



National
Qualifications
2017

X707/75/02

Biology
Section 1 — Questions

TUESDAY, 23 MAY

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 X707/75/01.

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 diagrams for Question 1. The diagrams represent three different cells. Identify the plant cell(s).

- A P and R only
- B P and Q only
- C P only
- D R only

- * 2. Refer to the graph for Question 2. The graph shows the concentrations of ions in a single-celled organism and the sea water surrounding it.

Use the graph to identify which of the following statements is correct.

- A Sodium ions will move into the organism by active transport.
- B Sodium ions will move out of the organism by diffusion.
- C Potassium ions will move out of the organism by active transport.
- D Potassium ions will move into the organism by active transport.

- * 3. Stages involved in genetic engineering are listed below.

P – Modified cells grown

Q – Gene and plasmid extracted

R – Gene inserted into plasmid

S – Required gene identified

Which of the following shows the correct order of stages involved in genetic engineering?

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

- * 4. Refer to the graph for Question 4. The graph shows the effect of increasing carbon dioxide concentration on the rate of photosynthesis.

Two factors which could be limiting the rate of photosynthesis between points X and Y on the graph are

- A starch concentration and light intensity
- B temperature and light intensity
- C temperature and carbon dioxide concentration
- D sugar concentration and carbon dioxide concentration.

5. Which row in the table describes a process in plants which requires sugar and a substance into which sugar is converted?

	<i>Process</i>	<i>Substance</i>
A	Photosynthesis	Cellulose
B	Respiration	Starch
C	Photosynthesis	Protein
D	Respiration	ATP

6. What is the difference in the number of ATP molecules produced per glucose molecule by fermentation compared to aerobic respiration?

- A 2
- B 36
- C 38
- D 40

7. Which of the following shows terms listed in order of increasing level of organisation in a multicellular organism?

- A organ → tissue → system
- B organ → system → tissue
- C tissue → system → organ
- D tissue → organ → system

8. Stem cells are

- A specialised cells which can divide to produce new stem cells
- B specialised cells which are unable to divide to produce new stem cells
- C non-specialised cells which can divide to produce new stem cells
- D non-specialised cells which are unable to divide to produce new stem cells.

- * 9. Refer to the diagram for Question 9. The diagram shows the main parts of a flower.
Which row in the table describes the type of gametes produced by the anther and the chromosome complement these gametes contain?

	<i>Type of gamete produced</i>	<i>Chromosome complement</i>
A	female	diploid
B	male	diploid
C	female	haploid
D	male	haploid

10. Which of the following shows the passage of water through the tissues when it enters a plant?

- A root hair → xylem → spongy mesophyll
 B root hair → spongy mesophyll → xylem
 C spongy mesophyll → xylem → root hair
 D xylem → spongy mesophyll → root hair

- * 11. Villi in the small intestine have an internal structure called a lacteal. The lacteal is a vessel found in the centre of each villus.

Which of the following products of digestion are both absorbed into the lacteal?

- A Glycerol and fatty acids
 B Glucose and fatty acids
 C Glycerol and amino acids
 D Glucose and amino acids

12. The process which moves food along the digestive system is called

- A diffusion
 B absorption
 C peristalsis
 D osmosis.

13. Regular physical activity can help reduce the risk of heart disease.

The table shows the percentage of males and females of different age groups, who meet the weekly recommendations for physical activity.

Age group	Percentage meeting the weekly recommendations for physical activity	
	Males	Females
16–24	83	68
25–34	75	65
35–44	74	67
45–54	69	64
55–64	61	53

Which of the following statements is **not** correct for this data?

- A The percentage of males meeting the weekly recommendations always decreases as age increases.
 - B The percentage of females meeting the weekly recommendations always decreases as age increases.
 - C 26% of males aged 35–44 do not meet the weekly recommendations.
 - D 35% of females aged 25–34 do not meet the weekly recommendations.
14. An example of a biotic factor affecting a population of plants is
- A a leaf disease reducing the growth of lettuce plants
 - B acidic soil preventing the growth of daisies
 - C shade from buildings causing a decrease in the growth of grass
 - D a cold winter causing a decrease in the growth of geranium plants.

15. Which of the following statements is true of predation?
- A It is an abiotic factor and causes a decrease in prey numbers.
 - B It is an abiotic factor and causes an increase in prey numbers.
 - C It is a biotic factor and causes a decrease in prey numbers.
 - D It is a biotic factor and causes an increase in prey numbers.
16. On average, 90% of energy is lost at each energy transfer in a food chain. Which of the following is a cause of this energy loss?
- A Digested material
 - B Cell repair
 - C Movement
 - D Growth
- *17. Refer to the diagram for Question 17. The diagram shows a pyramid of numbers. Which letter represents the producer?
- *18. Refer to the graph for Question 18. The graph shows the changes in wheat yield over a fifty-year period. The percentage increase in wheat yield from 1950 to 2000 is
- A 5
 - B 40
 - C 250
 - D 350.
19. Which row in the table describes a type of competition and a matching example?

	<i>Type of competition</i>	<i>Example</i>
A	Interspecific	Two birch trees growing close together in a wood
B	Interspecific	Lions and hyenas feeding on zebra
C	Intraspecific	Seals and dolphins feeding on small fish
D	Intraspecific	Buttercups and daisies growing in the same field

*20. The following paired statement key can be used to identify invertebrate groups.

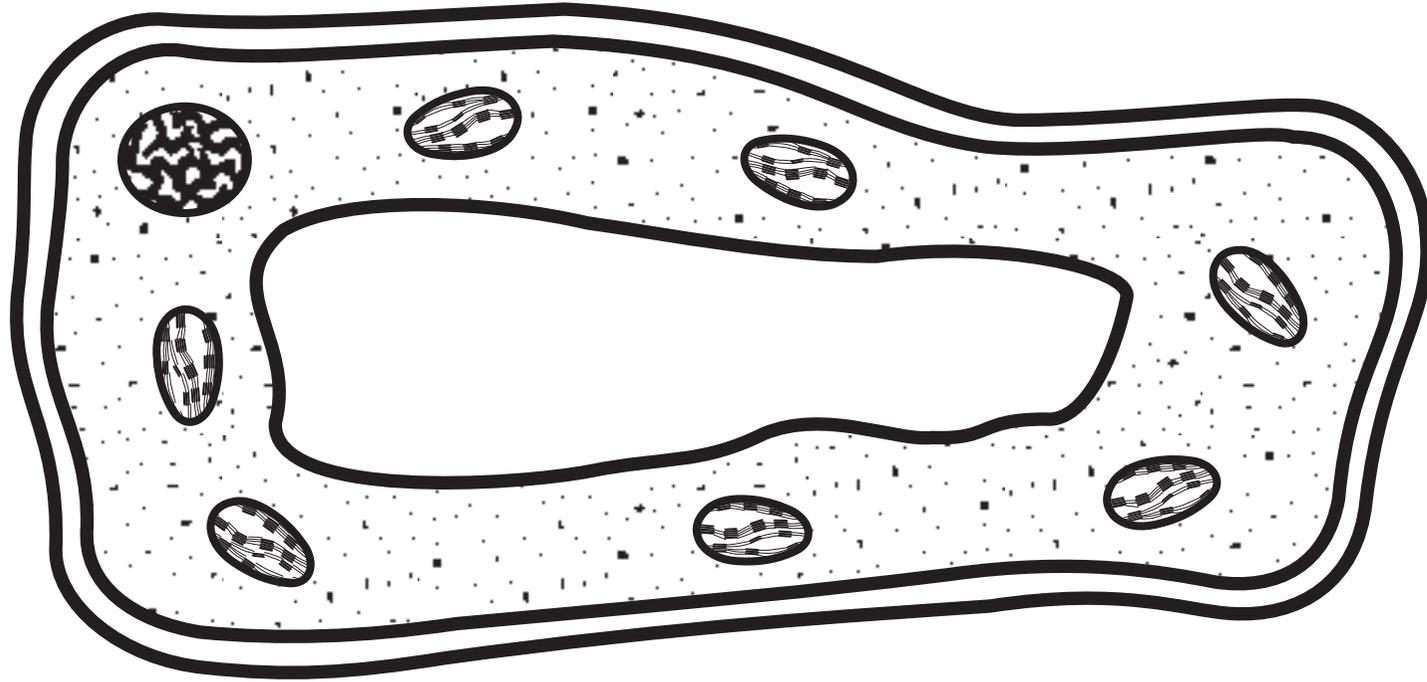
1. Six legs..... *Hexapoda*
More than six legs..... go to 2
2. 8 legs go to 3
More than 8 legs go to 4
3. Curved sting *Dromopoda*
No curved sting *Arachnida*
4. 1 pair of legs per body segment..... *Chilopoda*
2 pairs of legs per body segment *Diplopoda*

An organism has two antennae on its head and venomous pincers. It has a long body made of 19 segments. Each segment has a pair of legs. Use the key to identify the invertebrate group to which the organism belongs.

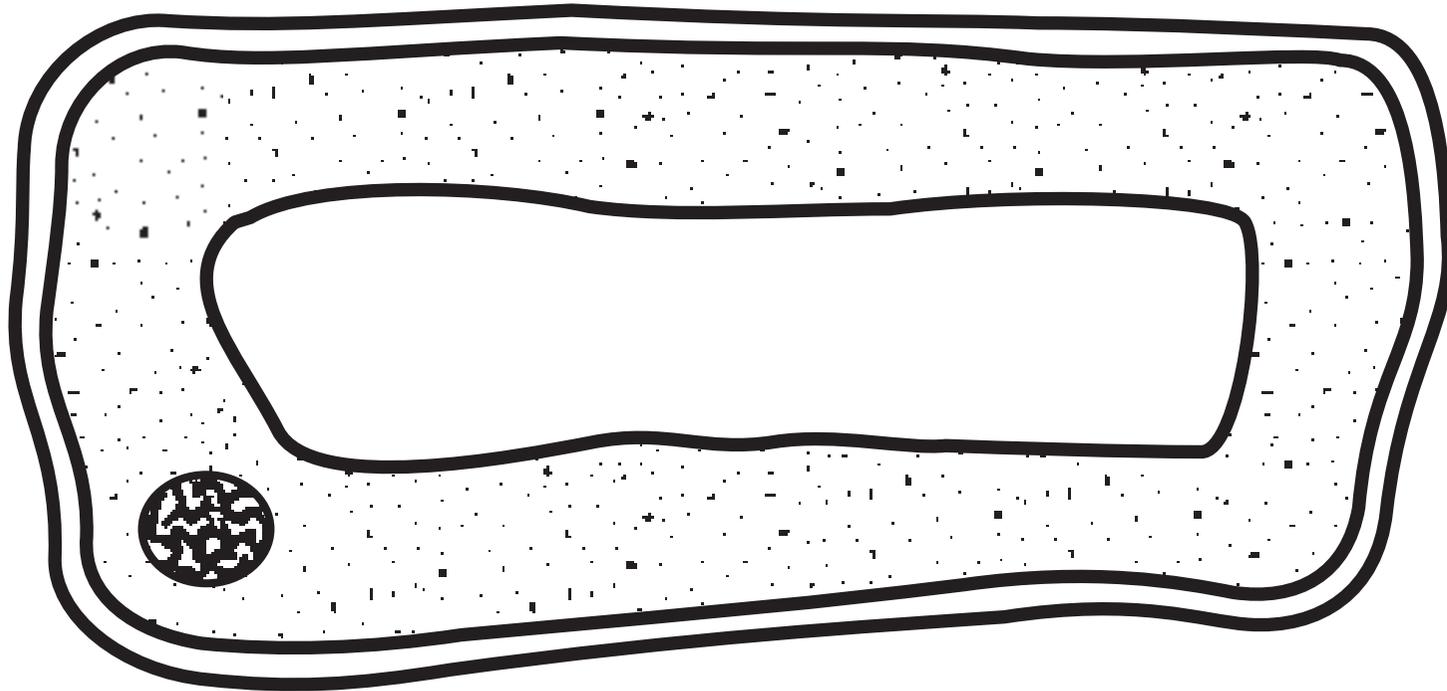
- A Dromopoda
- B Arachnida
- C Chilopoda
- D Diplopoda

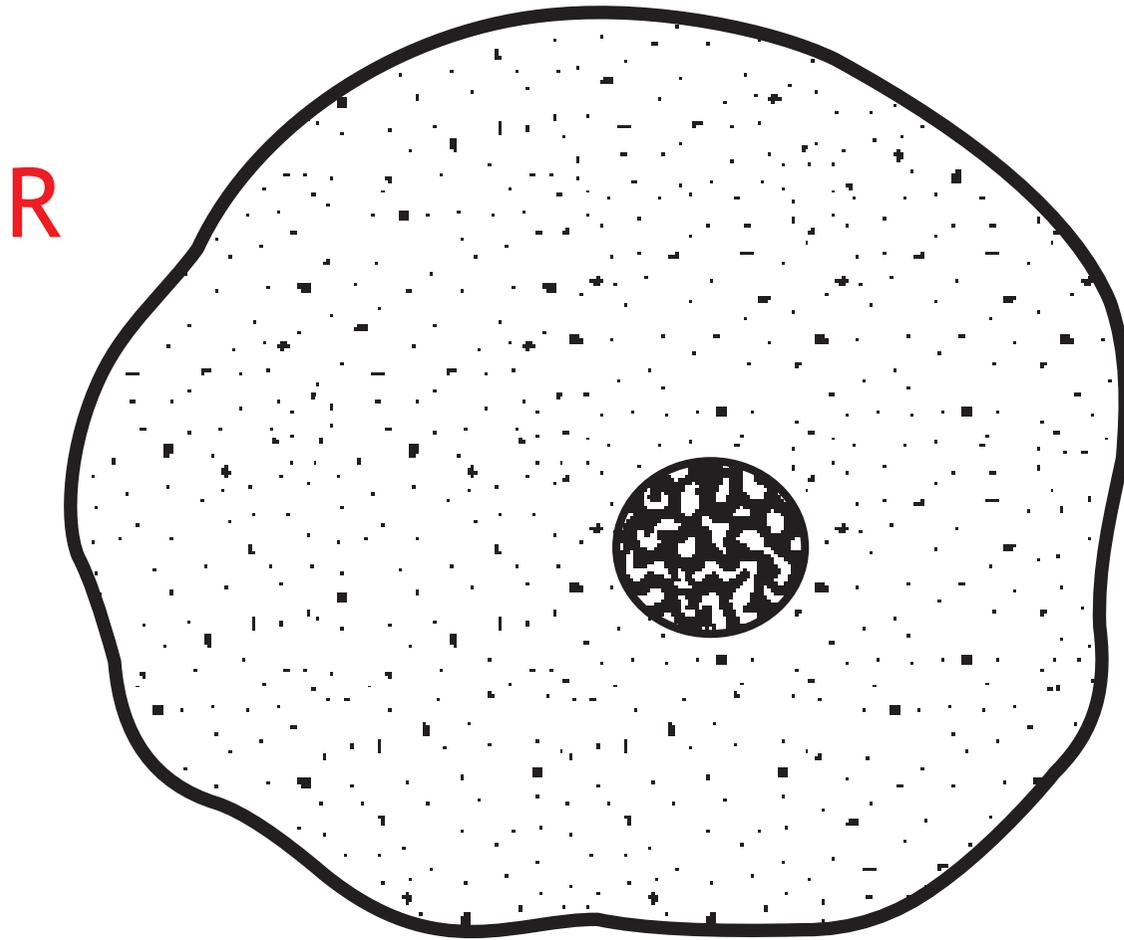
[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION BOOKLET.]

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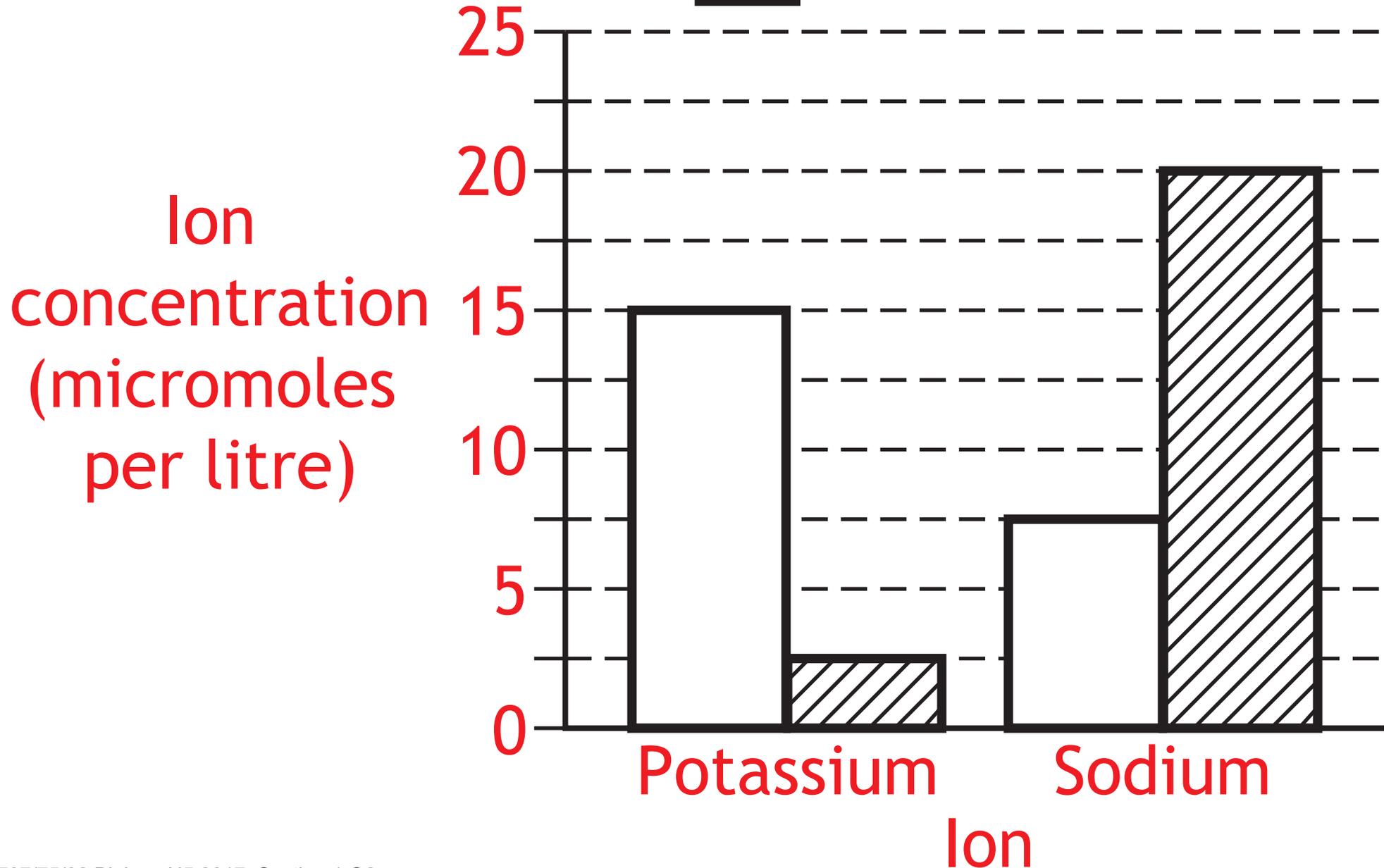


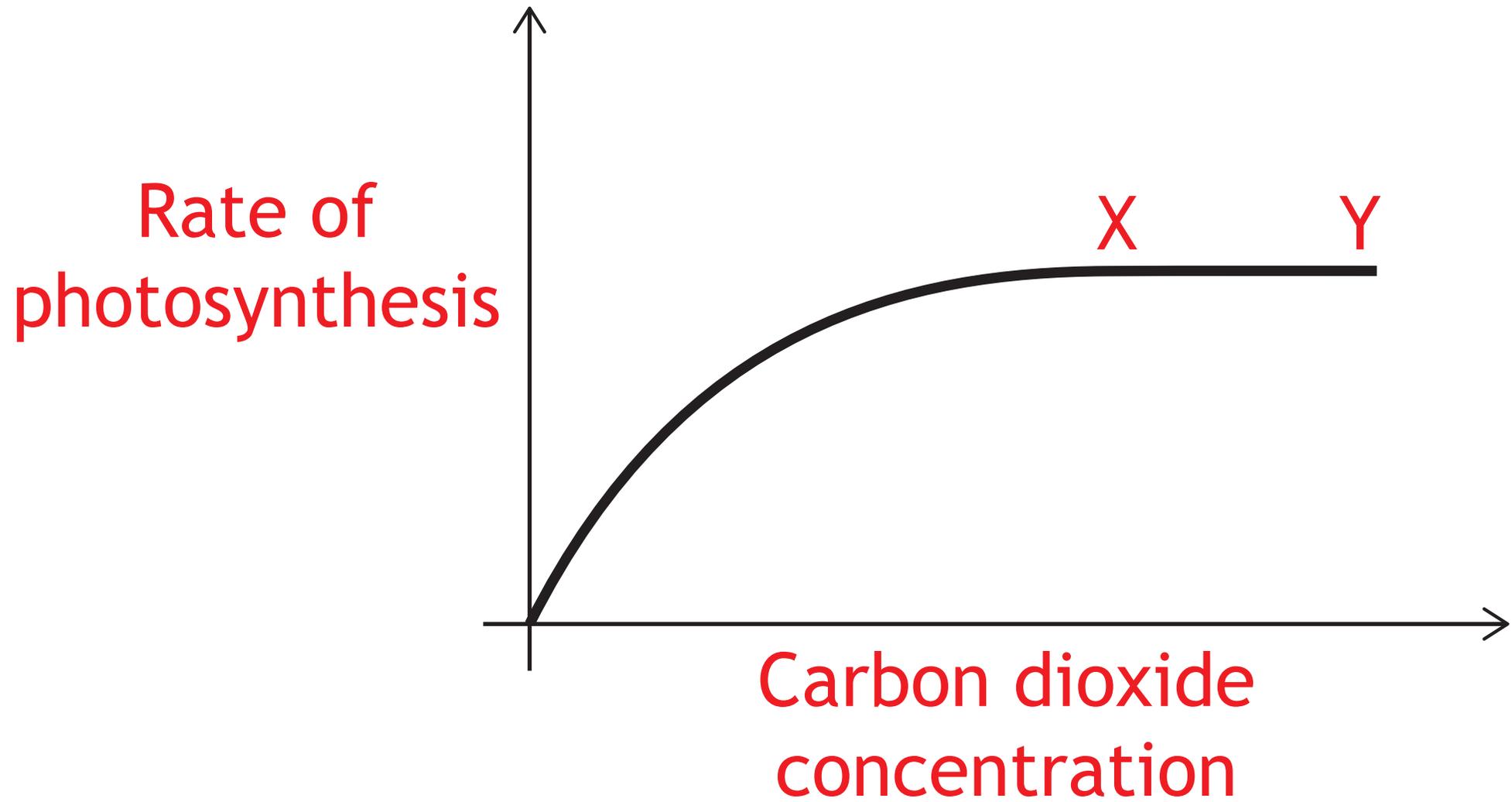
Q

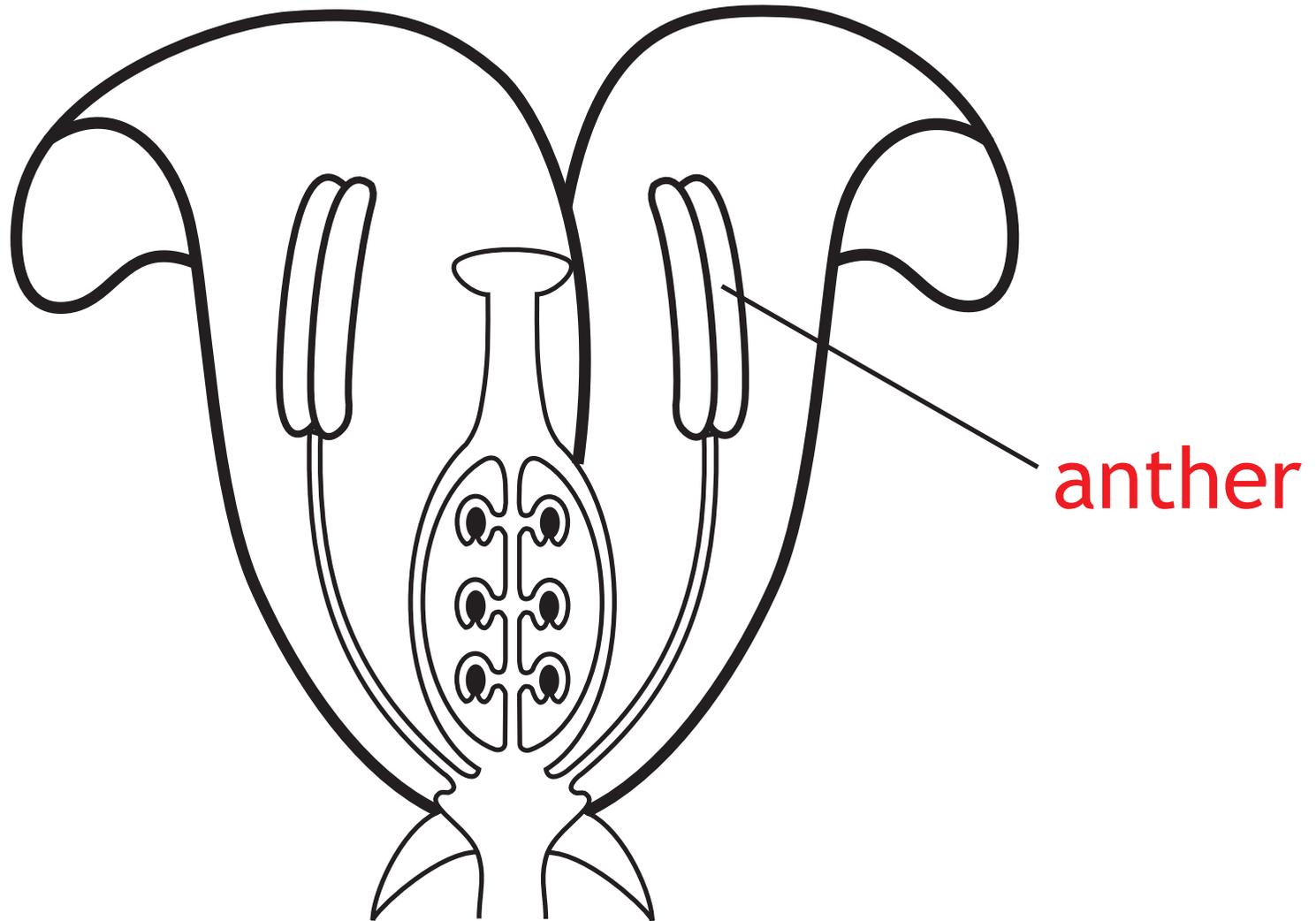




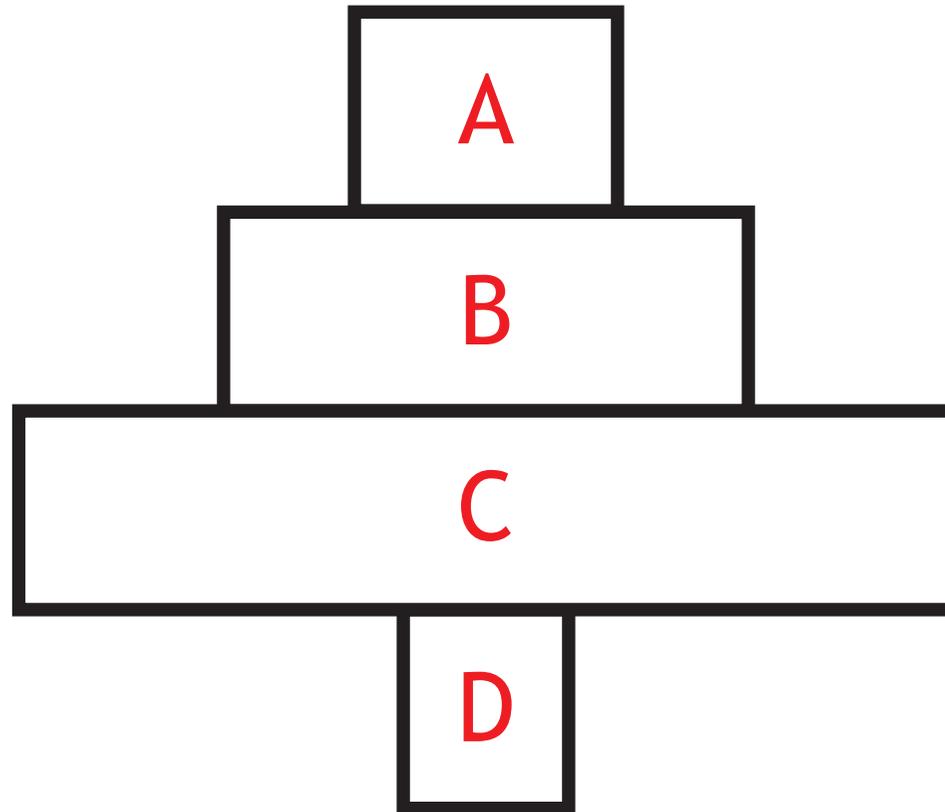
Key  organism
 sea water



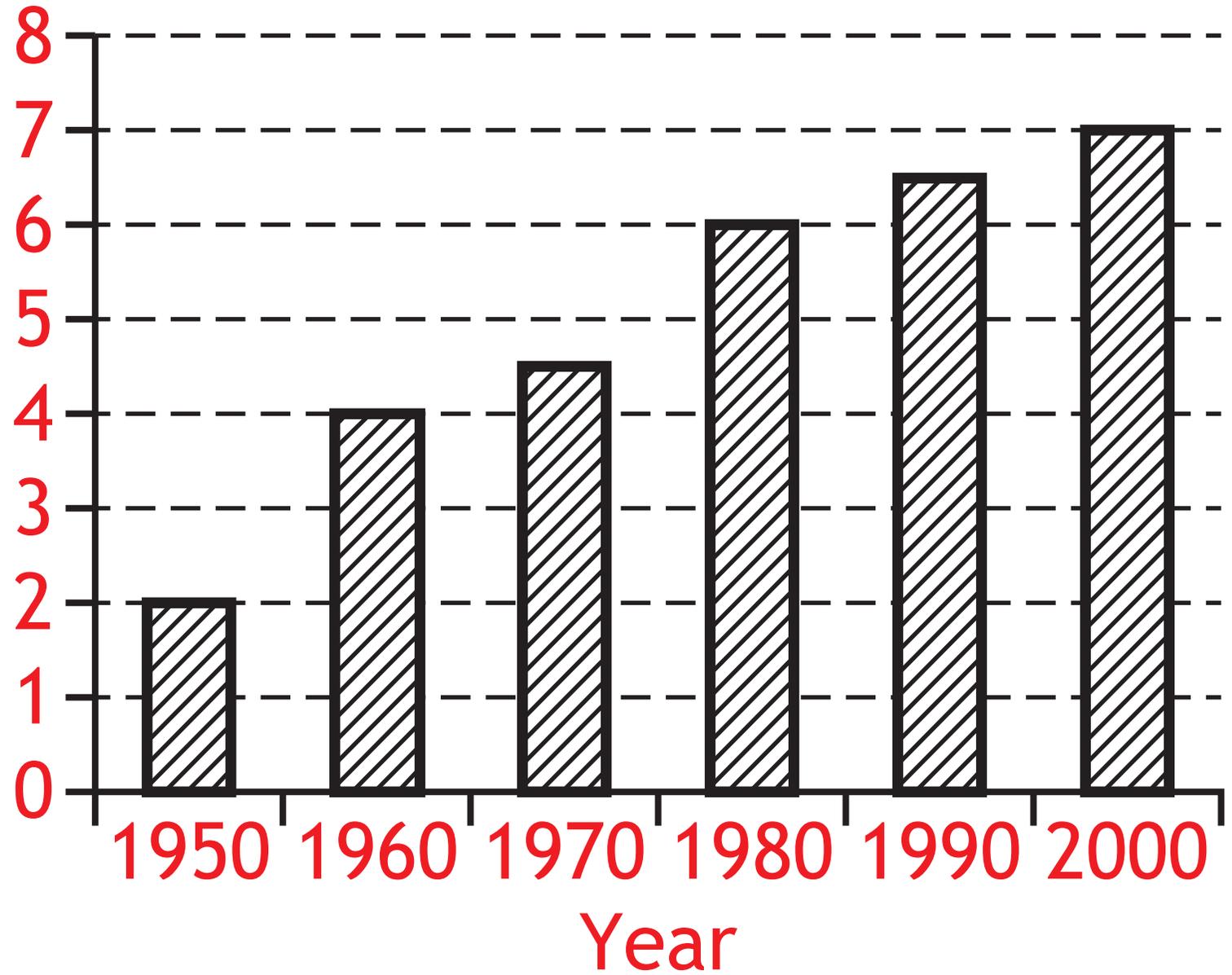




Q17



Wheat yield
(tonnes per
hectare)





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Biology
Section 2 — Questions

TUESDAY, 23 MAY

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 — 80

SECTION 2 — 60 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 — 20 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 — 60 marks

Attempt ALL questions

- * 1. Refer to the diagram for Question 1. *Paramecium* is a single-celled organism which lives in fresh water. The diagram shows some of its structures.
- (a) (i) Choose one of the following structures and describe its function. [1 mark]
- Cytoplasm
 - Cell membrane
 - Nucleus
- (ii) The water concentration outside the paramecium is higher than the water concentration of the cytoplasm. This causes the diffusion of water into the cell. Name this movement of water. [1 mark]
- (b) Name the structure present in a plant cell which prevents it from bursting when full of water. [1 mark]
- * 2. (a) (i) Some stages occur during cell division. In stage 1 the chromosomes shorten and thicken. The other stages are listed below but not in the correct order.
- Cytoplasm divides
 - Nuclear membrane forms
 - Chromosomes move to the equator of the cell
 - Pairs of chromatids are pulled apart
- Identify the third stage from the list above and write the description for this stage. [1 mark]
- (ii) Name the structure that originates from each pole of the cell and attaches to the chromosomes when they are lined up across the equator of the cell. [1 mark]
- (b) During mitosis a pair of chromatids was pulled apart, each moving away from the equator, towards opposite poles, at a rate of 1 micrometre per second.
- Calculate the distance between them after 20 seconds. [1 mark]
- Give your answer in micrometres.

- * 3. Forensic scientists can take small quantities of DNA and use a process to make large quantities. Each DNA molecule is separated and used to make two complementary strands as shown below.

(a) A strand of the original DNA was composed of the following bases:

A G C C A T A G C C C T.

- (i) Give the full name of the base that would be found on the complementary strand paired with G.
- (ii) Give the full name of the base that would be found on the complementary strand paired with A. [2 marks]
- (b) The bases in a strand of DNA make up the code for the production of proteins. The DNA for every individual person varies.
Describe the way in which this code differs from person to person. [1 mark]
- (c) Name the single stranded molecule which carries a complementary copy of the code from the DNA in the nucleus to the ribosome for protein synthesis. [1 mark]

- * 4. Catalase, an enzyme found in living tissues, is involved in the breakdown of hydrogen peroxide into water and oxygen.

In an investigation, catalase was extracted in solution from a variety of tissues and used to soak paper discs. These discs were then dropped into beakers of hydrogen peroxide. The discs sank to the bottom of the beaker. As the oxygen was released the discs returned to the surface.

The time taken for these discs to return to the surface was recorded and shown in the table.

<i>Type of tissue</i>	<i>Time for disc to return to the surface (s)</i>
Apple	110
Banana	40
Liver	10
Onion	70

- (a) Refer to the graph for Question 4(a). A student plotted the results from the table as a bar graph.

(i) What label should be placed on the y-axis of the graph? [1 mark]

(ii) The student plotted the results for onion incorrectly. What value did they plot? [1 mark]

- (b) The aim of the experiment was to investigate catalase activity in a variety of tissues.

Using the information given, write an appropriate conclusion for this experiment. [1 mark]

- (c) The experiment was carried out at pH 7, the optimum pH for catalase.

Choose one option from the brackets in the sentence below to make a prediction about what would happen if the experiment was repeated at pH 4.

At pH 4, the rate of oxygen production would (increase/decrease/stay the same) in each tissue. [1 mark]

- * 5. A student investigated the effect of temperature on the rate of respiration in germinating (growing) peas. Four respirometers labelled A–D were set up at the temperatures shown in the table below.

Each respirometer was set up as follows:

- a chemical to absorb carbon dioxide was placed at the bottom of a boiling tube
- a metal gauze platform was inserted into the boiling tube
- germinating or dead peas were placed on the platform
- a rubber stopper sealed the boiling tube
- a thermometer was inserted into the boiling tube through one hole in the rubber stopper
- one end of an inverted U-shaped capillary tube was inserted through a second hole in the rubber stopper
- the other end of the capillary tube was placed in a beaker of coloured liquid
- a scale was positioned above the beaker, next to the capillary tube.

The level of the coloured liquid in the capillary tube was measured on the scale at the start of the investigation and again after 20 minutes. The rise in liquid level was due to oxygen uptake by the germinating peas. The results are shown in the table.

<i>Respirometer</i>	<i>Temperature (°C)</i>	<i>Contents</i>	<i>Rise in liquid level (mm)</i>	<i>Rate of oxygen uptake (mm per minute)</i>
A	15	Germinating peas	14	0.7
B	15	Dead peas	0	0
C	25	Germinating peas	26	
D	25	Dead peas	0	0

- (a) (i) Calculate the rate of oxygen uptake per minute by the peas in respirometer C. [1 mark]
- (ii) Using the results from the table complete the following conclusion by selecting one option in the bracket. [1 mark]

Increasing the { temperature
liquid level
oxygen uptake } increases the rate of respiration in germinating peas.

5. (a) (continued)

- (iii) Another respirometer was set up at 60 °C with germinating peas and the coloured liquid did not rise. The student concluded that the peas were not respiring.

Explain why this temperature prevented the peas from carrying out respiration. [2 marks]

- (iv) Respirometers B and D were set up as control experiments.

Describe the purpose of the controls in **this** investigation. [1 mark]

- * (b) Refer to the diagram for Question 5(b). The diagram represents the fermentation pathway in a plant cell.

Choose either molecule X or Y and state its name. [1 mark]

- * 6. Chromosomes contain the genetic information responsible for variation amongst members of a species.

Fruit flies can have either a grey or black body colour.

A grey bodied fruit fly with the genotype GG was crossed with a black bodied fruit fly with the genotype gg.

- (a) Using the information given, select one option in each bracket to complete the following sentences. [2 marks]

Body colour in fruit flies is an example of $\left\{ \begin{array}{l} \text{discrete} \\ \text{continuous} \end{array} \right\}$ variation.

The F_1 flies produced from this cross will be $\left\{ \begin{array}{l} \text{homozygous} \\ \text{heterozygous} \end{array} \right\}$.

- * (b) Refer to the diagram for Question 6(b). The diagram relates to sexual reproduction in humans.

- (i) Name organ R. [1 mark]
- (ii) Describe what happens during fertilisation. [1 mark]
- (iii) An egg cell is haploid but a zygote is diploid.

Explain what this means in terms of the chromosome complement found in each of these cells. [1 mark]

7. (a) The table shows some information about causes of adult deaths in Scotland.

<i>Cause of adult deaths</i>	<i>Number of adult deaths (per 100 000 population)</i>	
	<i>Males</i>	<i>Females</i>
Cancer	385	274
Coronary heart disease	165	105
Chronic obstructive pulmonary disease	71	58

Calculate the simple whole number ratio of male deaths to female deaths due to coronary heart disease. [1 mark]

- (b) (i) Coronary heart disease can gradually cause the coronary arteries to get narrower or become blocked completely.

Name **one** essential substance that will no longer be able to reach the cells in the heart if these arteries become blocked. [1 mark]

- (ii) A person has been told that they have a high risk of developing coronary heart disease.

Suggest a lifestyle choice that they could make, other than exercising more, to help reduce this risk. [1 mark]

- (c) Chronic obstructive pulmonary disease is a condition which affects the lungs. It can destroy the alveolar walls, leading to fewer larger alveoli.

Identify a feature of the alveoli which will be affected by this reduction in their number. [1 mark]

- * 8. A student investigated the link between transpiration rate and the number of leaf stomata. A microscope was used to look at the number of stomata on a leaf surface of plant species A.

Six stomata were recorded in an 0.04 mm^2 area of leaf surface.

- (a) Calculate the expected number of stomata present in 1 mm^2 on this leaf surface. [1 mark]

- (b) A leaf from another plant, species B, had fewer stomata per mm^2 of leaf surface and a different rate of transpiration.

It was concluded that the number of stomata present affects the rate of transpiration.

- (i) Suggest an advantage to plant species B of having fewer stomata. [1 mark]
- (ii) Select the environmental condition to which this plant has become best adapted from the list below. [1 mark]
- A. Dry
 - B. Cool
 - C. Moist

9. After a head injury, a student became dizzy and occasionally lost balance.

- (a) Name the part of the brain which controls balance. [1 mark]

- (b) To test if there was also damage to the spinal cord, doctors touched different areas of the student's skin with a blunt needle.

Describe how the stimulus is detected at the skin and how the message is then carried into and across the spinal cord. [4 marks]

10. Type 1 diabetes occurs if the body does not produce any or enough insulin.

- (a) (i) Name the organ which produces insulin. [1 mark]
- (ii) As a result of Type 1 diabetes, glucose is unable to enter the cells of the body. A symptom of this is extreme tiredness.

Using your knowledge of respiration, explain why a person suffering from diabetes might show extreme tiredness. [1 mark]

- (b) People with Type 1 diabetes need to inject insulin.

The table contains information about some of the different types of insulin available.

<i>Type of insulin</i>	<i>Time for insulin to start working</i>	<i>Time for insulin levels to peak</i>	<i>Duration in blood (hours)</i>
P	1 hour	No peak	20–26
Q	1–3 hours	8 hours	12–16
R	30–60 minutes	2–4 hours	5–8
S	15 minutes	30–90 minutes	3–5

Using information from the table, answer the following questions.

- (i) A fast acting type of insulin can be injected just before meals.
Identify the type of insulin that is best suited for this. [1 mark]
- (ii) Another type of insulin can be injected once a day to provide a steady supply of insulin to the body.
Identify the type of insulin that would be most effective at doing this. [1 mark]
- (c) Diabetes also occurs if the target tissues in the body do not respond to insulin reaching them through the bloodstream.
Name the structures found on the surface of the target tissues that respond to the hormone insulin. [1 mark]

*11. Refer to the graph for Question 11. Certain varieties of potato plant are eaten by beetles, reducing the yield of potatoes. A beetle-resistant variety of potato plant was developed.

In an investigation, the beetle-resistant variety was grown outdoors in one field and the non-resistant variety grown in another.

The yields of both varieties were recorded and the results are shown in the graph.

- (a) Describe how the reliability of these results could be increased. [1 mark]
- (b) Calculate the difference in yield between the two varieties. [1 mark]
Give your answer in kg per hectare.
- (c) Identify a variable that would have to be kept the same between the two fields to ensure the results were valid. [1 mark]
- (d) Genetic engineering was used to develop the beetle-resistant variety of potato plant.
Before the development of genetic engineering, farmers used other methods to control the beetle numbers in their potato fields.
Name **one** of these methods. [1 mark]

12. The Scottish crossbill is a small bird which is native to Scotland. It inhabits pine forests in northern Scotland and feeds on pine seeds using its crossed beak.

(a) State the term used to describe the role of the Scottish crossbill within its community. [1 mark]

(b) The shape of a crossbill's beak is a structural adaptation which is the result of a new allele being produced.

Name the process by which new alleles are produced. [1 mark]

(c) The Scottish crossbill has been classified as a separate species, but can still mate with other species of crossbill.

Give a feature of any offspring produced from this mating, which proves that the parents are different species. [1 mark]

*13. Decide if each of the following statements about evolution is **True** or **False** and write T or F.

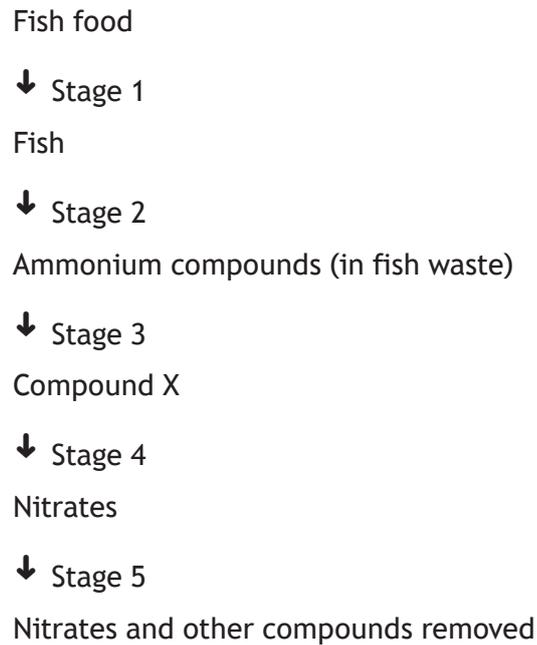
If the statement is **False**, write the correct word to replace the word in capitals in the statement. [3 marks]

A. Genetic variation within a population allows the population to ADAPT in a changing environment.

B. Isolation barriers can be geographical, ENVIRONMENTAL or reproductive.

C. Sub-populations evolve until they become genetically IDENTICAL.

14. The flow of nitrogen in a fish farm is shown in the diagram below.



- (a) (i) Name compound X. [1 mark]
(ii) Give the number of a stage in the process shown above, which involves nitrifying bacteria. [1 mark]
- (b) In the fish farm the nitrates have to be removed from the water to prevent build-up. In some situations living organisms remove nitrates from the soil.
(i) Name the type of organism which can absorb nitrates from the soil. [1 mark]
(ii) Nitrates supply organisms with nitrogen.
State why nitrogen is required. [1 mark]
- (c) Decomposers, such as bacteria, help to break down waste and dead organisms.
Name another type of microorganism which carries out this role. [1 mark]

15. Levels of air pollution can be estimated by the presence or absence of organisms called lichens.

<i>Air pollution level</i>	<i>Most common type of lichen present</i>
Low	Shrubby
Medium	Leafy
High	Crusty

Environmental scientists carried out a study on lichen species at four different sites and obtained the results shown in the table below.

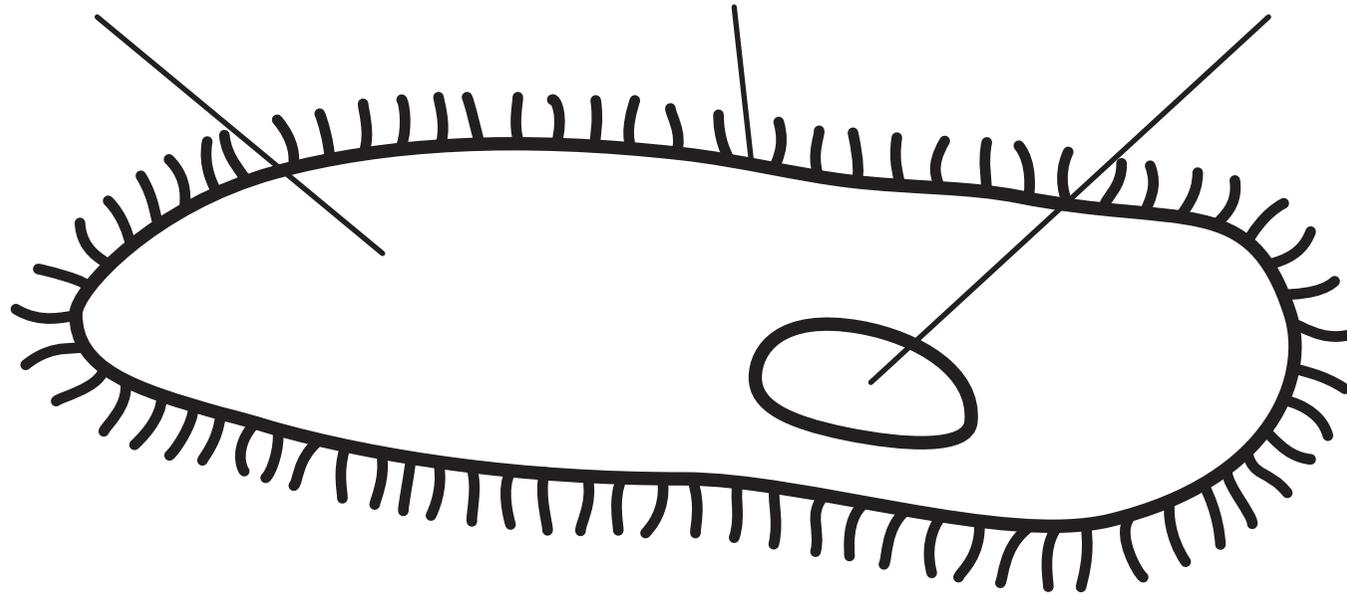
<i>Site</i>	<i>Number of lichen species present</i>		
	<i>Shrubby</i>	<i>Leafy</i>	<i>Crusty</i>
A	0	5	19
B	3	2	0
C	16	3	0
D	7	14	2

- (a) (i) Site A had the highest levels of air pollution.
Using information from **both tables**, describe the evidence supporting this statement. [1 mark]
- (ii) Calculate the average number of leafy lichen species present at the four sites. [1 mark]
- (b) State the name given to species, such as lichen, which are used to estimate levels of pollution. [1 mark]

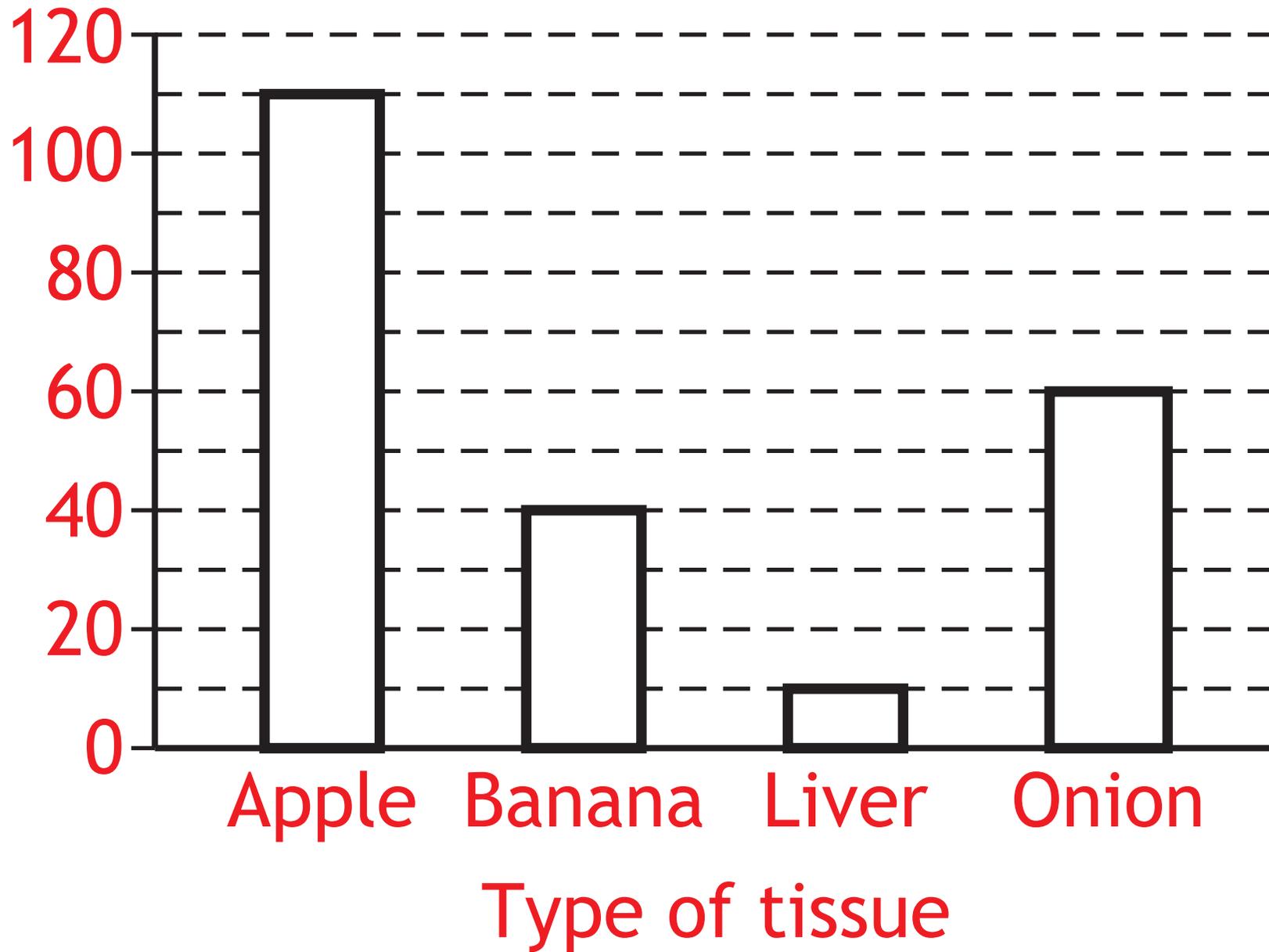
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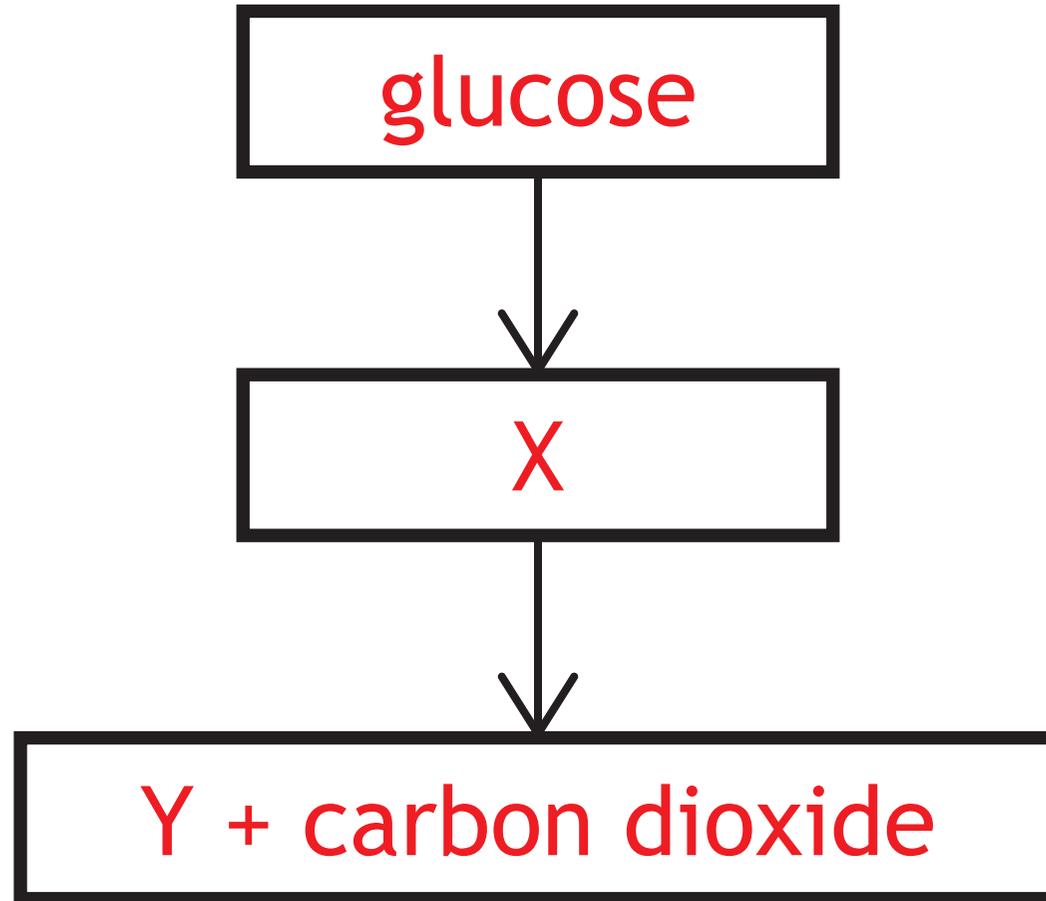
Q1

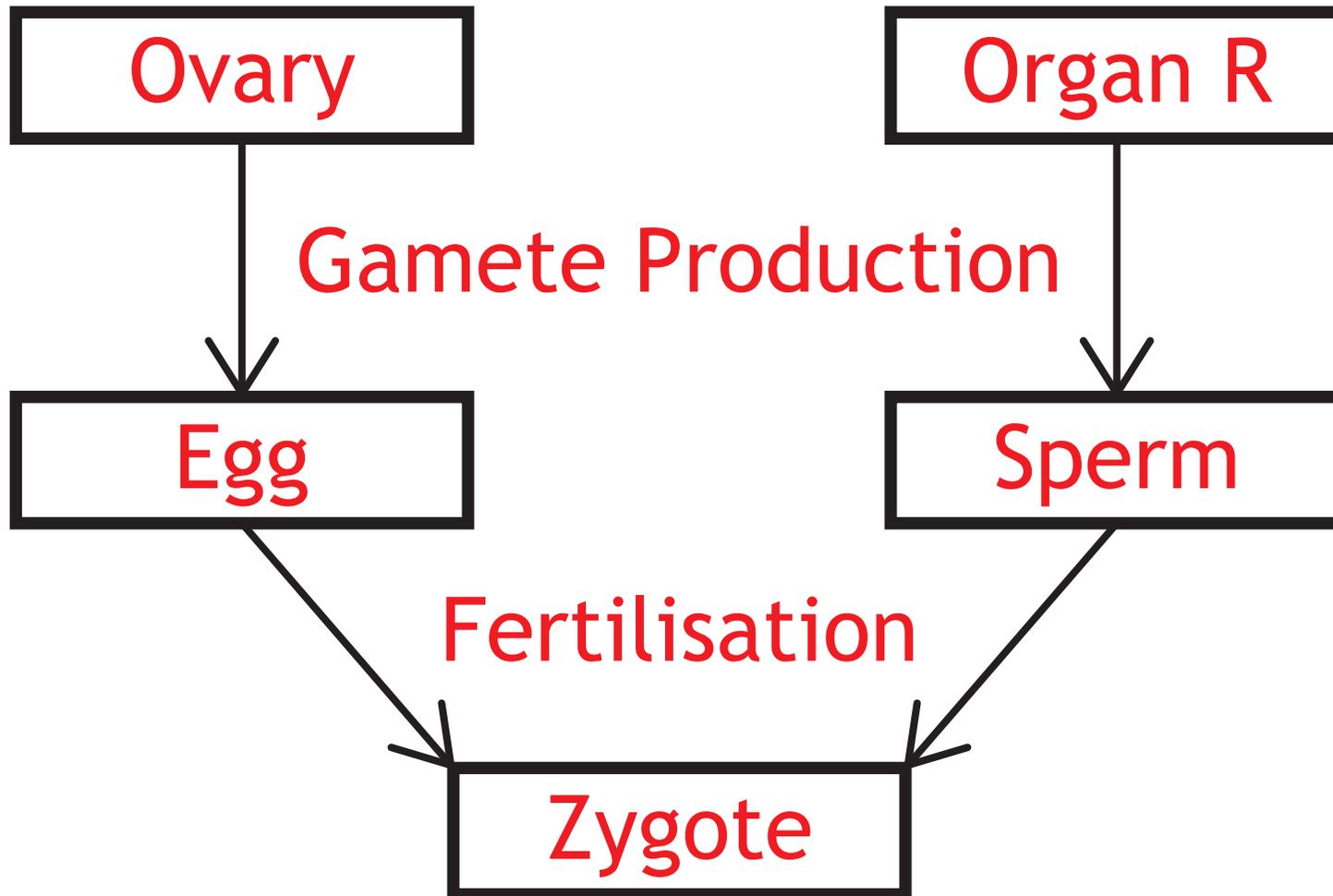
cytoplasm cell membrane nucleus



Q4a







Q11

Yield (kg per hectare)

