



National  
Qualifications  
2018

**X807/75/02**

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

TUESDAY, 15 MAY

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**INSTRUCTIONS TO CANDIDATES**

Candidates should enter their surname, forename(s), date of birth, Scottish candidate number and the name and Level of the subject at the top of their first answer sheet.

Instructions for the completion of Section 1 are given below.

**Section 1 — 20 marks**

Attempt ALL questions.

See *page 02* of your question booklet X807/75/01.

Questions marked with an asterisk differ in some respects from those in the printed paper.

An OW in the margin indicates a new question.

## SECTION 1

- \* 1. Refer to the diagram for Question 1. The diagram shows a section of the cell membrane magnified.

Molecule X is

- A phospholipid
  - B protein
  - C cellulose
  - D starch.
- \* 2. An experiment was set up in which a model cell was placed in a sucrose solution. The model cell was made from a section of visking tubing knotted at each end and filled with 15% sucrose solution. The model cell was placed in a boiling tube filled with 5% 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

\* 6. Refer to the flowchart for Question 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. An experiment was set up to find the energy content of different foods. A sample of each food was placed in a long-handled spoon and positioned under a test tube filled with a fixed volume of water. A thermometer was placed in the water in the test tube. 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 described below was set up to investigate the rate of respiration in yeast at 20 °C.
- A boiling tube was three-quarters filled with a yeast and 5% glucose solution.
  - A thin layer of oil covered the surface of this solution.
  - The boiling tube was sealed with a stopper.
  - One end of an inverted U-shaped tube was inserted through a hole in the stopper into the boiling tube.
  - The other end of the U-shaped tube went into a beaker of indicator solution.
  - Gas from the boiling tube passed through the U-shaped tube and bubbled out through the indicator solution.

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 cm<sup>3</sup>.
- \* 9. Three neurons are involved in a reflex arc.

Neuron P links to Neuron R in the spinal cord and has a nerve ending in the body.  
 Neuron Q links to Neuron R in the spinal cord and to a muscle in the body.  
 Neuron R is found in the spinal cord and links Neuron P and Neuron Q.

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. Refer to the diagram for Question 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.

Refer to the flow diagram for Questions 11 and 12. Questions 11 and 12 refer to the 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.
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. Refer to the diagrams for Question 16. The diagrams show four different components of blood. The following key can be used to identify the different components of blood. Use the key below to identify which of the diagrams represents a platelet.

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

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.

\*19. Refer to the diagram for Question 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. Six test tubes were set up in an investigation into seed germination. Each test tube contained an equal layer of cotton wool. The cotton wool was either dry or wet. 10 or 20 seeds were added to the test tubes. The test tubes were then sealed with stoppers. The test tubes were then placed at either 5 °C or 20 °C.

The table below shows how the different test tubes were set up.

<i>Test tube</i>	<i>Number of seeds</i>	<i>Cotton wool (wet/dry)</i>	<i>Temperature (°C)</i>
1	10	Dry	5
2	10	Wet	20
3	20	Dry	5
4	20	Dry	20
5	10	Wet	5
6	20	Wet	20

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

\*21. Refer to the diagram for Question 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

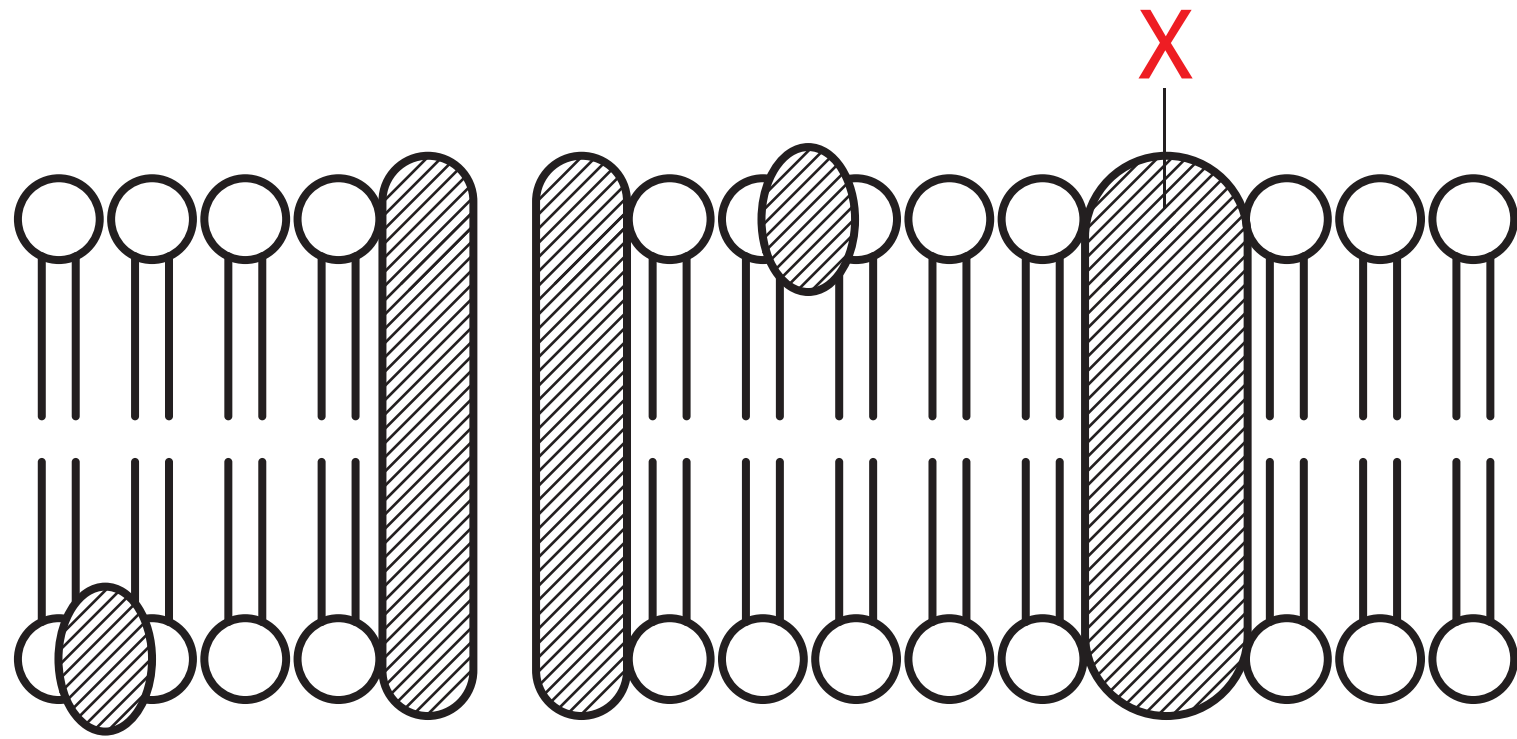


25. Which row in the table identifies biotic and abiotic factors which can affect a population?

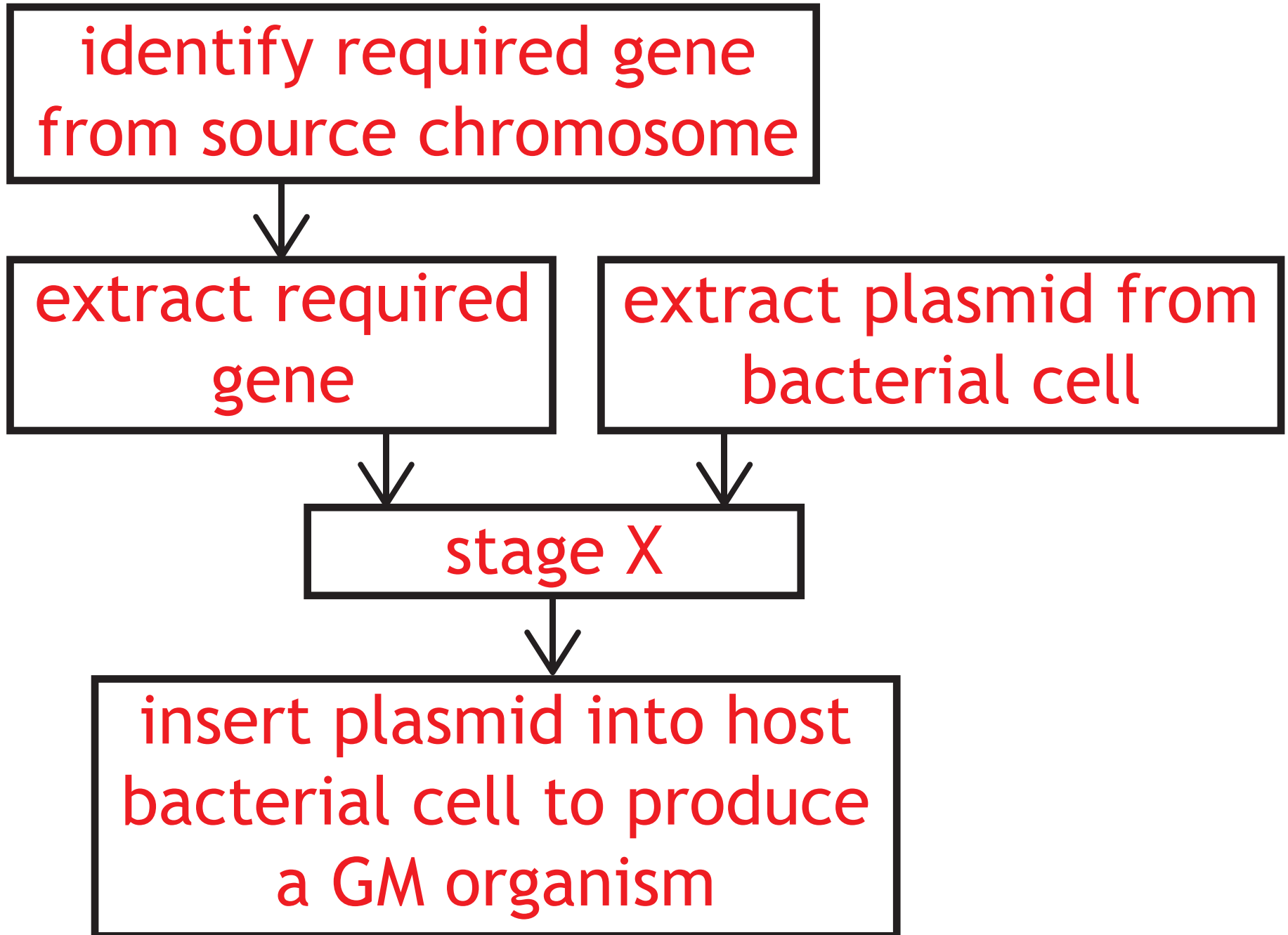
	<i>Biotic factors</i>	<i>Abiotic factors</i>
A	grazing and predation	pH and temperature
B	predation and temperature	pH and grazing
C	pH and temperature	grazing and predation
D	pH and grazing	predation and temperature

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

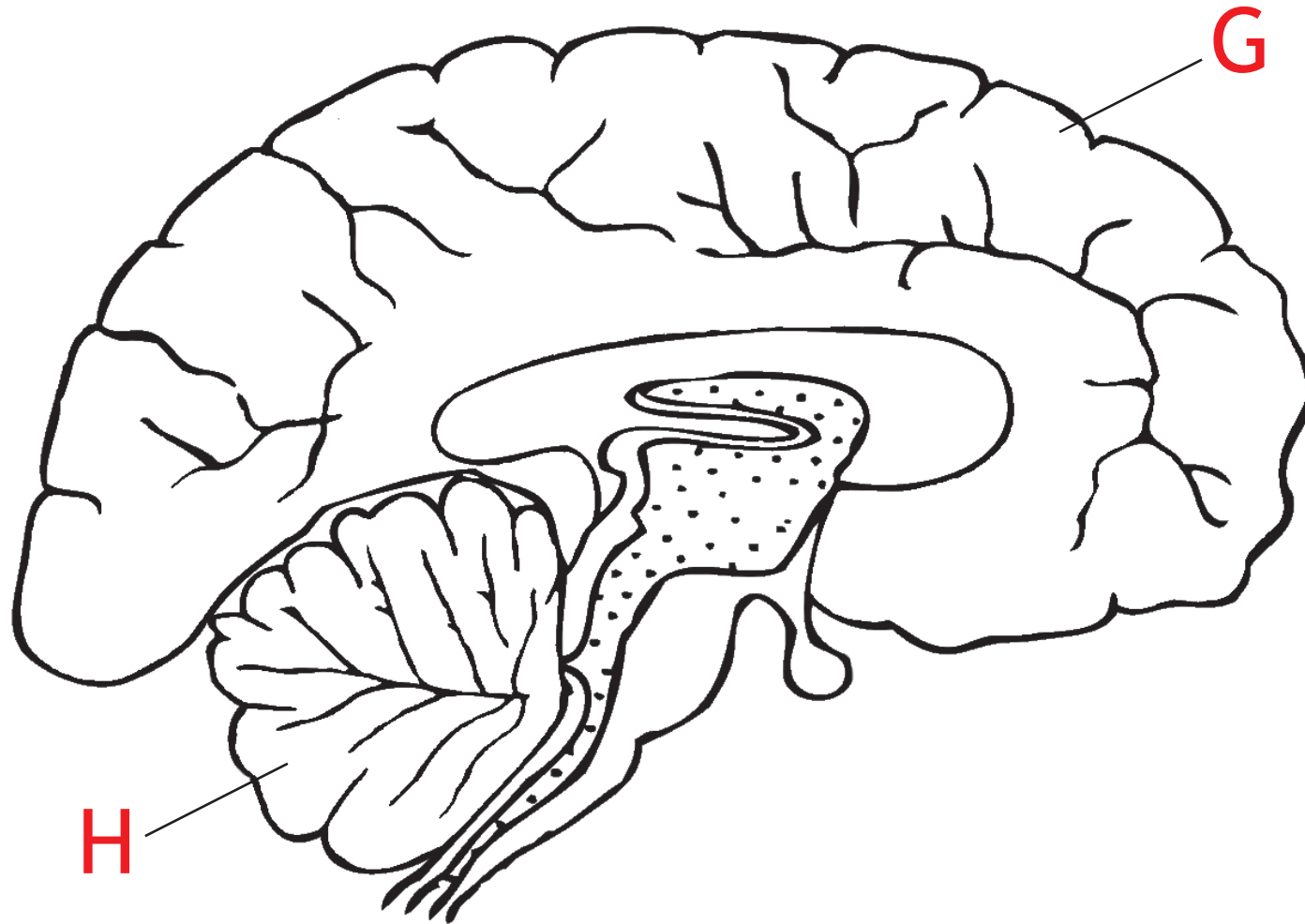
Q1

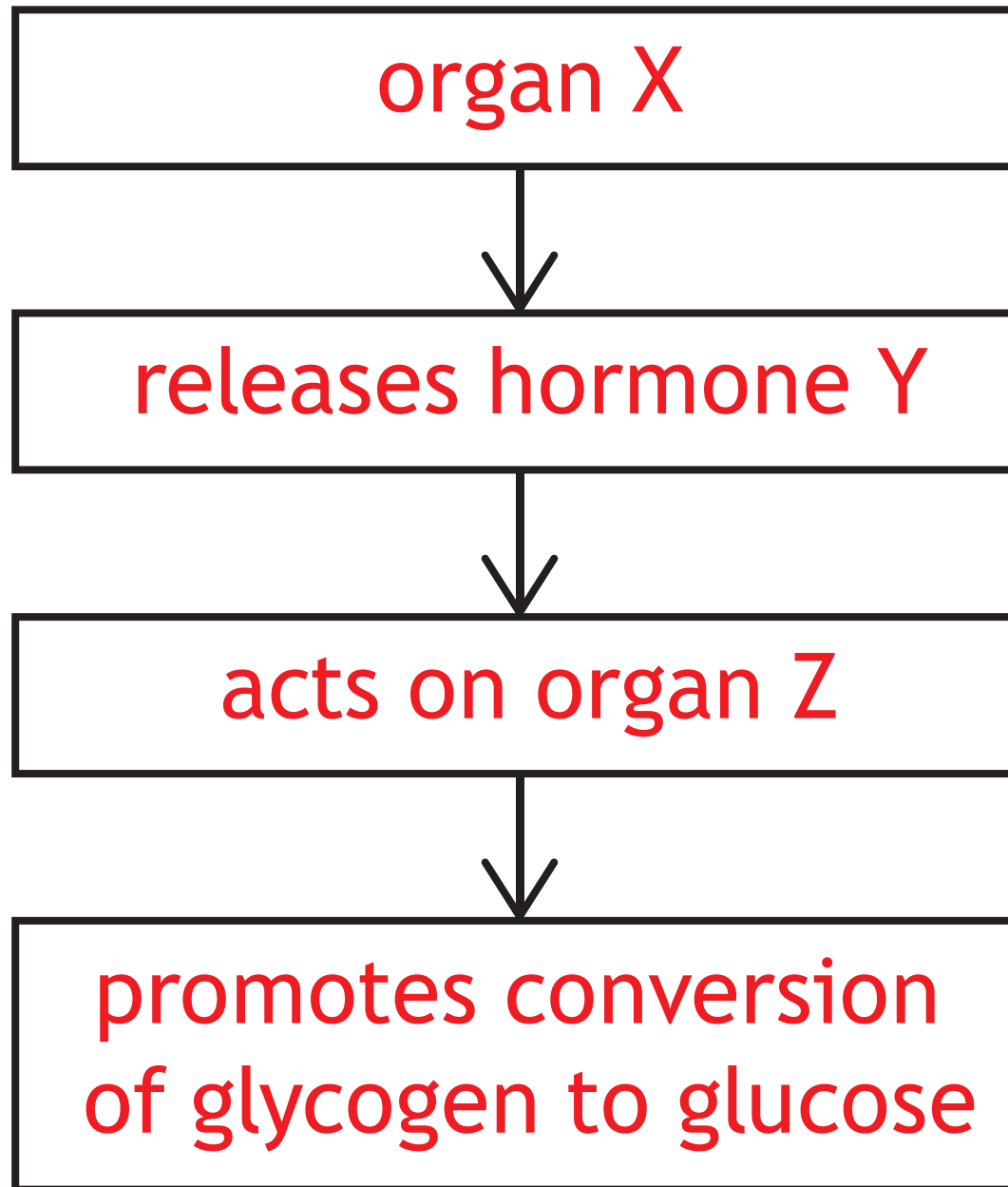


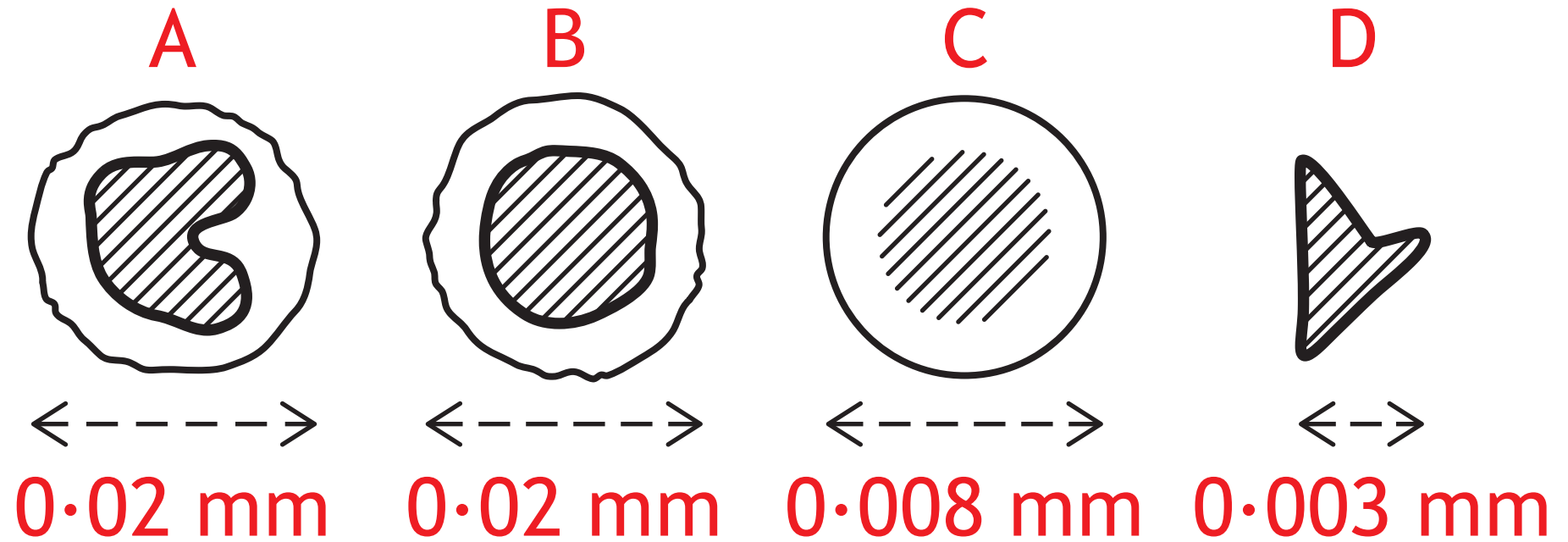
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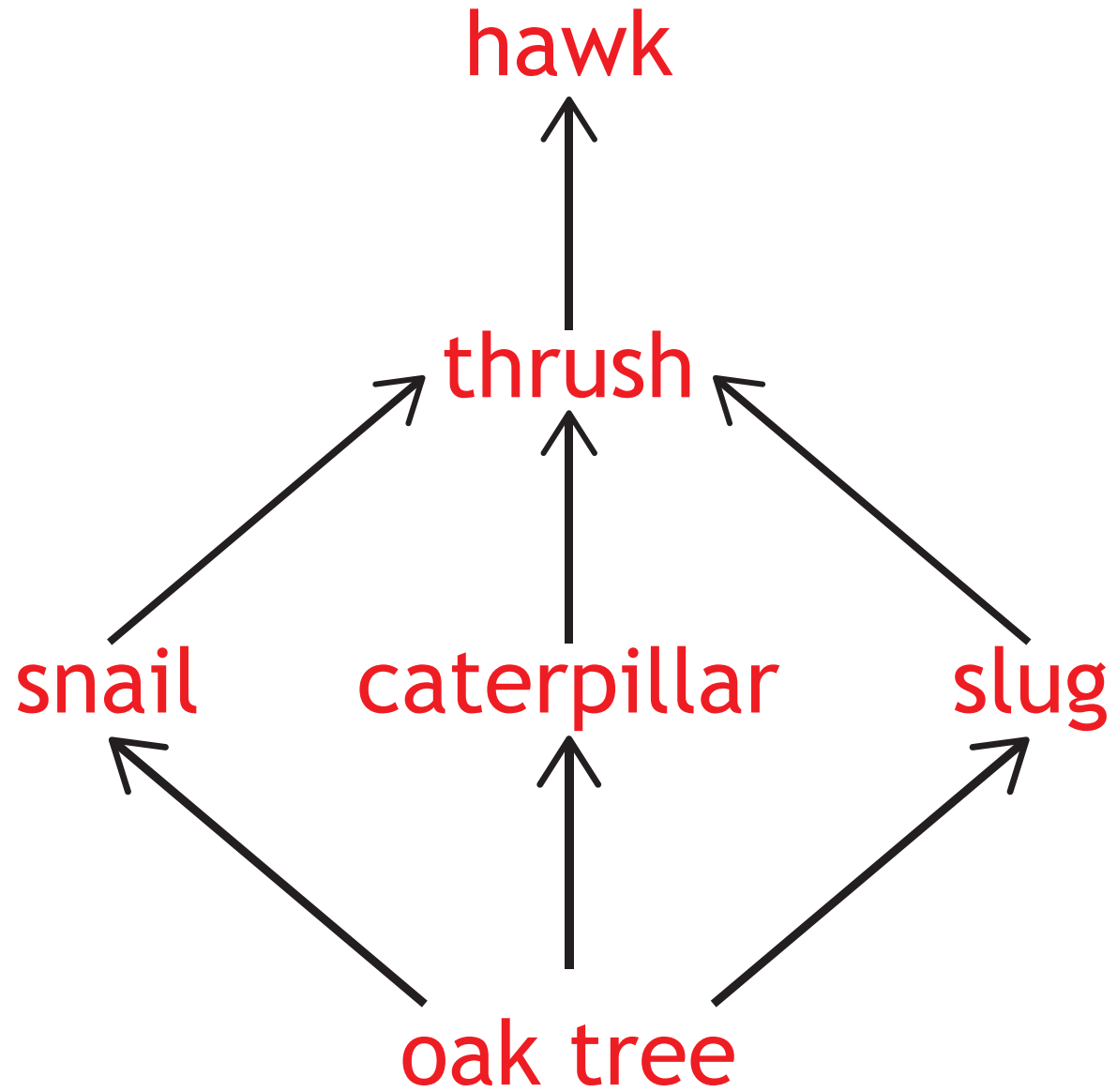


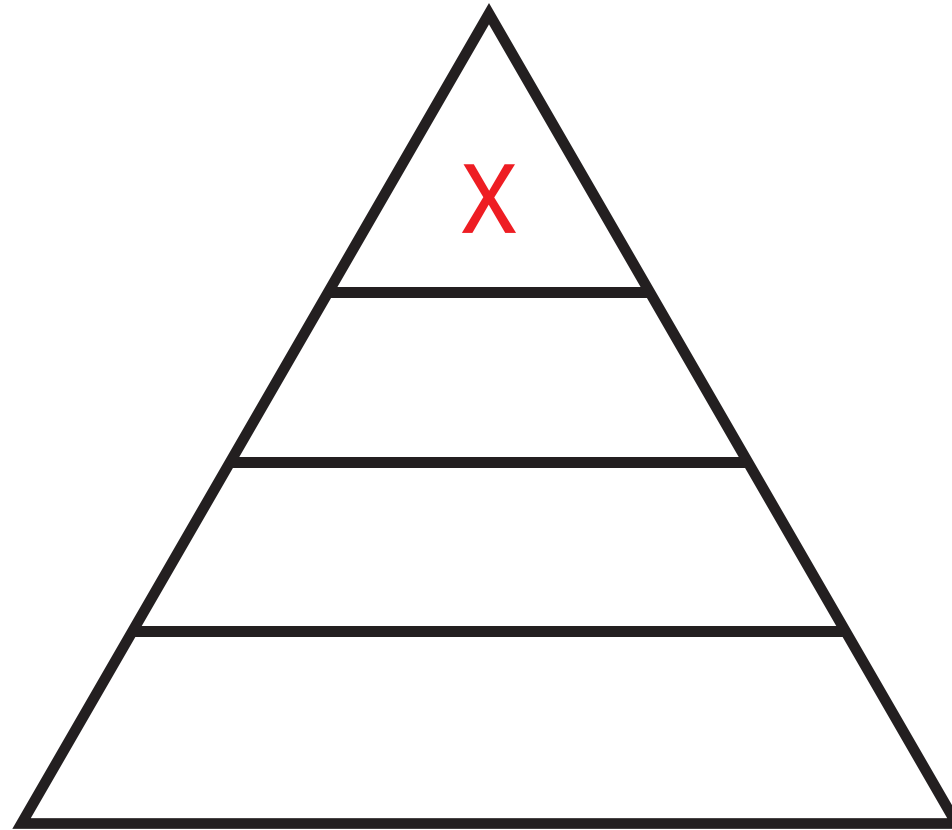
Q10















National  
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**X807/75/01**

**Biology**  
**Section 2 — Questions**

TUESDAY, 15 MAY

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**INSTRUCTIONS TO CANDIDATES**

Candidates should enter their surname, forename(s), date of birth, Scottish candidate number and the name and Level of the subject at the top of their first answer sheet.

**Total marks — 100**

**SECTION 2 — 75 marks**

Attempt ALL questions.

Write your answers clearly on your answer sheet. Clearly identify the question number you are attempting. Any rough work must be written in this booklet.

Marks are shown in square brackets at the end of each question or part question.

Questions marked with an asterisk differ in some respects from those in the printed paper.

An OW in the margin indicates a new question.

## SECTION 1 — 25 marks

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then write the letter at the end of each question.
2. There is **only one correct** answer to each question.

### Sample question

The thigh bone is called the

- A humerus
- B femur
- C tibia
- D fibula.

The correct answer is **B** — femur. You write: Question 7. B

### Changing an answer

If you decide to change your answer, cancel your first answer by brailleing it out and write the answer you want.

**SECTION 2 — 75 marks**

**Attempt ALL questions**

- \* 1. (a) Refer to the diagram for Question 1. The diagram shows a typical animal cell and some of its structures.  
Choose **two** of the structures labelled. State the name of the chosen structure and their functions. [2 marks]
- (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 mark]
- \* 2. Refer to the diagram for Question 2. A student examined plant and animal cells using a microscope. The animal and plant cells were placed in either pure water, 2% salt solution or 10% salt solution. After several minutes a sample of cells was taken from each solution and examined.
- (a) Changes in the cells were due to osmosis.  
Explain why osmosis is described as a passive process. [1 mark]
- \* (b) Refer to the diagram for Question 2 (b).
- (i) Identify the type of cell and state whether it had been placed in pure water, 2% salt solution or 10% salt solution. [1 mark]
- (ii) State the term used to describe the condition of this cell. [1 mark]
- (c) The animal cell burst when it was placed in pure water, but the plant cell did not. Explain why the results observed were different. [2 marks]
- \* 3. A DNA molecule is composed of two DNA strands.
- (a) (i) Give the term which describes the shape of a DNA molecule. [1 mark]
- (ii) Describe the way in which the DNA strands are linked together. [1 mark]
- (b) Name the organelle in animal cells which stores the DNA. [1 mark]

- \* 4. Refer to the diagrams for Question 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 for Question 4. [1 mark]
- (b) Describe the events occurring in the enzyme reaction shown. [3 marks]
- \* 5. (a) Four statements about respiration in animal cells are listed below.
1. Oxygen is required
  2. Pyruvate is formed
  3. Lactate is formed
  4. Carbon dioxide is formed
- (i) List the numbers for the statements that apply in aerobic respiration.
- (ii) List the numbers for the statements that apply in fermentation. [2 marks]
- (b) ATP is an energy-rich molecule formed by respiration. Name a cellular process which requires energy from ATP. [1 mark]
- \* 6. Refer to the diagram for Question 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 as shown in the diagram for Question 6.
- 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.
- Refer to the graph for Question 6. The results are shown in the graph.
- (a) (i) Identify the optimum pH for pepsin in this experiment. [1 mark]
- (ii) Calculate how many times more active the enzyme is at pH 2.5 than at pH 4.5. [1 mark]
- (b) State two variables which should be controlled to make this experiment valid. [2 marks]
- (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.
- List three pH values the students could use. [1 mark]

7. The process of mitosis begins with the chromosomes becoming visible.

Describe the sequence of events which follows on from this resulting in the production of two daughter cells. [4 marks]

\* 8. Some structures in the human reproductive systems of females and males are listed below.

Female reproductive system:

- Oviduct
- Ovary
- Uterus
- Vagina

Male reproductive system:

- Penis
- Sperm duct
- Testis

(a) From the lists, identify **one** site of gamete production. [1 mark]

(b) In the process of fertilisation, the nucleus of a sperm and of an egg fuse together to produce cell F.

(i) For each of the cells listed below, state whether they are haploid or diploid. [1 mark]

1. Sperm
2. Egg
3. Cell F

(ii) Name cell F which is produced when the sperm fertilises the egg. [1 mark]

**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 mark]

\*(b) The outline of a table is given below. The table has three columns and is designed to present the information from the passage, to give details of the two studies and the people involved.

Country ..... Heading 2 ..... Heading 3

.... ..... .....

.... ..... .....

(i) As shown in the table, the heading for column 1 is Country. State the headings for columns 2 and 3. [1 mark]

(ii) List the information from the passage to complete the rows in your table. [1 mark]

(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 mark]

\*(d) Decide whether this research would be described as reliable or not. State your choice from:

- Reliable
- Not reliable.

Give a reason for your choice. [1 mark]

(e) The researcher took 'other factors of influence' into consideration. Suggest one of these factors. [1 mark]

**\*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. Name your chosen blood vessel and select two statements from the list above which describe that type of blood vessel. [2 marks]

**\*10(b)** Refer to the graph for Question 10(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 marks]

(ii) Predict the volume of blood pumped by the left ventricle at 130 beats per minute. Give your answer in  $\text{dm}^3$  per minute. [1 mark]

**\*10(c)** Refer to the diagram for Question 10(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 mark]

(ii) Name the heart chamber labelled R. [1 mark]

**\*11.** (a) Refer to the diagram for Question 11. 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  $F_2$  generation. [1 mark]

(ii) Give the genotypes of individuals E and F. [2 marks]

**\*11(iii)** Refer to the Punnett square for Question 11 (a) (iii). Complete the Punnett square to show the gametes and expected genotypes of the offspring of E and F at the positions indicated. [2 marks]

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

**\*12.** A student examines a diagram showing a section through a leaf. Tissue W is a layer of tightly packed rectangular cells immediately below the upper epidermis of the leaf. Below tissue W, the cells are rounder; have large air spaces between them and the leaf vein runs through this layer of the leaf.

- (a) (i) Name tissue W. [1 mark]
- (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 mark]
- (b) The leaf vein consists of xylem and phloem tissues. Choose either xylem or phloem. Name your chosen tissue and describe one structural feature of that tissue. [1 mark]
- Feature of tissue.

**\*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.

The results are shown in the table.

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

- (a) (i) Calculate the number of seedlings surviving in Dish C. [1 mark]
- (ii) Describe the relationship between the number of seeds sown and the percentage of seedlings surviving after six days. [1 mark]
- (iii) Explain why the type of competition shown in this investigation is described as being intraspecific. [1 mark]
- \*(b)** Refer to the diagram for Question 13 (b). The diagram represents positions of organisms in a food chain. State the letter of the box to show the position cress would occupy in the food chain. [1 mark]
- (c) Name one resource, other than water, for which plants may be in competition. [1 mark]



**\*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 mark]

**\*(ii)** Refer to the graph for Question 14. 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 mark]

2 The students concluded that males were always more abundant than females. Identify the animal for which this is **not** true. [1 mark]

(iii) It was decided that the samples were not fully representative of the area. Suggest how the investigation could be improved. [1 mark]

(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.

<i>Sample site</i>	<i>Soil moisture (units)</i>	<i>Number of plants</i>		
		<i>Number of Species E</i>	<i>Number of Species F</i>	<i>Number of Species G</i>
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 mark]

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

- \*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.

<i>Temperature (°C)</i>	<i>Volume of oxygen released in one hour in experiment 1 (cm<sup>3</sup>)</i>	<i>Volume of oxygen released in one hour in experiment 2 (cm<sup>3</sup>)</i>	<i>Average volume of oxygen released in one hour (cm<sup>3</sup>)</i>
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) Refer to the graph for Question 15 (a). The line graph shows the effect of temperature on the average volume of oxygen released in one hour.
- (i) What label should be placed on the x-axis of the graph? [1 mark]
  - (ii) The student plotted the results for 40 °C incorrectly. What value did they plot? [1 mark]
- (b) Predict the average volume of oxygen released in one hour if the experiment was carried out at a temperature of 60 °C. Give your answer in cm<sup>3</sup>. [1 mark]
- (c) State one factor, other than temperature, which can limit the rate of photosynthesis. [1 mark]
- \* (d) Refer to the diagram for Question 15 (d). The diagram represents the second stage of photosynthesis.
- Name substances X and Y. [2 marks]

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 mark]
- (ii) Describe the use that plants make of nitrates. [1 mark]
- (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 mark]

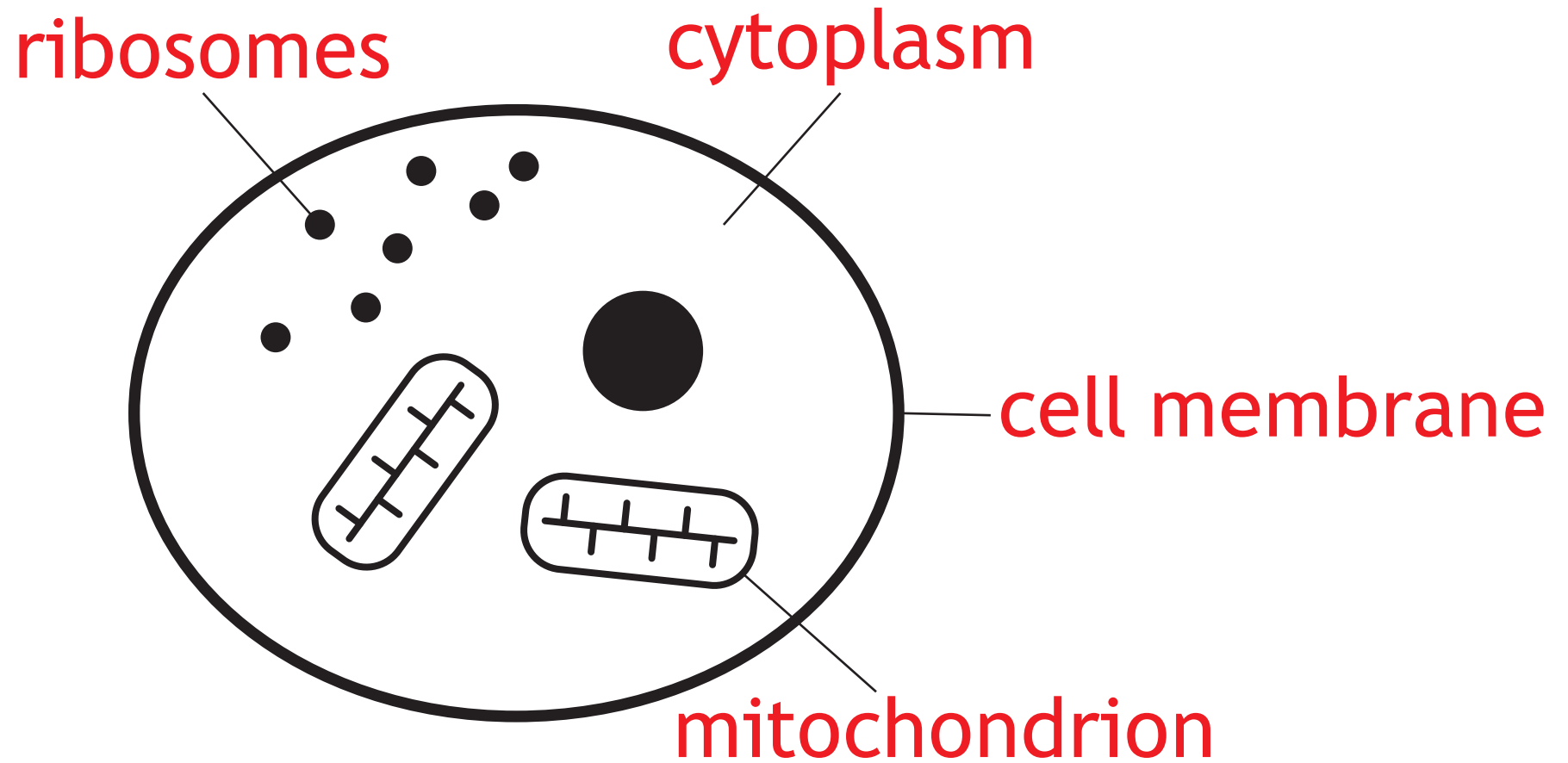
\* (b) Later in the year the gardener noticed that the algae in his pond had increased and now covered the surface of the water. He sampled the pond water over 5 weeks and measured its oxygen concentration and number of bacteria present.

Refer to the graph for Question 16 (b). The results are shown in the graph.

- (i) What name is given to the increased growth of algae in the pond? [1 mark]
- (ii) Explain why the increased growth of algae resulted in an increase in the number of bacteria. [1 mark]
- (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 mark]

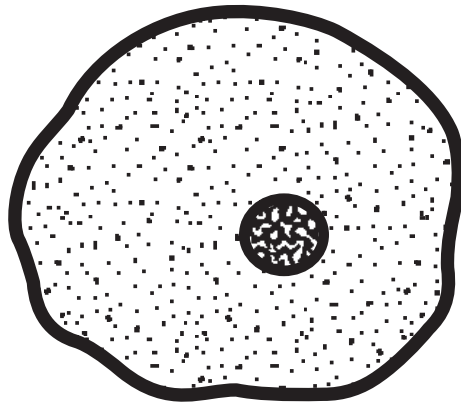
[END OF QUESTION PAPER]

Q1a

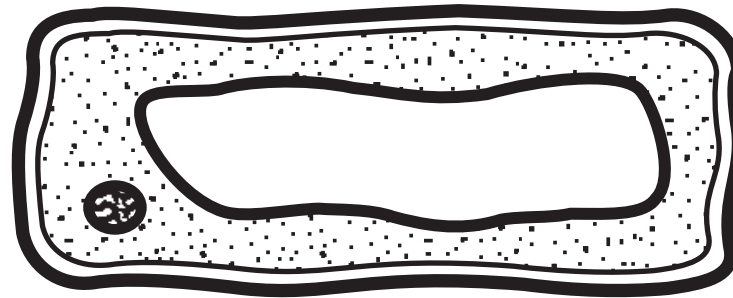


Q2(i)

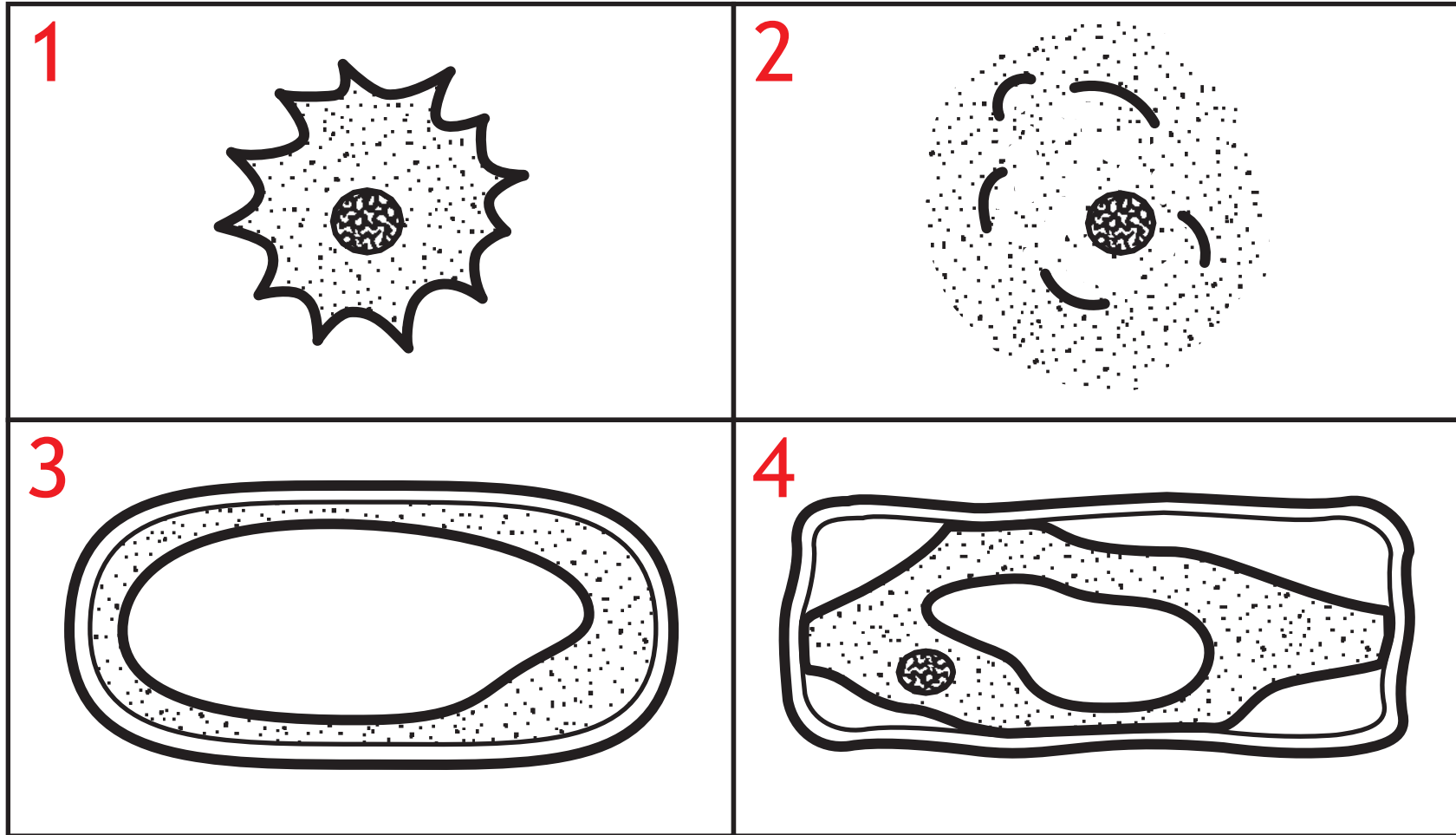
Animal cell



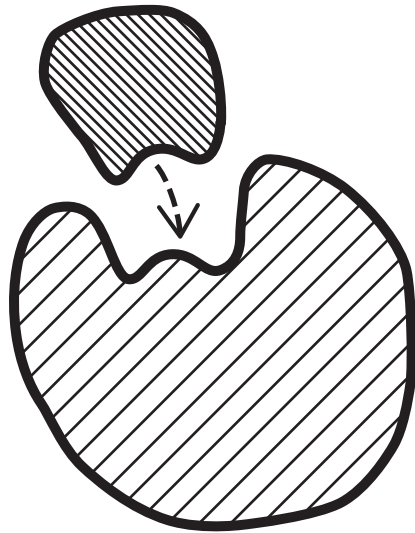
Plant cell



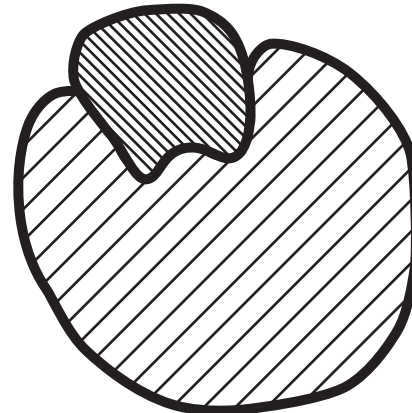
Q2(ii)



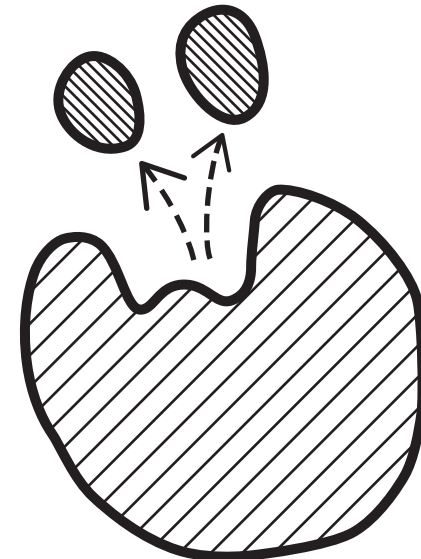
Q4



Stage 1

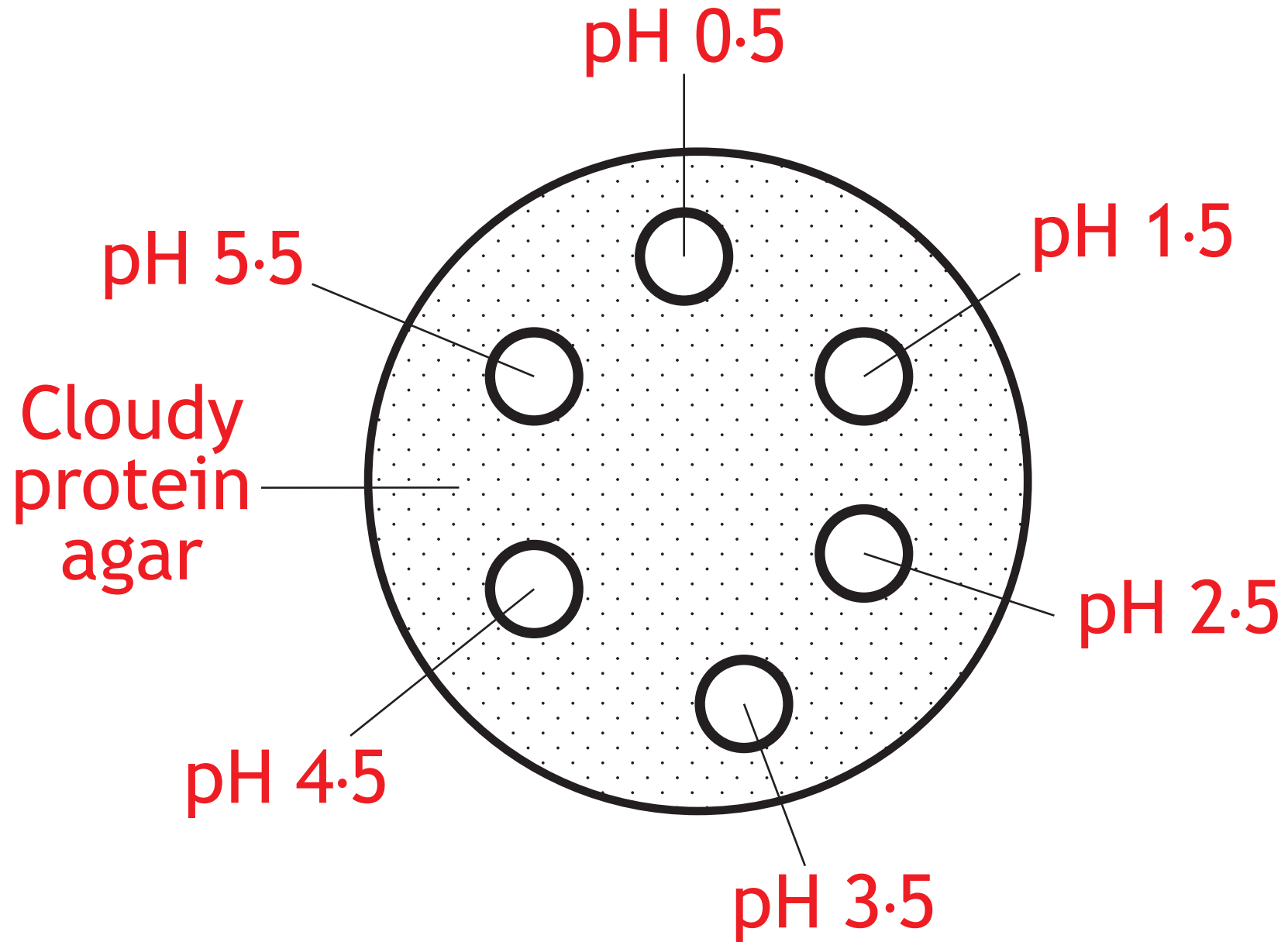


Stage 2



Stage 3

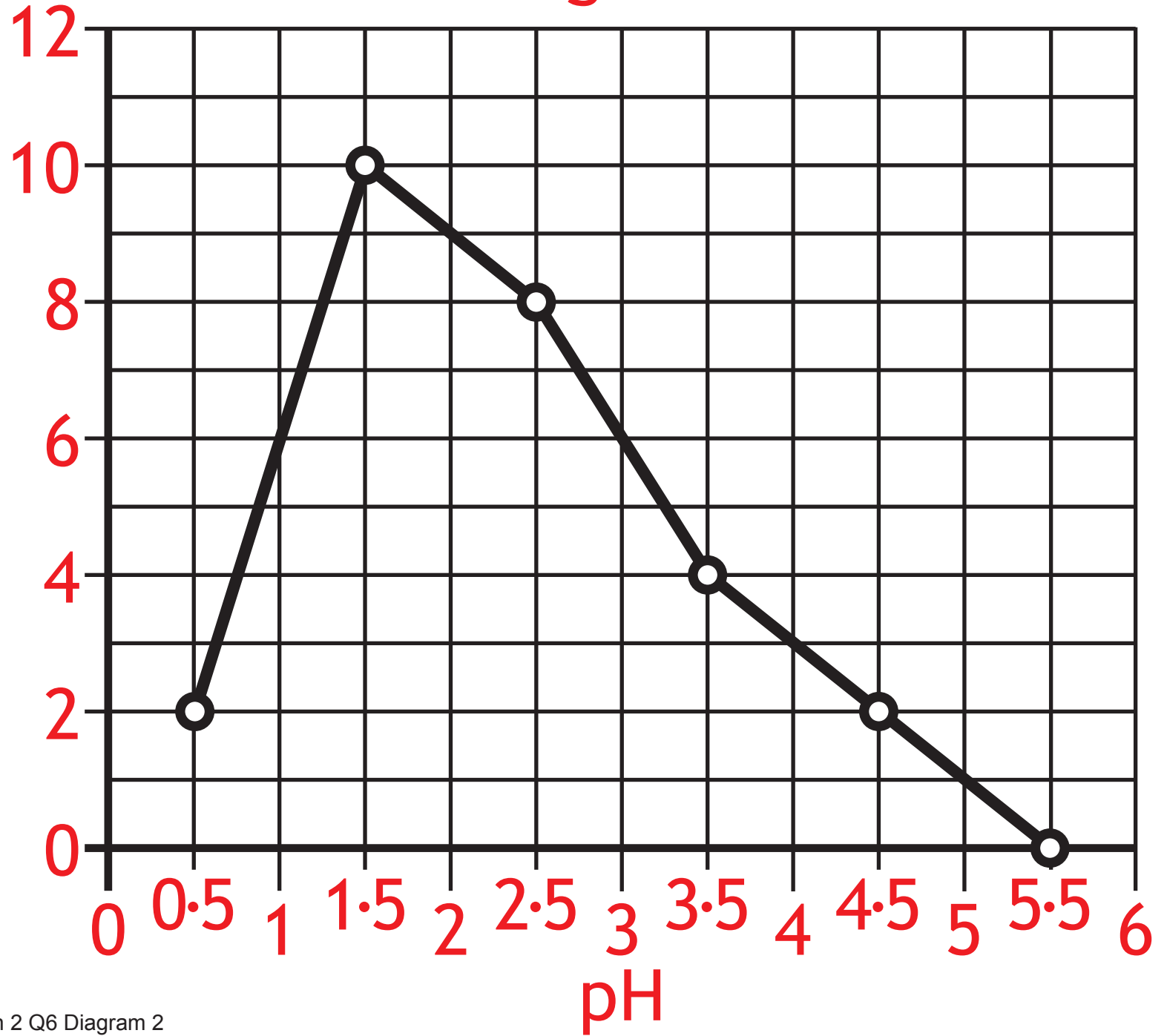
# Diagram 1





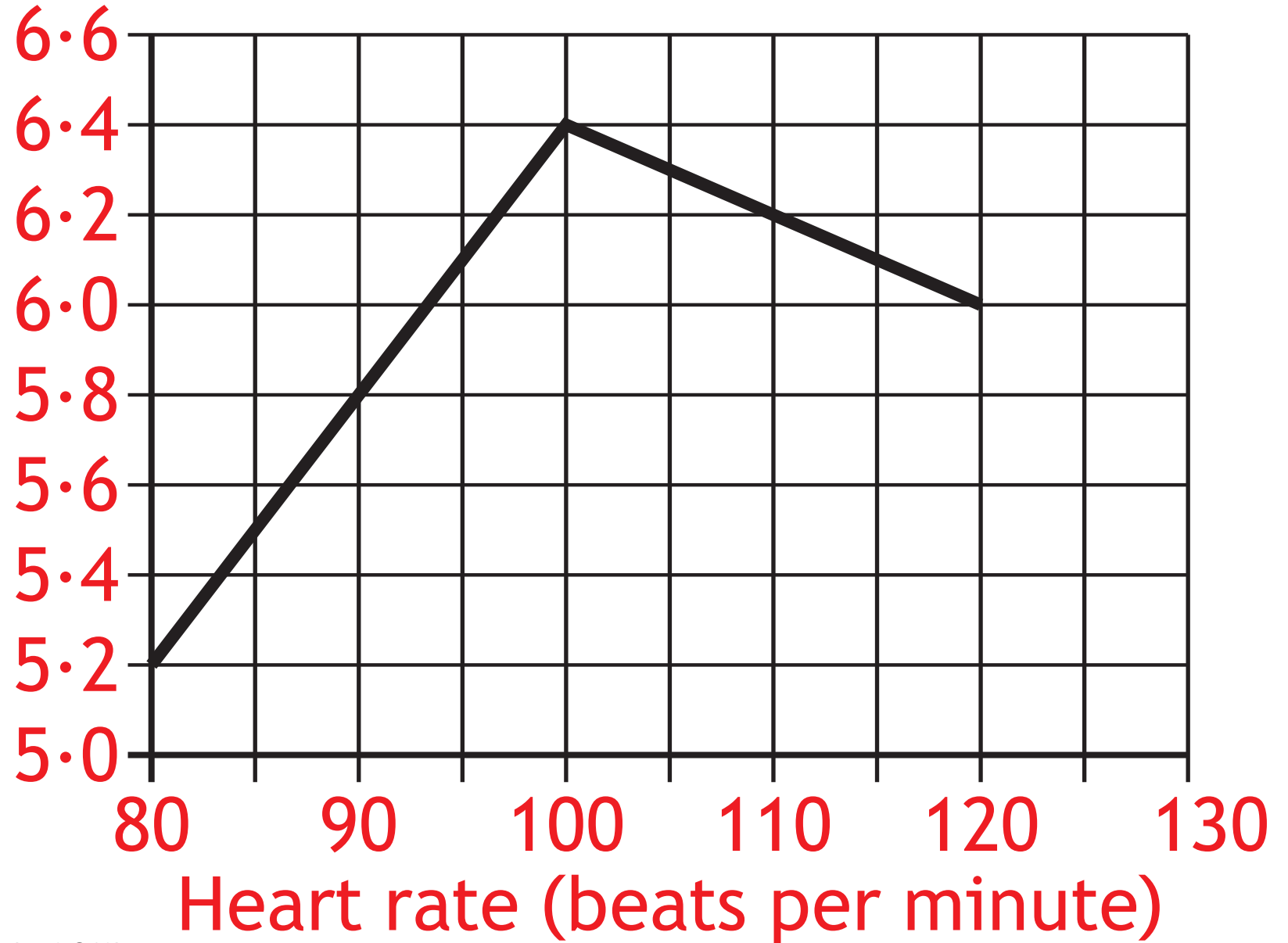
# Diagram 2

Diameter  
of clear  
area (mm)

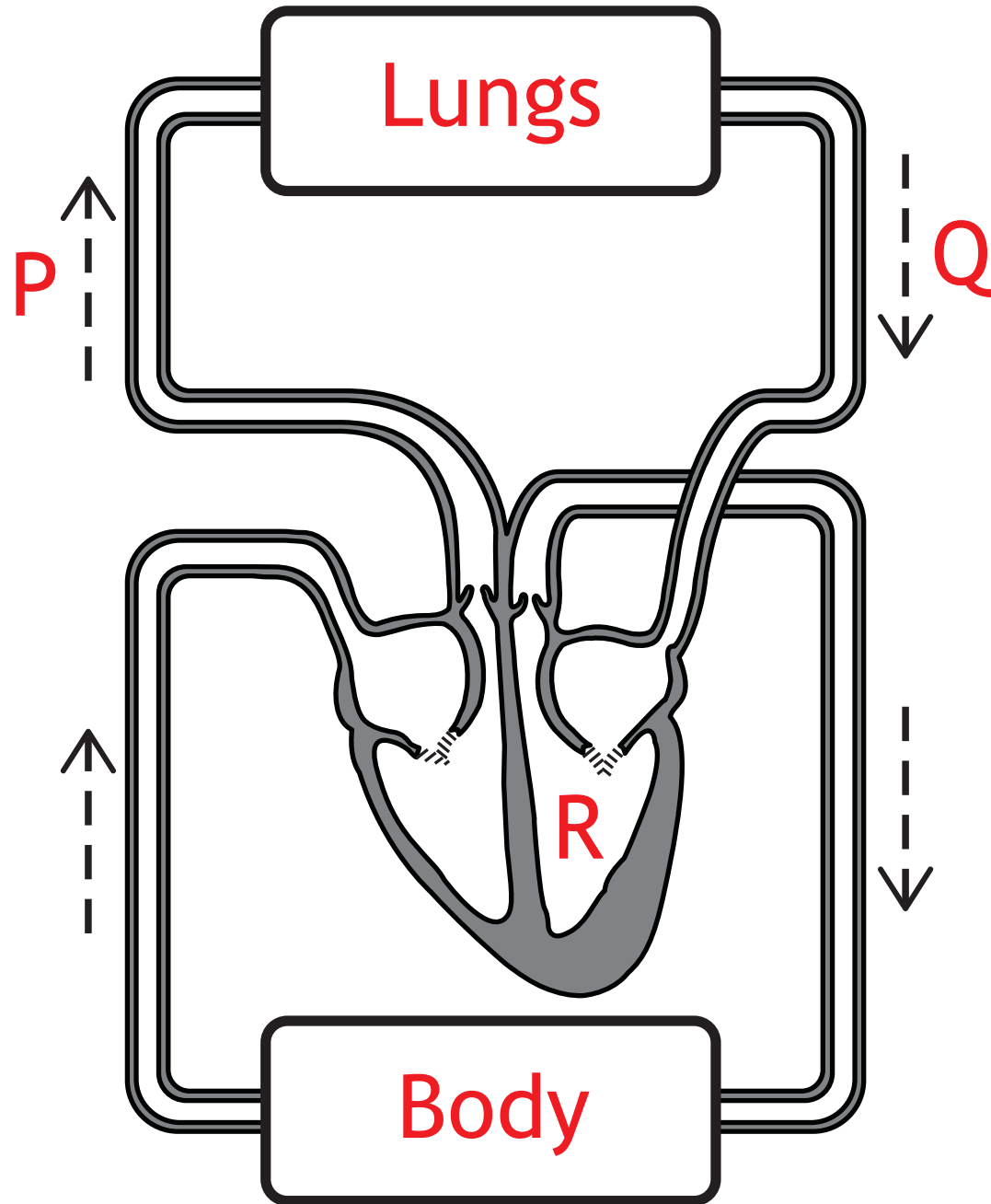


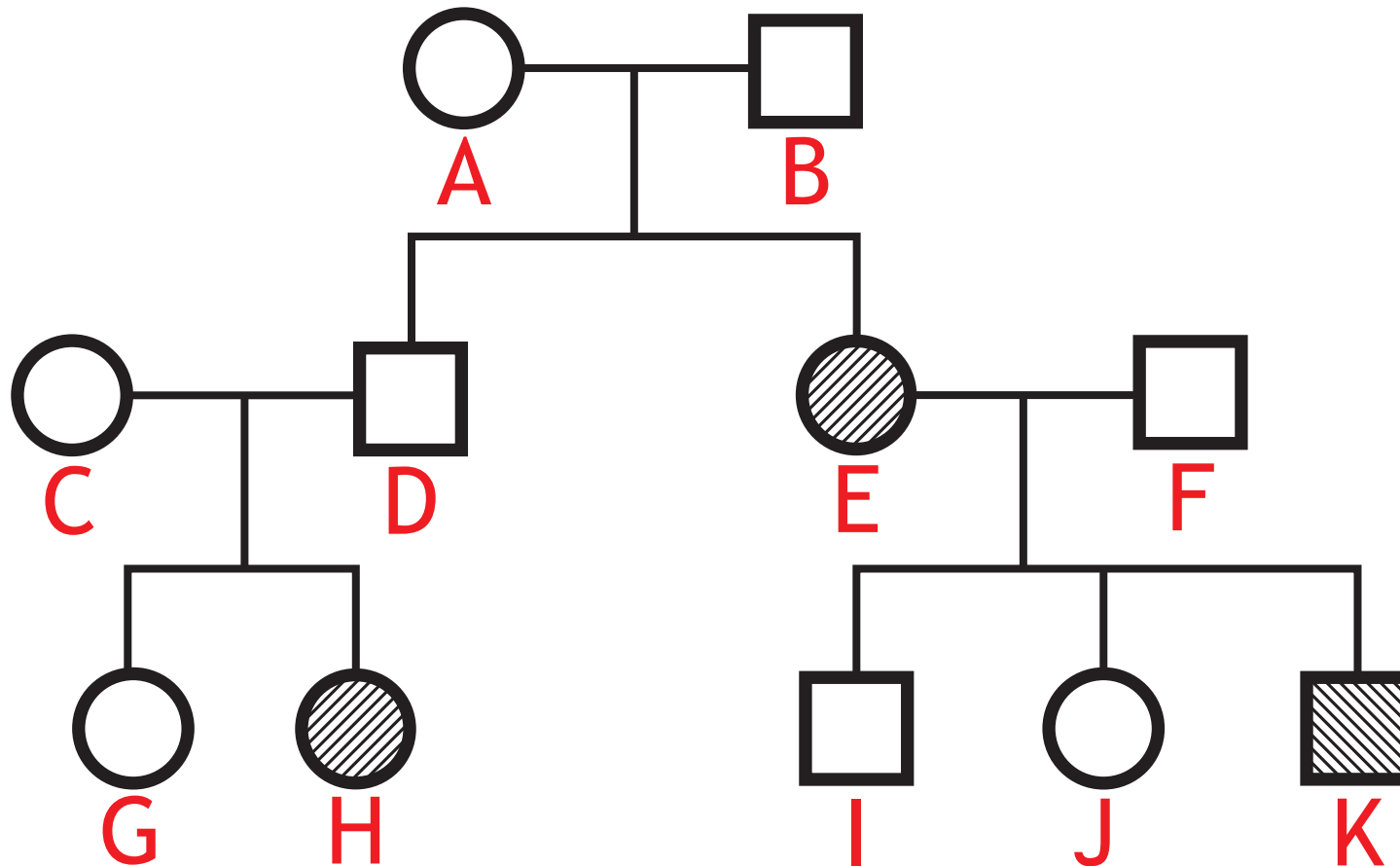
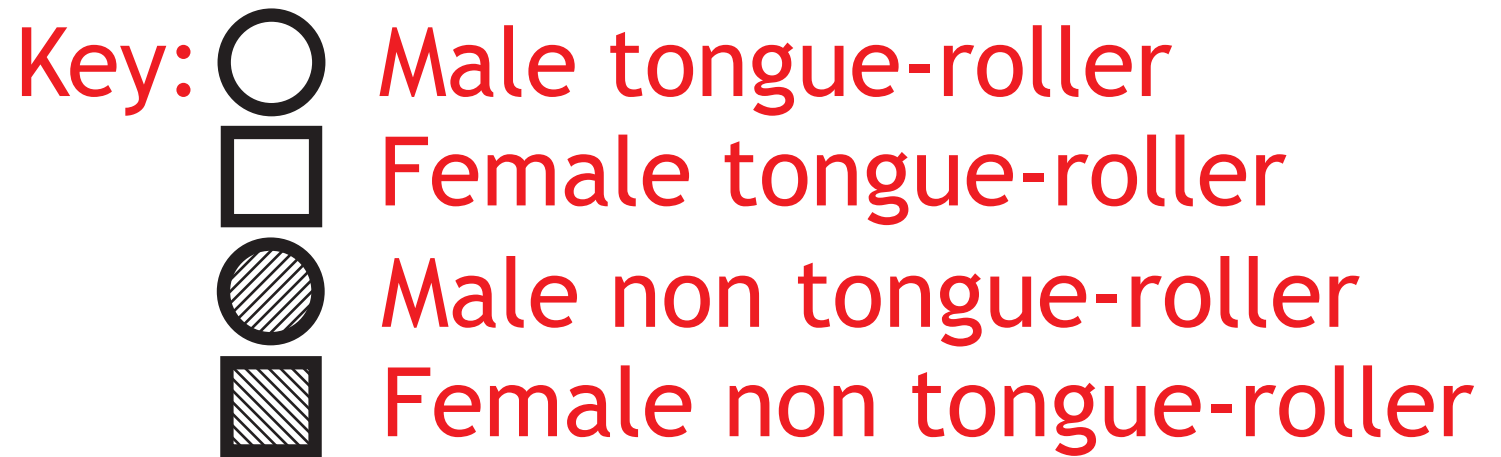
Q10b

# Volume of blood (dm<sup>3</sup> per minute)



Q10c

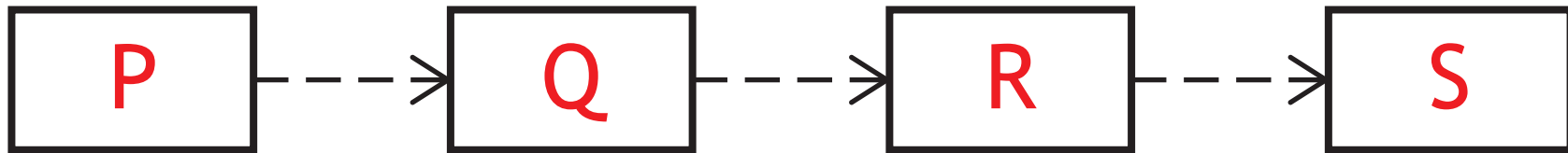




Q11a(iii)

		<i>Genotype of gametes from F</i>	
		F1	F2
<i>Genotype of gametes from E</i>	E1	O1	O1
	E2	O3	O4

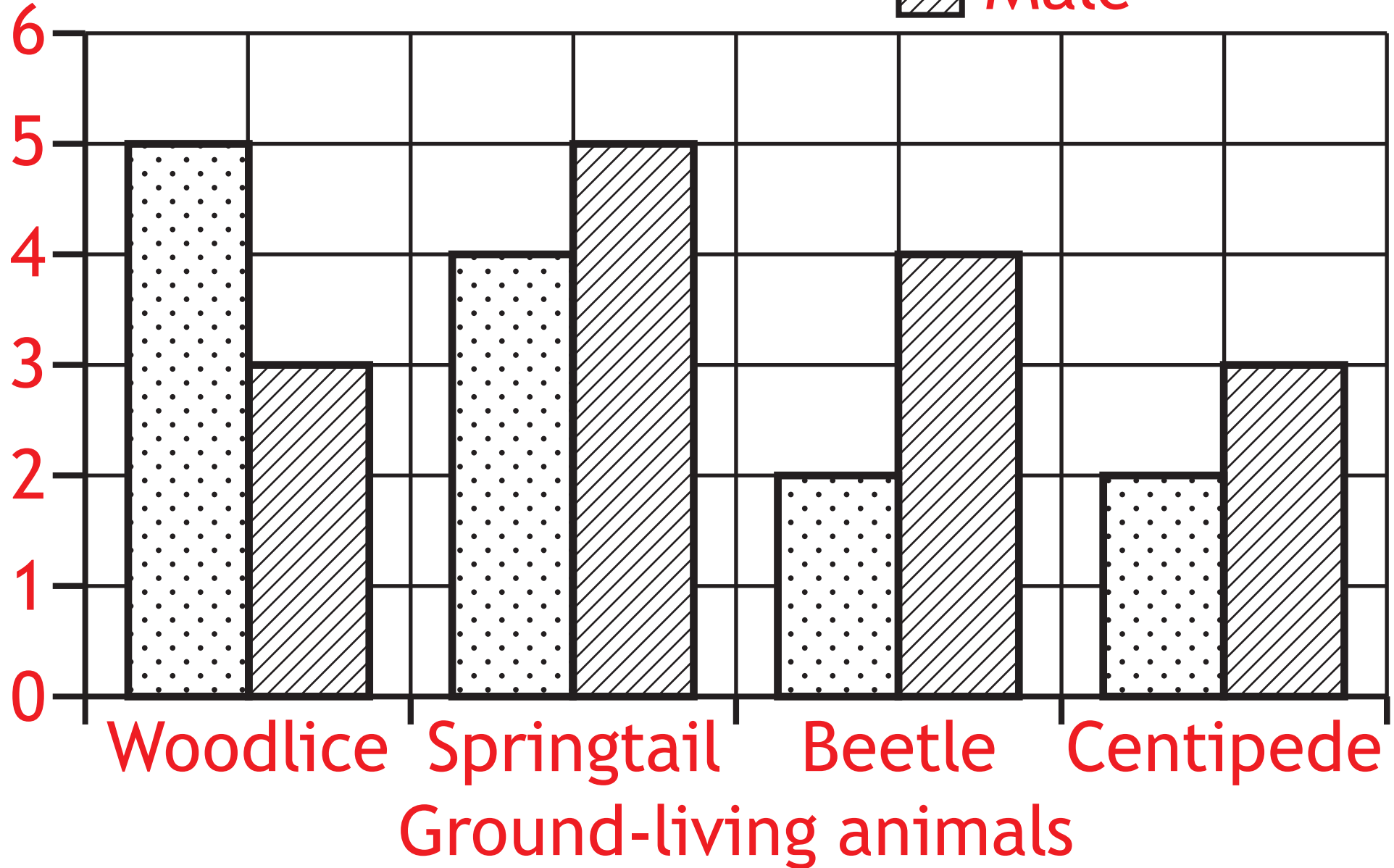
Q13b



Q14a(ii)

Key:  Female  
 Male

Number of individuals



Average volume  
of oxygen  
released in  
one hour (cm<sup>3</sup>)

