



National
Qualifications
2024

X807/75/02

Biology
Section 1 — Questions

WEDNESDAY, 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 *

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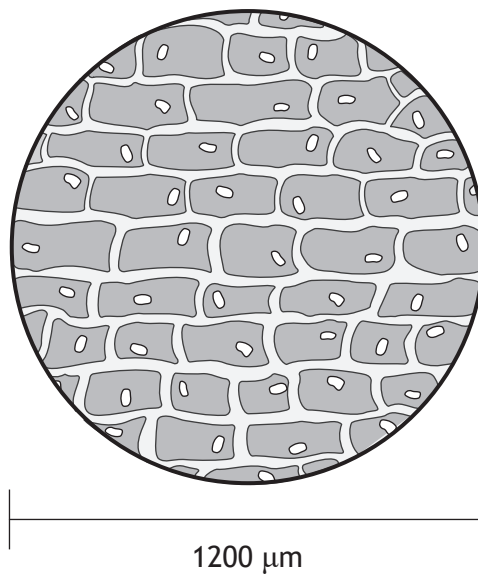
SECTION 1 — 25 marks

Attempt ALL questions

1. Cells in the stomach produce enzymes to help digest food.
Identify the structure where these enzymes are produced.

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

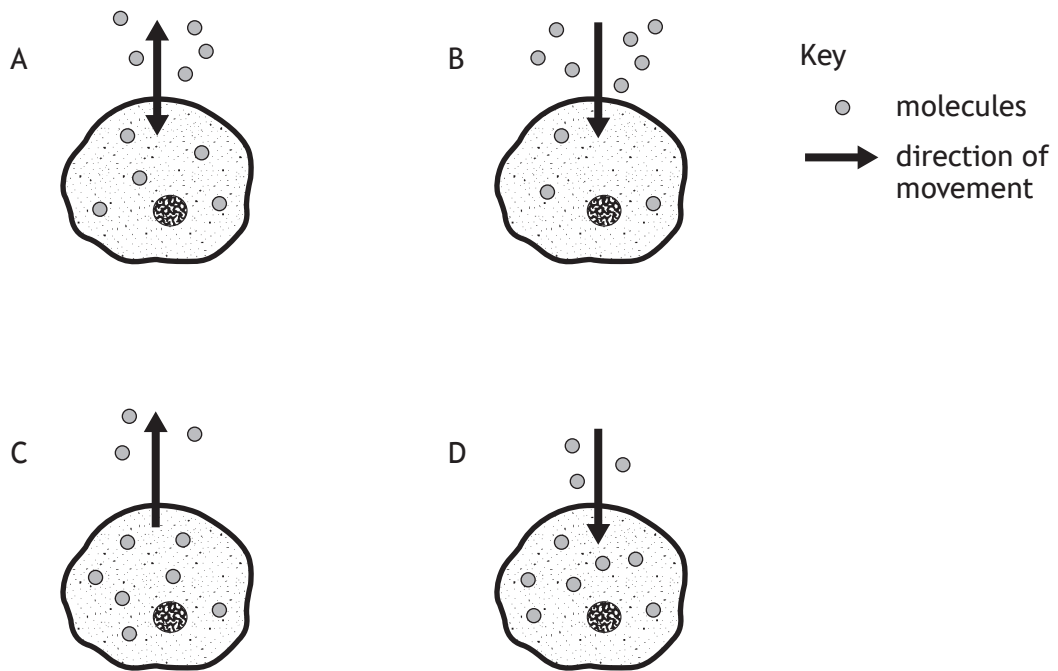
2. The diagram shows cells viewed under a microscope at a magnification of $\times 100$.



What is the average length, in μm , of the cells shown?

- A 2.4
- B 12
- C 240
- D 24 000

3. The diagrams represent the movement of molecules across a cell membrane.
Which cell would require the greatest number of mitochondria to allow the movement shown?

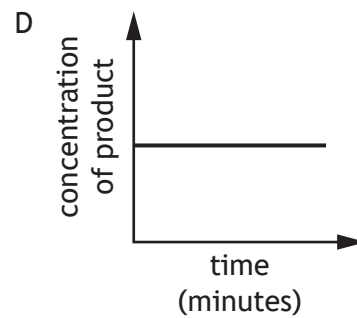
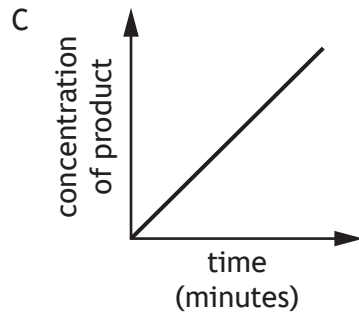
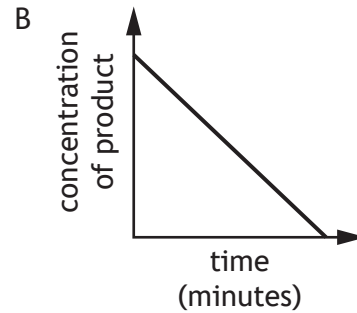
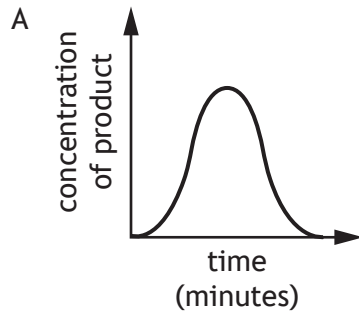


4. A section of DNA contains a total of 6400 bases of which 32% are guanine.
The number of adenine bases in this section of DNA is

- A 1152
- B 2048
- C 2304
- D 4352

[Turn over

5. Which diagram shows the concentration of product during a degradation reaction?



6. The following stages occur during the process of genetic engineering:

1. gene inserted into plasmid
2. plasmid cut open
3. plasmid extracted from bacterial cell
4. gene extracted from chromosome.

Which of the following shows the stages in the order they occur?

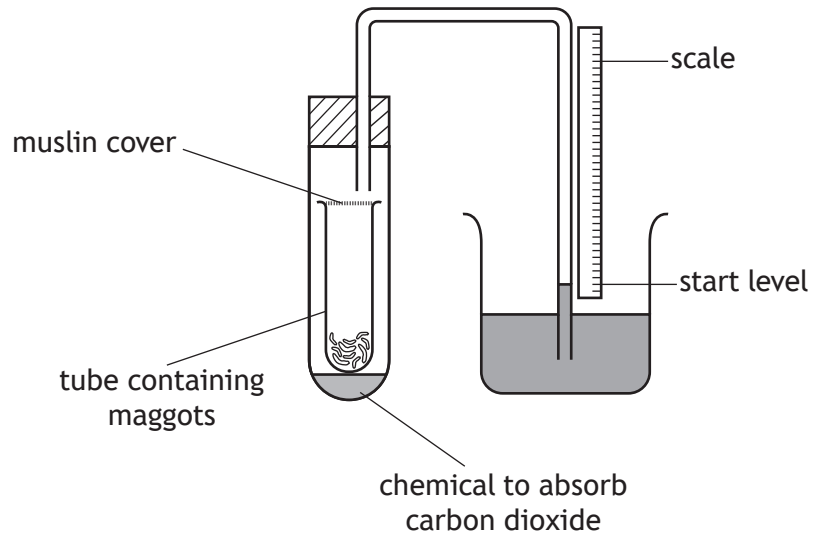
- A 2 → 4 → 1 → 3
- B 2 → 1 → 3 → 4
- C 4 → 2 → 1 → 3
- D 4 → 3 → 2 → 1

7. A group of scientists investigated the effect of temperature on the growth of genetically modified (GM) cells. The GM cells were grown in a nutrient solution at 20 °C. This was repeated at 30 °C and 40 °C using fresh nutrient solutions at each temperature.

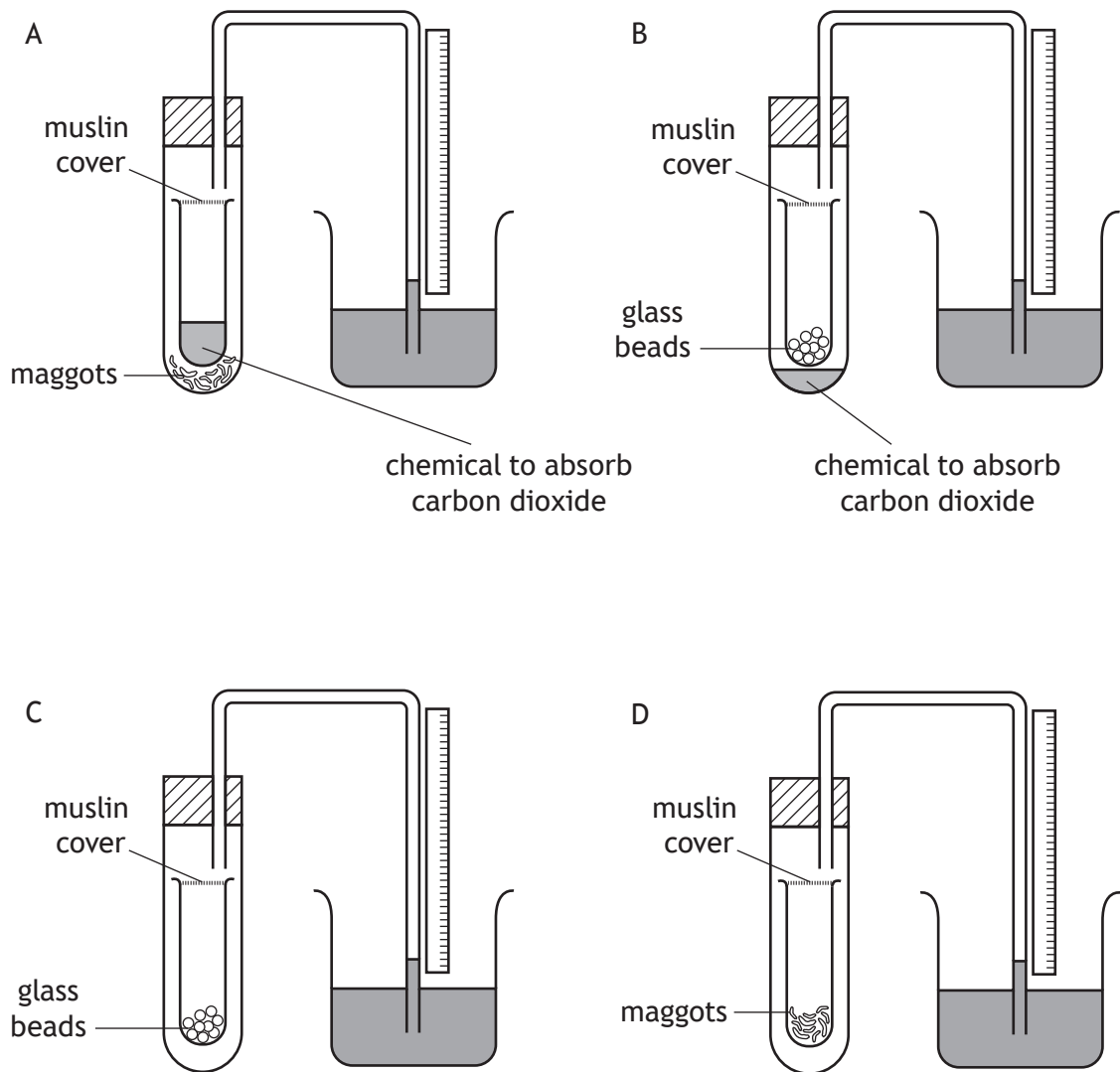
Which of the following would improve the reliability of the results?

- A Set up nutrient solutions containing GM cells at 25 °C and 35 °C.
- B Set up 10 nutrient solutions containing GM cells at each temperature.
- C Use the same concentration of nutrient solution at each temperature.
- D Use the same types of GM cell at each temperature.

8. A respirometer was set up as shown to investigate respiration in maggots.



Which of the following would be a suitable control for this investigation?



9. A chemical called colchicine stops cells from producing spindle fibres during mitosis, which prevents further stages occurring.

Which stage of mitosis would still occur when colchicine is present?

- A Chromosomes move to opposite poles of the cell.
- B Chromatids are pulled apart.
- C Chromosomes shorten and thicken.
- D Two diploid cells produced.

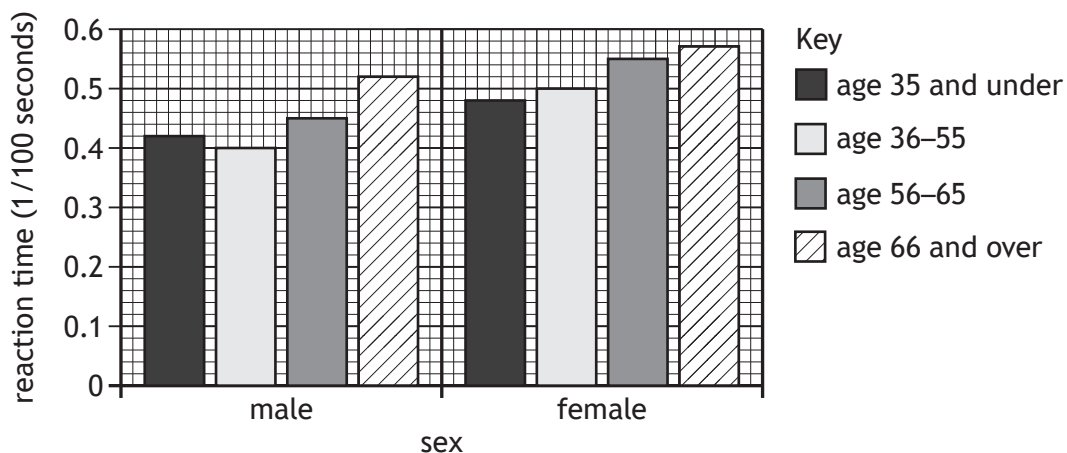
10. Which statement describes a function of the cerebrum?

- A Remembering the rules of rugby.
- B Increasing heart rate during a sprint.
- C Co-ordinating movement of muscles when playing football.
- D Maintaining balance during yoga.

11. Which row in the table identifies a hormone, its site of production and its target tissue?

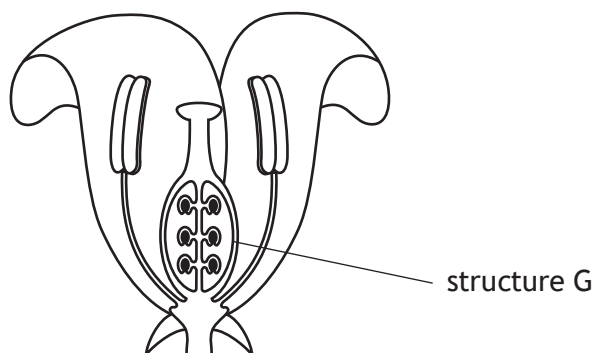
	Hormone	Site of hormone production	Target tissue
A	insulin	liver	pancreas
B	glycogen	pancreas	liver
C	glucose	liver	pancreas
D	glucagon	pancreas	liver

12. A study was carried out to investigate the relationship between age and reaction time. The results are shown in the graph.



Which of the following conclusions is correct for these results?

- A Reaction time always increases with age for both males and females.
 - B Reaction time always decreases with age for both males and females.
 - C Females have a lower reaction time than males in each age group.
 - D Males have a lower reaction time than females in each age group.
13. The diagram shows the main parts of a flower.



Which row in the table identifies structure G and the chromosome complement of the cells it produces?

	Structure G	Chromosome complement of cells produced
A	ovary	haploid
B	ovary	diploid
C	ovule	haploid
D	ovule	diploid

14. The height of some cattle was measured, and the presence or absence of horns was noted. Which row in the table is correct?

	Feature	Type of variation	Type of inheritance
A	horns	continuous	single gene
B	height	continuous	polygenic
C	height	discrete	single gene
D	horns	discrete	polygenic

15. In which part of a leaf are stomata found?

- A Lower epidermis
- B Palisade mesophyll
- C Spongy mesophyll
- D Leaf vein

16. The following factors can affect the rate of transpiration:

- 1. increasing humidity
- 2. decreasing humidity
- 3. increasing surface area
- 4. decreasing wind speed.

Which of these factors would cause a decrease in the rate of transpiration in a leafy shoot?

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

17. Haemoglobin's ability to bind to oxygen is affected by the pH of the blood.

The table shows the percentage of haemoglobin bound to oxygen at different pH levels.

pH of blood	Percentage of haemoglobin bound to oxygen
7.1	
7.2	60.0
7.4	69.0
7.5	73.5

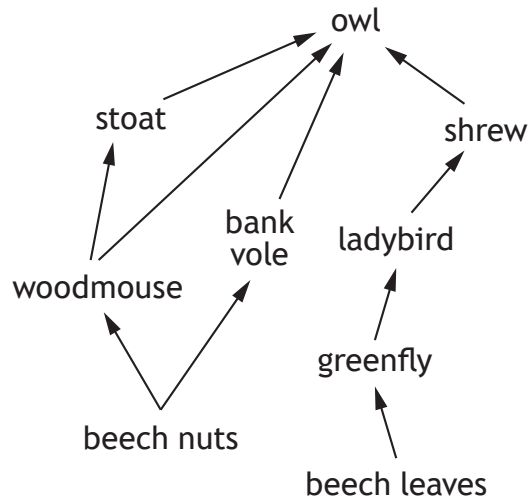
The percentage of haemoglobin bound to oxygen when the pH of blood is 7.1 is likely to be

- A 42.0
 - B 51.0
 - C 55.5
 - D 59.9
18. Which row in the table identifies the substances absorbed into a structure found in the villus?

	Structure	Substances
A	capillaries	fatty acids and glucose
B	capillaries	amino acids and glycerol
C	lacteal	amino acids and glucose
D	lacteal	fatty acids and glycerol

[Turn over

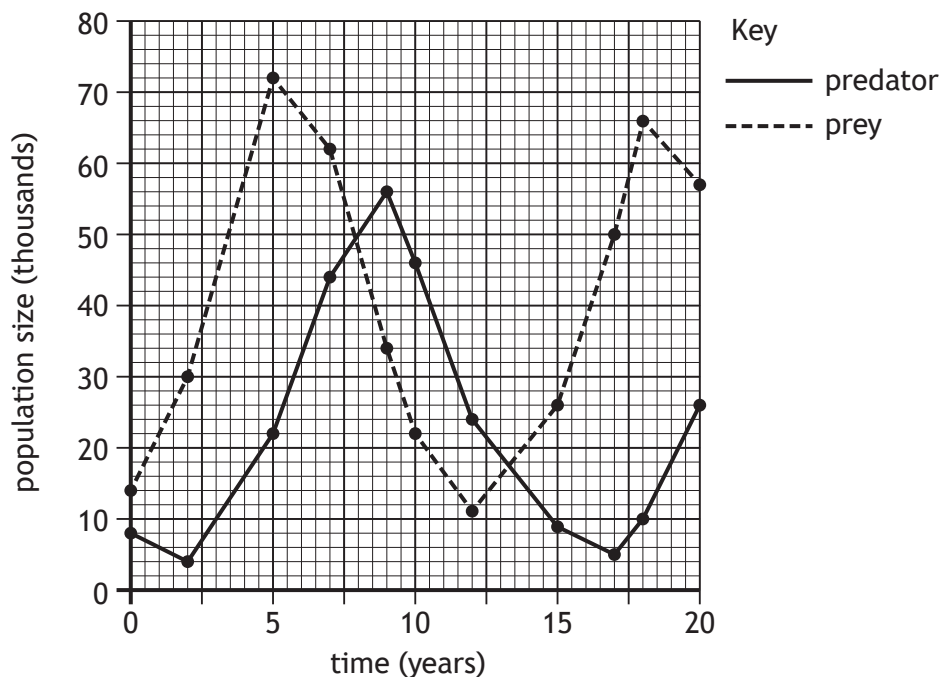
19. The diagram represents part of a woodland food web.



Which statement is true for the organisms in the food web?

- A Owl and stoat are in intraspecific competition.
- B Bank vole and shrew are in interspecific competition.
- C Ladybird is both predator and prey.
- D Greenfly is a producer.

20. The graph shows the changes in population size of a predator and its prey over 20 years.



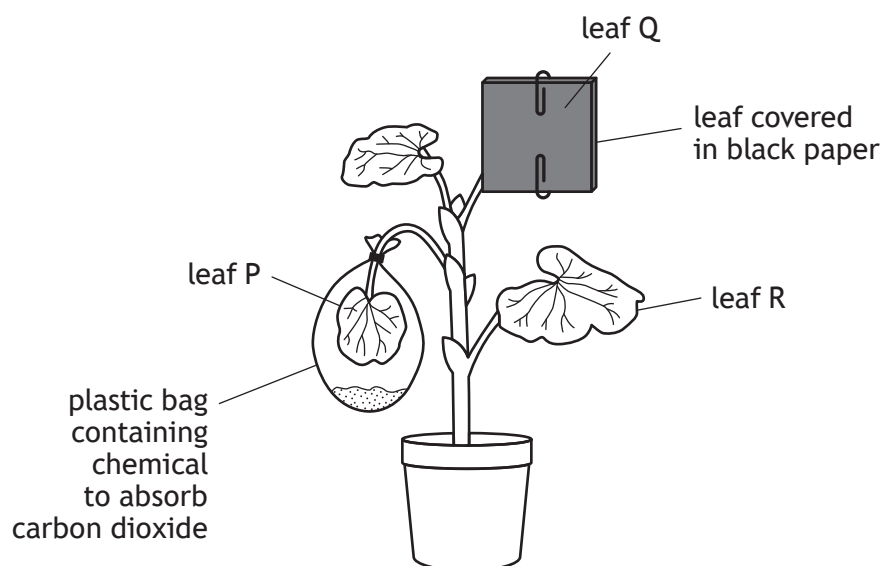
The difference in the population sizes of the predator and its prey when each population was at its maximum is

- A 6000
- B 16 000
- C 22 000
- D 50 000

21. Which of the following is a biotic factor which could affect biodiversity?

- A Soil moisture
- B Temperature
- C Grazing
- D Carbon dioxide concentration

22. In an investigation into photosynthesis, a green plant was set up as shown and left in the light for 2 days.



Leaves P, Q and R were then tested for the presence of starch.

In which of the leaves was starch present?

- A Leaf P only
- B Leaf R only
- C Leaves P and R only
- D Leaves P, Q and R

[Turn over

23. The table shows the results of an investigation into the effect of temperature on egg laying mites.

Feature	Temperature (°C)		
	20 °C	25 °C	30 °C
Average length of egg laying period (days)	36	27	18
Average number of eggs laid per female during egg laying period	108	108	108

As the temperature increases, the average number of eggs laid per female **per day**

- A increases
- B decreases
- C stays the same
- D halves.

24. Which row in the table describes the changes that take place when fertiliser leaches into a river?

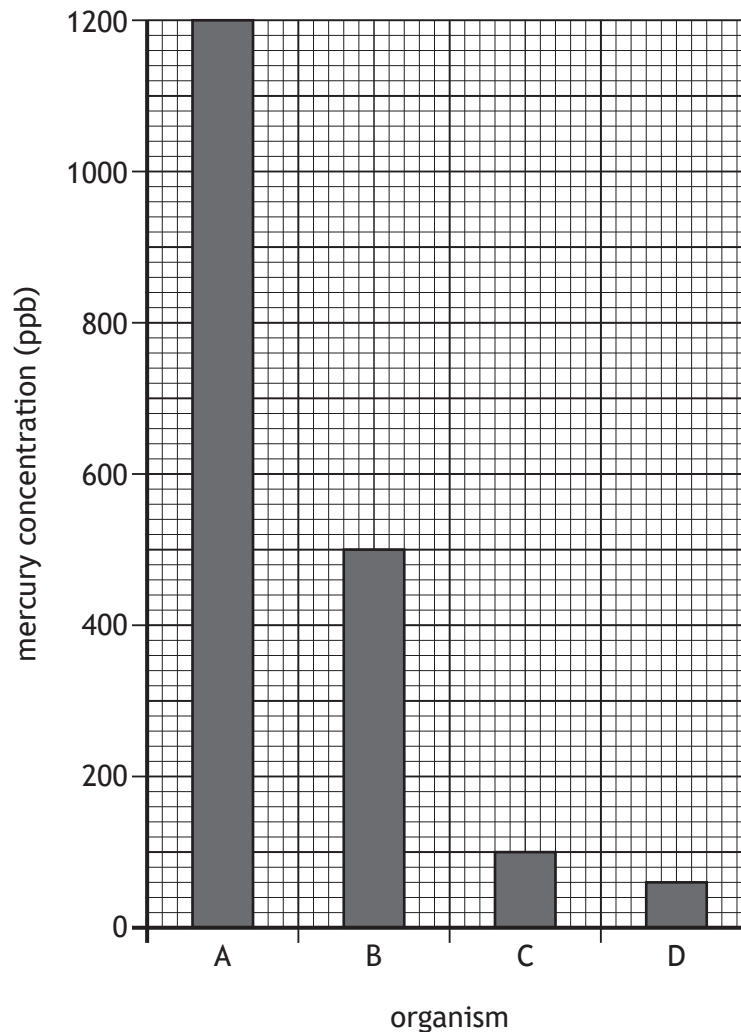
	Algal population	Light levels	Bacteria numbers	Oxygen concentration
A	increases	decrease	increase	decreases
B	increases	decrease	decrease	increases
C	decreases	increase	increase	decreases
D	decreases	increase	decrease	increases

25. Paints containing toxic mercury compounds were used to paint ships. As a result, mercury entered marine food chains.

The concentration of mercury compounds in the tissues of the organisms in the following marine food chain was measured.

plankton → aquatic insects → small fish → large fish

Which bar on the graph represents the mercury concentration of the small fish?



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



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National
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Mark

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X807/75/01**Biology**
Section 1 — Answer grid
and Section 2

WEDNESDAY, 15 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

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Town

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Forename(s)

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Surname

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Number of seat

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Date of birth

Day

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Month

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Year

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Scottish candidate number

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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.

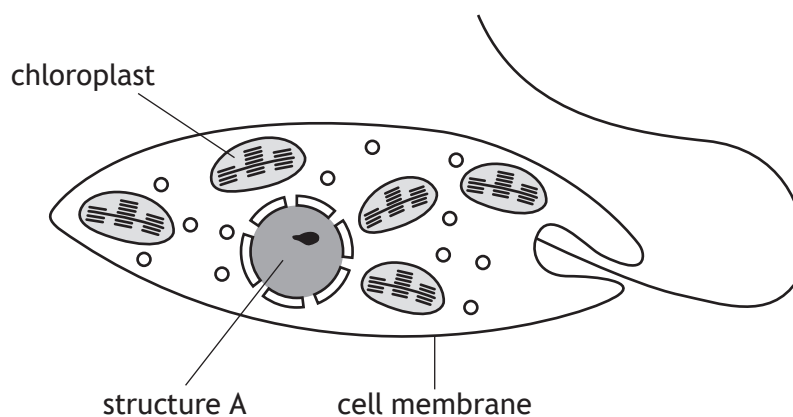


* X 8 0 7 7 5 0 1 0 1 *

SECTION 2 — 75 marks

Attempt ALL questions

1. Euglena is a single celled organism found in water.
The diagram shows some of the structures within Euglena.



- (a) (i) Name structure A. 1
- _____
- (ii) Give the function of a chloroplast. 1
- _____
- (b) Suggest why Euglena is **not** a typical plant cell. 1
- _____
- _____
- (c) The average body length of a Euglena is 50 micrometres.
They can travel 1.3 body lengths in one second.
Calculate how many micrometres a Euglena could travel in 30 seconds. 1
- Space for calculation*

_____ micrometres



2. A group of students measured the mass of pieces of turnip tissue before placing them in different concentrations of salt solution. After one hour, the change in mass of the turnip tissue was recorded.

The results are shown in the table.

Concentration of salt solution (g/100 cm ³)	Percentage change in mass (%)
1	+17
3	+11
6	-2
8	-9
10	-16

- (a) Predict the percentage change in mass in a 2 g/100 cm³ salt solution. 1

_____ %

- (b) Identify the salt solution where most of the turnip cells would be turgid. 1

_____ g/100 cm³

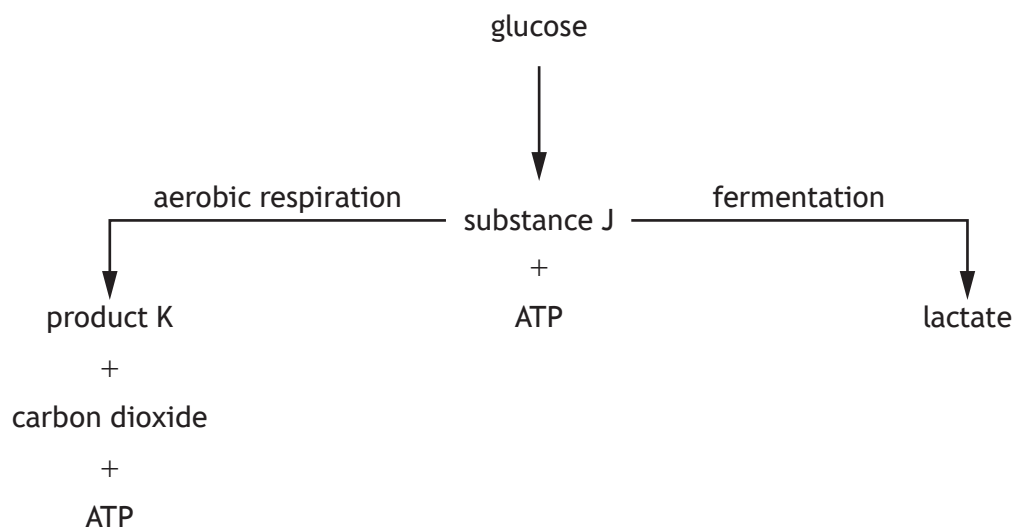
- (c) The pieces of turnip used in this investigation all had a starting mass of 6 g. Calculate the final mass of the piece of turnip in the 8 g/100 cm³ of salt solution. 1

Space for calculation

_____ g



3. The diagram represents processes that generate ATP in muscle cells.



(a) (i) Name substance J and product K. 2

Substance J _____

Product K _____

(ii) State the number of ATP molecules that would be produced from each molecule of glucose during fermentation. 1

(b) Name the cell structure where aerobic respiration is completed. 1

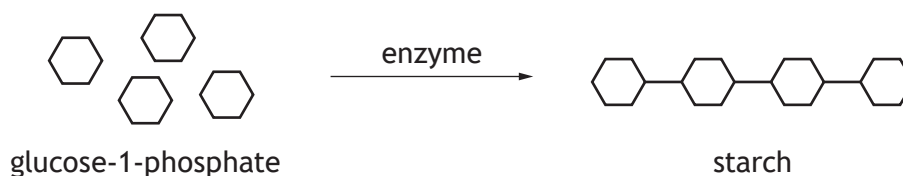
(c) Suggest why a muscle cell might carry out fermentation rather than aerobic respiration. 1

[Turn over



4. Potatoes store sugar in the form of starch. Glucose-1-phosphate (G-1-P) molecules are converted to starch in an enzyme-controlled reaction.

This enzyme can be found in potato extract.



- (a) (i) Identify the type of reaction carried out by this enzyme.

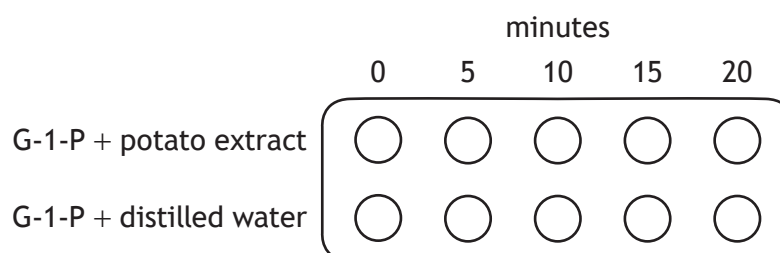
1

- (ii) Identify the substrate in this reaction.

1

- (b) An experiment was set up to investigate the time taken for starch to be produced. All previously made starch was removed from the potato extract.

Two rows of a dimple tile were set up as shown in the diagram.



At 5-minute intervals the content of the dimples in each column was tested for the presence of starch.

The results are shown in the table.

Time (minutes)	Starch present	
	G-1-P + potato extract	G-1-P + distilled water
0	no	no
5	no	no
10	yes	no
15	yes	no
20	yes	no

4. (b) (continued)

- (i) Suggest a reason for any previously made starch being removed from the potato extract.

1

- (ii) State two variables that should be controlled to make this experiment valid.

2

1 _____

2 _____

- (iii) Explain how the results show that the enzyme is required for the reaction to occur.

1

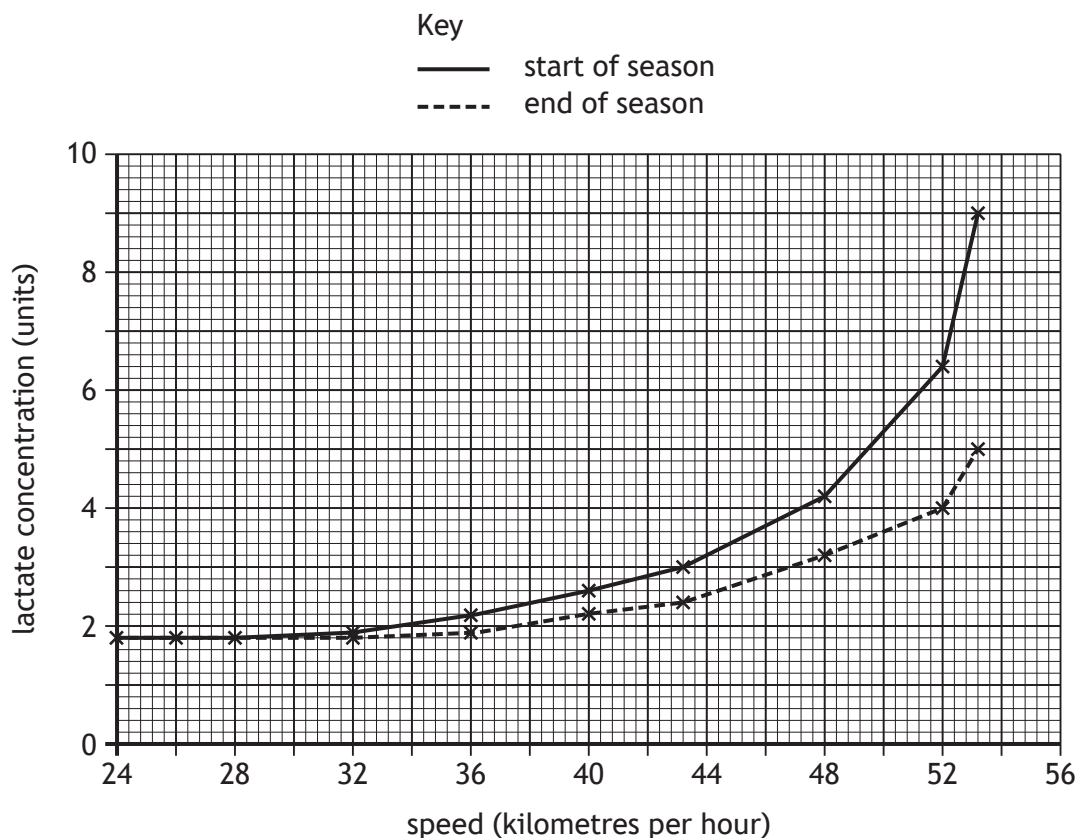
[Turn over



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

5. The concentration of lactate in the blood of a long distance cyclist was measured whilst cycling at different speeds.

The graph shows these measurements at the start and end of the competition season.



- (a) What was the lactate concentration at the start of the season when the cyclist was travelling at 40 kilometres per hour?

1

_____ units

- (b) Calculate the percentage decrease in lactate concentration at the end of the season compared to the start of the season when the cyclist was travelling at 52 kilometres per hour.

1

Space for calculation

_____ %



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

5. (continued)

- (c) Calculate how many times greater the maximum lactate concentration was at the start of the season compared to the end of the season.

1

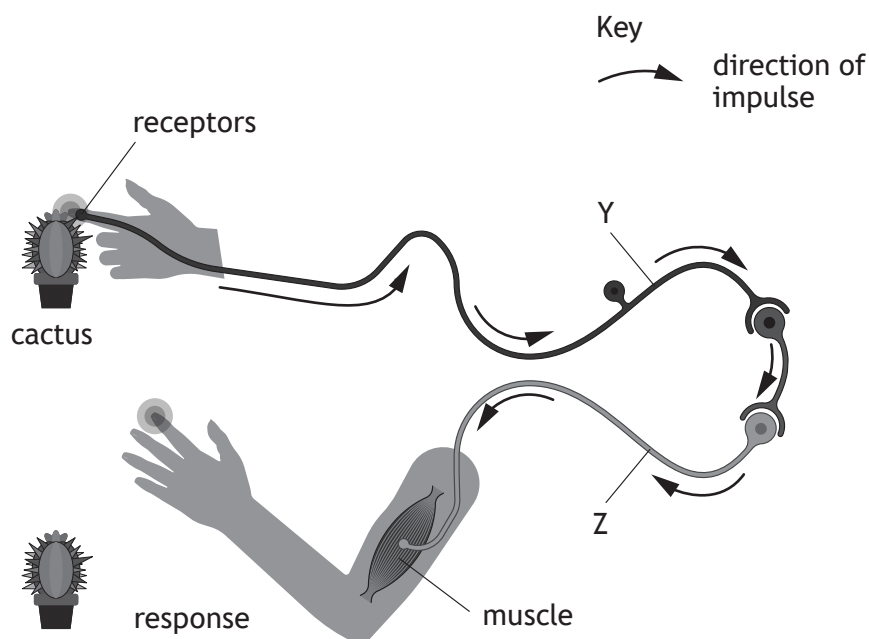
Space for calculation

_____ times

[Turn over



6. The diagram represents a reflex arc when a person touches a cactus plant.



(a) (i) Identify neurons Y and Z.

2

Neuron Y _____

Neuron Z _____

(ii) State how messages are transferred at a synapse.

1

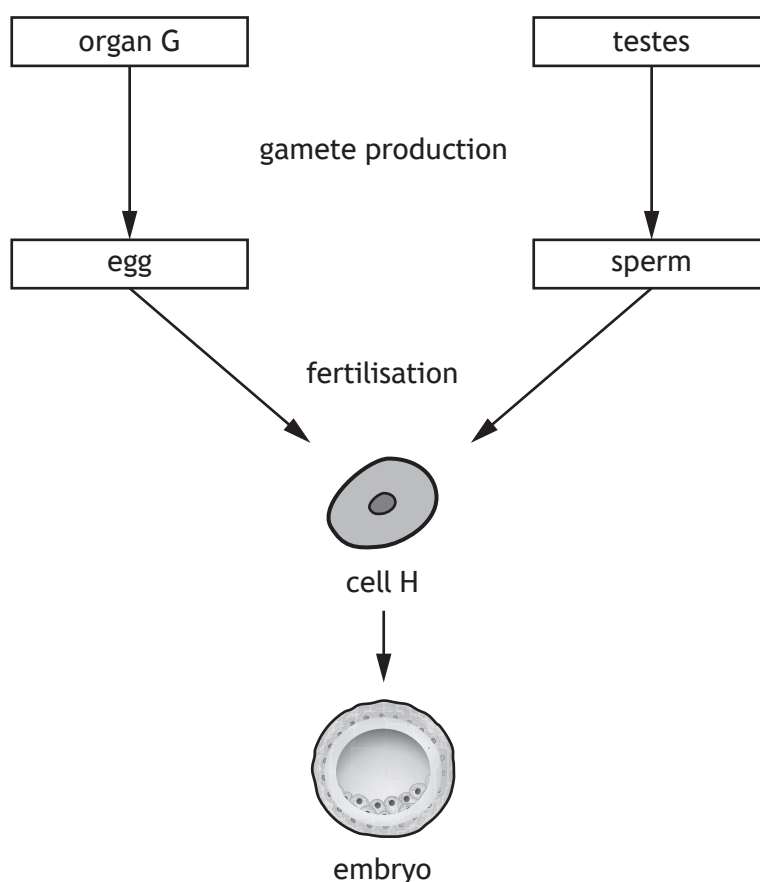
(b) Identify the effector in this reflex arc.

1

(c) State the function of a reflex.

1

7. The diagram relates to reproduction in humans.



(a) (i) Name organ G. 1

(ii) Describe what happens during fertilisation. 1

(iii) Name cell H. 1

(b) Name the unspecialised cells that can be obtained from an embryo at a very early stage. 1



8. Progressive retinal atrophy (PRA) is a rare condition in some dogs, such as cockapoos, that can result in blindness.



PRA is caused by the inheritance of the recessive form of a particular gene, which is represented by r .

Depending on their genotype, a dog's phenotype can be described as **affected**, **unaffected** or a **carrier**.

A cockapoo breeder tested the DNA of a female dog and three male dogs before choosing which pair to breed. The results are shown in the table.

Dog	Genotype	Phenotype
Female	Rr	carrier
Male 1	Rr	carrier
Male 2	rr	
Male 3	RR	

- (a) (i) **Complete the table** by adding the phenotype for male 2 and male 3. 1
- (ii) State the term used to describe the genotype of a carrier of PRA. 1

- (iii) The breeder selected a male based on their DNA results for this condition.

The offspring were as follows:

4 unaffected and 4 carriers

Which male was chosen to breed with the female? 1

Male _____



8. (continued)

- (b) Another breeder did not carry out DNA tests before breeding a pair of cockapoos. All their offspring were affected by PRA.

Give the genotypes of the parents in this cross.

1

Male genotype _____ × Female genotype _____

- (c) Give the term used to describe different forms of a gene.

1

[Turn over



9. Coronavirus is a pathogen, which causes COVID-19. Most people with COVID-19 feel better within a few days or weeks of their first symptoms. Long COVID can be diagnosed when symptoms last longer.

Symptoms of long COVID include extreme breathlessness, memory and concentration issues. In some cases, other organs can also be affected causing other health issues.

A study monitored changes in the health of 500 patients with long COVID.

Between the start and the end of the study, the percentage of patients with extreme breathlessness decreased from 38% to 30%, those with memory and concentration issues decreased from 48% to 38%, and those with other health issues decreased from 57% to 45%.

At the end of the study, 10% had no organs affected, 65% of patients had only one organ affected and 25% had multiple organs affected.

- (a) Name the type of white blood cell that produces antibodies against coronavirus.

1

- (b) Using information from the passage, complete the table by adding:

(i) a column heading

1

(ii) the relevant data.

1

(An additional table, if required, can be found on *page 27*.)

	Percentage of patients (%)	
	Start of study	End of study
Extreme breathlessness		
Memory and concentration issues		
Other health issues		



9. (continued)

- (c) Calculate the simple whole number ratio of the percentage of long COVID patients who had multiple organs affected, to those with one organ affected, to those with no organs affected.

1

Space for calculation

_____	:	_____	:	_____
multiple organs affected		one organ affected		no organs affected

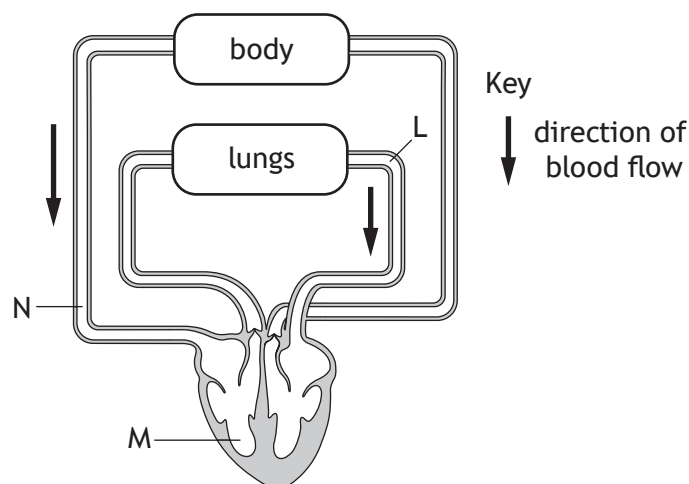
- (d) Suggest a reason why the study could be considered invalid.

1

[Turn over



10. (a) The diagram represents part of the circulatory system in humans.



(i) Name the heart chamber labelled M.

1

(ii) Compare the carbon dioxide concentrations in the blood travelling through blood vessels L and N.

1

(b) The heart is composed of muscle tissue that requires its own blood supply.

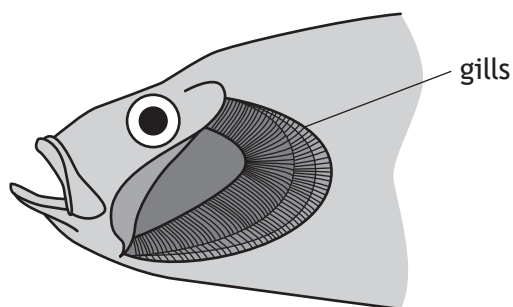
(i) Name the blood vessel that supplies the heart tissue with blood.

1

(ii) Explain why the heart muscle cells will stop contracting if this blood vessel becomes blocked.

2

11. The gas exchange surfaces in fish are called gills. Gills absorb oxygen from water.



- (a) Suggest two features of gills that increase the efficiency of absorption.

2

1 _____

2 _____

- (b) An investigation into the effect of water temperature on the breathing rate of fish was carried out. The results are shown in the table.


Water temperature (°C)	Average breathing rate (breaths/min)
4	4
10	26
14	56
20	79
26	100

Use these results to draw a conclusion for this investigation.

1

[Turn over

12. Students investigated the distribution of some organisms on a rocky shore.
Starting at the lowest tide level, quadrats were placed every two metres along a single transect line and the number of barnacles and mussels were counted.
The results are shown in the table.

Position on shore	Quadrat number	Number of barnacles	Number of mussels
Low tide level  High tide level	1	7	60
	2	13	58
	3	18	55
	4	15	50
	5	24	32
	6	41	30
	7	42	18
	8	47	13
	9	53	4
	10	54	0

- (a) (i) Calculate the average number of mussels per quadrat.
Space for calculation

1

_____ mussels

- (ii) Describe how the reliability of the results could be improved.

1



12. (continued)

- (b) Another group of students conducted a study of 10 rock pools found along the transect.

- (i) To provide information about the levels of water pollution, samples of water were taken from these rock pools and examined for the presence or absence of certain species.

What name is given to these species?

1

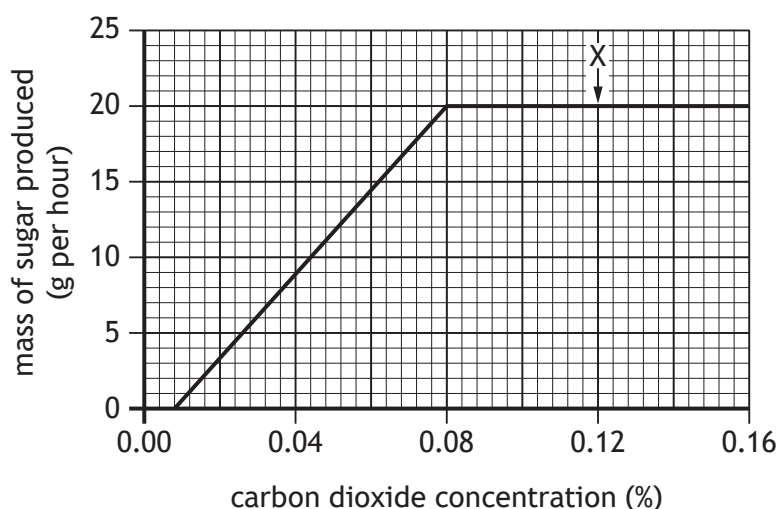
- (ii) Name the type of factors, such as pH, that can affect the distribution of organisms living in rock pools.

1

[Turn over



13. An experiment was carried out to investigate the effect of carbon dioxide concentration on the rate of photosynthesis. The rate of photosynthesis was measured by recording the mass of sugar produced per hour.



- (a) (i) Describe the relationship shown between carbon dioxide concentration and the mass of sugar produced.

2

- (ii) Suggest one factor that could be limiting the rate of photosynthesis at point X in the graph.

1

- (b) (i) Hydrogen is a product of the light reactions and is required for carbon fixation.

Describe how this hydrogen is produced.

1

- (ii) The sugar produced during the carbon fixation stage can be converted into other substances, such as starch.

Name one other substance sugar can be converted into and state its role in the cell.

2

Substance _____

Role _____



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

14. The following represents a food chain from a Scottish river.

pond weed → tadpole → water beetle → pike

Describe the role of pond weed in this food chain and explain what happens to the energy at each level in this food chain.

4

[Turn over



15. (a) The increasing human population requires an increase in food production.
Name a chemical in fertilisers that helps to increase food yield.

1

- (b) Food crops are often affected by insects and disease.

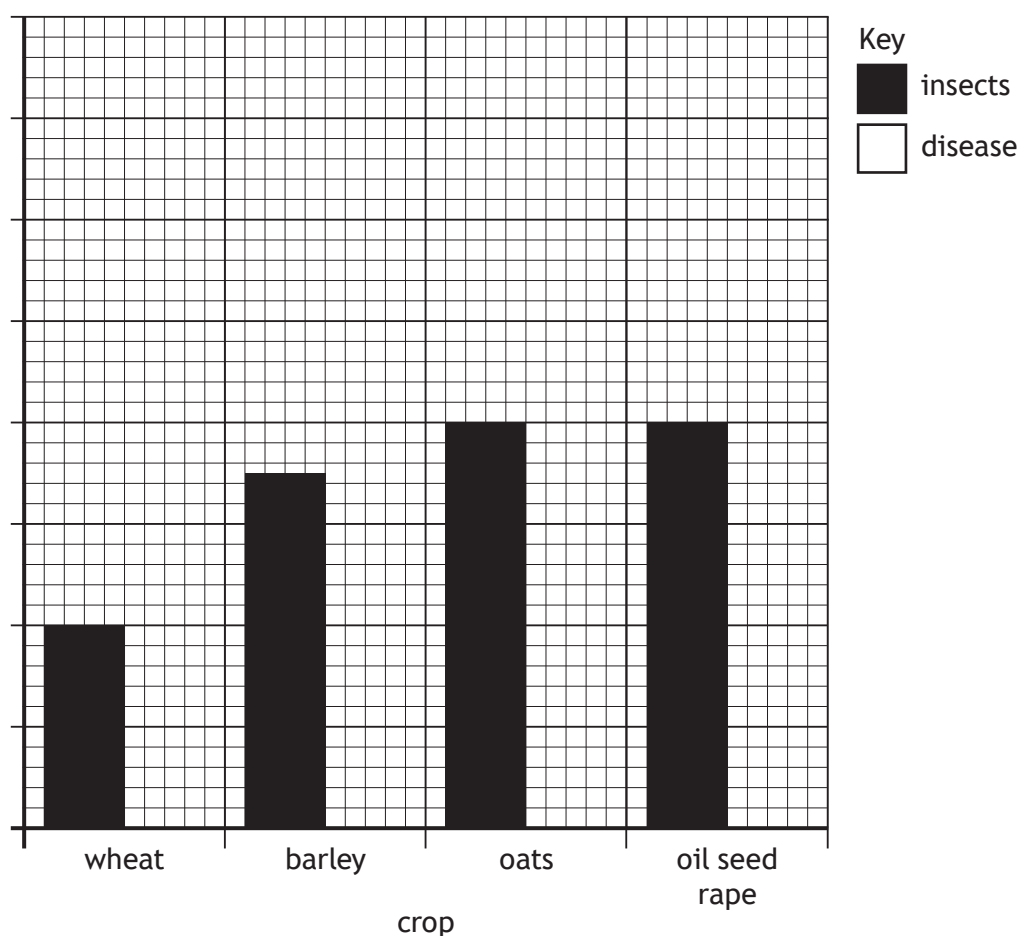
The table shows the average annual losses in yield caused by insects and disease in the production of four crops in Scotland.

Crop	Average loss in yield (%)	
	Insects	Disease
Wheat	4	7
Barley	7	6
Oats	8	14
Oil seed rape	8	12

- (i) On the grid complete the vertical axis by adding a label and scale and plot the remaining bars to show the average losses in yield caused by disease.

2

(An additional grid, if required, can be found on *page 27*.)



* X 8 0 7 7 5 0 1 2 4 *

15. (b) (continued)

- (ii) Identify the crop with the lowest combined percentage loss from these two causes.

1

- (iii) Explain why it would be incorrect to conclude that the yield for each crop plant is affected more by disease than insects.

1

- (iv) The total crop of oil seed rape harvested was 140 000 tonnes.
Calculate the yield of oil seed rape that would have been produced if insects and disease had **not** affected the plants.

1

Space for calculation

_____ tonnes

- (c) Over time pesticides can build up in the cells of living organisms.
State the term given to this build-up of pesticides.

1

- (d) Sometimes a predator of the pest species is used as an alternative to pesticides.

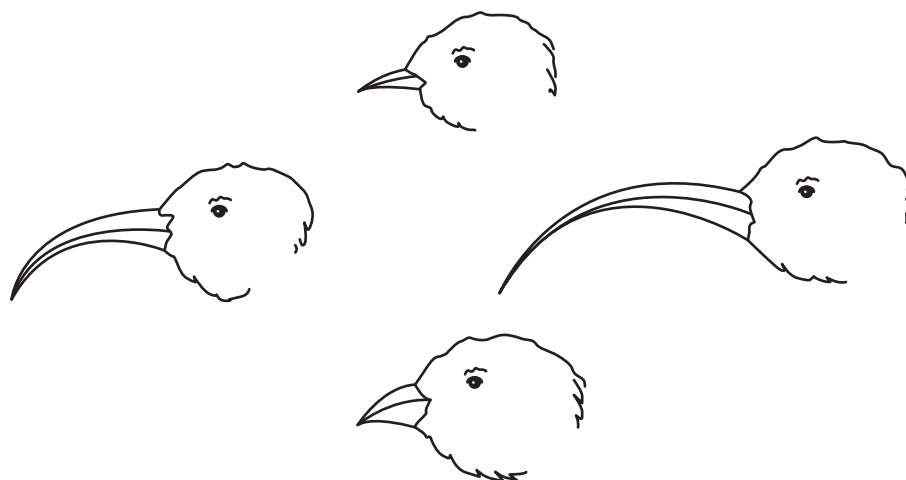
Name this method of reducing pest species.

1

[Turn over



16. Hawaiian honeycreepers are species of birds that have evolved from a single ancestor to have different shapes of beak. This is an example of speciation.



- (a) For speciation to occur, a population must be split by an isolation barrier.
Name one type of isolation barrier. 1
- _____
- (b) Different mutations occurred in each sub-population of honeycreepers after a population was split.
- (i) Name the molecule within a cell in which mutations would occur. 1
- _____
- (ii) Name one environmental factor which increases the rate of mutation. 1
- _____
- (c) Suggest the selection pressure that could have led to the differences in the honeycreepers shown in the diagram. 1
- _____
- (d) Explain what is meant by the term species. 1
- _____
- _____

[END OF QUESTION PAPER]

