



National  
Qualifications  
2022

**X807/75/02**

**Biology**  
**Section 1 — Questions**

THURSDAY, 19 MAY

1:00 PM – 3:30 PM

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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.

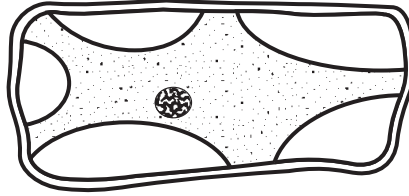


\* X 8 0 7 7 5 0 2 \*

SECTION 1 — 25 marks

Attempt ALL questions

1. The diagram shows a plant cell after being placed in a liquid for 30 minutes.



This cell has become:

- A plasmolysed due to water loss
  - B plasmolysed due to water gain
  - C turgid due to water loss
  - D turgid due to water gain.
2. The following statements relate to the transport of molecules across membranes:
- 1. Energy is required.
  - 2. Molecules move from an area of high concentration to an area of low concentration.
  - 3. Membrane proteins are involved.

Which of the statements apply to active transport?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

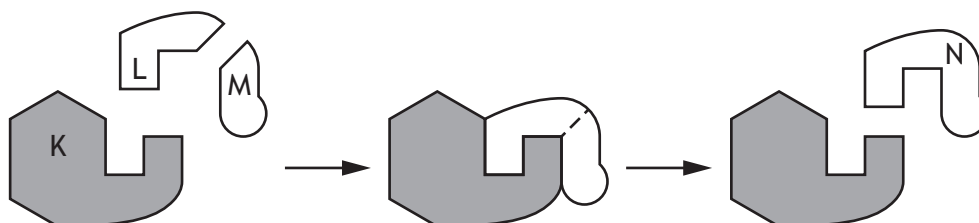
3. In an investigation into the effects of different solutions on plant cells, a beetroot cylinder was dried with a paper towel, weighed, and placed in a concentrated salt solution. After 30 minutes, the beetroot cylinder was removed from the salt solution, dried and reweighed. It was then placed in water for 30 minutes, removed, dried and reweighed. Which row in the table shows the most likely results?

	Initial mass (g)	Mass after 30 minutes in salt solution (g)	Mass after 30 minutes in water (g)
A	2.5	3.0	3.5
B	3.0	3.5	2.5
C	3.0	2.5	3.5
D	3.5	3.0	2.5

4. Where in a cell would mRNA **not** be found?

- A Cell membrane
- B Cytoplasm
- C Nucleus
- D Ribosome

5. The diagram represents three stages in an enzyme-controlled reaction.



Which row in the table identifies the labelled structures?

	Substrate	Enzyme	Product
A	L	N	K
B	N	K	M
C	K	L	N
D	M	K	N

[Turn over

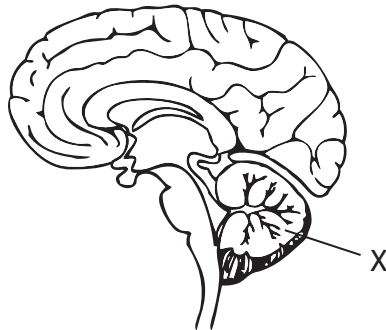
6. The following statements relate to cellular processes:

1. Completed in the mitochondria.
2. Affected by temperature.
3. Release oxygen.

Which of the statements are correct for aerobic respiration?

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

7. A patient is diagnosed with a tumour in the part of the brain labelled X.



Which of the following effects on brain function might the patient experience due to the tumour?

- A Memory loss
- B Irregular heart rate
- C Increased breathing rate
- D Loss of balance

8. Which of the following shows the pathway involved in a reflex arc after a person touches a very hot object?

- A Sensory neuron → brain → motor neuron
- B Sensory neuron → inter neuron → motor neuron
- C Motor neuron → brain → sensory neuron
- D Motor neuron → inter neuron → sensory neuron

9. The flowchart shows how the water concentration of blood in the human body is controlled by a hormone.

brain detects a decrease in the water concentration of blood



a hormone is released from an endocrine gland and travels in the blood



kidneys regulate water concentration of blood



water concentration of blood returns to normal

The target tissue for this hormone is the:

- A brain
  - B endocrine gland
  - C kidneys
  - D blood.
10. Insulin is involved in the regulation of blood glucose.  
Which row in the table describes the response to an increased concentration of insulin in the blood?

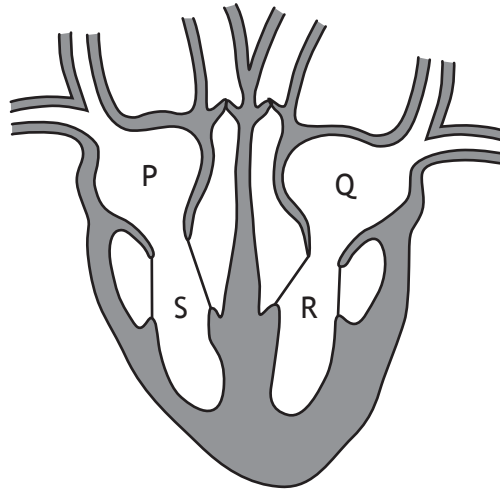
	Concentration of glycogen in the liver	Concentration of glucose in the bloodstream
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

11. A recessive allele is expressed in an individual's phenotype when the:
- A dominant allele has not been inherited from either parent
  - B dominant allele has been inherited from only one parent
  - C recessive allele has been inherited from only one parent
  - D recessive allele has not been inherited from either parent.

12. The human body can be defended against disease by:

- A lymphocytes producing phagocytes
- B phagocytes producing antibodies
- C antibodies producing lymphocytes
- D lymphocytes producing antibodies.

13. The diagram represents the human heart.



Starting where **oxygenated** blood first enters the heart, identify the order of blood flow through the heart.

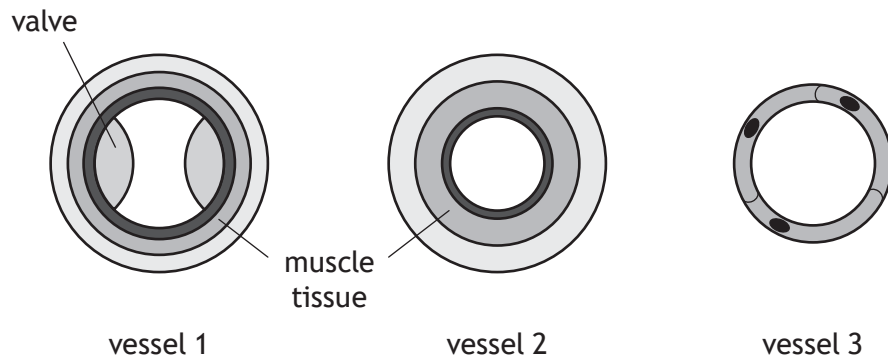
- A  $Q \rightarrow R \rightarrow S \rightarrow P$
- B  $P \rightarrow S \rightarrow R \rightarrow Q$
- C  $Q \rightarrow R \rightarrow P \rightarrow S$
- D  $P \rightarrow S \rightarrow Q \rightarrow R$

14. A heart attack can be caused by a blockage to a blood vessel that supplies the heart tissue with oxygen.

In which blood vessel does this blockage occur?

- A Vena cava
- B Pulmonary artery
- C Coronary artery
- D Pulmonary vein

15. The diagrams represent cross sections of three types of blood vessel.



Which row in the table identifies the blood vessels shown in the diagrams?

	Vessel 1	Vessel 2	Vessel 3
A	artery	vein	capillary
B	vein	artery	capillary
C	vein	capillary	artery
D	capillary	artery	vein

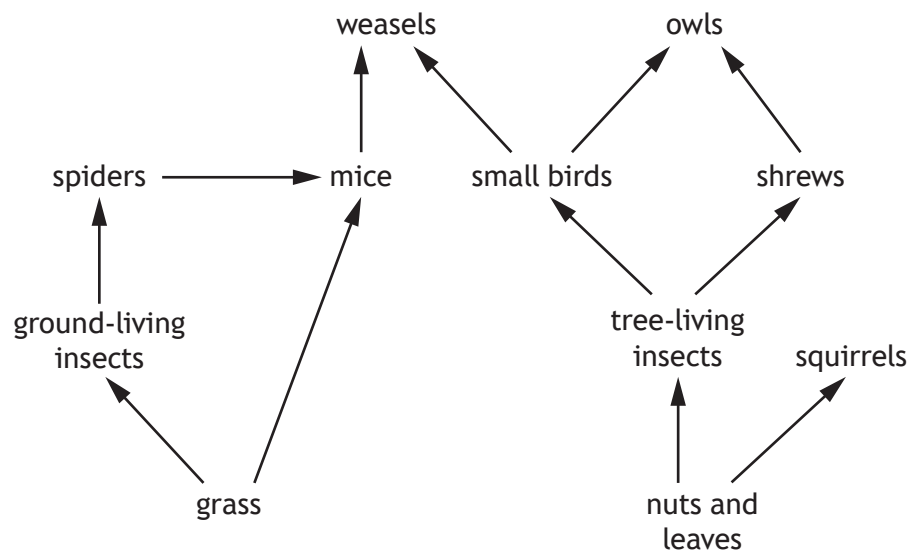
16. Nutrients from food are absorbed into the villi in the small intestine.

Which of the following statements is correct?

- A Glucose and fatty acids are absorbed into the lacteals.
- B Glucose and amino acids are absorbed into the capillaries.
- C Glycerol and fatty acids are absorbed into the capillaries.
- D Glycerol and amino acids are absorbed into the lacteals.

[Turn over

17. Some feeding relationships of organisms in a woodland ecosystem are shown in the food web.



Due to extreme weather conditions, the populations of tree-living and ground-living insects were greatly reduced.

This could lead to:

- A an increase in small birds and a decrease in spiders
- B an increase in squirrels and a decrease in spiders
- C a decrease in nuts and leaves and an increase in small birds
- D a decrease in weasels and an increase in owls.



18. When investigating the distribution of bluebell plants in a woodland, five quadrats were thrown randomly.

Soil moisture and bluebell abundance values were recorded for each quadrat.

The results are shown in the table.

Quadrat	Soil moisture (%)	Bluebell abundance
1	10	5
2	36	25
3	22	14
4	31	20
5	14	7

Predict the bluebell abundance if the soil moisture was 34%.

- A 13
  - B 19
  - C 23
  - D 27
19. The following paired statement key can be used to identify some birds.
- 1. Has webbed feet ..... go to 2  
Does not have webbed feet ..... go to 3
  - 2. Has a black head ..... puffin  
Has a white head ..... swan
  - 3. Has a curved beak ..... go to 4  
Has a straight beak ..... rook
  - 4. Has a brown head ..... curlew  
Has a black head ..... avocet

Use the information in the key to identify two features of a curlew.

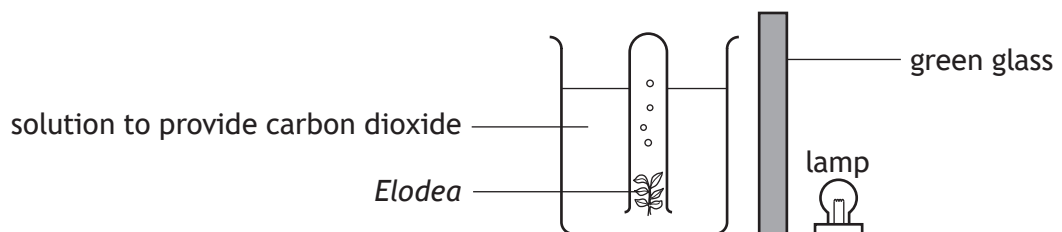
- A Curved beak and a brown head
- B Straight beak and a white head
- C Brown head and webbed feet
- D Straight beak and webbed feet

[Turn over

20. Which row in the table describes changes in conditions that may improve the growth of plants in a greenhouse?

	Light intensity	Carbon dioxide concentration
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

21. An experiment was carried out to investigate the effect of green light on the rate of photosynthesis in the pondweed, *Elodea*.

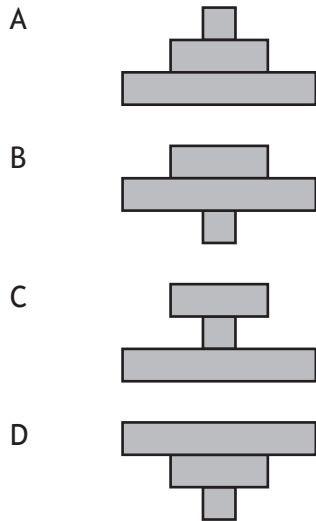


Which of the following changes would provide a suitable control for this experiment?

- A Replace the solution with water.
- B Increase the brightness of the lamp.
- C Use a different species of pondweed.
- D Replace green glass with clear glass.

22. Identify the pyramid of energy that would represent the following food chain.

Oak tree → squirrel → fox



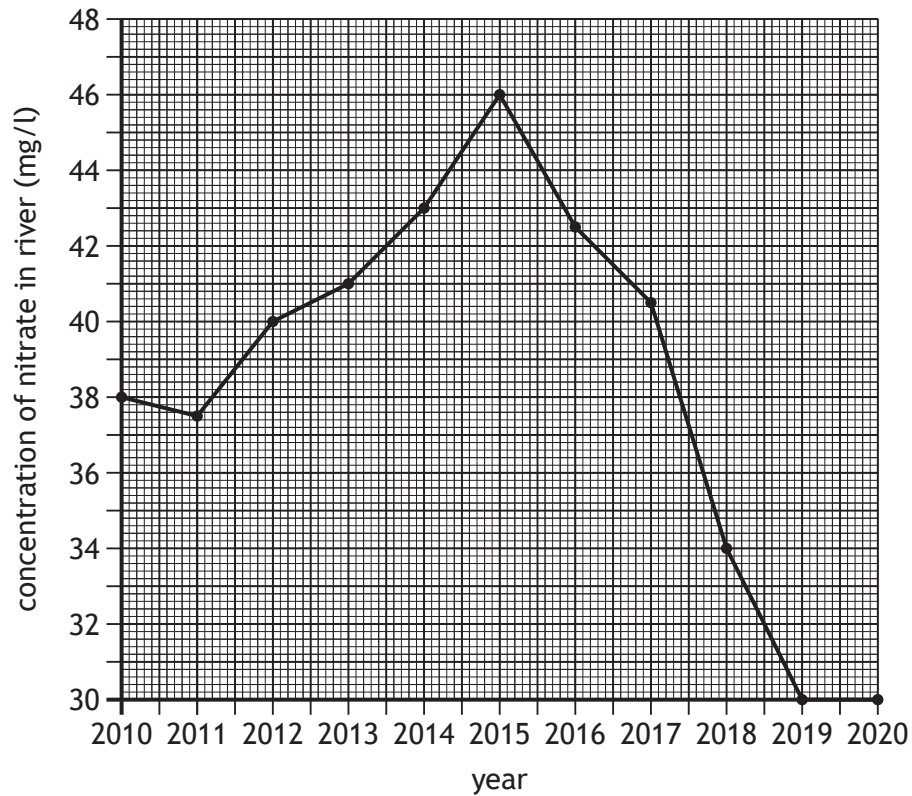
23. An investigation was carried out to measure the change in body mass in a population of adult locusts kept in a tank at 25 °C. The percentage of food converted into body mass was recorded over a three-week period.

The reliability of the results could be improved by:

- A decreasing the length of time of the investigation
- B increasing the mass of food given to the locusts
- C increasing the number of locusts in the tank
- D decreasing the temperature in the tank.

[Turn over

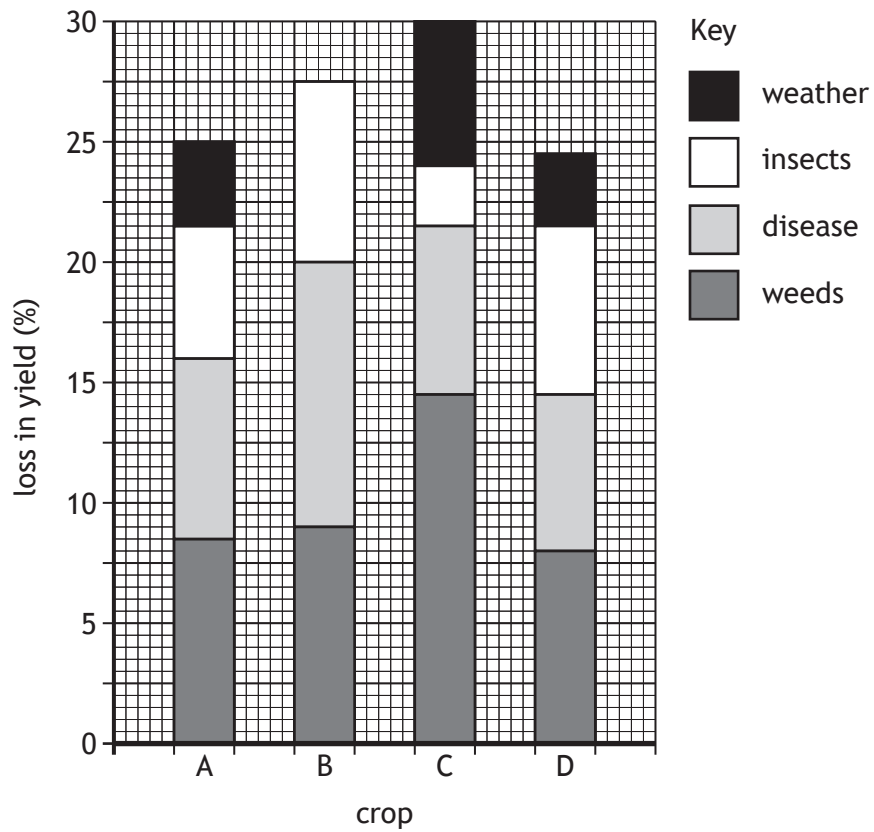
24. The graph shows the concentration of nitrate in a river measured on the first day of each year.



A valid conclusion from this data would be:

- A nitrate concentration increased every year between 2010 and 2014
- B there was a greater increase in nitrate concentration between 2011–2012 compared to between 2014–2015
- C no nitrates were present in river water between 2019 and 2020
- D the greatest decrease in nitrate concentration was between 2017 and 2018.

25. The bar chart shows the percentage loss in yield of four crops and the cause of loss.



To reduce losses, pesticides can be sprayed onto the crops to kill weeds and insects. Predict which crop is most likely to show the greatest percentage increase in yield, when the crops are sprayed with pesticides.

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

FOR OFFICIAL USE



National  
Qualifications  
2022

Mark

**X807/75/01**

**Biology**  
**Section 1 — Answer grid**  
**and Section 2**

THURSDAY, 19 MAY

1:00 PM – 3:30 PM



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

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 — 100**

**SECTION 1 — 25 marks**

Attempt ALL questions.

Instructions for the completion of Section 1 are given on *page 02*.

**SECTION 2 — 75 marks**

Attempt ALL questions.

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. 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.

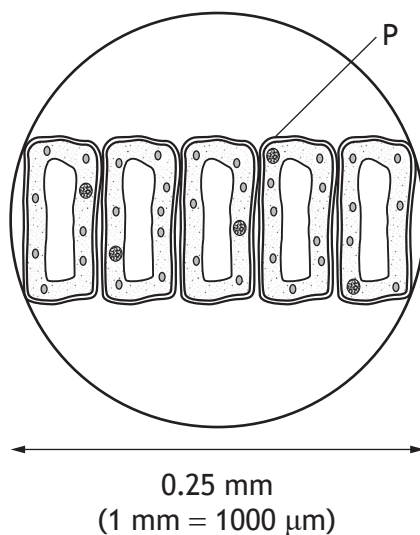


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SECTION 2 — 75 marks

Attempt ALL questions

1. Palisade mesophyll cells are found in leaves and carry out photosynthesis. The diagram shows a layer of these cells viewed under a microscope.



- (a) (i) Name structure P.

1

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- (ii) Calculate the average width of a single palisade mesophyll cell in micrometres ( $\mu\text{m}$ ).

1

*Space for calculation*

\_\_\_\_\_  $\mu\text{m}$

- (b) Describe the difference that would be found in the ultrastructure of plant cells that do not carry out photosynthesis.

1

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[Turn over



2. The diagram represents a section of DNA.



(a) Give the term used to describe the structure of a DNA molecule.

1

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(b) The following results show an analysis of the DNA bases contained in a cell.

DNA Base	Composition (%)
X	28
Guanine	22
Y	22
Z	28

Which letter in the table represents the base cytosine?

1

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2. (continued)

(c) (i) Name the type of molecule coded for by a section of DNA.

1

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(ii) A mutation occurred in a section of DNA as shown.

original code    C A T G T A A A T

mutated code    C A T C T A A A T

Describe the effect of this mutation on the molecule produced.

1

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(iii) State one environmental factor that can increase the rate of mutation.

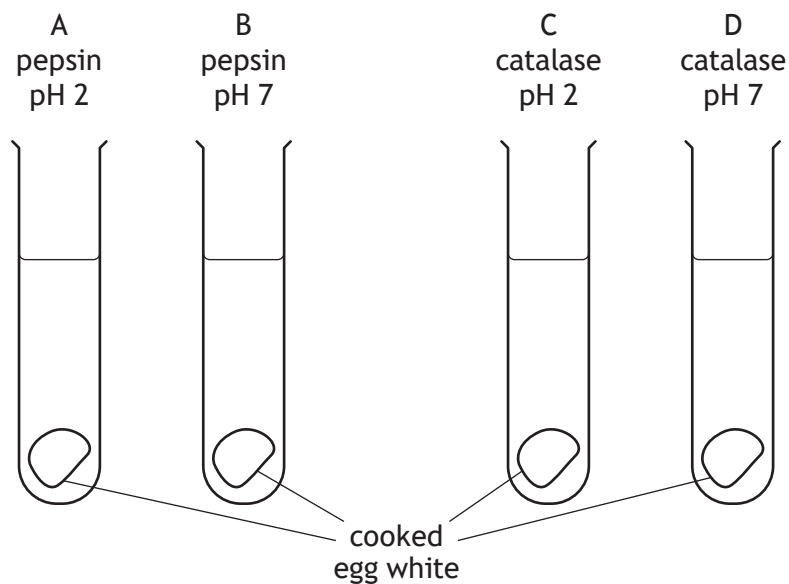
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3. An investigation was carried out into the breakdown of cooked egg white by enzymes.
- 2 g of cooked egg white was placed in each of four test tubes containing different enzyme solutions at different pH levels as shown.



The test tubes were placed in a water bath at 37 °C for 2 hours.

The cooked egg white was then removed and weighed.

The results are shown in the table.

Test tube	Mass after 2 hours (g)	Change in mass (g)	% change in mass
A	0.3		85.0
B	1.9	0.1	5.0
C	2.0	0	0
D	2.0	0	0

- (a) Complete the table by calculating the change in mass of the egg white in test tube A.

*Space for calculation*

1

3. (continued)

(b) (i) Explain why the change in mass in test tube B was less than in test tube A. 1

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(ii) Explain why there was no change in mass in test tubes C and D. 1

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(c) If the investigation was repeated at 70 °C, describe the change in the:  
 (i) structure of the active site of the enzymes 1

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(ii) rate of the reaction in test tubes A and B. 1

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[Turn over

4. Describe similarities and differences in the process of fermentation in yeast cells and muscle cells.

4

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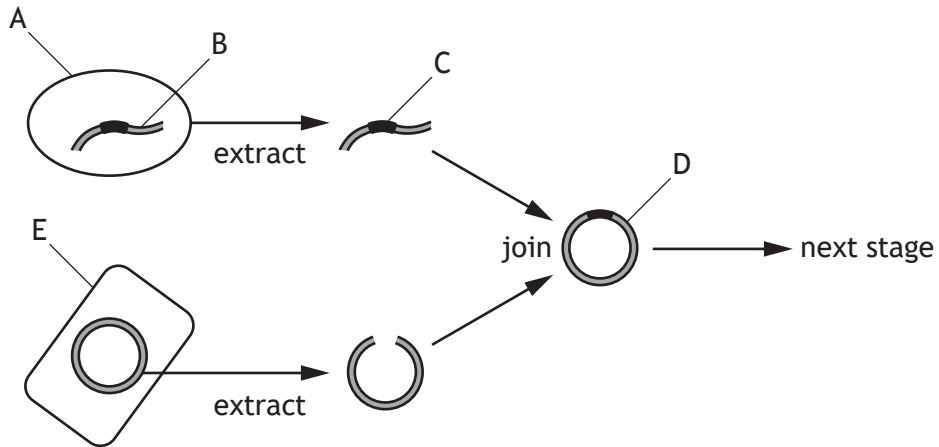
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5. Penicillin was the first antibiotic used to treat bacterial infections. Bacteria have been genetically engineered to produce large quantities of penicillin. The diagram represents some stages of this process.



- (a) Using information from the diagram, complete the table.

3

Structure	Letter
Bacterial cell	
Gene for penicillin	
	D

- (b) Describe the next stage in the production of penicillin.

1

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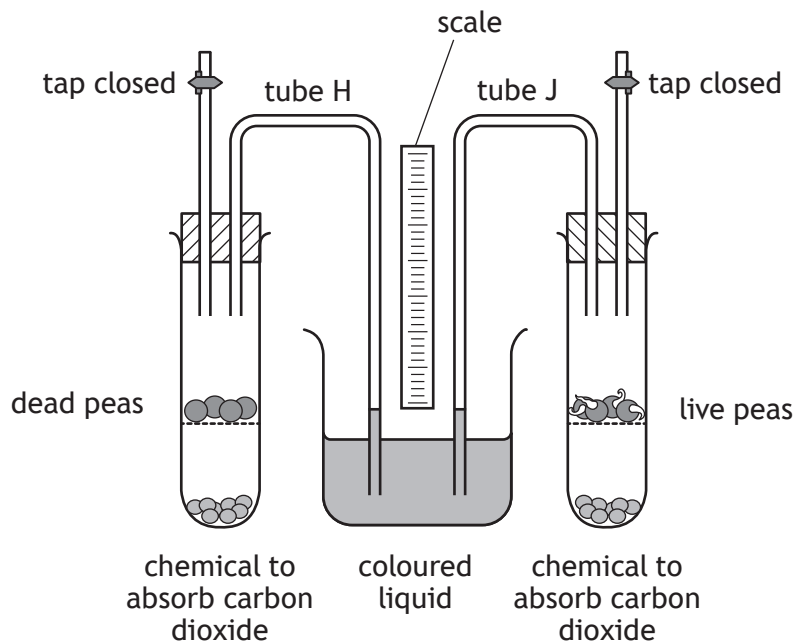


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[Turn over



6. The following apparatus was set up to investigate aerobic respiration in peas.



When peas respire this alters the composition of the gases in the test tubes, causing a change in the liquid levels in tubes H and J.

Liquid levels were recorded as shown in the table.

Tube	Liquid level (mm)		
	At start	30 minutes	60 minutes
H	0	0	0
J	0	25.5	40.8

(a) Explain why the same number of peas were placed in both test tubes. 1

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(b) Calculate the percentage increase between the 30 minute and 60 minute readings in tube J. 1

*Space for calculation*

\_\_\_\_\_ %



6. (continued)

(c) Give a suitable conclusion for this investigation.

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(d) Suggest an improvement to this investigation that would make the results more reliable.

1

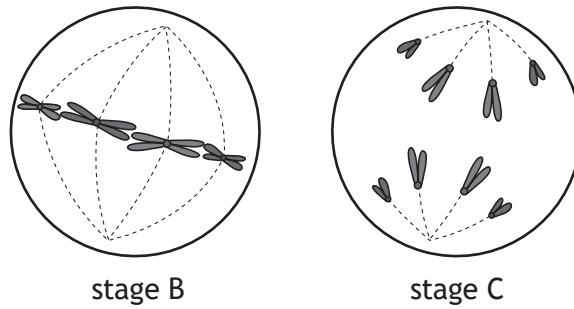
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[Turn over



7. (a) Two stages of mitosis are shown in the diagrams.



(i) Name the structures that pull the pairs of chromatids apart.

1

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(ii) Describe what happens immediately after stage C.

1

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(b) Stem cells can divide in order to self-renew.

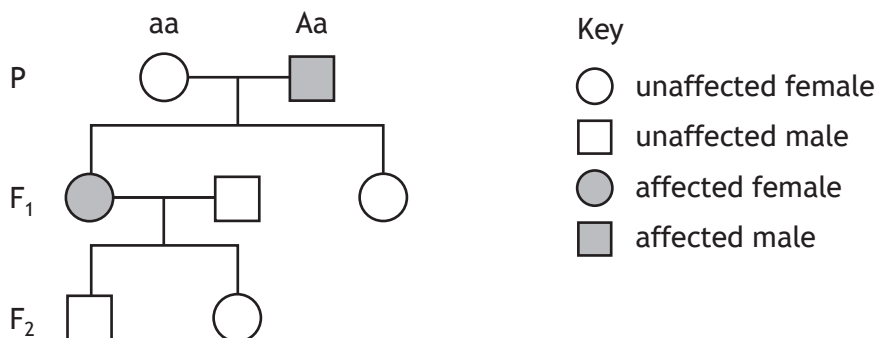
State the feature of stem cells that gives them the potential to develop into different types of cell.

1

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8. Cholesterol is a fatty substance found in blood. High cholesterol levels can be caused by a condition known as familial hypercholesterolemia (FH).  
 The following diagram shows part of a family tree showing the inheritance of FH.  
 'A' represents the FH allele.  
 'a' represents the non-FH allele.



- (a) Use the information given about the male in the parental generation to explain how it is known that the FH allele is dominant. 1

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- (b) The unaffected female in the F<sub>2</sub> generation has a child with a male who is homozygous dominant for FH.  
 State the percentage chance of their child having FH. 1

\_\_\_\_\_ %

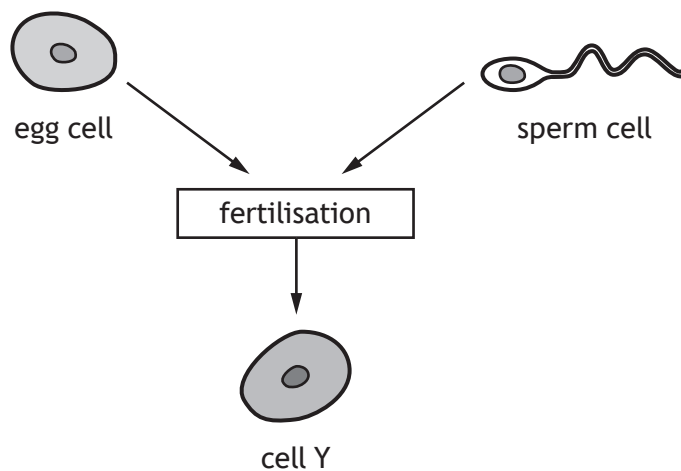
- (c) Identify the type of variation shown by FH. 1

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[Turn over



9. The diagram shows the process of fertilisation in animals.



(a) Name the organ that produces egg cells.

1

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(b) Underline one option in the brackets to complete the following sentence.

1

Cell Y contains a  $\left\{ \begin{array}{l} \text{haploid} \\ \text{diploid} \end{array} \right\}$  number of chromosomes.

9. (continued)

- (c) In vitro fertilisation (IVF) is a technique that can be used to help people with fertility problems to have a baby.

The table shows the results of IVF treatments for women of different ages.

Age of woman (years)	IVF treatments resulting in births (%)
Under 35	32.2
35–37	27.7
38–39	22.0
40–42	14.0
43–44	4.4
45+	1.9

- (i) Calculate how many times greater the chance of a 38 year old woman giving birth to a baby is compared to that of a 44 year old woman.

1

*Space for calculation*

\_\_\_\_\_ times greater

- (ii) Calculate the number of births likely to occur if an IVF clinic treated 250 women aged 41.

1

*Space for calculation*

\_\_\_\_\_ births

- (d) One of the causes of fertility problems is that some sperm are unable to swim to the egg due to a lack of energy.

Name the organelle that is low in number in these affected sperm.

1

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[Turn over



10. Multicellular organisms require efficient communication amongst their cells, tissues and organs.

(a) (i) Name the chemical messengers carried from one part of the human body to another in the blood.

1

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(ii) Explain why only the target tissues are affected by these chemical messengers.

2

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(b) Chemical messengers are also found in plants.

Name a transport structure through which these chemicals could flow to move around the plant.

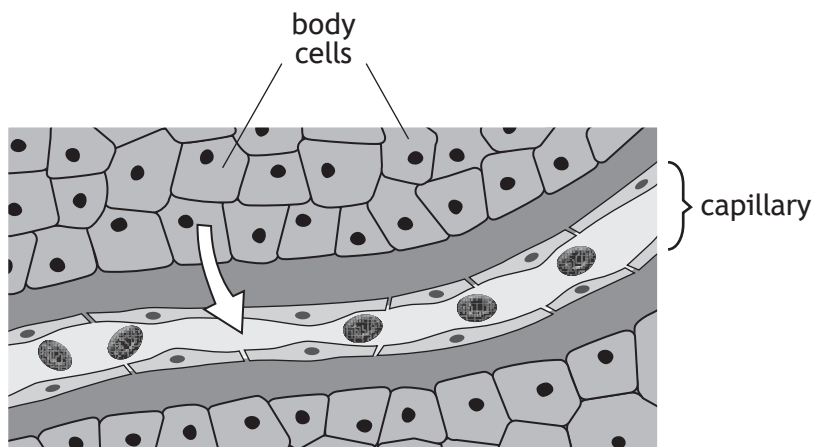
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\* X 8 0 7 7 5 0 1 1 8 \*

11. The diagram represents a blood capillary passing through the body cells of a mammal.



- (a) Name a gas that is transported in the direction shown by the arrow in the diagram and name this method of transport.

2

Gas \_\_\_\_\_

Method of transport \_\_\_\_\_

- (b) Give a feature of a capillary network that increases the efficiency of absorption of materials.

1

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[Turn over

12. Measles in the UK

Measles is a disease that can be prevented through two doses of the MMR vaccine. The target set by health experts to achieve measles-free status is to have at least 95% of the population vaccinated. The World Health Organization declared the UK measles-free in 2016.

However, since 2016, cases of measles in the UK have been increasing, with too few people being vaccinated. It was suggested by experts that when measles cases became less common, some people believed that the threat of the disease was less. Another factor was the publication in the late 1990s of a controversial, and since discredited, piece of research wrongly linking the MMR vaccine with autism.

In 2018, there was a marked increase in reported cases, with 994 cases in England and Wales, compared with 284 cases in 2017. There were 307 cases across the UK during the first three months of 2019. In 2019, only 87% of the population in England received their second dose of MMR. In both Wales and Scotland it was 92%, and in Northern Ireland it was 91%.

- (a) Measles is caused by a pathogen.

State the meaning of the term 'pathogen'.

1

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- (b) (i) Describe the relationship between the uptake of the vaccine and the number of cases of measles.

1

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- (ii) Suggest a reason why the uptake of the vaccine in the UK has been lower since 2016.

1

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12. (continued)

- (c) Calculate the simplest, whole number ratio, of measles cases in England and Wales in 2017 to 2018.

*Space for calculation*

1

\_\_\_\_\_ : \_\_\_\_\_ cases  
2017                      2018

- (d) Using data from the passage, explain why Scotland lost its measles-free status in 2019.

1

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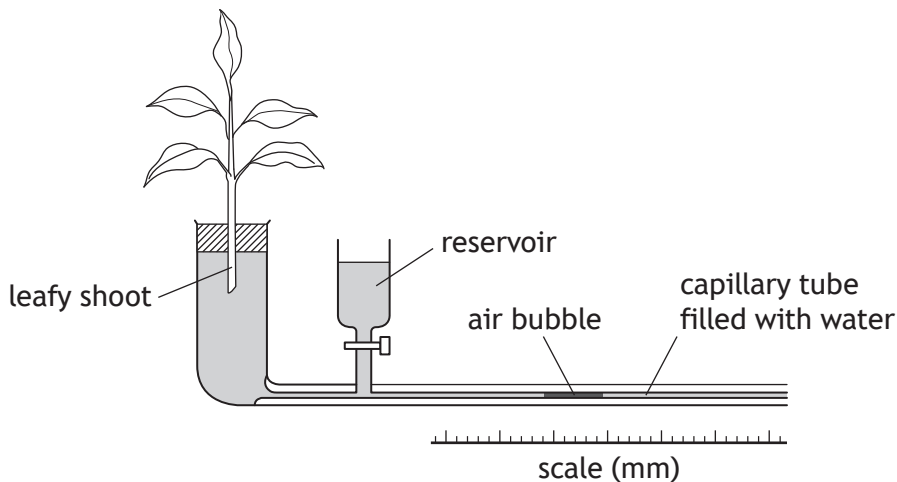
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[Turn over



13. The apparatus shown can be used to investigate the effect of the total leaf surface area on the rate of water uptake.

The rate of water uptake can be calculated by measuring the distance the air bubble moves along the capillary tube in a set time.



- (a) Name this apparatus.

1

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- (b) The apparatus was set up and the distance moved by the bubble in 10 minutes was recorded. One of the leaves was then removed from the plant and the distance moved by the bubble was measured over another 10 minute period. This was repeated until only one leaf remained.

The results are shown in the table.

Number of leaves	Distance moved by bubble in 10 minutes (mm)
5	85
4	69
3	52
2	12
1	8

With reference to the aim, give a conclusion for this investigation.

1

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\_\_\_\_\_





13. (continued)

- (c) (i) Name the process responsible for the movement of water and its evaporation from the leafy shoot.

1

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- (ii) Water evaporates from leaves through stomata.

Name the cells surrounding the stomata that control their opening and closing.

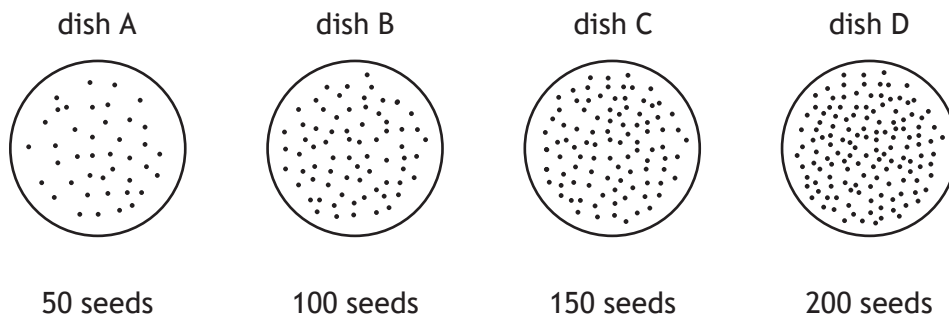
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[Turn over



14. A student set up four Petri dishes of equal size to investigate competition in cress seeds of the same species. The seeds were scattered on moist filter paper and left to germinate (grow) in the dark.



(a) (i) Identify a variable, not already mentioned, that should have been kept the same for each dish.

1

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(ii) The number of seeds germinating in each dish was counted. The table shows the results.

Dish	Seeds per dish	Number of germinating seeds	Germinating seeds (%)
A	50	45	90
B	100	80	80
C	150		60
D	200	60	30

Complete the table by calculating the number of germinating seeds in dish C.

1

*Space for calculation*

(iii) Competition was greatest in dish D. Explain why this conclusion was drawn.

1

\_\_\_\_\_  
\_\_\_\_\_

14. (continued)

(b) Name the type of competition that occurs among these germinating seeds.

1

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(c) Explain why competition in ecosystems occurs.

1

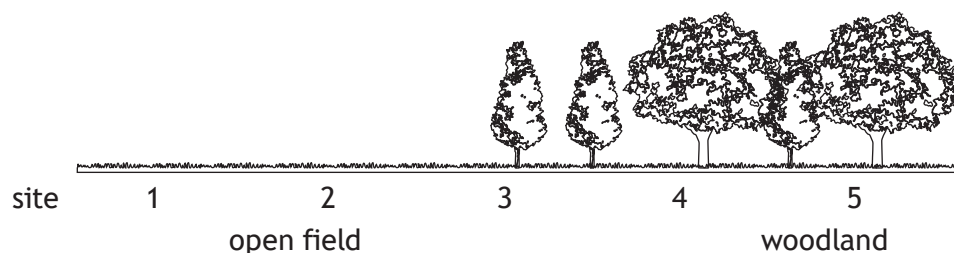
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[Turn over



15. Light intensity readings were taken at 5 sites along a transect line running from an open field to a woodland.



- (a) Name the apparatus used to measure light intensity and give one precaution that should be taken when using it to minimise error.

2

Apparatus \_\_\_\_\_

Precaution \_\_\_\_\_

- (b) Three readings were taken at each site at the same time on different days. The results are shown in the table.

Site	Light intensity reading (lux)		
	Day 1	Day 2	Day 3
1	18 160	17 845	18 180
2	11 500	11 306	11 494
3	14 600	14 550	14 590
4	5300	4800	5275
5	3600	3200	3610

- (i) Suggest a reason why the readings taken on day 2 were lower than the readings on days 1 and 3.

1

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15. (b) (continued)

(ii) Explain why three readings were taken at each site.

1

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(c) Light intensity is an example of an abiotic factor.

Name one other abiotic factor.

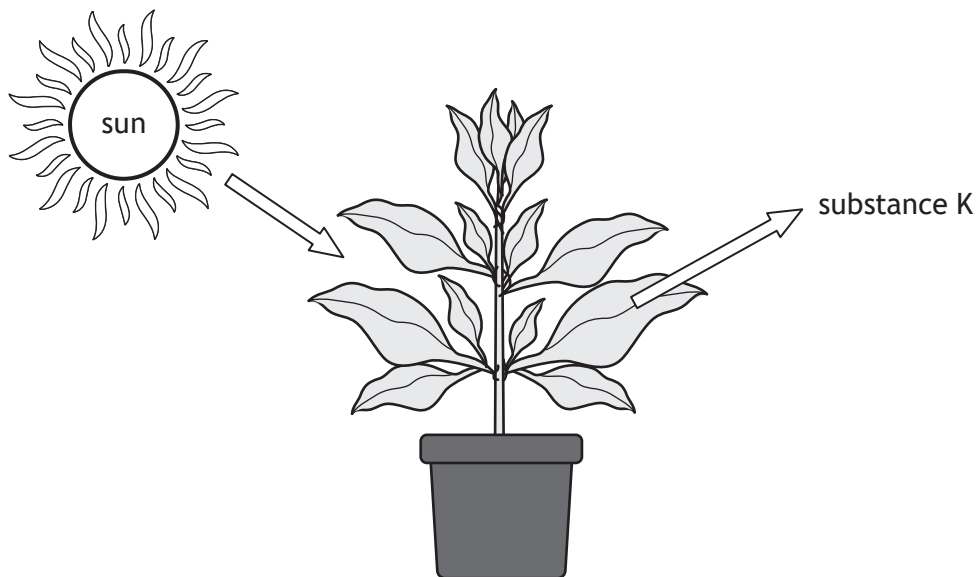
1

---

[Turn over



16. When light is absorbed by a plant, photosynthesis takes place and as a result substance K is released from the leaves.



(a) Name substance K.

1

\_\_\_\_\_

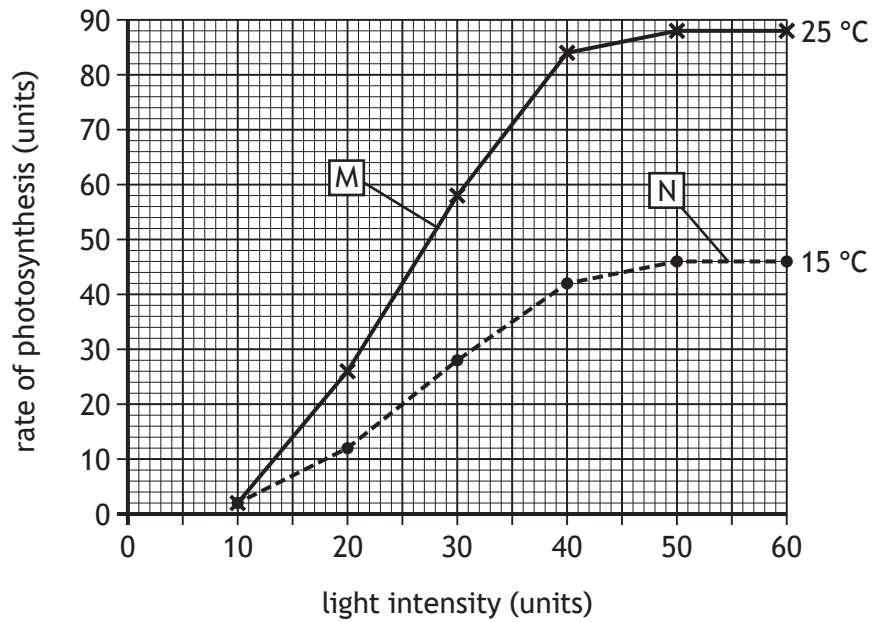
(b) Describe the energy change that takes place during the first stage of photosynthesis.

1

\_\_\_\_\_  
\_\_\_\_\_

16. (continued)

- (c) The graph shows the effect of increasing light intensity on the rate of photosynthesis at two different temperatures. All other factors were kept constant.



Identify the limiting factor at each of the points M and N.

2

M \_\_\_\_\_

N \_\_\_\_\_

[Turn over

17. A study was carried out to investigate the effect of using the chemicals ethanol and methanol on bacterial growth.

Controls without either chemical were also set up.

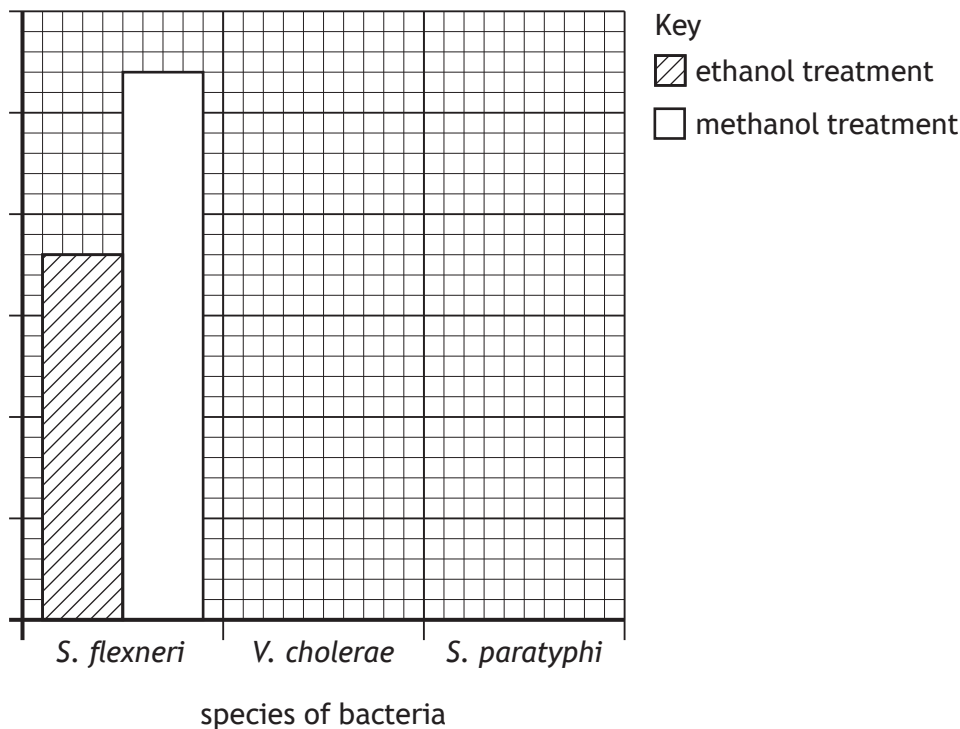
The results in the table show the growth of three species of bacteria as a percentage of the overall bacterial growth in the control experiment.

Species of bacteria	Bacterial growth (percentage of control)	
	Ethanol treatment	Methanol treatment
<i>S. flexneri</i>	36	54
<i>V. cholerae</i>	45	44
<i>S. paratyphi</i>	4	12

(a) On the grid, complete the vertical axis by adding a label and scale, and plot the remaining bars to show bacterial growth for *V. cholerae* and *S. paratyphi*.

2

(An additional grid, if required, can be found on page 33.)





17. (continued)

- (b) It was concluded that ethanol was more effective than methanol at preventing bacterial growth.

Tick one box to identify whether this conclusion is valid or invalid.

Give a reason for your answer.

valid

invalid

1

Reason \_\_\_\_\_  
\_\_\_\_\_

- (c) The researchers used a 6% ethanol solution in their study.

Predict the effect of using a 3% ethanol solution instead, on the growth of the bacteria.

1

\_\_\_\_\_  
\_\_\_\_\_

[Turn over



18. (a) Plant growth can be improved if the soil has a suitable nitrate content.

(i) Describe the use of nitrates in a plant.

1

\_\_\_\_\_

(ii) Nitrates can be found in compost.

The table gives some information about the nutrient content of three different composts.

Type of compost	Carbon content (g/100 g)	Nitrogen content (g/100 g)	Carbon : Nitrogen ratio
R	9.45	1.35	7:1
S	14.40		24:1
T	9.80	0.20	49:1

Complete the table by calculating the nitrogen content in 100 g of compost S.

1

*Space for calculation*

(b) Nitrates can leach from the soil into nearby rivers.

(i) Give the term that describes the increased growth of algae caused by leached nitrates.

1

\_\_\_\_\_

(ii) Explain how this increase in algae can cause aquatic plants in a river to die.

2

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[END OF QUESTION PAPER]

