answer booklet X707/75/01.

Record your answers on the answer grid on Page three of your question and answer booklet

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

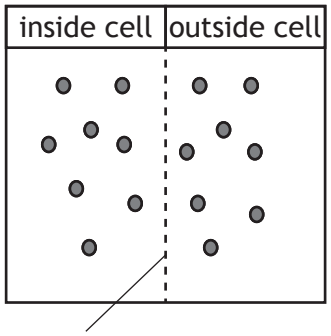
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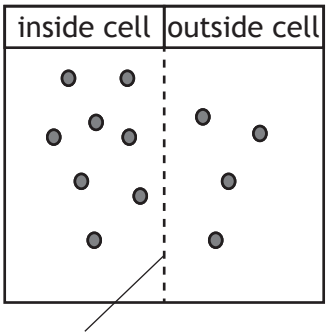
SECTION 1

1. In the diagrams below, the circles represent molecules on either side of a cell membrane. In which of these diagrams would the molecules move into a cell by diffusion?

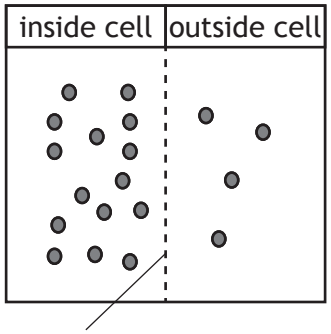
A



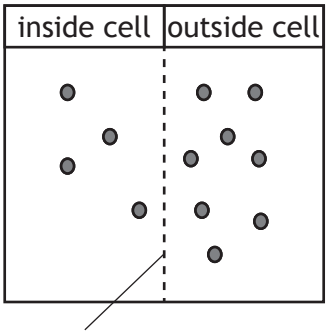
B



C



D



2. Which of the following does **not** involve mitosis?

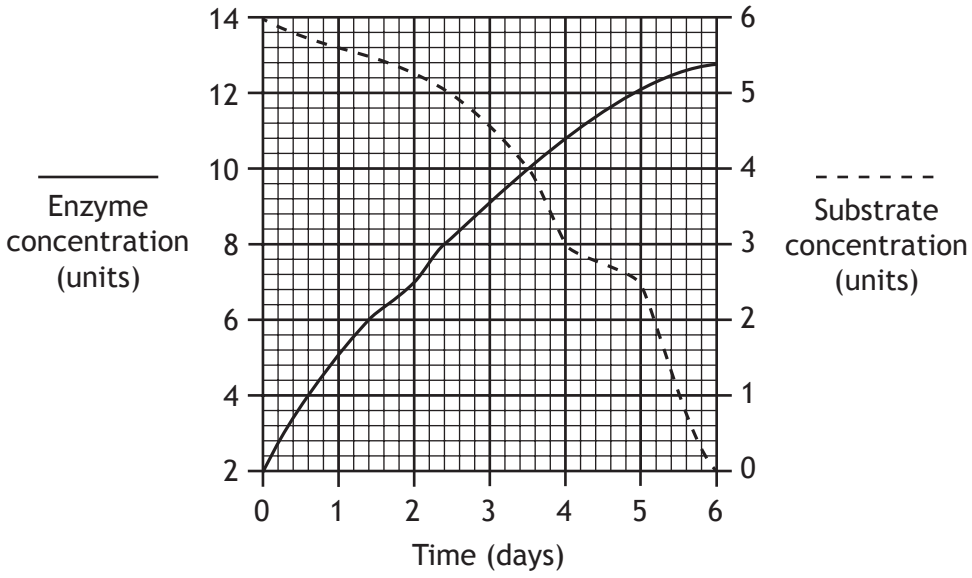
A Synthesis of proteins

B Growth of tissue

C Maintenance of the diploid chromosome complement

D Repair of tissue

3. The graph below shows changes in the enzyme and substrate concentrations in a seed over a period of time.



How many days does it take for the substrate concentration to decrease by 50%?

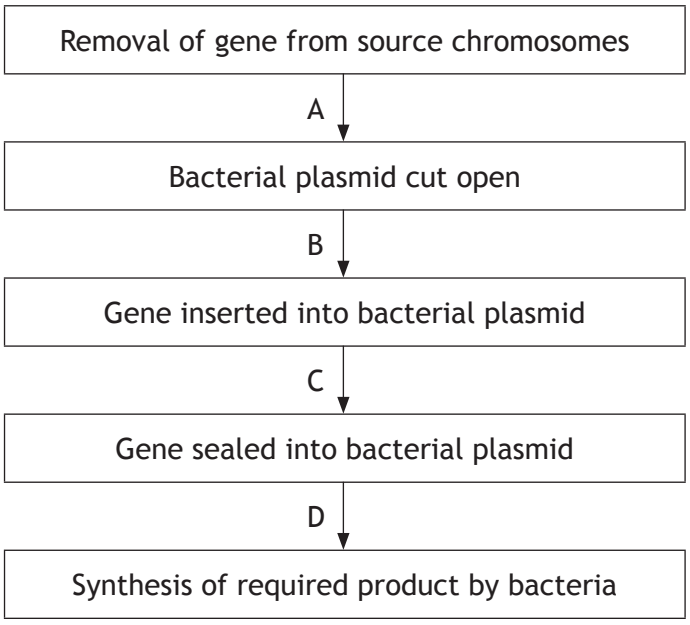
A 2

B 3

C 4

D 5

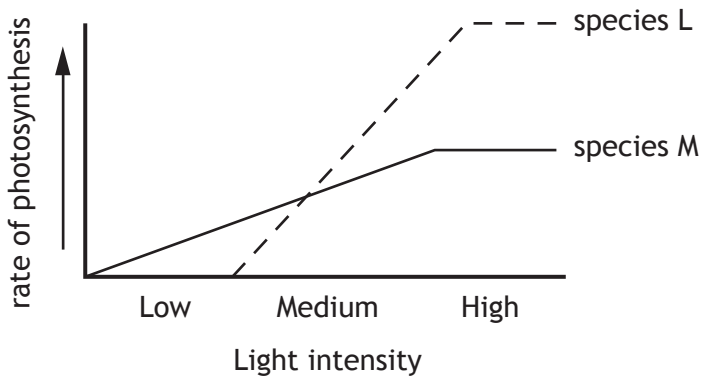
4. Some stages of genetic engineering are shown below.



Which letter indicates the stage where the plasmid is inserted into a bacterial cell?

5. The effect of light intensity on the rate of photosynthesis was measured for two species of plants, L and M.

The results are shown in the graph below.



The rate of photosynthesis of species M is

A slower than L in low light intensities

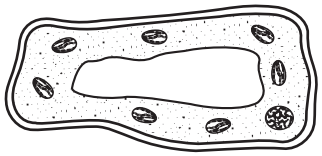
B slower than L in high light intensities

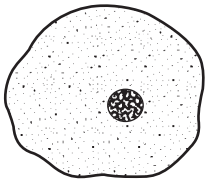
C faster than L in medium light intensities

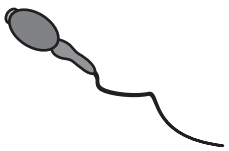
D faster than L in high light intensities.

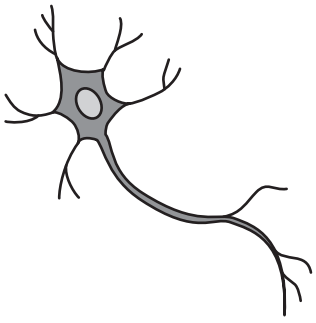
6. The diagrams below show four different types of cell.

Which cell was produced by a meristem?

A 

B 

C 

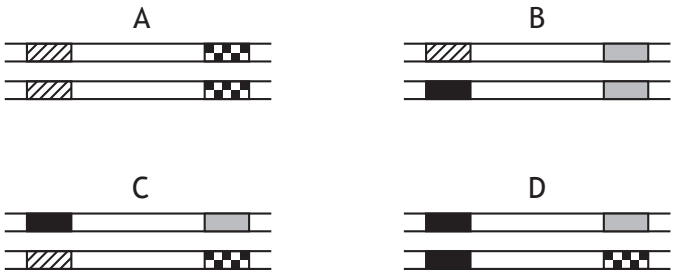
D 

7. The diploid number of chromosomes in a cell from a kangaroo is 12.

Which line in the table below identifies the number of chromosomes for the cell type shown?

	Kangaroo Cell Type	*Number of chromosomes*
A	sperm	12
B	skin	6
C	nerve	6
D	zygote	12

8. The diagrams below show the same sections of matching chromosomes found in four flies, A, B, C and D.



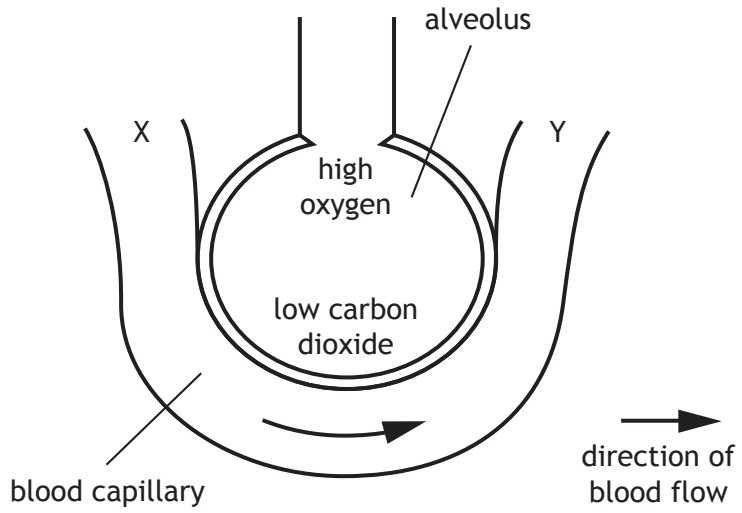
The alleles shown on the chromosomes can be identified using the following key.

- allele for striped body
- allele for unstriped body
- allele for normal antennae
- allele for abnormal antennae

Which fly is homozygous for body pattern and heterozygous for antennae type?

[Turn over

9. The diagram below shows an alveolus and an associated blood capillary.

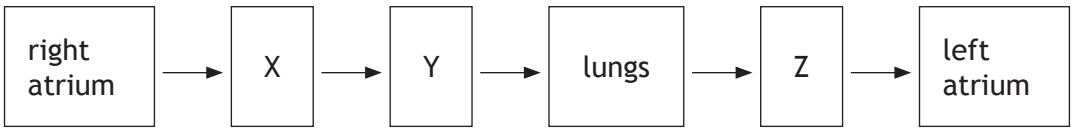


As blood flows from X to Y gases are exchanged with the alveolus.

Which line in the table below identifies the concentrations of gases at X and Y?

	Concentration at X	*Concentration at Y*
A	high oxygen	high carbon dioxide
B	low oxygen	high carbon dioxide
C	low oxygen	low carbon dioxide
D	high oxygen	low carbon dioxide

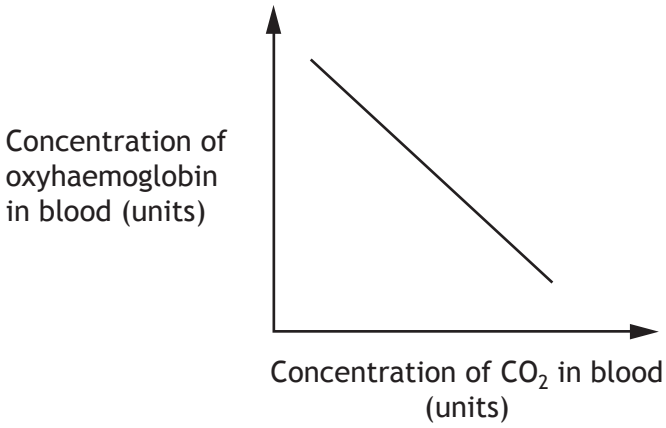
10. The following sequence shows part of the blood flow through the body.



Which line in the table below identifies X, Y and Z?

	X	*Y*	*Z*
A	right ventricle	pulmonary vein	pulmonary artery
B	right ventricle	pulmonary artery	pulmonary vein
C	pulmonary vein	pulmonary artery	right ventricle
D	pulmonary artery	right ventricle	pulmonary vein

11. The graph below shows the relationship between the concentration of carbon dioxide and oxyhaemoglobin in the blood.



Which of the following statements describes this relationship?

A As the carbon dioxide concentration increases the concentration of oxyhaemoglobin decreases.

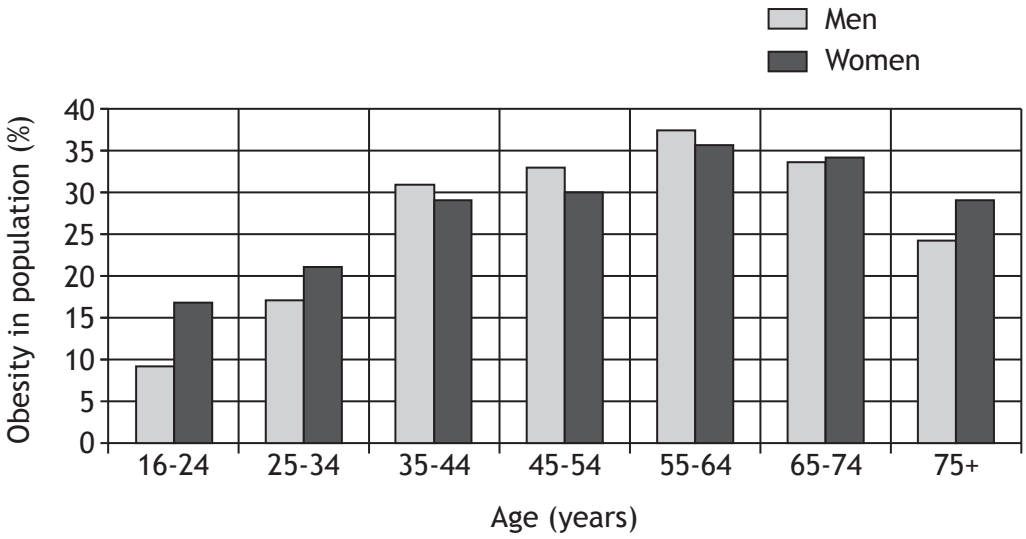
B As the carbon dioxide concentration decreases the concentration of oxyhaemoglobin decreases.

C As the carbon dioxide concentration increases the concentration of oxyhaemoglobin increases.

D Increasing carbon dioxide concentration has no effect upon the concentration of oxyhaemoglobin.

[Turn over

12. The chart below shows the percentage of men and women with obesity at different ages, in a population.



Which of the following statements is true?

A For each age group there is a higher percentage of obese men than obese women.

B For each age group there is a higher percentage of obese women than obese men.

C Obesity in men and women increases with age up to 64 years.

D Obesity in men and women decreases with age up to 64 years.

13. Which of the following statements best describes a biome?

A All the organisms in an area and their habitat.

B The role that an organism plays within a community.

C A living factor which affects biodiversity in an ecosystem.

D A region of our planet as distinguished by its climate, fauna and flora.

14. The size of a population of snails can be estimated using the following formula.

$$\text{Population} = \frac{\text{Number collected on 1st day} \times \text{Number collected on 2nd day}}{\text{Number of marked individuals found on 2nd day}}$$

A student investigated the population of snails in a garden. He collected 40 snails, marked their shells and released them. Next day, 35 snails were collected and 14 of these were found to be marked.

The snail population was estimated to be

A 16

B 100

C 560

D 1400.

15. Which of the following describes interspecific competition?

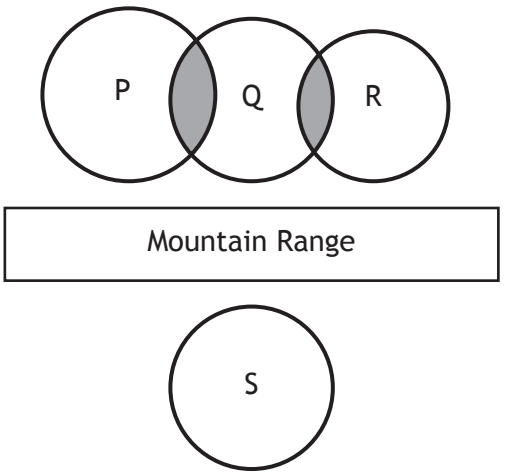
A Individuals of different species requiring different resources.

B Individuals of different species requiring similar resources.

C Individuals of the same species requiring different resources.

D Individuals of the same species requiring similar resources.

16. The diagram below represents four populations of animals P, Q, R and S and areas of interbreeding. Interbreeding takes place in the shaded areas.



How many species may evolve over time?

A 1

B 2

C 3

D 4

17. Antibiotic resistance in bacteria is an example of evolution. Which of the following shows the sequence of events leading to this?

A Natural selection ⟶ mutation ⟶ use of antibiotic

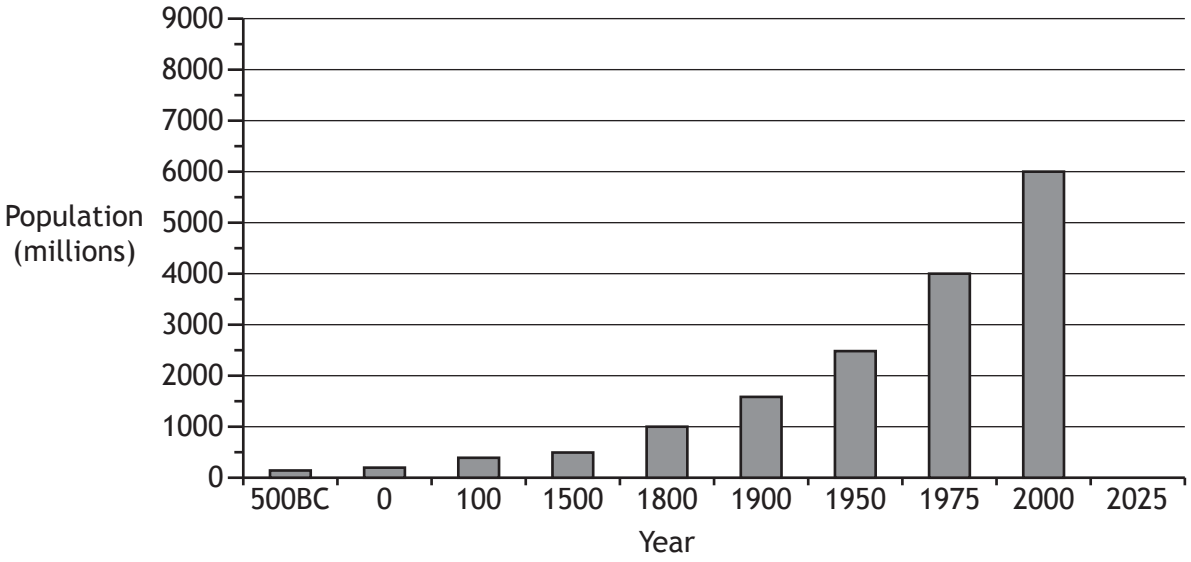
B Mutation ⟶ natural selection ⟶ use of antibiotic

C Mutation ⟶ use of antibiotic ⟶ natural selection

D Natural selection ⟶ use of antibiotic ⟶ mutation

[Turn over

18. The graph below shows information about the growth of the human population.



If the population continues to increase at the same rate as between 1975 and 2000, predict the population size in 2025.

A 7000

B 7500

C 8000

D 8500

19. DDT can be sprayed onto crops to kill insects. It can be washed off the crops by rainwater and flow into rivers where it accumulates in food chains.

A typical freshwater food chain and the concentration of DDT in each organism is shown below.

Food chain:	algae	→ stickleback	→ trout	→ osprey
DDT concentration:	0·001	2·0	5·0	20·0

The percentage increase in DDT concentration between the trout and osprey is

A 15

B 100

C 300

D 400.

20. Which of the following statements describes the sequence of events when fertiliser leaches into a loch?

A Algal bloom develops ⟶ algae die ⟶ oxygen concentration increases

B Algal bloom develops ⟶ algae die ⟶ oxygen concentration decreases

C Oxygen concentration increases ⟶ algal bloom develops ⟶ algae die

D Algae die ⟶ oxygen concentration decreases ⟶ algal bloom develops

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

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National Qualifications 2015

Mark

X707/75/01

Biology
Section 1—Answer Grid and Section 2

WEDNESDAY, 13 MAY

9:00 AM – 11:00 AM

X7077501

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day | Month | Year

Scottish candidate number

Total marks — 80

SECTION 1 — 20 marks

Attempt ALL questions.

Instructions for the completion of Section 1 are given on Page two.

SECTION 2 — 60 marks

Attempt ALL questions in this section.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

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X707750101

SECTION 1— 20 marks

The questions for Section 1 are contained in the question paper X707/75/02.
Read these and record your answers on the answer grid on *Page three* opposite.
Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

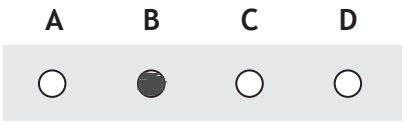
3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample Question

The thigh bone is called the

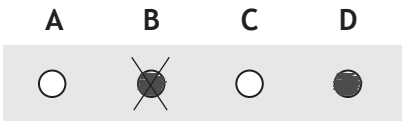
A humerus
B femur
C tibia
D fibula.

The correct answer is **B**—femur. The answer **B** bubble has been clearly filled in (see below).

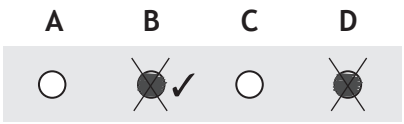


Changing an answer

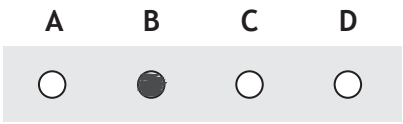
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



or



SECTION 1 — Answer Grid

OBJ20AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

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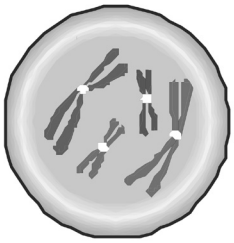
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SECTION 2 — 60 marks

Attempt ALL questions

1. (a) The diagram below represents a cell in an early stage of mitosis.



(i) State the number of chromosomes present in this cell. **1**

_____

(ii) State how many chromosomes will be present in each of the two cells produced by the process. **1**

_____

(b) Name a site of mitosis in plants. **1**

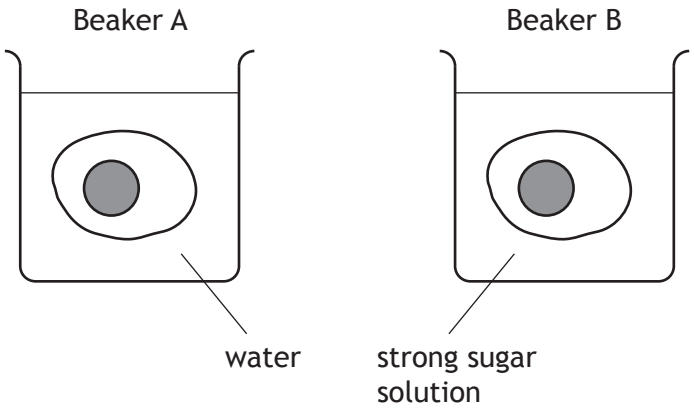
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[Turn over

2. (a) Shells can be removed from eggs by dissolving them in vinegar for 2–3 days. The egg contents remain inside a thin membrane.

In an investigation the shells from two eggs were removed. The eggs were then weighed and placed in beakers as shown below.



After 2 hours the eggs were removed from the beakers, blotted dry and reweighed. The results are shown in the following table.

Beaker	*Mass at start* (g)	*Mass after 2 hours* (g)	*Percentage change in mass*
A	54·0	67·5	
B	52·1	47·8	−8·2

(i) Complete the table by calculating the percentage change in mass for beaker A. **1**

Space for calculation

(ii) Suggest why the eggs were blotted dry before being reweighed. **1**

_____

_____

2. (a) (continued)

(iii) Choose either beaker A or B and explain how osmosis caused the change in mass of the eggs in that beaker. **2**

Beaker _____

Explanation _____

_____

_____

(b) The movement of molecules in or out of cells can be by passive or active transport.

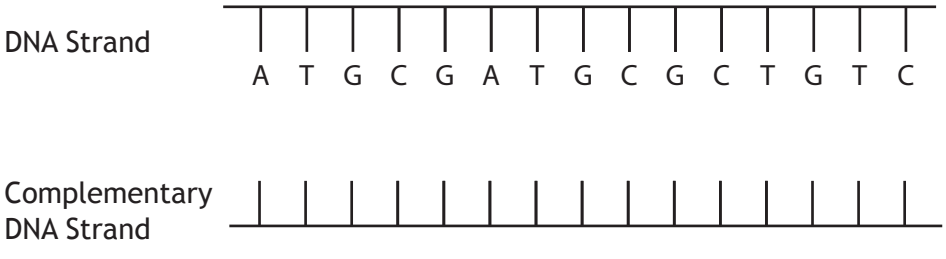
Describe **one** difference between passive and active transport. **1**

_____

_____

[Turn over

3. (a) DNA is a double stranded molecule. The following diagram shows part of one strand. Complete the diagram to show the complementary strand.



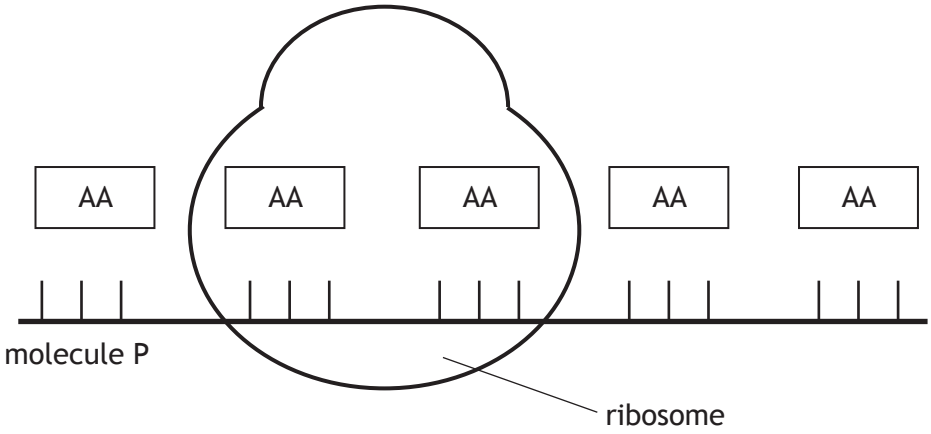
1

(b) (i) DNA contains genetic material which controls the synthesis of chemicals made from amino acids.

Name the type of chemicals synthesised. **1**

_____

(ii) The diagram below shows an example of one of these chemicals being synthesised.



Name molecule P and describe how it determines the sequence of amino acids, represented by AA, as shown in the diagram. **2**

Molecule P _____

Description _____

_____

(iii) Name the part of the cell where molecule P was made. **1**

_____

4. Photosynthesis is a two stage process used by green plants to produce food.

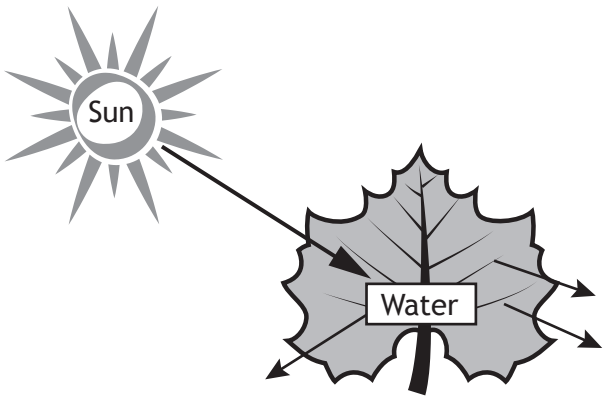
(a) The diagram below represents a summary of the first stage of photosynthesis.

Complete the diagram by filling in the three boxes, selecting terms from the list in the box below. **3**

ATP	**carbon dioxide**		**carbon fixation**
sugar	**hydrogen**	**oxygen**	**light reactions**

Name of the first stage

_____



Two products used in second stage.

1. _____

2. _____

Diffuses out of the leaf

_____

(b) Describe the second stage of photosynthesis. **2**

_____

_____

_____

_____

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

5. (a) Cellular processes occur in different parts of the cell.

Name the energy producing process which starts in the cytoplasm and is completed in the mitochondria. **1**

_____

(b) As a result of the complete breakdown of a number of glucose molecules, 114 molecules of ATP were produced.

State the number of glucose molecules which were broken down to achieve this. **1**

Space for calculation

_____ Glucose molecules

(c) Explain why a sperm cell contains more mitochondria than a skin cell. **1**

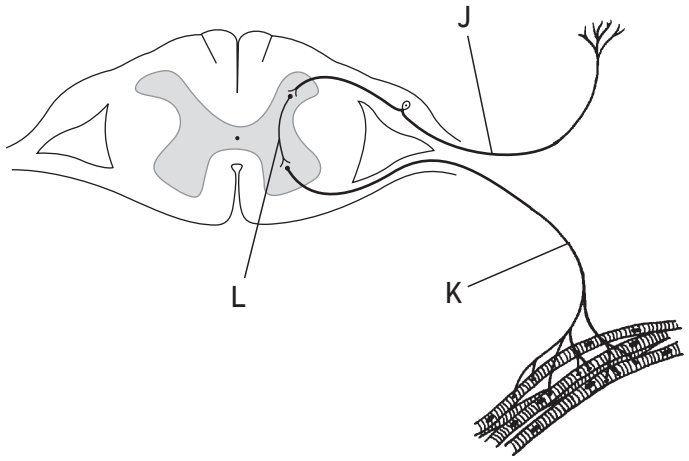
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_____

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MARKS | DO NOT WRITE IN THIS MARGIN

6. The diagram below shows the neurons involved in a reflex action. Neurons J, K and L form a reflex arc.



(a) Describe how information is passed along a neuron. **1**

_____

(b) Select **one** of the neurons shown in the diagram and tick (✓) the appropriate box below.

Name that type of neuron and describe its particular function. **2**

J ☐ K ☐ L ☐

Name _____

Function _____

_____

_____

(c) During a reflex action, the speed at which the information flows was measured to be 90 metres per second.

Calculate how long it would take for the information to complete a reflex arc which was 0·9 m in length. **1**

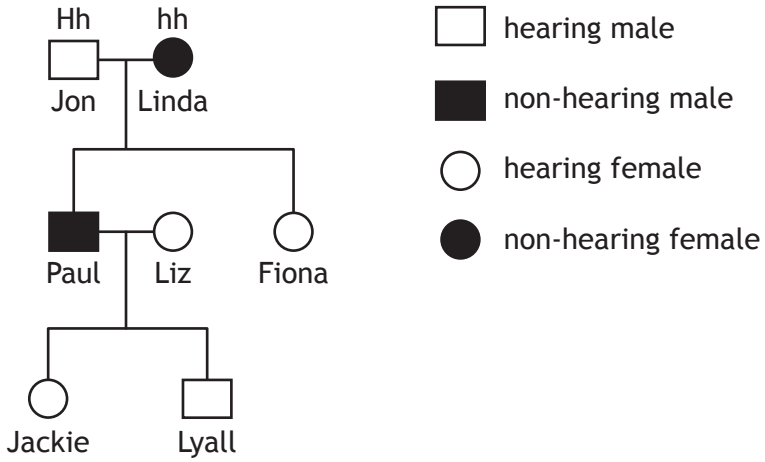
Space for calculation

_____ seconds

7. (a) One type of deafness in humans is caused by a single gene.

The diagram below shows the pattern of inheritance in one family.

H represents the hearing form of the gene.
h represents the non-hearing form of the gene.



(i) Using Jon as an example, explain how it is known that the hearing form of the gene is dominant. **1**

(ii) Use information in the family tree to complete the following table to show the genotype and phenotype of each individual. **2**

Individual	*Genotype*	*Phenotype*
Paul		
Lyall		

(iii) Fiona has a child with a man who has the same genotype as her. State the chance of their child being able to hear. **1**

Space for calculation

7. (continued)

(b) Most features of an individual's phenotype are controlled by more than one gene.

Name this type of inheritance. **1**

_____

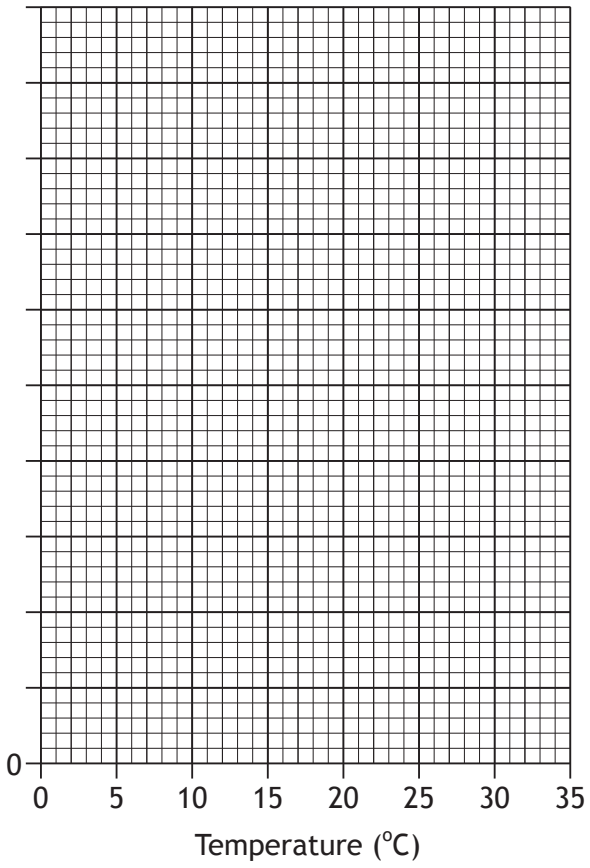
[Turn over

8. (a) An experiment was set up to find out the optimum temperature for the growth of tomatoes in a glasshouse. The following table gives the results of this experiment.

Temperature (°C)	*Fresh mass of tomatoes* (g/plant)	*Dry mass of tomatoes* (g/plant)
14	1000	50
18	8300	415
22	9000	450
26	2200	110
32	1600	80

(i) On the grid below, complete the vertical axis and plot a line graph to show the effect of temperature on the dry mass of tomatoes. **2**

(Additional graph paper, if required, can be found on *Page twenty-three*)



8. (a) (continued)

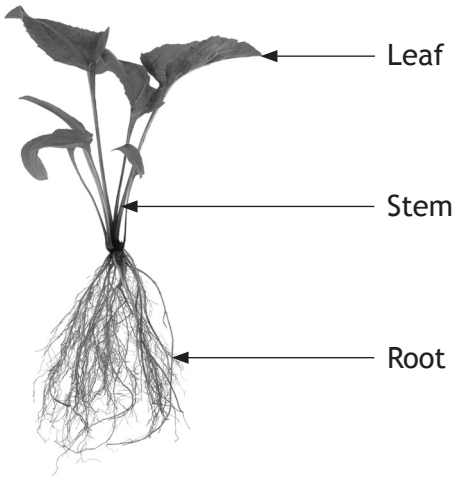
(ii) Above 26 °C the drop in the fresh mass of tomatoes continues at a steady rate.

Using the information in the table, predict the fresh mass of tomatoes which will be produced at 35 °C. **1**

Space for calculation

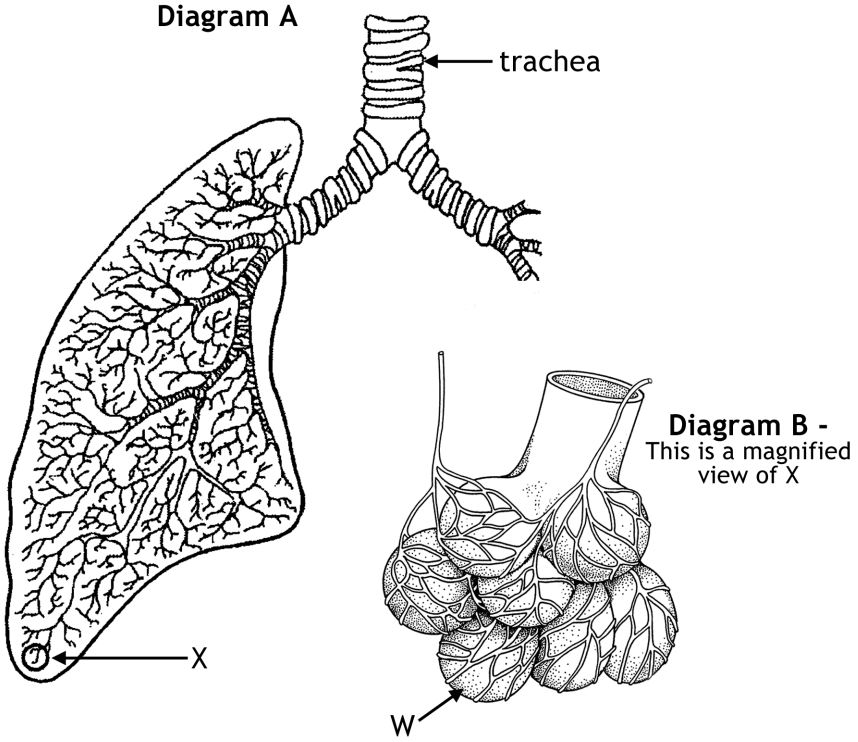
_____ g/plant

(b) The diagram below shows three parts of a plant.



Describe the structures and processes involved as water moves through the plant from the soil to the air. **3**

9. The diagrams below represent part of the human breathing system.



(a) (i) Name the structure labelled W. **1**

_____

(ii) Describe **two** features of these structures which improve the efficiency of gas exchange. **2**

1 _____

2 _____

(b) Mucus and cilia are found in the trachea.

Describe how the mucus and cilia work together to help prevent bacteria getting into the lungs. **2**

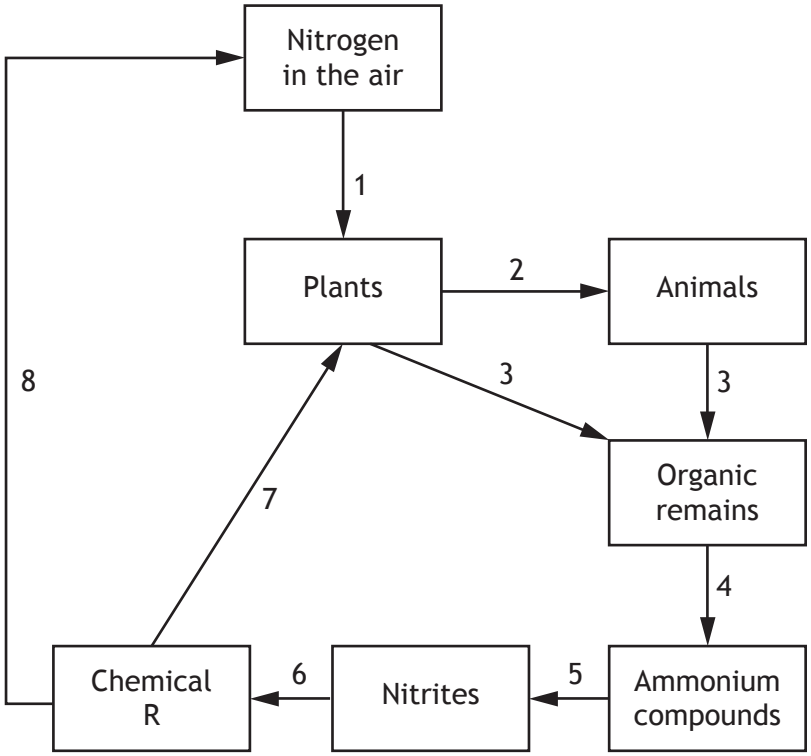
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_____

_____

_____

10. Nitrogen is an important element in living organisms. The diagram below shows stages in the transfer of nitrogen in an ecosystem.



(a) The numbers in the diagram above represent stages in the transfer of nitrogen in an ecosystem.

Select the correct number(s) to complete the table below to identify the named stages. **2**

Stage	*Number*
Death and decay	
Denitrification	

(b) Nitrogen fixing bacteria are involved in stage 1.

State **one** place where these microorganisms can be found. **1**

_____

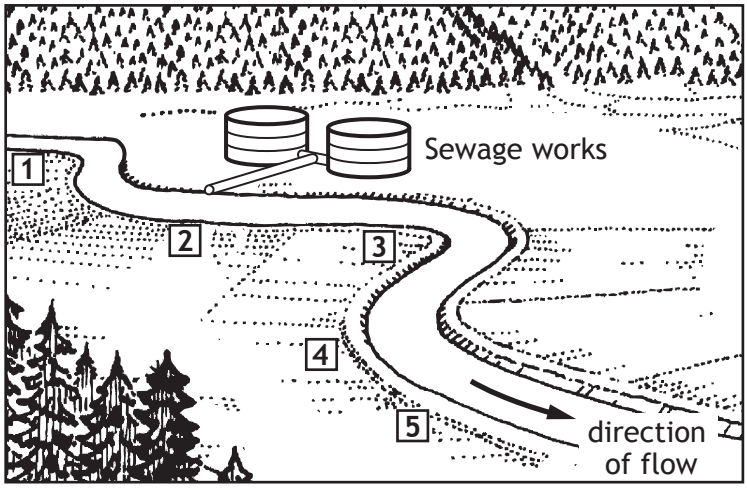
(c) Identify chemical R and explain its importance to plants. **2**

Chemical R _____

Importance to plants _____

_____

11. A river was sampled at five sites as shown in the diagram below.



The following tables show the results of analysing the samples at each site.

Table 1

Site	*Oxygen levels* (Units)	*Number of bacteria per 100ml*
1	1·2	500
2	0·04	150 000
3	0·40	12 680
4	0·54	3 400
5	1·12	1 250

Table 2

Organism Present	*Site 1*	*Site 2*	*Site 3*	*Site 4*	*Site 5*
Mayfly nymphs	23	0	0	0	8
Stonefly nymphs	42	0	0	0	21
Caddis fly larvae	18	0	0	10	15
Fresh water shrimp	2	0	0	1	1
Blood worms	1	5	24	7	1
Sludge worms	1	67	43	9	0

11. (continued)

(a) (i) Using data from Table 1, describe the relationship between the number of bacteria and the oxygen level in the water. **1**

_____

_____

(ii) Methylene blue is a chemical which can be used to compare oxygen levels in the water. The lower the oxygen level, the faster methylene blue changes from blue to colourless.

A sample of water from each of the five sites was tested.

Predict which sample would lose its blue colour fastest. **1**

Sample from site number _____

(b) Use data from Tables 1 and 2 to answer the following questions.

(i) State which of the organisms in the samples would be found in areas of high oxygen content. **1**

_____

(ii) Sewage in the river is a form of water pollution.

Describe the effect this pollution has on the number of different types of organisms in this river. **1**

_____

_____

(c) Some species are known as indicator species.

Explain what is meant by indicator species. **1**

_____

_____

[Turn over

12. Ivy is a climbing plant which produces stems that grow vertically up trees and walls. It can also produce horizontal stems allowing the ivy to spread out along the ground.



Variation is shown in the width of the leaves of the ivy plant.

A group of students carried out an investigation to find out if the difference in leaf width is linked to the height of the leaves from the ground.

Five leaves were collected from a horizontal stem and another five from a vertical stem. The widths of the leaves were measured and the results are shown in the table below.

leaf	*Leaf width* (mm)	
	Horizontal stem	*Vertical stem*
1	52	32
2	60	34
3	56	35
4	50	44
5	52	35
average	54	

(a) Complete the table by calculating the average width of the leaves from the vertical stem. **1**

Space for calculation

12. (continued)

(b) State the type of variation shown by leaf width. **1**

_____

(c) The results show that leaves from a horizontal stem are bigger than leaves from a vertical stem.

Give a reason why these results might not be reliable. **1**

_____

_____

(d) To make the investigation valid, all leaves were taken from the same plant.

Explain why this was necessary. **1**

_____

_____

(e) The students wanted to find out what abiotic factors may have affected the width of the leaves from that plant.

Suggest **one** abiotic factor which they could have investigated. **1**

_____

[Turn over

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13. Researchers have discovered an advantageous genetic mutation that causes high bone density in humans.



One man in the USA was discovered to possess this mutation after he walked away without injury from a serious car crash. Further studies have found several members of the same extended family with this mutation.

20 members of the family provided blood samples for DNA and biochemical testing. 7 of them were found to have high bone density. The same tests were performed on another group of 20 unrelated individuals with normal bone density.

The location of the gene mutation was able to be identified and it is hoped that the findings will help in developing medications to increase bone density for the treatment of conditions such as osteoporosis.

(a) (i) Calculate the percentage of the family who did **not** have the mutation for high bone density. **1**

Space for calculation

_____ %

(ii) Explain why the biochemical tests were also performed on the 20 individuals with normal bone density. **1**

_____

_____

(b) Name **one** factor which can increase the rate of mutation. **1**

_____

(c) Mutations are the only source of new alleles.

Explain why it is important that new alleles arise in a species. **1**

_____

_____

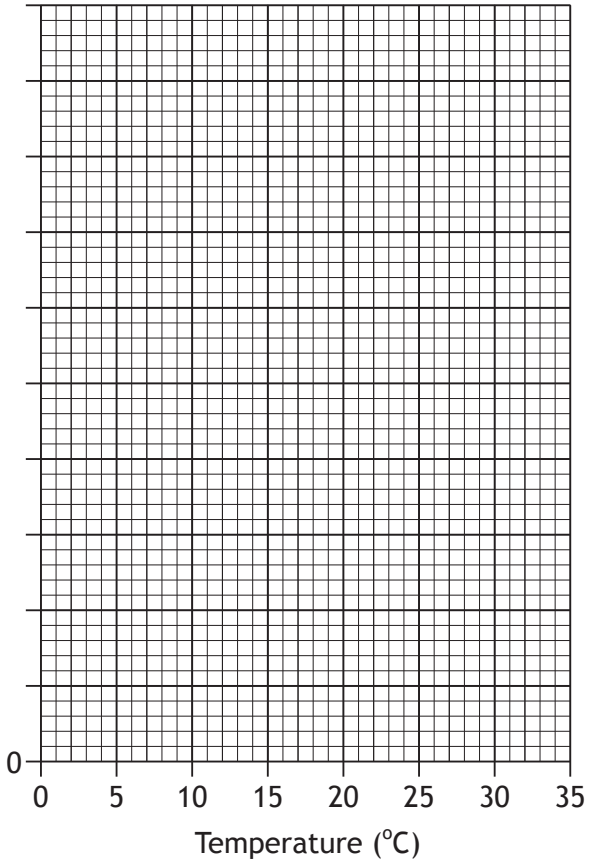
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[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL GRAPH PAPER FOR QUESTION 8(a)(i)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ACKNOWLEDGEMENTS

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Question 12 – Reika/shutterstock.com
Question 13 – Viktor Gladkov/shutterstock.com