



N5 Biology
SQA Past Paper booklet 1
2019 and 2018



National
Qualifications
2019

X807/75/02

Biology
Section 1 — Questions

TUESDAY, 30 APRIL

1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X807/75/01.

Record your answers on the answer grid on *page 03* 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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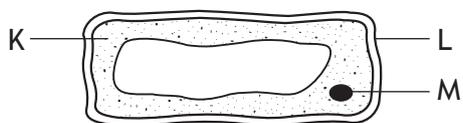
SECTION 1 — 25 marks

Attempt ALL questions

1. Animal cells left in a solution with a lower water concentration than their contents

- A shrink
- B burst
- C become turgid
- D become plasmolysed.

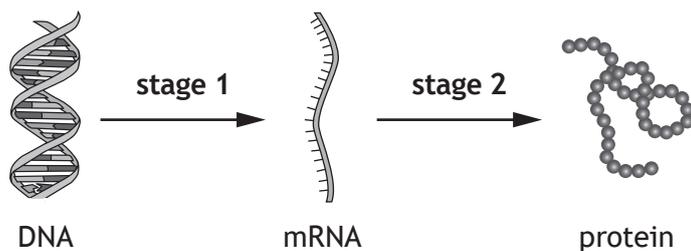
2. The diagram represents a typical plant cell.



Which of the labelled parts could also be found in a typical fungal cell?

- A L and M
- B K and M
- C K and L
- D K, L and M

3. The diagram shows stages in the production of a protein in a cell.



Which row in the table identifies the exact location of each stage?

	Stage 1	Stage 2
A	nucleus	cytoplasm
B	nucleus	ribosome
C	cytoplasm	ribosome
D	cytoplasm	nucleus

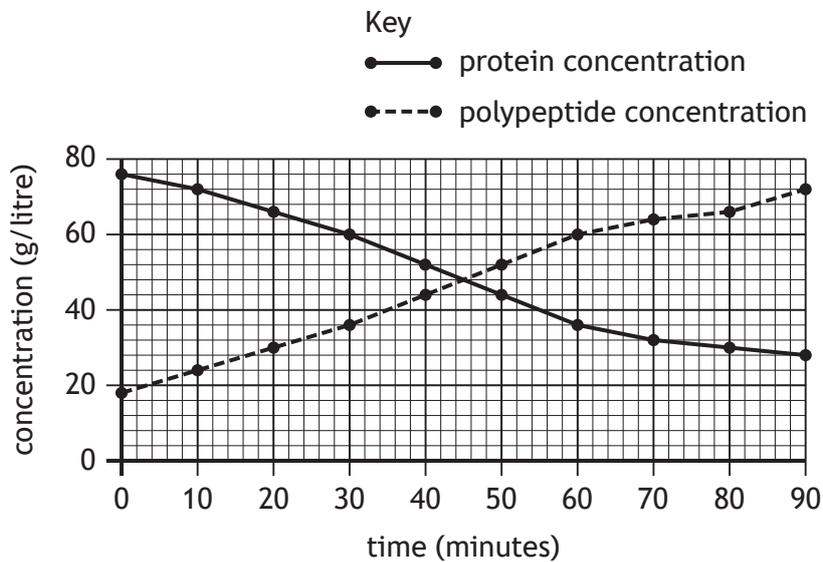
4. A single strand of DNA contains 830 adenine, 929 cytosine, 774 guanine and 615 thymine bases.

How many guanine bases would be in the complementary strand?

- A 615
- B 774
- C 830
- D 929

5. Proteins are broken down in the stomach into polypeptides.

The graph shows the concentration of proteins and polypeptides in the stomach over 90 minutes.

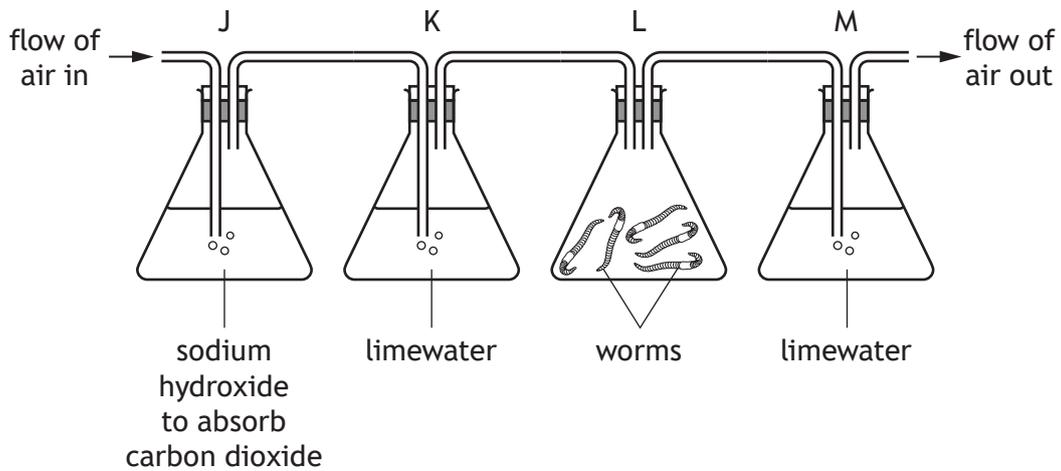


The ratio of protein concentration to polypeptide concentration in the stomach after 30 minutes is

- A 3:5
- B 5:3
- C 13:7
- D 7:13

[Turn over

6. Four flasks, J, K, L and M, were set up to investigate the production of carbon dioxide during respiration.



Limewater turns increasingly cloudy as more carbon dioxide is passed through it.

Predict what would happen if only one worm was used in flask L.

The limewater in flask

- A K would turn cloudy more slowly
 - B K would turn cloudy more quickly
 - C M would turn cloudy more slowly
 - D M would turn cloudy more quickly.
7. Which of the following reactions takes place during fermentation in plant cells?
- A pyruvate \longrightarrow carbon dioxide + ethanol
 - B glucose \longrightarrow carbon dioxide + water
 - C glucose \longrightarrow water + ethanol
 - D pyruvate \longrightarrow lactate

8. A cell with 10 chromosomes divided by mitosis.

Which row in the table identifies the number of daughter cells produced and the number of chromosomes in each daughter cell?

	Number of daughter cells produced	Number of chromosomes in each daughter cell
A	1	20
B	1	5
C	2	10
D	2	5

9. Which row in the table shows the type of message that is transferred through various structures in a reflex arc?

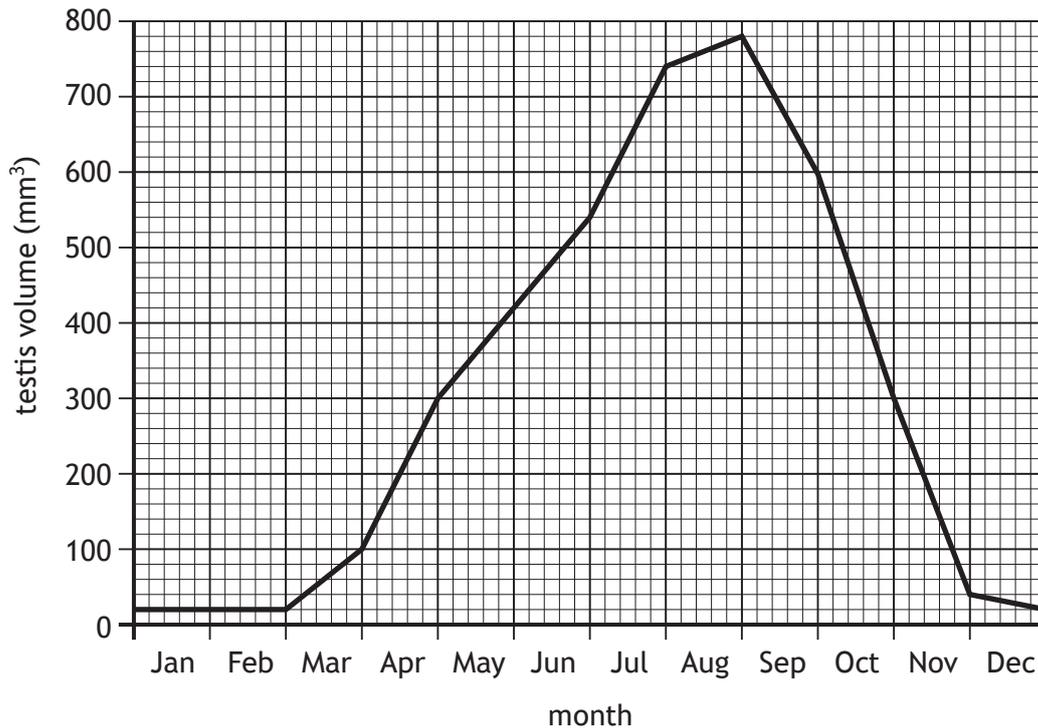
	Sensory neuron	Synapse	Motor neuron
A	chemical	electrical	chemical
B	electrical	chemical	electrical
C	chemical	chemical	electrical
D	electrical	electrical	chemical

10. Hormones are released by

- A endocrine glands
- B blood cells
- C receptor cells
- D target tissues.

[Turn over

11. The volume of one bird's testis was measured on the last day of each month for a year. The graph shows the results.



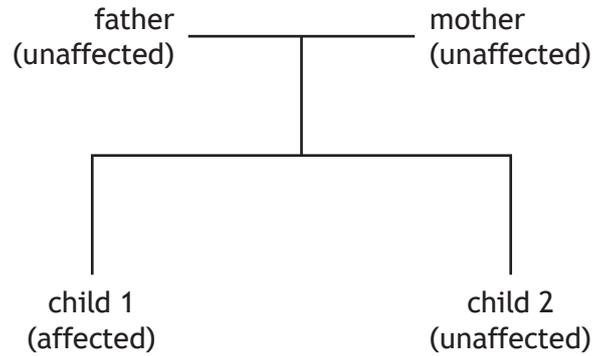
Which of the following statements is true?

The volume of the testis

- A is constant from end of November to end of February
 - B increases more between end of March and end of April than any other month
 - C increases for only five months of the year
 - D decreases for only four months of the year.
12. Which term describes the type of variation in which a characteristic is controlled by more than one gene?
- A Continuous
 - B Discrete
 - C Polygenic
 - D Heterozygous

13. Albinism is a condition in which the production of a pigment that colours the skin is limited. It is controlled by a recessive allele.

The diagram shows how a family was affected by the condition.



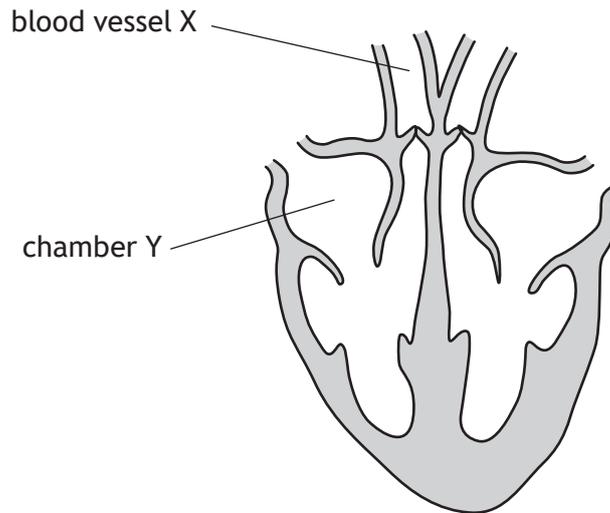
The chance of this couple's 3rd child being affected by the condition is

- A 1 in 1
 - B 1 in 2
 - C 1 in 3
 - D 1 in 4.
14. Which row in the table describes features of phloem?

	Substance transported	Sieve plates
A	sugar	present
B	sugar	absent
C	water	absent
D	water	present

[Turn over

15. The diagram shows a mammalian heart and associated blood vessels.



Which row in the table identifies blood vessel X and chamber Y?

	Blood vessel X	Chamber Y
A	pulmonary artery	left atrium
B	pulmonary vein	right atrium
C	pulmonary artery	right atrium
D	pulmonary vein	left atrium

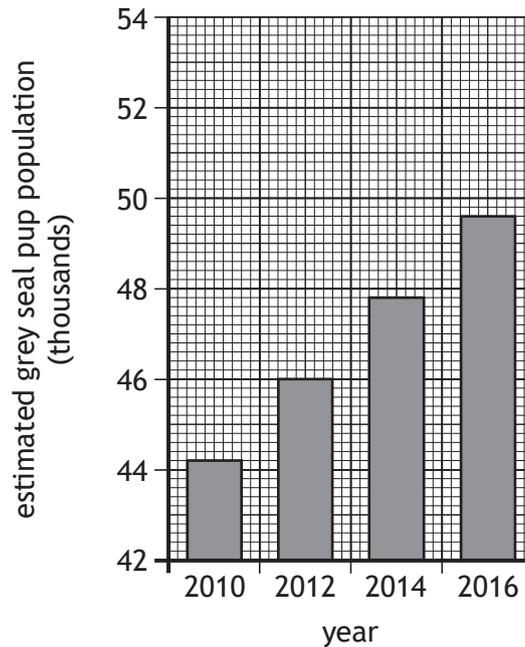
16. The table shows the composition of some of the gases in inhaled and exhaled air.

Gas	Gas composition (%)	
	Inhaled air	Exhaled air
Oxygen	20	16
Carbon dioxide	0.04	4

How many times greater is the carbon dioxide concentration in exhaled air than in inhaled air?

- A 0.16
- B 3.96
- C 100
- D 500

17. The graph shows survey results of estimated grey seal pup populations every two years from 2010 to 2016.



If the grey seal pup population continues to increase by the same number at each survey, what will the estimated population be in 2020?

- A 51 400
 - B 53 200
 - C 55 000
 - D 56 800
18. Competition occurs when required resources are in short supply. Interspecific competition occurs when individuals of
- A the same species compete for a few of the same resources
 - B different species compete for a few of the same resources
 - C the same species compete for all the same resources
 - D different species compete for all the same resources.

[Turn over

19. At six different sample sites in a stream, the oxygen concentration, pH and numbers of different organisms were recorded.

The higher the number of organisms in the sample the more abundant they are.

The results are shown in the tables.

Table 1

Factor	Sample site					
	1	2	3	4	5	6
Oxygen concentration (units)	88	80	75	72	28	61
pH	5.7	6.0	6.6	7.3	7.6	8.0

Table 2

Organism	Sample site					
	1	2	3	4	5	6
Mayfly nymphs	0	0	0	5	7	122
Dragonfly nymphs	3	3	2	3	2	2
Chironimid fly larvae	0	1	1	2	227	32
Freshwater snails	0	0	0	0	50	75

Using the results from both tables identify which of the following conclusions is **false**.

- A Freshwater snails do not survive in water with a lower pH
 - B Changes in pH have little effect on the distribution of dragonfly nymphs
 - C Mayfly nymphs are at their most abundant when the oxygen concentration is lowest
 - D Chironimid fly larvae are at their most abundant when the oxygen concentration is lowest
20. In which parts of a green leaf would most photosynthesis occur?
- A Palisade mesophyll and lower epidermis
 - B Lower epidermis and guard cells
 - C Guard cells and spongy mesophyll
 - D Spongy mesophyll and palisade mesophyll

21. The table shows the rate of photosynthesis in a plant under different light intensities.

Light intensity (kilolux)	Rate of photosynthesis (units)
10	2
20	28
30	53
40	76
50	85

Which change in light intensity produces the greatest increase in the rate of photosynthesis?

- A 10 to 20 kilolux
- B 20 to 30 kilolux
- C 30 to 40 kilolux
- D 40 to 50 kilolux

22. A gardener decided to treat his crops with both fertiliser and pesticides. The result of this would be

- A a decrease in soil nitrates and an increase in crop yield
- B an increase in soil nitrates and an increase in crop yield
- C an increase in soil nitrates and a decrease in crop yield
- D a decrease in soil nitrates and a decrease in crop yield.

23. Which of the following could occur as a result of fertiliser leaching into a fresh water pond?

	Algae population	Bacterial population	Oxygen concentration
A	increases	increases	increases
B	decreases	decreases	decreases
C	decreases	decreases	increases
D	increases	increases	decreases

[Turn over for next question

24. For the successful biological control of whitefly in a greenhouse, it was recommended to use 50 individuals of a predator species to kill a population of 1500 whitefly.
The number of predators that would be required to kill 21 000 whitefly is
- A 420
 - B 700
 - C 19 500
 - D 75 000.
25. Which of the following statements describe the possible effects of a mutation on the survival of an organism?
- 1. It has no effect
 - 2. It gives the organism an advantage
 - 3. It disadvantages the organism
- A 1 and 2 only
 - B 1 and 3 only
 - C 2 and 3 only
 - D 1, 2 and 3

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

SECTION 2 — 75 marks
Attempt ALL questions

1. (a) The list gives four types of cells.

Bacteria Fungus Animal Plant

(i) Cell membranes are found in all of these cell types.

Describe the function of the cell membrane.

1

(ii) Name **one** other structure that is also present in all of these cells.

1

(b) The table gives information on the numbers of mitochondria in different types of mammalian cells.

Cell type	Number of mitochondria per cell			
	Cell 1	Cell 2	Cell 3	Average
Muscle	1352	1203	1450	1335
Skin epithelium	250	330	275	
Lymphocyte	953	1112	860	975

(i) Complete the table by calculating the average number of mitochondria per cell in skin epithelium.

1

Space for calculation

(ii) Compared to skin epithelium cells, muscle and lymphocyte cells have higher numbers of mitochondria.

Suggest why these cells need more mitochondria.

1



* X 8 0 7 7 5 0 1 0 5 *

2. Ions move in and out of cells by passive and active processes.

The table shows the concentration of three ions outside and inside a human cell.

Ions	Outside cell (mM)	Inside cell (mM)
Sodium (Na ⁺)	145	12
Potassium (K ⁺)	4	139
Chloride (Cl ⁻)	116	4

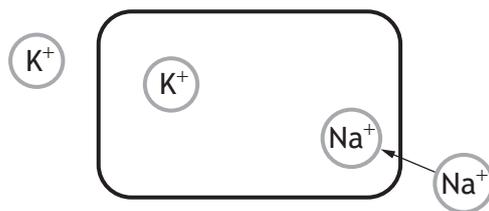
(a) Name the process by which sodium ions move into this cell.

1

(b) (i) Potassium ions (K⁺) move by active transport.

1

Using the information in the table, complete the diagram, by drawing an arrow, to show the direction in which the potassium ions move.



(ii) Name the type of molecule, found in a cell membrane, which is involved in moving ions by active transport.

1

(c) Calculate how many times greater the concentration of chloride ions is outside the cell compared to inside the cell.

1

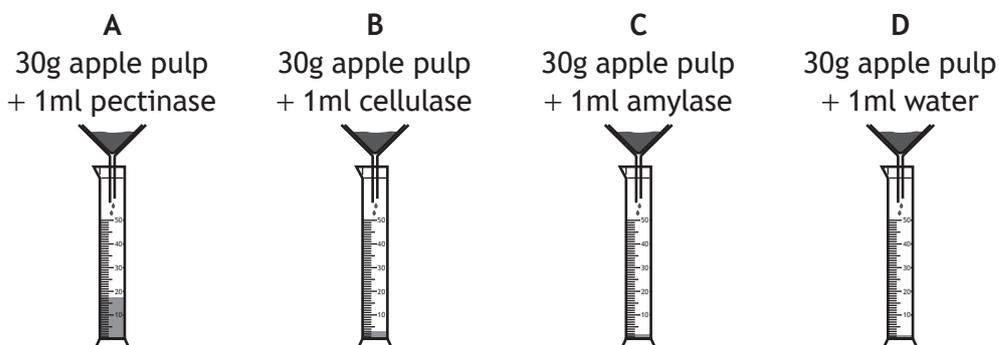
Space for calculation

_____ times greater



3. Enzymes are used to help extract juice from fruit pulp.

The diagrams show a student's investigation into the effectiveness of different enzymes on the volume of juice produced.



After 30 minutes, the volume of apple juice collected was measured and the procedure was then repeated.

The average for each cylinder was calculated and the results are shown in the table.

Cylinder	Liquid added to apple pulp	Average volume of apple juice collected (ml)
A	pectinase	17.6
B	cellulase	3.2
C	amylase	1.8
D	water	1.6

(a) Name the enzyme which was the least effective at extracting juice from the apple pulp. 1

(b) Enzymes can be involved in two types of reaction. The extraction of juice from apple pulp is an example of a degradation reaction. 1

Name the other type of reaction.

[Turn over



3. (continued)

- (c) Cellulase is an enzyme that speeds up the breakdown of a component of the plant cell wall.

Name this component.

1

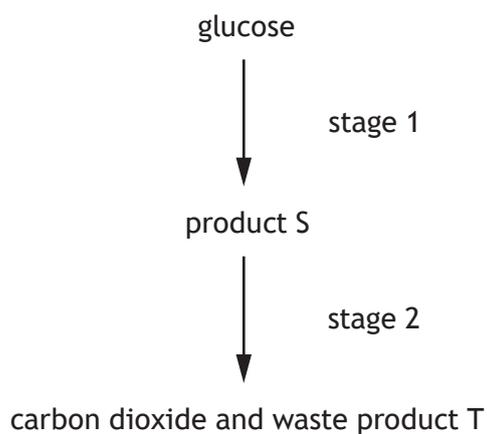
- (d) All of the enzymes broke down at least some part of the apple pulp to produce apple juice.

What name is given to the substance that an enzyme breaks down?

1



4. The diagram represents the process of aerobic respiration in yeast cells.



- (a) (i) Name product S and waste product T. 2
 S _____
 T _____
- (ii) Name the substance that must be present for yeast to respire aerobically. 1

- (iii) Identify which of the two stages releases the larger quantity of ATP. 1
 Stage _____

[Turn over



4. (continued)

MARKS

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- (b) An investigation was carried out into the respiration of yeast. A dough was made containing live yeast and left in optimum conditions. As the yeast respired, the carbon dioxide produced caused the dough to rise. The volume of the dough was measured every 10 minutes for 60 minutes.

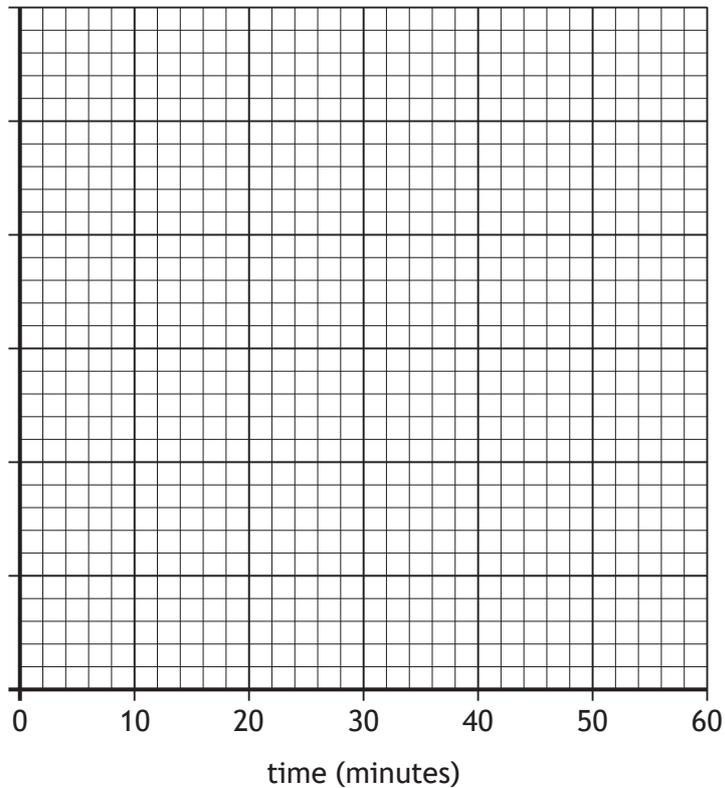
The results are shown in the table.

Time (minutes)	Volume of dough (cm ³)
10	8
20	14
30	22
40	26
50	28
60	28

- (i) On the grid, complete the vertical axis and plot a line graph to show the effect of time on the volume of dough.

2

(An additional grid, if required, can be found on *page 31*)



* X 8 0 7 7 5 0 1 1 0 *

4. (b) (continued)

MARKS
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MARGIN

(ii) Predict the volume of dough at 50 minutes if the experiment was carried out at a lower temperature.

1

Give a reason for your answer.

1

Prediction _____ cm³

Reason _____

[Turn over



* X 8 0 7 7 5 0 1 1 1 *

5. New cells are produced by mitosis throughout life.

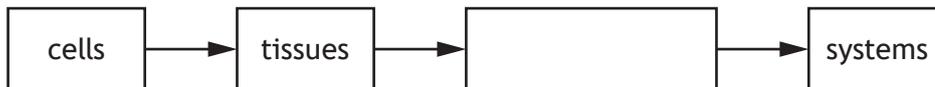
- (a) Name the cells, found in the early stages of an embryo's development, which have the potential to develop into specialised cells.

1

- (b) As cells become specialised they are organised according to their function.

Complete the flowchart to show the levels of organisation found within a multicellular organism.

1



- (c) State a reason, other than growth, why cells continue to be produced throughout life.

1

- (d) Lymphocytes and phagocytes are specialised white blood cells.

Describe the different ways in which these two types of cell destroy pathogens.

2

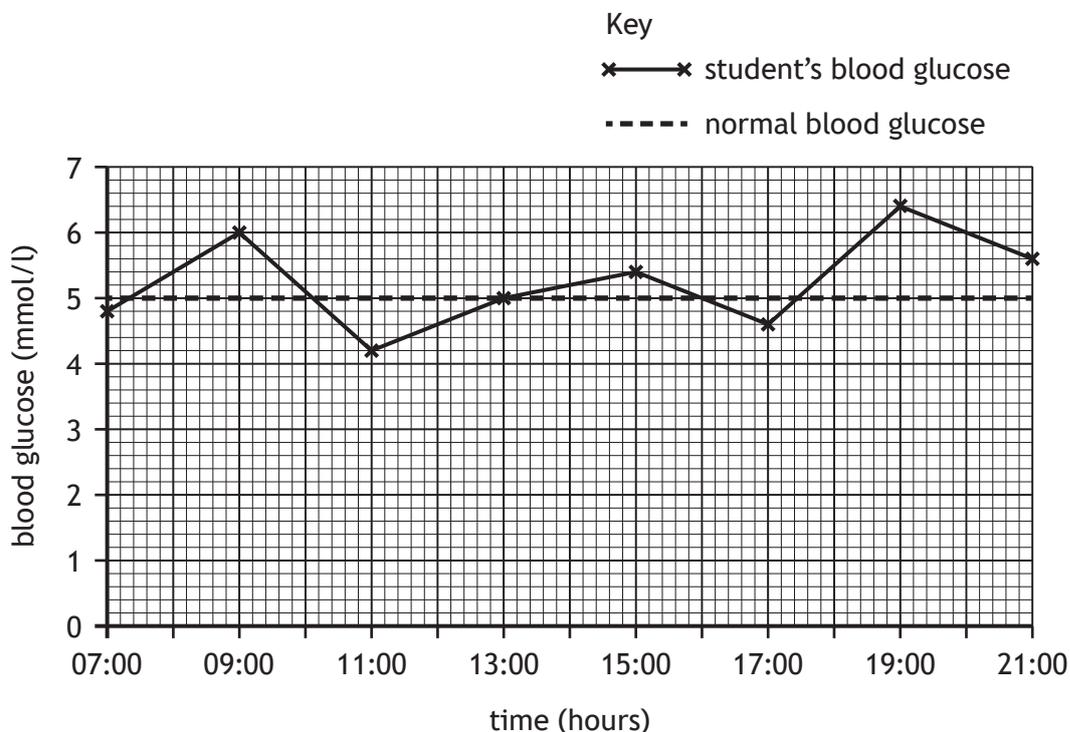
- (e) Name the system in the human body which destroys pathogens.

1



6. As part of a study into the health of a group of students, blood glucose readings were taken over a period of time.

The graph shows the readings for one of the students.



- (a) Identify the time when this student's blood glucose reached its maximum value. 1

_____ hours

- (b) Calculate the percentage decrease in blood glucose between 09:00 and 11:00 hours. 1

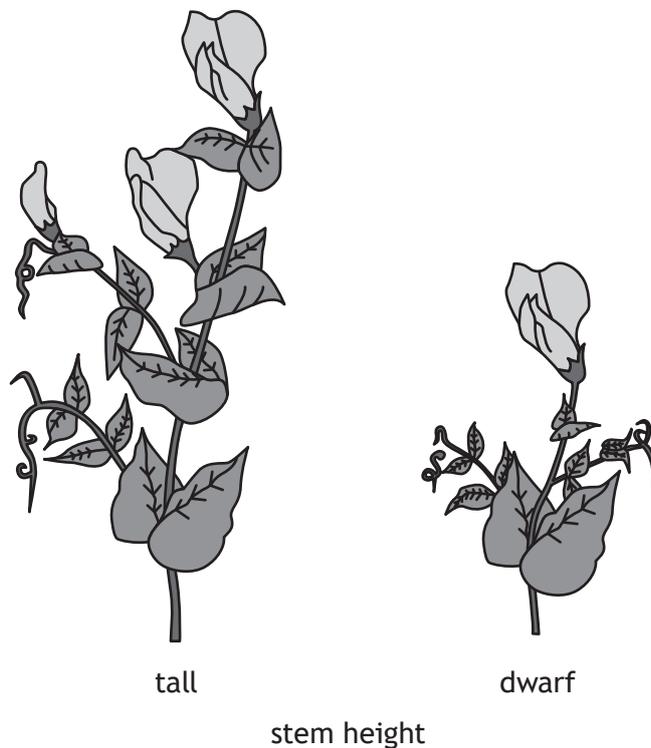
Space for calculation

_____ %

[Turn over



7. An experiment was carried out to investigate stem height in pea plants. The parental phenotypes were tall and dwarf as shown in the diagrams.



- (a) The parent plants were both homozygous. When they were crossed the F_1 generation were all tall. These plants were then crossed with each other to produce the F_2 generation.

(i) Explain what is meant by the term homozygous.

1

(ii) The dwarf characteristic is recessive.

Using the information given, explain how this is known.

1

[Turn over



7. (continued)

- (b) (i) The expected ratio in the F₂ generation was 3 tall to 1 dwarf.

Calculate the expected number of tall plants if there were 144 plants produced in this generation.

1

Space for calculation

_____ tall plants

- (ii) The results obtained in the F₂ generation differed from the expected results.

The actual results were 90 tall and 36 dwarf plants.

Calculate the simplest whole number ratio for these results.

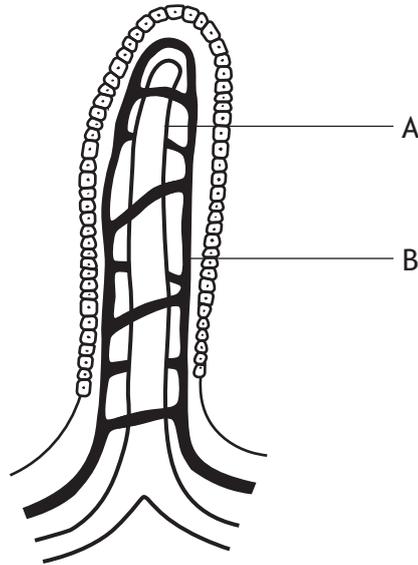
1

Space for calculation

_____ : _____
tall dwarf



8. Nutrients from food are absorbed into villi found in the small intestine.
The diagram represents a single villus.



- (a) Name one type of molecule absorbed by each of the labelled structures. 2

A _____

B _____

- (b) Explain why having a large number of villi improves the efficiency of absorption in the small intestine. 1

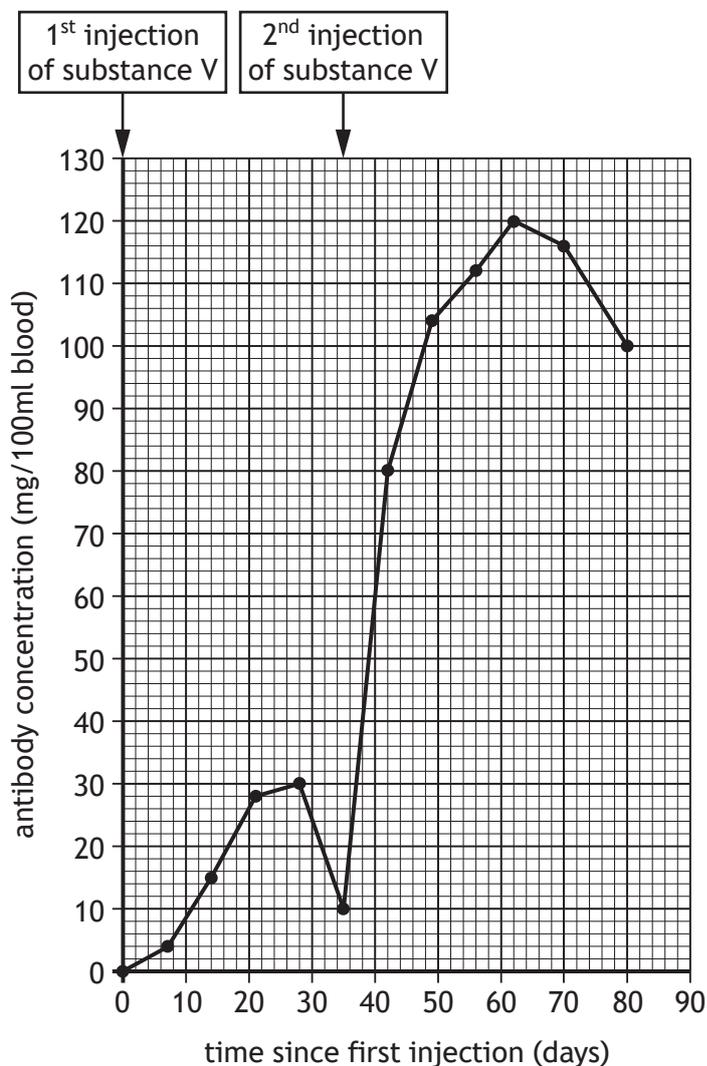
- (c) Identify the structural feature of a single villus, that is also found in an alveolus, which increases the efficiency of absorption. 1

[Turn over



9. In a study, volunteers were injected with substance V on day 0 and again on day 35. Substance V causes antibodies to be produced.

The graph shows the antibody concentration in the blood of one of the volunteers in response to the two injections.



- (a) Identify the maximum antibody concentration following the first injection, but before the second. 1

_____ mg/100 ml

- (b) Calculate the number of days after the second injection that it took for the antibody concentration to reach its maximum value. 1

Space for calculation

_____ days



9. (continued)

- (c) The second injection caused a higher concentration of antibody to be produced than the first.

Give **two** other differences in the antibody production in response to the two injections.

2

1 _____

2 _____

- (d) If the trend continues as shown in the graph, predict the antibody concentration on day 90.

1

Space for calculation

_____ mg/100 ml

[Turn over



* X 8 0 7 7 5 0 1 1 9 *

10. A study found that exercise can reduce the risk of developing some types of cancer.

Researchers examined the level of exercise of 1.4 million people over an 11 year period and recorded any diagnosis of cancer and when it occurred.

Participants were asked to keep their own record of the frequency and intensity of their exercise.

Those participants who exercised were found to have a reduced risk of developing some types of cancer. These results are shown in the table.

Type of cancer	Average risk reduction (%)
lung	26
kidney	23
stomach	22
myeloma	17
bladder	13

The study did not take into account factors such as diet and smoking, which may have affected the results. The fact that participants were asked to record their own exercise is another limitation of this study.

The doctor in charge of the research suggested that these results support the promotion of exercise as a means of reducing the risk of cancer.

However, it was suggested by a different researcher that further studies would need to be carried out before the results could be considered valid.

- (a) Most research starts off with a question. For example, 'Is enzyme activity affected by pH?'

Suggest a question that could have led to the research described above. 1

- (b) Name the type of graph that should be used to present the results shown in the table. 1



10. (continued)

- (c) Suggest one reason why the participants recording their own exercise is described as a limitation.

1

- (d) Three factors that could affect the results are age, duration of exercise and type of exercise.

Choose one of these factors.

Describe how the study would be carried out to take the chosen factor into account and improve the validity of the results.

1

Factor _____

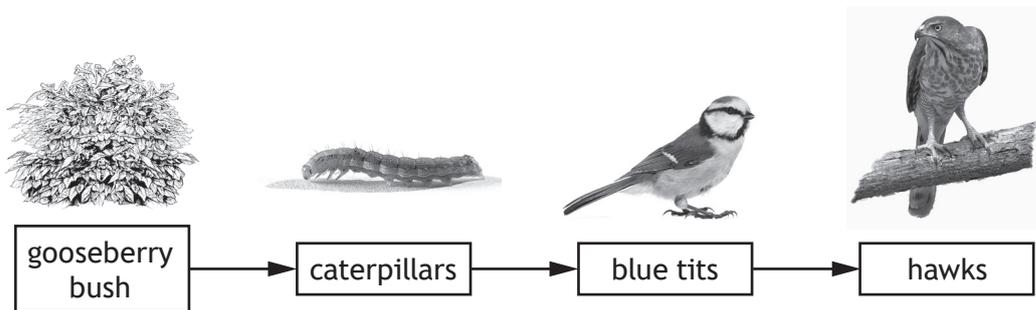
Description _____

[Turn over



* X 8 0 7 7 5 0 1 2 1 *

11. (a) The food chain represents the transfer of energy from organism to organism.



(i) Name the process carried out by the gooseberry bush that allows energy to enter the food chain.

1

(ii) The blue tits are consumers.

Give another ecological term that describes the role of the blue tits in this food chain.

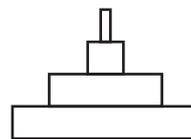
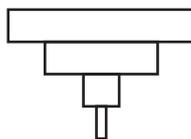
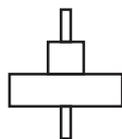
1

(iii) A food chain can be shown as a pyramid of numbers.

pyramid A

pyramid B

pyramid C



Identify which pyramid would be used to represent the food chain shown above.

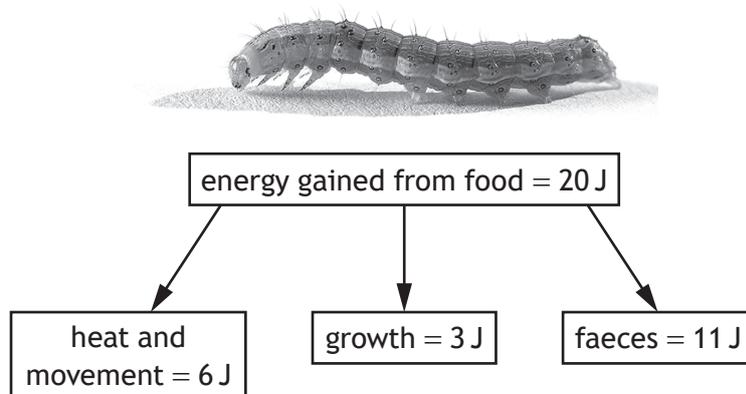
1

Pyramid _____



11. (continued)

(b) The diagram shows the fates of 20 joules (J) of energy gained by a caterpillar from food.



(i) Calculate the percentage of the caterpillar's energy intake that is used for growth. 1

Space for calculation

_____ %

(ii) Tick one box to identify which of the fates allows energy to be passed onto the next level in the food chain shown. 1

Heat and movement
 Growth
 Faeces

[Turn over

12. Students carried out an investigation into the effect of soil moisture on the percentage ground cover of moss in their school lawn.

A quadrat was used to estimate the percentage ground cover of moss at several sites. Soil moisture was also measured at each of the sites.

The results of the investigation are shown in the table.

Sample site	Average soil moisture (%)	Ground cover of moss (%)
1	18	86
2	14	70
3	15	80
4	11	58
5	13	65
6	12	60
7	22	98
8	30	99
9	35	100

- (a) Describe the relationship between average soil moisture and percentage ground cover of moss. 1

- (b) Describe how the reliability of these results could be increased. 1

12. (continued)

(c) The students also used a soil thermometer to gather data on soil temperature at each of the sample sites.

(i) Describe what the students should have done each time they used the soil thermometer, to ensure valid results. 1

(ii) Soil moisture and temperature are examples of abiotic factors.

Name **one** other abiotic factor that can affect plant growth. 1

(d) (i) The students observed a species of lichen growing on some of the damper parts of the lawn.

Lichens are indicator species.

State what is meant by the term ‘indicator species’. 1

(ii) Identify the sample site that would be least likely to contain this lichen. 1

Sample site number _____

[Turn over

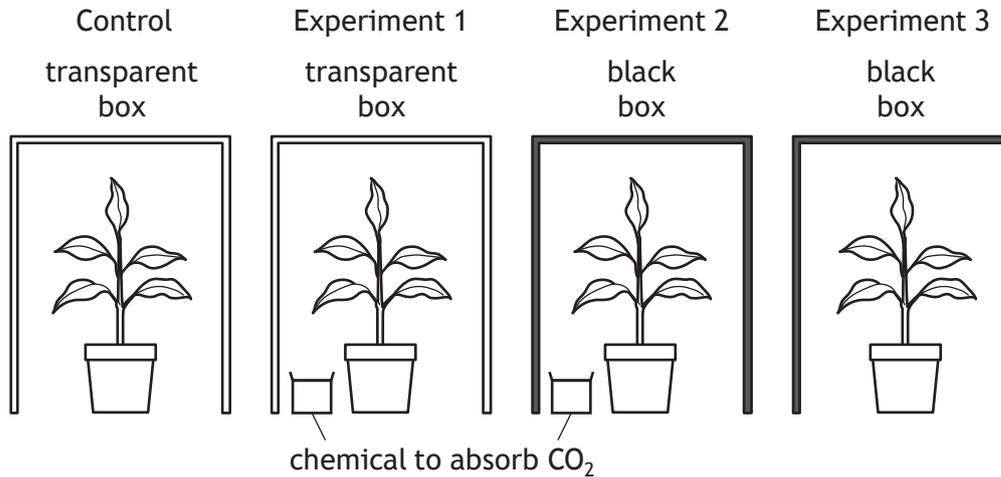


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13. An investigation was carried out into the conditions needed for photosynthesis.

Before starting the investigation, four plants were de-starched by placing them in the dark for 24 hours.

The plants were then placed in the conditions shown and then left for 48 hours.



The leaves of each plant were then tested for the presence of starch.

(a) (i) Tick the box(es) to show in which of the following starch would be present after 48 hours. 1

Control

Experiment 1

Experiment 2

Experiment 3

(ii) Explain the purpose of the control. 1

(iii) Explain why experiment 2 is invalid. 1



MARKS

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13. (a) (continued)

(iv) State the factor that is being investigated in experiment 3.

1

(b) Name the product of carbon fixation that is converted to starch.

1

[Turn over



* X 8 0 7 7 5 0 1 2 7 *

14. Antibiotic drugs are only effective in the treatment of bacterial infections. They either kill or prevent the growth of bacteria. Sometimes antibiotics are given but do not have any effect on the particular infection.

(a) The table gives information about the number of cases treated with antibiotics and the success rate for a range of infections.

Type of infection	Number of these cases treated with antibiotics (millions)	Number of these cases successfully treated with antibiotics (millions)	Success rate (%)
ear	23	16.1	70
common cold	18	0	0
chest	16	3.2	20
throat	15		48

(i) Complete the table by calculating the number of cases of throat infections successfully treated with antibiotics. 1

Space for calculation

(ii) Antibiotics have no effect in the treatment of the common cold. From the information given, suggest a reason why antibiotics have no effect on the pathogen that causes the common cold. 1



14. (continued)

(b) The overuse of antibiotics has caused populations of antibiotic-resistant bacteria to evolve. The stages in their evolution are described in the table.

Stage	Description
A	Random mutations in bacteria make some of the bacteria antibiotic-resistant
B	The next generation of bacteria are antibiotic-resistant
C	The surviving bacteria reproduce and pass on the alleles for antibiotic resistance to their offspring
D	Bacterial populations show genetic variation
E	When antibiotics are used, the non-resistant bacteria are killed and the resistant bacteria survive

(i) Place letters from the table in the boxes, to show the order of the stages describing how populations of bacteria become resistant to antibiotics. 1

The first stage has been completed.



(ii) Name the process by which the bacteria, best adapted to their environment, survive and reproduce. 1

(iii) Name an environmental factor that can increase the rate of mutation. 1

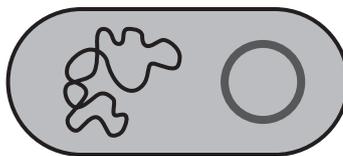
[Turn over for next question



15. Scientists use bacteria to act as host cells, to produce enzymes commercially by the process of genetic engineering.



source cell



bacterial cell

(a) Name the structure in the source cell from which the required gene is extracted during the first stage of this process.

1

(b) Describe the stages of the process that would be used to produce genetically engineered bacteria, after the required gene has been extracted from the source cell.

4

[END OF QUESTION PAPER]

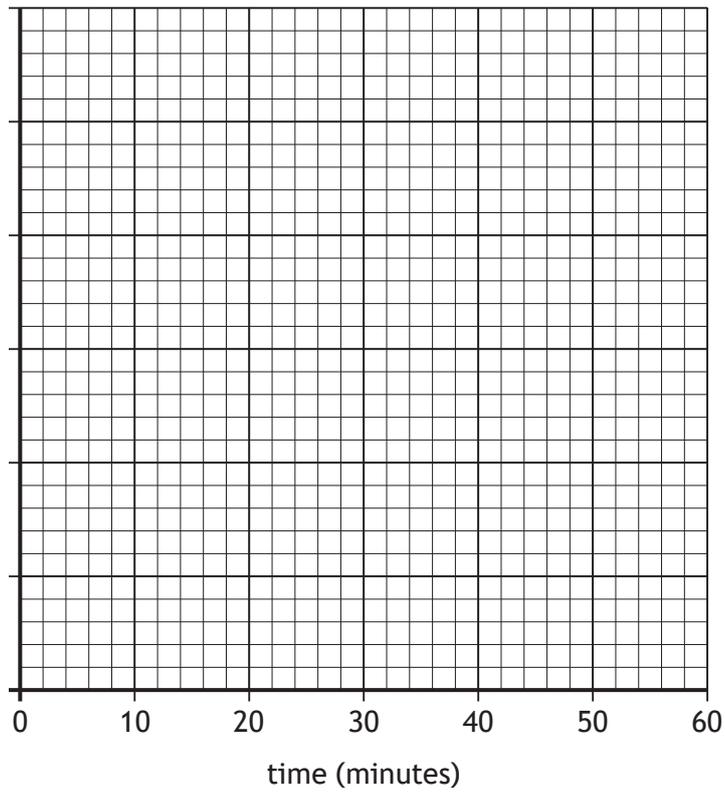


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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional grid for question 4 (b) (i)





National
Qualifications
2018

X807/75/02

Biology
Section 1 — Questions

TUESDAY, 15 MAY

1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X807/75/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

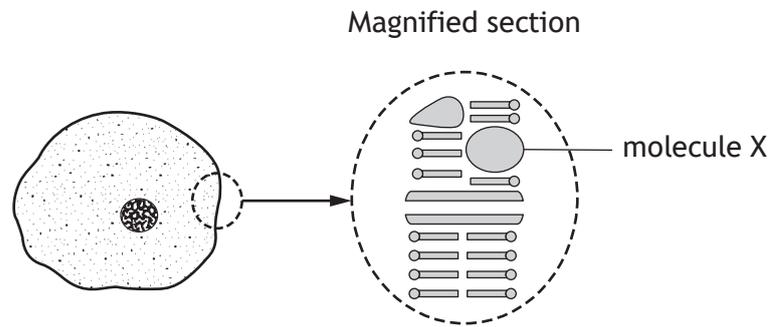
Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



* X 8 0 7 7 5 0 2 *

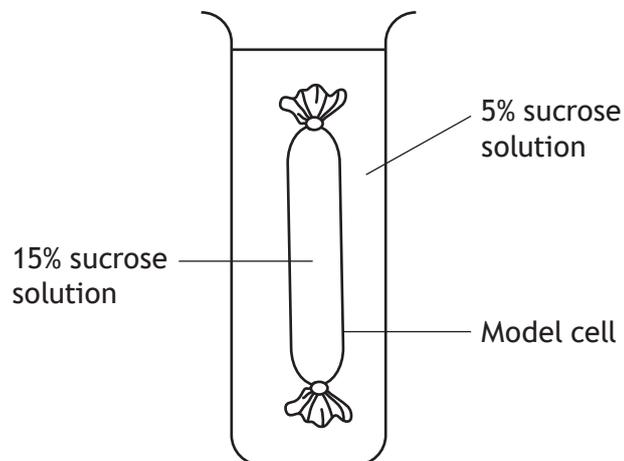
SECTION 1

1. The diagram shows a cell with a section of the cell membrane magnified.



Molecule X is

- A phospholipid
 - B protein
 - C cellulose
 - D starch.
2. The diagram shows an experiment in which a model cell was placed in a sucrose solution.



At the start of the experiment the model cell weighed 25 g and at the end it weighed 30 g.
What was the percentage increase in mass?

- A 5.0%
- B 16.7%
- C 20.0%
- D 83.3%

3. Glucose molecules in low concentration in the kidney have to be moved into the bloodstream, where there is a higher concentration of glucose.

The process responsible for this action is

- A osmosis
 - B diffusion
 - C passive transport
 - D active transport.
4. Which of the following represents the sequence of events in the production of a protein from the genetic code?

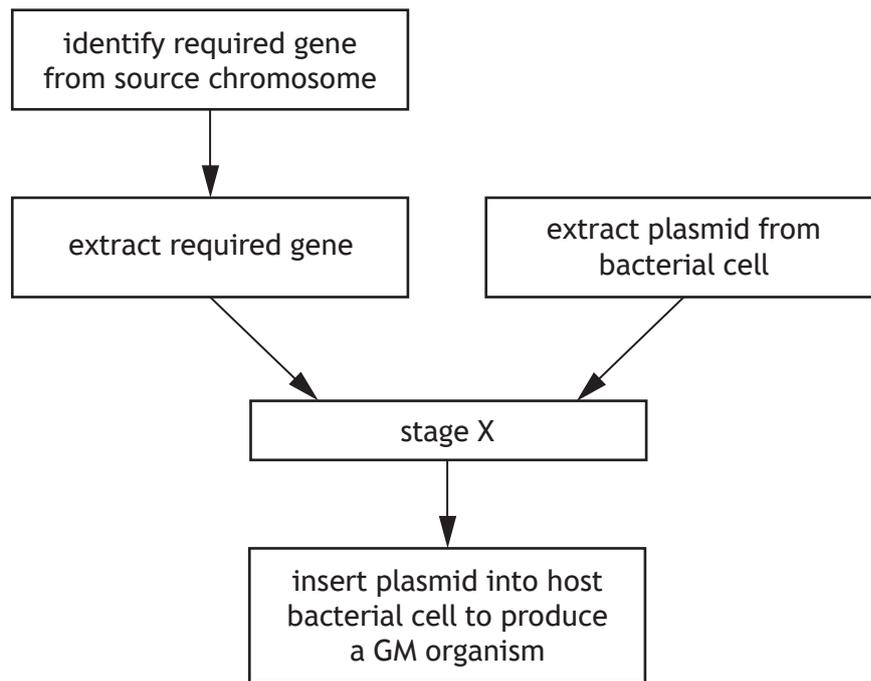
- A DNA → amino acids → mRNA → protein
- B DNA → mRNA → amino acids → protein
- C mRNA → DNA → amino acids → protein
- D amino acids → DNA → mRNA → protein

5. Which of the following are all types of proteins?

- A Hormones, enzymes and nitrates
- B Antibodies, enzymes and plasmids
- C Hormones, receptors and antibodies
- D Receptors, antibodies and nitrates

[Turn over

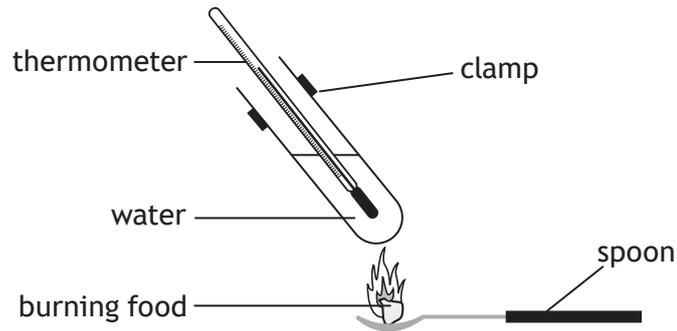
6. The flowchart represents some of the stages of genetic engineering.



A suitable description of stage X would be

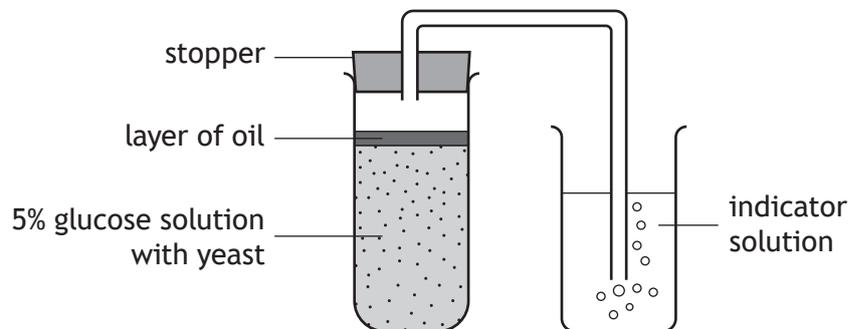
- A insert bacterial plasmid into required gene
- B insert bacterial plasmid into source chromosome
- C insert required gene into host bacterial cell
- D insert required gene into bacterial plasmid.

7. The diagram shows an experiment which can be used to find the energy content of different foods. Each food was completely burned and the energy content was estimated by the rise in temperature of the water.



The reliability of this experiment could be improved by

- A burning each food for the same length of time
 - B repeating the experiment with each food several times
 - C removing the thermometer from the tube to read it accurately
 - D repeating the experiment using a different food each time.
8. The apparatus shown was used to investigate the rate of respiration in yeast at 20 °C.

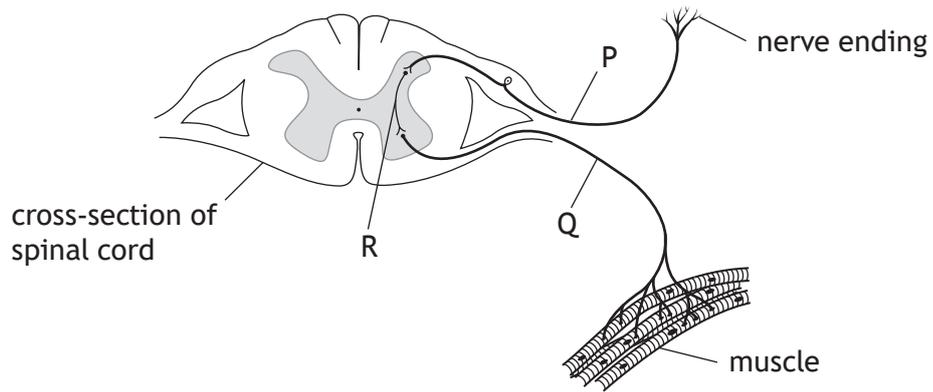


Which of the following changes would cause a decrease in the rate of respiration of the yeast?

- A Increase the thickness of the layer of oil by 1 mm.
- B Increase the temperature of the glucose solution by 1 °C.
- C Decrease the concentration of the glucose solution by 1%.
- D Decrease the volume of indicator solution by 1 cm³.

[Turn over

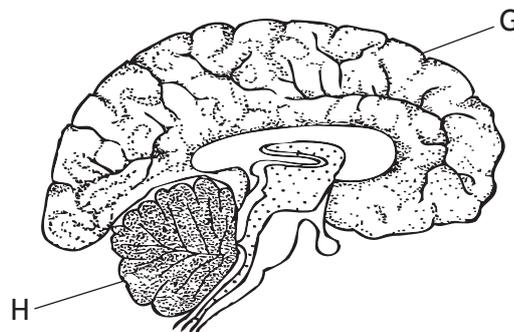
9. The diagram shows some of the structures found in a reflex arc.



Which row in the table identifies P, Q and R?

	<i>Motor neuron</i>	<i>Sensory neuron</i>	<i>Inter neuron</i>
A	Q	R	P
B	Q	P	R
C	R	P	Q
D	P	R	Q

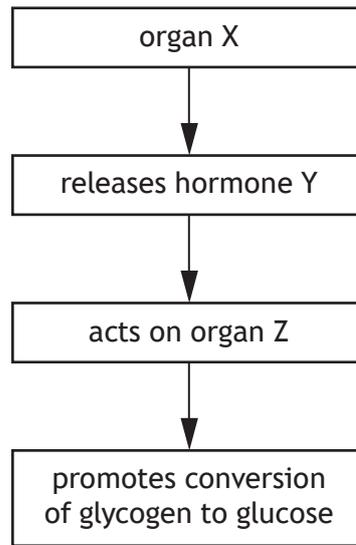
10. The diagram represents a section through the brain.



Which of the following links a letter to its correct structure and function?

- A G is the cerebrum and is the site of reasoning and memory.
- B G is the cerebellum and is the site of reasoning and memory.
- C H is the medulla and controls muscle coordination.
- D H is the cerebellum and controls breathing and heart rate.

Questions 11 and 12 refer to the following flow diagram related to blood glucose regulation.



11. Which row in the table identifies organ X and hormone Y?

	<i>Organ X</i>	<i>Hormone Y</i>
A	Liver	Insulin
B	Liver	Glucagon
C	Pancreas	Insulin
D	Pancreas	Glucagon

12. Specialised cells allow organ Z to respond to hormone Y.

This is because the surface of the cells in organ Z have complementary

- A synapses
- B neurons
- C effectors
- D receptors.

[Turn over

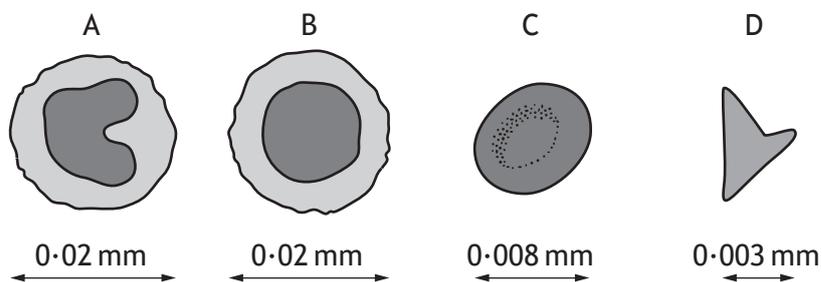
13. An **increase** in which of the following factors would **decrease** the rate of transpiration in plants?
- A Wind speed
 - B Humidity
 - C Surface area
 - D Temperature
14. Which of the following statements about blood cells is **false**?
- A White blood cells are part of the immune system.
 - B Phagocytes are a type of white blood cell.
 - C Red blood cells contain haemoglobin.
 - D Phagocytes transport nutrients around the body.
15. Which row in the table identifies how lymphocytes destroy pathogens?

	<i>Antibody production</i>	<i>Phagocytosis</i>
A	Yes	No
B	No	No
C	No	Yes
D	Yes	Yes

16. The following key can be used to identify the different components of blood.

- | | |
|-----------------------------------|-----------------------|
| 1. Nucleus absent | go to 2 |
| Nucleus present | go to 3 |
| 2. Diameter greater than 0.005 mm | red blood cell |
| Diameter less than 0.005 mm | platelet |
| 3. Nucleus is circular | lymphocyte |
| Nucleus is not circular | macrophage |

Use the key above to identify which of the diagrams represents a platelet.



17. Which of the following statements is true of villi?

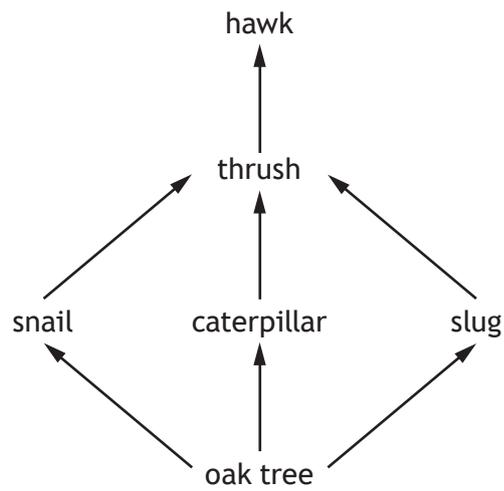
- A Blood capillaries absorb glycerol and amino acids.
- B Blood capillaries absorb glucose and fatty acids.
- C Lacteals absorb glycerol and fatty acids.
- D Lacteals absorb glucose and amino acids.

18. An ecosystem consists of abiotic factors plus a

- A community and its biodiversity
- B population and its biodiversity
- C population and its habitat
- D community and its habitat.

[Turn over

19. The diagram shows part of a food web.

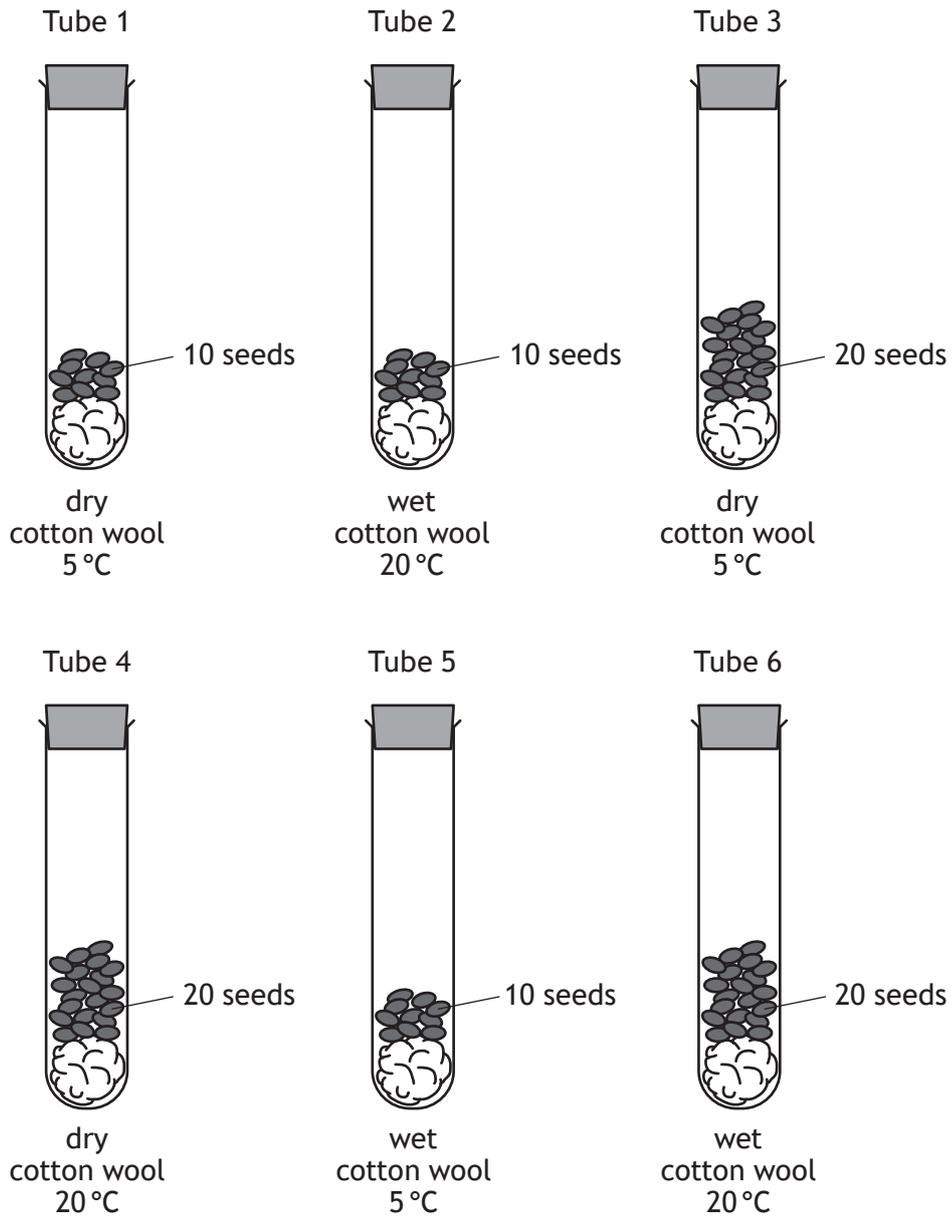


A chemical was used to control the number of slugs.

Which of the following could be a result of a large decrease in slug numbers?

- A An increase in snails.
- B An increase in hawks.
- C A decrease in caterpillars.
- D A decrease in oak trees.

20. The diagrams show an investigation into seed germination.

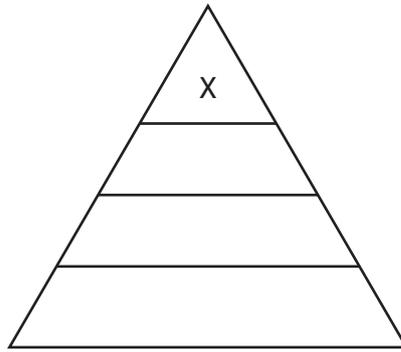


For a valid conclusion to be drawn, which two tubes should be compared to show the effect of temperature on germination?

- A 1 and 3
- B 3 and 6
- C 2 and 5
- D 4 and 6

[Turn over

21. The diagram represents a pyramid of energy.



There is less energy at level X in the pyramid because

- A there are fewer organisms at each level in the food chain
- B the organisms at level X are very small
- C energy is lost at each level in the food chain
- D energy is stored in each level and not passed on.

22. Mutations result in changes to genetic material.

Which of the following is **not** true of mutations?

- A Radiation can increase their rate.
- B They always have a harmful effect.
- C Genetic material is affected at random.
- D New alleles may be produced.

23. Natural selection occurs when there are selection pressures.

Which of the following could be a result of selection pressures?

- A Organisms with favourable alleles survive and reproduce.
- B Organisms with new alleles always have an advantage.
- C All alleles in a population increase in frequency.
- D All alleles in a population decrease in frequency.

24. Pesticides sprayed onto crops can get into food chains. The following statements refer to stages in this process.

- J Pesticides are absorbed by plants.
- K Pesticides build up in animals.
- L Plants are eaten by animals.

Identify the order of steps by which pesticides could reach lethal levels in the bodies of animals.

	<i>Step 1</i>	<i>Step 2</i>	<i>Step 3</i>
A	J	K	L
B	L	J	K
C	L	K	J
D	J	L	K

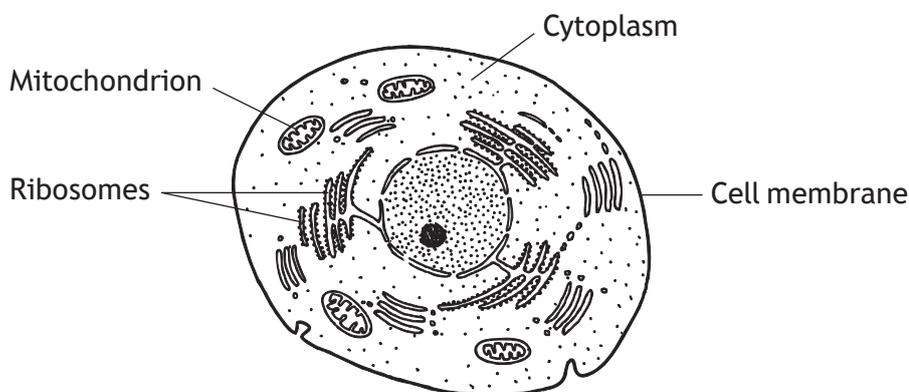
25. Which row in the table identifies biotic and abiotic factors which can affect a population?

	<i>Biotic factors</i>	<i>Abiotic factors</i>
A	grazing and predation	pH and temperature
B	predation and temperature	pH and grazing
C	pH and temperature	grazing and predation
D	pH and grazing	predation and temperature

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

SECTION 2 — 75 marks
Attempt ALL questions

1. (a) The diagram shows a typical animal cell and some of its structures.



Choose **two** of the structures labelled and state their functions.

2

1 Structure _____

Function _____

2 Structure _____

Function _____

- (b) The field of view of a light microscope measures 2 mm in diameter.
20 plant cells were counted in a line across the diameter.

1 mm = 1000 micrometres

Calculate the average size of a cell in micrometres.

1

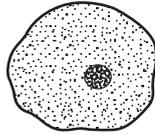
Space for calculation

_____ micrometres

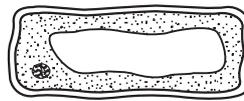


2. A student examined plant and animal cells using a microscope.

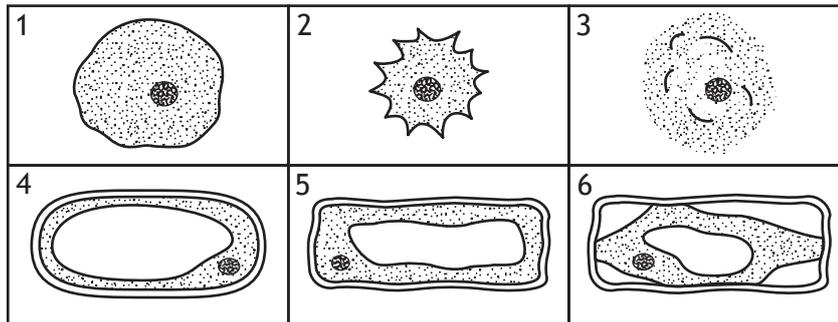
Animal cell



Plant cell



The animal and plant cells were placed in solutions of different salt concentrations. After several minutes a sample of cells was taken from each solution and examined. One cell from each solution is shown.



(a) Changes in the cells were due to osmosis.

Explain why osmosis is described as a passive process.

1

(b) Identify the animal cell shown which had been placed in a solution of higher salt concentration than its cell contents.

1

Cell number _____

(c) State the term used to describe the condition of cell 6.

1

(d) Cells 3 and 4 had been placed in solutions which were both of the same concentration.

Explain why the results observed were different.

2



3. The diagram represents part of a DNA molecule.



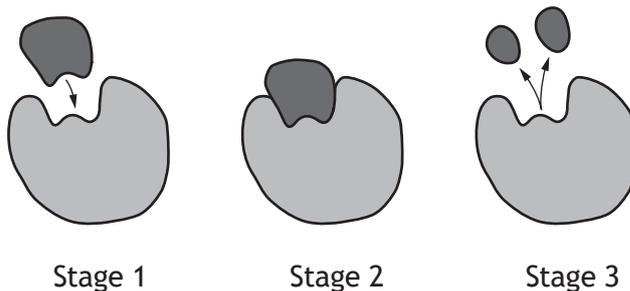
- (a) (i) Give the term which describes the shape of a DNA molecule as shown in the diagram. 1

- (ii) Describe the way in which the DNA strands are linked together. 1

- (b) Name the organelle in animal cells which stores the DNA. 1

[Turn over

4. The diagrams represent stages in an enzyme-controlled reaction.



(a) Enzymes are involved in two types of reaction.
Identify the type of reaction shown in the diagrams above.

1

(b) Describe the events occurring in the enzyme reaction shown.

3

5. (a) The table shows information about two types of respiration in animal cells.

Tick the boxes in the table to indicate whether the statements apply to aerobic respiration, fermentation or both.

2

<i>Statement</i>	<i>Type of respiration</i>	
	<i>Aerobic</i>	<i>Fermentation</i>
Oxygen is required		
Pyruvate is formed		
Lactate is formed		
Carbon dioxide is formed		

- (b) ATP is an energy-rich molecule formed by respiration.

Name a cellular process which requires energy from ATP.

1

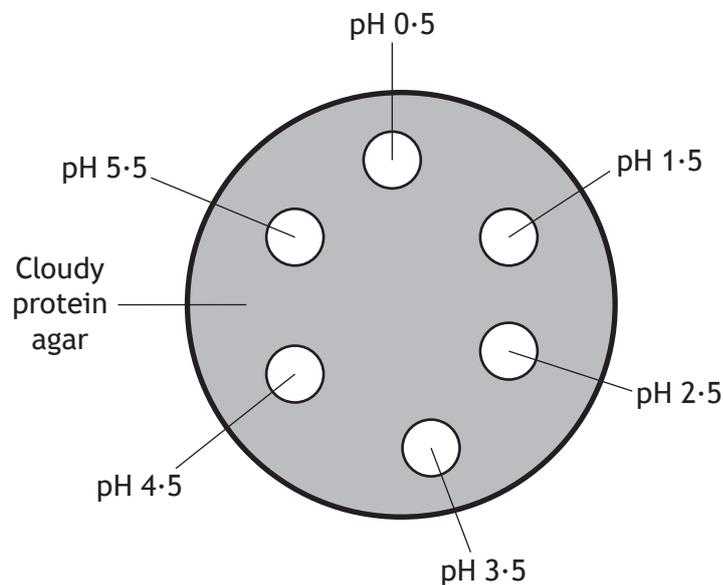
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* X 8 0 7 7 5 0 1 0 9 *

6. An investigation was carried out into the effect of pH on the activity of the enzyme pepsin.

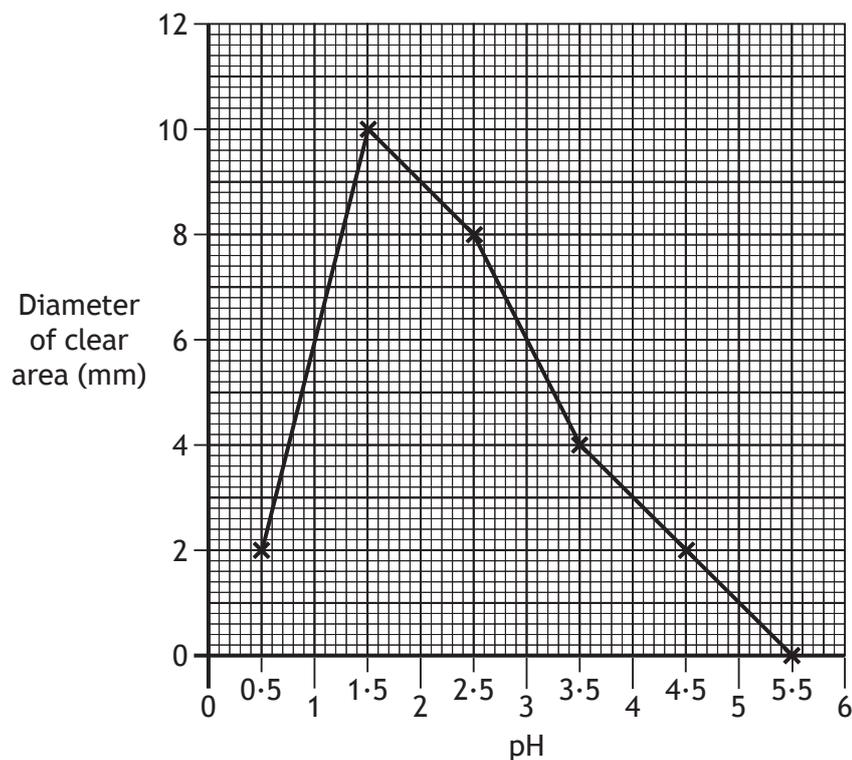
A Petri dish was filled with cloudy protein agar. Six holes were made in the agar and each was filled with pepsin solution at the pH values shown.



When the protein is broken down, cloudy agar becomes clear.

The dish was examined after 24 hours and the diameter of the clear area around each hole was measured. The larger the clear area, the more active the enzyme.

The results are shown in the graph.



6. (continued)

- (a) (i) Identify the optimum pH for pepsin in this experiment.

1

pH _____

- (ii) Calculate how many times more active the enzyme is at pH 2.5 than at pH 4.5.

1

Space for calculation

_____ times

- (b) State two variables which should be controlled to make this experiment valid.

2

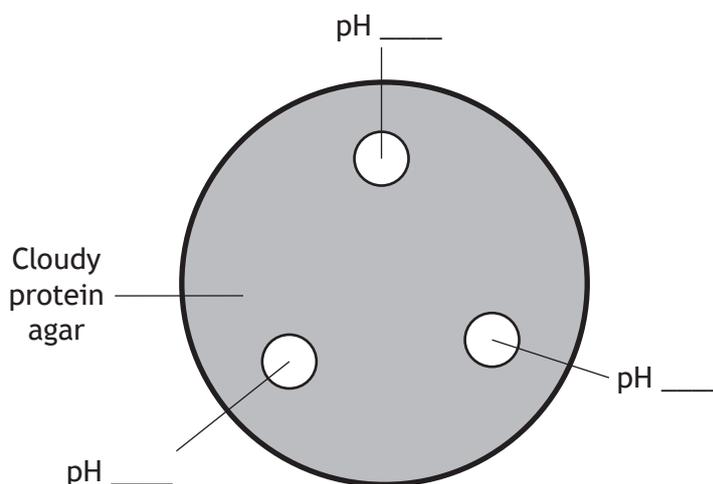
1 _____

2 _____

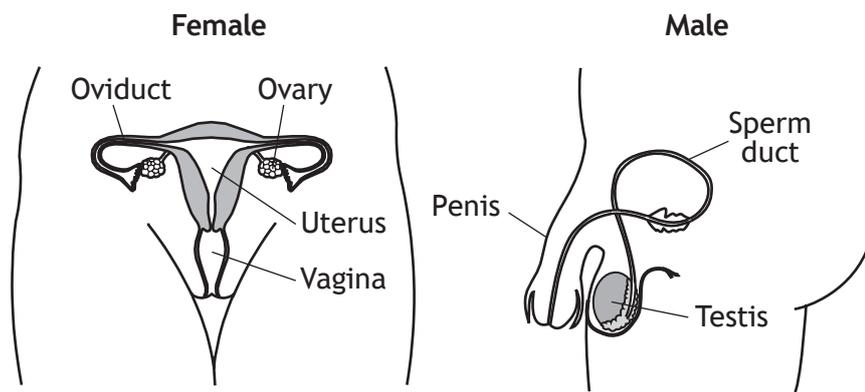
- (c) As a follow-up to this investigation, students were asked to design an experiment using the same apparatus to identify a more exact optimum pH value.

Complete the diagram below to show the pH values the students could use.

1



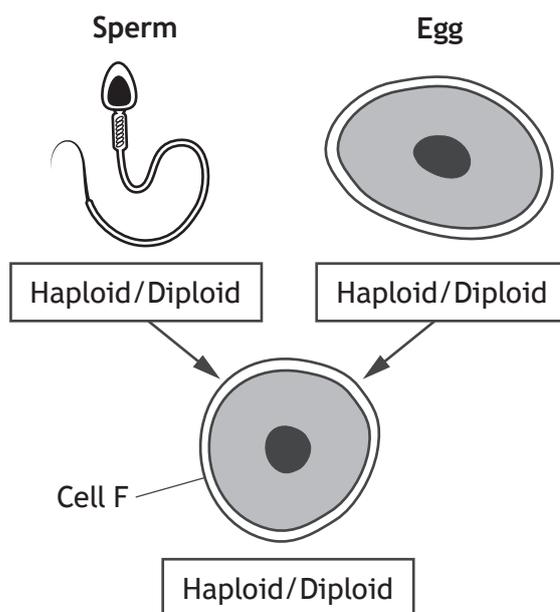
8. The diagrams show the human reproductive system in females and males.



(a) From the diagrams, identify **one** site of gamete production.

1

(b) The diagram represents the process of fertilisation.



(i) In the diagram, circle one term in each box to show the chromosome complement for each cell.

1

(ii) Name cell F which is produced when the sperm fertilises the egg.

1

[Turn over



9.

Adapted from the Herald, Friday 4 March 2016

Coffee and Multiple Sclerosis

Multiple sclerosis (MS) is a condition which affects the central nervous system and can cause problems with vision and balance as well as numbness in the skin. Scotland has one of the highest incidences of MS in the world, with a mixture of genetic and environmental factors thought to be the cause.

Research suggests that drinking a lot of coffee every day could potentially cut the risk of developing MS.

Experts found that consuming more than 900 ml daily may offer up to 30% reduced risk.

Researchers compared the results of studies from two different countries.

One study in Sweden involved 1,620 adults with MS and a comparison group of 2,788 people without MS. A second study in the USA involved 1,159 people with MS and 1,172 people without MS.

The results showed the risk of MS was consistently higher among people who drank fewer cups of coffee every day in both studies, even after taking into account other factors of influence.

- (a) Identify the factors thought to be the cause of the high incidence of MS in Scotland. 1

- (b) In the table below, present the information from the passage, to give details of the two studies and the people involved. 2

(An additional table, if required, can be found on page 28.)

<i>Country</i>		

9. (continued)

- (c) As part of the research described in the passage, groups of people with MS were compared to those without MS.

Give the term used to describe a comparison group in scientific research.

1

- (d) Decide whether this research would be described as reliable or not and tick the appropriate box.

Give a reason for your choice.

1

Reliable Not reliable

Reason _____

- (e) The researcher took 'other factors of influence' into consideration.

Suggest one of these factors.

1

[Turn over



10. The following statements are about blood vessels.

1. Contain valves.
2. Have a narrow central channel.
3. Carry blood under low pressure.
4. Form networks at organs and tissues.
5. Carry blood from the heart to organs.

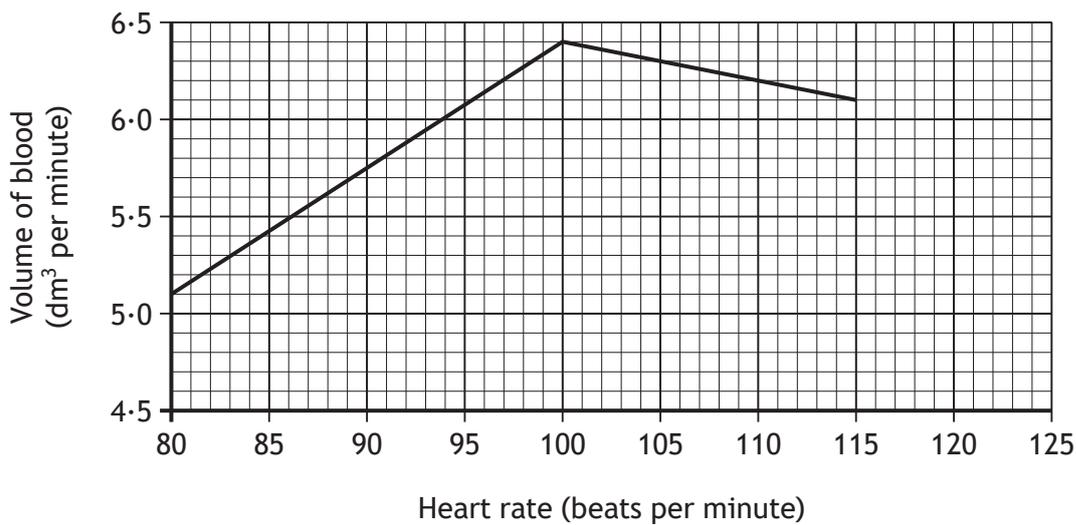
(a) Choose either arteries or veins and select two statements from the list above which describe that type of blood vessel.

2

Blood vessel _____

Statements _____ and _____

(b) The graph shows the effect of changes in heart rate on the volume of blood pumped by the left ventricle.



(i) Describe the relationship between heart rate and volume of blood pumped by the left ventricle.

2

(ii) Predict the volume of blood pumped by the left ventricle at 120 beats per minute.

1

_____ dm³ per minute

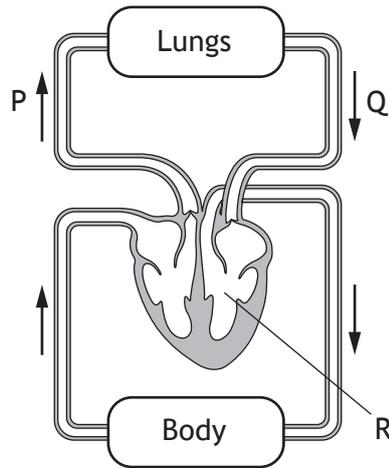


* X 8 0 7 7 5 0 1 1 6 *

10. (continued)

MARKS
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(c) The diagram represents part of the circulatory system in humans.



(i) Describe the difference in oxygen concentration in the blood travelling through blood vessels P and Q.

1

(ii) Name the heart chamber labelled R.

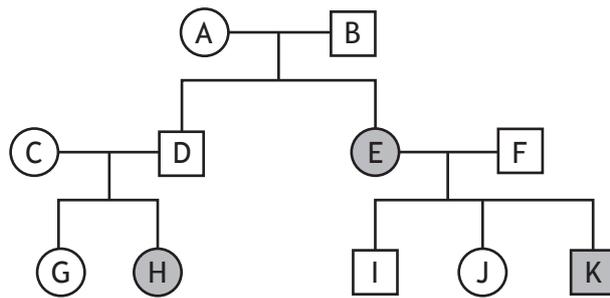
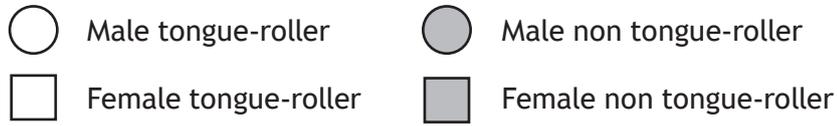
1

[Turn over



11. (a) Tongue-rolling is an inherited characteristic controlled by different forms of a gene. T (roller) represents the dominant form of the gene, and t (non-roller) represents the recessive form.

The family tree diagram shows a pattern of inheritance of the characteristic.



- (i) Use letters from the diagram to identify all the individuals in the F₂ generation. 1

- (ii) Give the genotypes of individuals E and F. 2

E _____ F _____

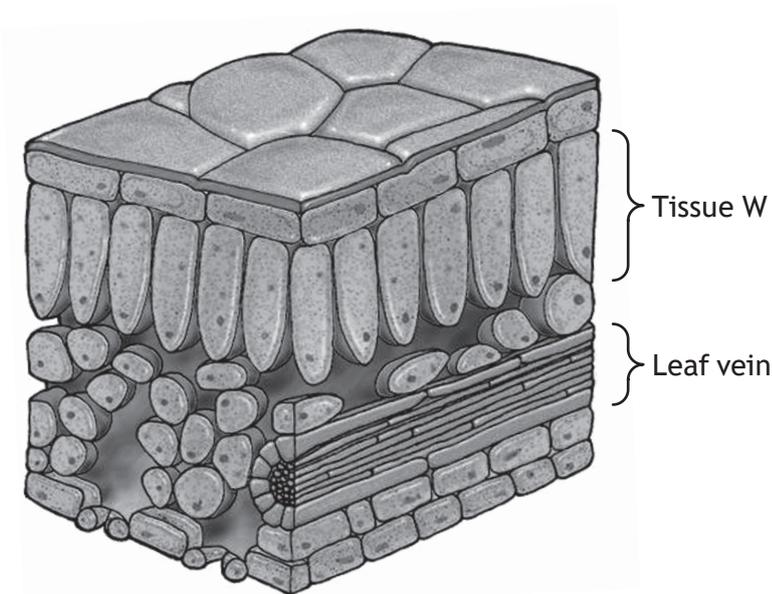
- (iii) Complete the Punnett square to show the gametes and expected genotypes of the offspring of E and F. 2

		Genotype of gametes from F	
Genotype of gametes from E			

- (b) State the type of variation shown by tongue-rolling. 1



12. The diagram represents a section through a leaf.



(a) (i) Name tissue W. 1

(ii) The cells in tissue W have a greater number of chloroplasts than other leaf cells.

Suggest the advantage of these cells being located near the upper surface of the leaf. 1

(b) The leaf vein consists of xylem and phloem tissues.

Choose either xylem or phloem, by ticking one box, and describe one structural feature of that tissue. 1

Xylem Phloem

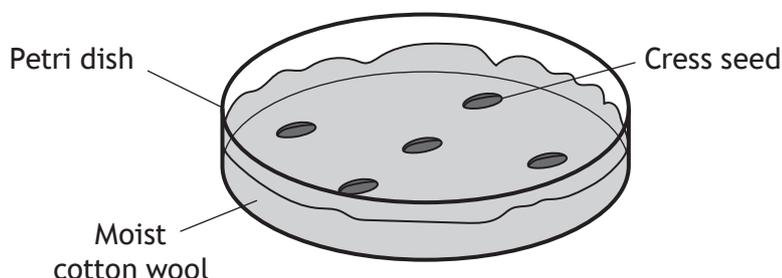
Feature of tissue _____

[Turn over



13. To investigate the effect of competition on the growth of cress seeds, five Petri dishes, labelled A–E, were set up and left for six days. Each dish contained a layer of moist cotton wool with different numbers of cress seeds sown evenly across its surface.

Dish A is shown in the diagram.



The results are shown in the table.

Dish	Number of seeds sown	Number of seedlings surviving after six days	Percentage of seedlings surviving after six days
A	5	5	100
B	10	10	100
C	20		95
D	40	34	85
E	80	60	75

- (a) (i) Complete the table by calculating the number of seedlings surviving in Dish C. 1

Space for calculation

- (ii) Describe the relationship between the number of seeds sown and the percentage of seedlings surviving after six days. 1



13. (a) (continued)

(iii) Explain why the type of competition shown in this investigation is described as being intraspecific.

1

(b) The diagram represents positions of organisms in a food chain.

Tick one of the boxes to show the position cress would occupy in the food chain.

1



(c) Name one resource, other than water, for which plants may be in competition.

1

[Turn over

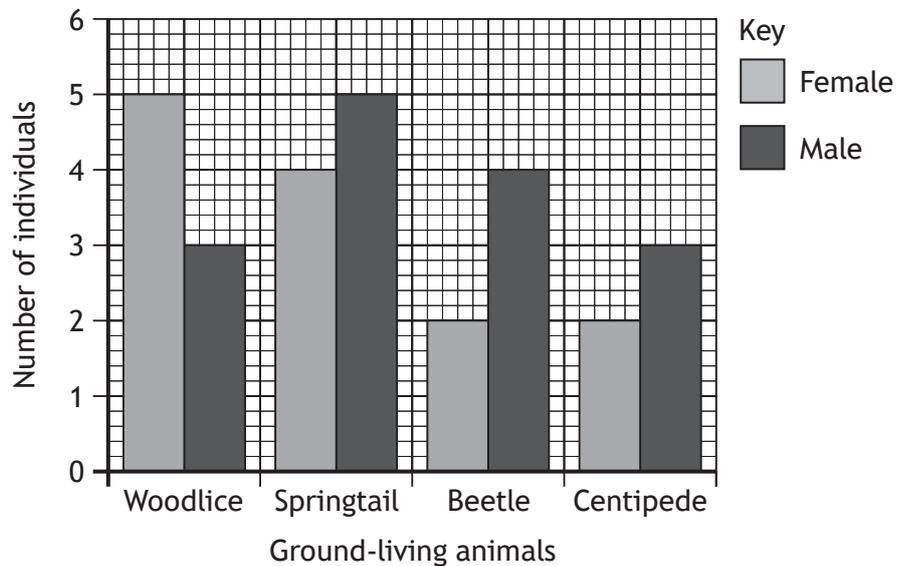
14. Sampling techniques can be used to estimate the abundance of plants and animals.

(a) In an investigation into ground-living animals in a woodland, a group of students collected and counted the animals they found.

(i) Name a sampling technique which could be used to collect the ground-living animals.

1

(ii) The students sorted the animals into male and female, counted them and recorded the results in a bar graph.



1 Identify the animal which had the greatest overall abundance.

1

2 The students concluded that males were always more abundant than females.

Identify the animal for which this is **not** true.

1

(iii) It was decided that the samples were not fully representative of the area.

Suggest how the investigation could be improved.

1



14. (continued)

(b) The distribution of organisms may be affected by abiotic factors.

The table shows the results of a study into the effect of soil moisture levels on the distribution of three species of plant.

Sample site	Soil moisture (units)	Number of plants		
		Species E	Species F	Species G
1	20.2	11	15	12
2	23.4	13	14	11
3	22.1	12	16	10
4	24.5	15	17	15
5	26.6	18	13	12
6	28.4	19	15	14

(i) State which species has its distribution most affected by the soil moisture levels. 1

Species _____

(ii) Calculate the average number of plants per sample site for species F. 1

Space for calculation

_____ plants

[Turn over



15. A student set up an investigation into the effect of temperature on the rate of photosynthesis in a green plant, by measuring the volume of oxygen released in one hour.

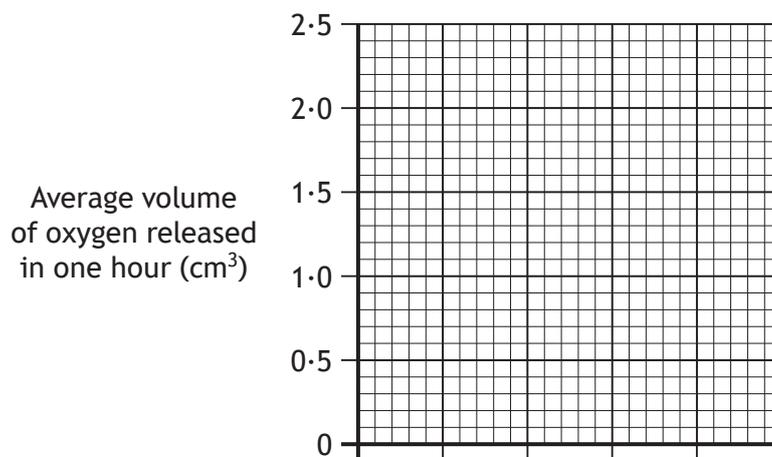
The results are shown in the table.

Temperature (°C)	Volume of oxygen released in one hour (cm ³)		
	Experiment 1	Experiment 2	Average
10	0.7	0.5	0.6
20	1.6	1.4	1.5
30	2.7	1.9	2.3
40	2.0	2.6	2.3
50	0.3	0.5	0.4

- (a) On the grid, plot a line graph to show the effect of temperature on the average volume of oxygen released in one hour.

2

(An additional grid, if required, can be found on page 28.)



- (b) Predict the average volume of oxygen released in one hour if the experiment was carried out at a temperature of 60 °C.

1

_____ cm³

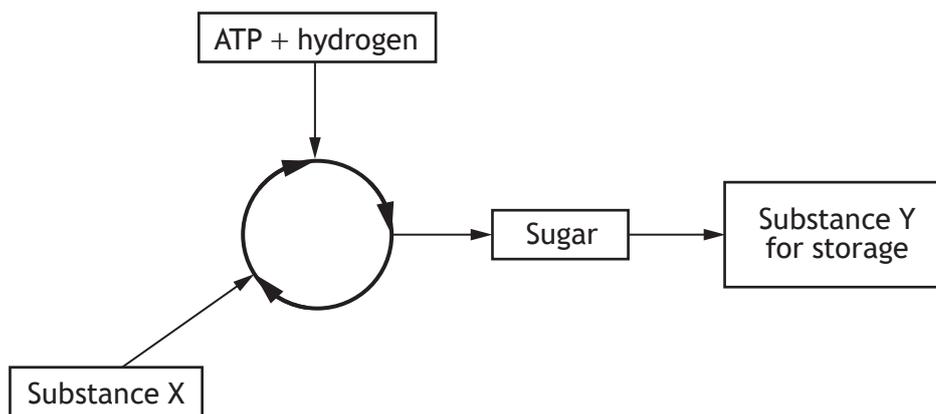


15. (continued)

(c) State one factor, other than temperature, which can limit the rate of photosynthesis.

1

(d) The diagram represents the second stage of photosynthesis.



Name substances X and Y.

2

X _____

Y _____

[Turn over



16. A gardener treated the soil in the area where he planted vegetables with a chemical to increase the yield.

(a) (i) The chemical added to the soil by the gardener contained nitrates. Give the general name for this type of chemical. 1

(ii) Describe the use that plants make of nitrates. 1

(iii) When the vegetables were picked and weighed, the total yield was 42 kilograms. The previous year the total yield was 35 kilograms.

Calculate the percentage increase in yield. 1

Space for calculation

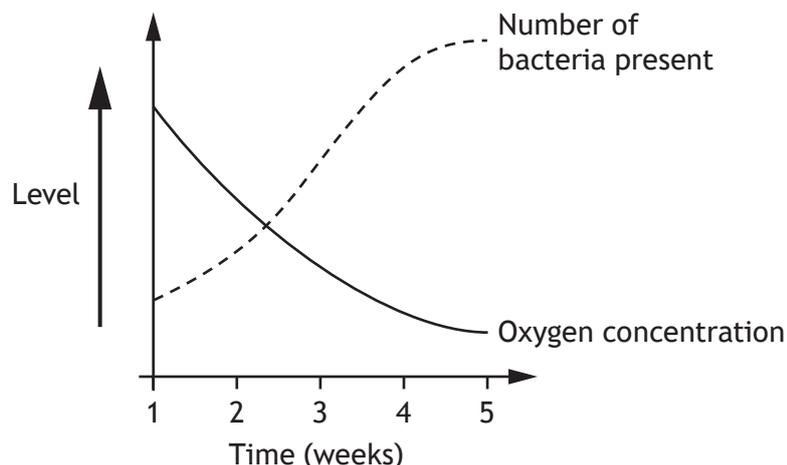
_____ %



16. (continued)

- (b) Later in the year the gardener noticed that the algae in his pond had increased and now covered the surface of the water. He sampled the pond water over 5 weeks and measured its oxygen concentration and number of bacteria present.

The results are shown in the graph.



- (i) What name is given to the increased growth of algae in the pond? 1

- (ii) Explain why the increased growth of algae resulted in an increase in the number of bacteria. 1

- (iii) Using the information in the graph, explain why the increase in number of bacteria resulted in the population of goldfish in the pond decreasing. 1

[END OF QUESTION PAPER]

