National Qualifications 2017

X707/75/02

Biology
Section 1 — Questions

TUESDAY, 23 MAY

1:00 PM – 3:00 PM

Instructions for the completion of Section 1 are given on *Page 02* of your question and answer booklet X707/75/01.

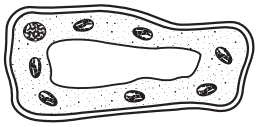
Record your answers on the answer grid on *Page 03* of your question and answer booklet.

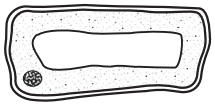
Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

SECTION 1

1. The following diagrams represent three different cells.

P 

Q 

R 

Identify the plant cell(s).

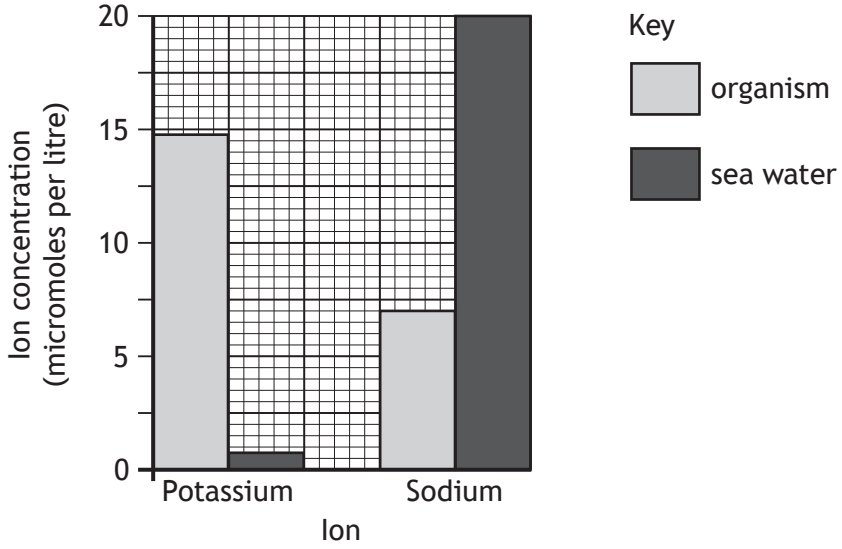
A P and R only

B P and Q only

C P only

D R only

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.

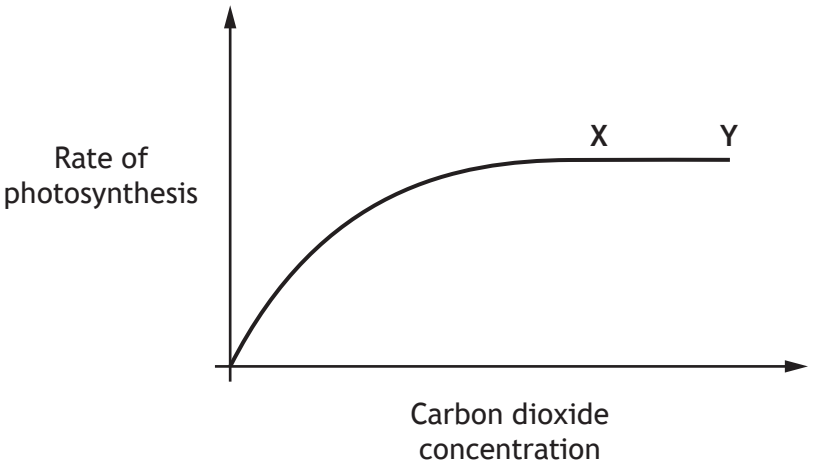
C Potassium ions will move out of the organism by active transport.

D Potassium ions will move into the organism by active transport.

3. Which row in the table identifies the order of stages involved in genetic engineering?

	Stage in Genetic Engineering			
	1st	2nd	3rd	4th
A	Required gene identified	Gene and plasmid extracted	Gene inserted into plasmid	Modified cells grown
B	Required gene identified	Gene inserted into plasmid	Gene and plasmid extracted	Modified cells grown
C	Gene inserted into plasmid	Required gene identified	Modified cells grown	Gene and plasmid extracted
D	Gene inserted into plasmid	Modified cells grown	Gene and plasmid extracted	Required gene identified

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.

[Turn over

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

	Process	*Substance*
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

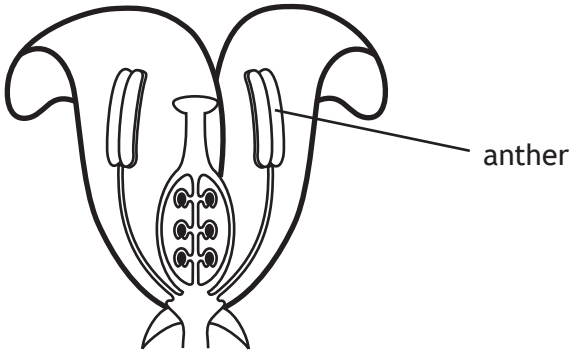
A specialised cells which can divide to produce new stem cells

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. 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?

	Type of gamete produced	*Chromosome complement*
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

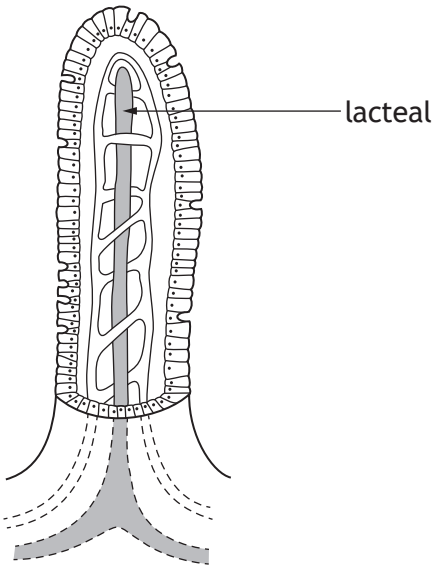
B root hair ⟶ spongy mesophyll ⟶ xylem

C spongy mesophyll ⟶ xylem ⟶ root hair

D xylem ⟶ spongy mesophyll ⟶ root hair

[Turn over

11. The diagram shows a villus from the small intestine.



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.

	Percentage meeting the weekly recommendations for physical activity	
Age group	*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.

[Turn over

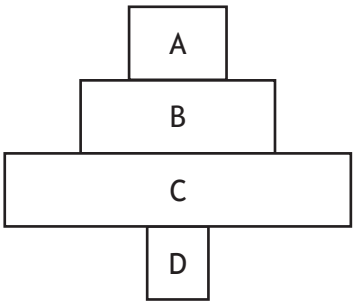
15. Which of the following statements is true of predation?

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?

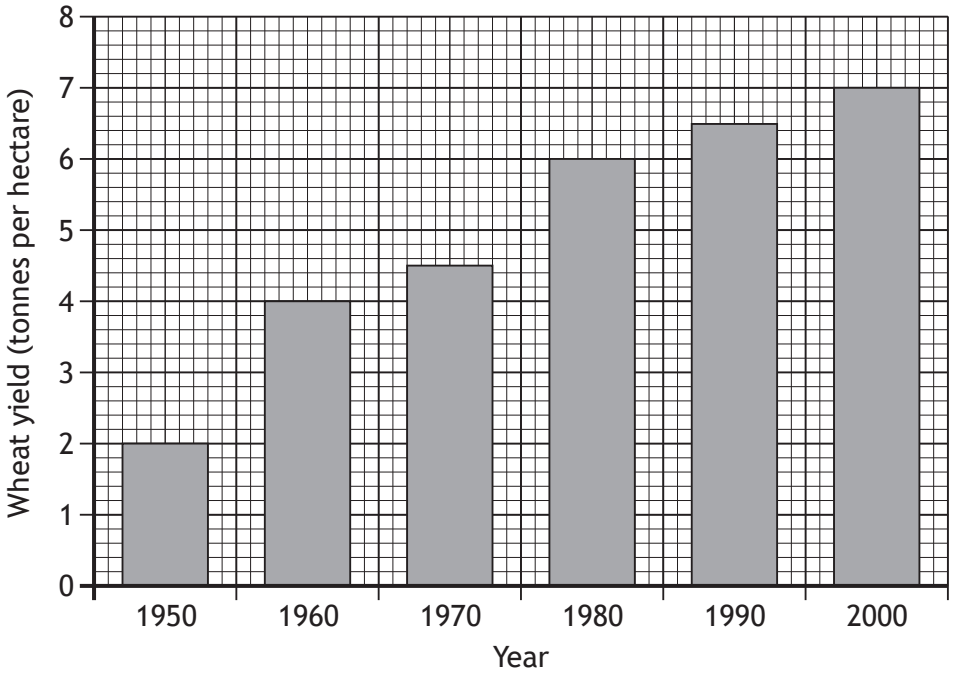
A Digested material
B Cell repair
C Movement
D Growth

17. The diagram below shows a pyramid of numbers.



Which letter represents the producer?

18. The following 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?

	Type of competition	*Example*
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

[Turn over

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

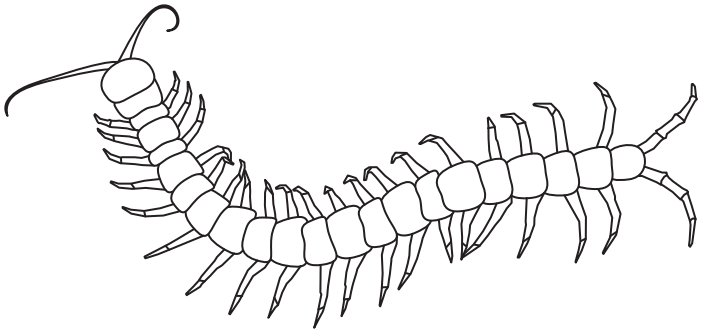
1. Six legs..... *Hexapoda*
   More than six legs..... go to 2

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*

Use the key to identify the invertebrate group to which the following organism belongs.



A Dromopoda
B Arachnida
C Chilopoda
D Diplopoda

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

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National Qualifications 2017

Mark

X707/75/01

Biology
Section 1 — Answer Grid and Section 2

TUESDAY, 23 MAY

1:00 PM – 3:00 PM

X7077501

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 — 80

SECTION 1 — 20 marks

Attempt ALL questions.

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

SECTION 2 — 60 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. You should 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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X707750101

SECTION 1 — 20 marks

The questions for Section 1 are contained in the question paper X707/75/02.

Read these and record your answers on the answer grid on *Page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample Question

The thigh bone is called the

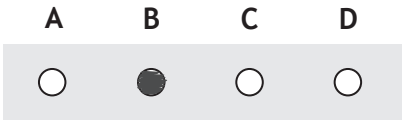
A humerus

B femur

C tibia

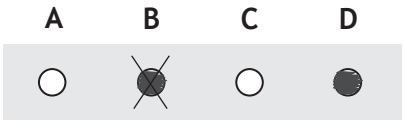
D fibula.

The correct answer is **B** — femur. The answer **B** bubble has been clearly filled in (see below).

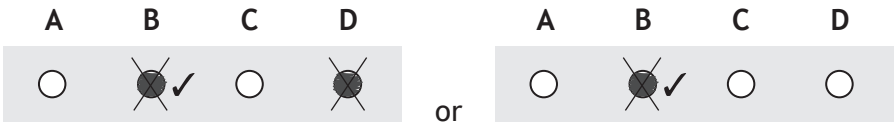


Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



SECTION 1 — Answer Grid

OBJ20AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○

X707750103

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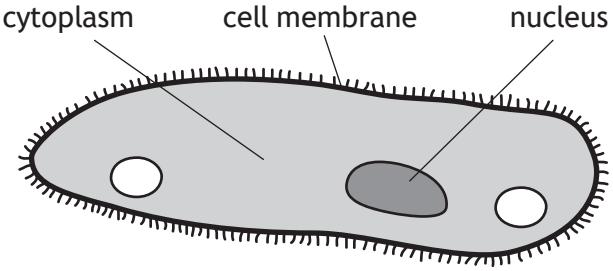
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SECTION 2 — 60 marks

Attempt ALL questions

1. *Paramecium* is a single-celled organism which lives in fresh water.

The following diagram shows some of its structures.



(a) (i) Choose one of the following structures by ticking (✓) one of the boxes and describe its function. **1**

Cytoplasm ☐ Cell membrane ☐ Nucleus ☐

Function _____

_____

(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**

_____

(b) Name the structure present in a plant cell which prevents it from bursting when full of water. **1**

_____

[Turn over

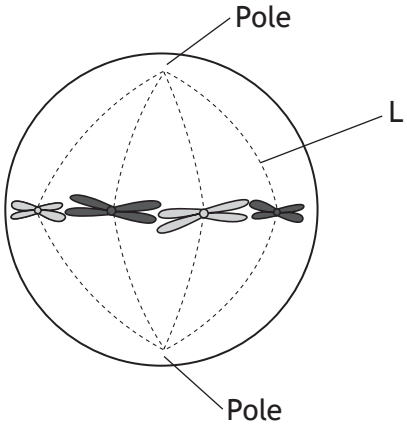
2. (a) (i) The table describes some stages which occur during cell division, but not in the correct order.

The first stage has been given.

Identify the **third stage** by writing the number 3 beside its description. **1**

Stage	*Description*
	cytoplasm divides
	nuclear membranes form
1	chromosomes shorten and thicken
	chromosomes move to the equator of the cell
	pairs of chromatids are pulled apart

(ii) The diagram represents a cell during one of the stages of mitosis.



Name the part labelled L in the diagram. **1**

_____

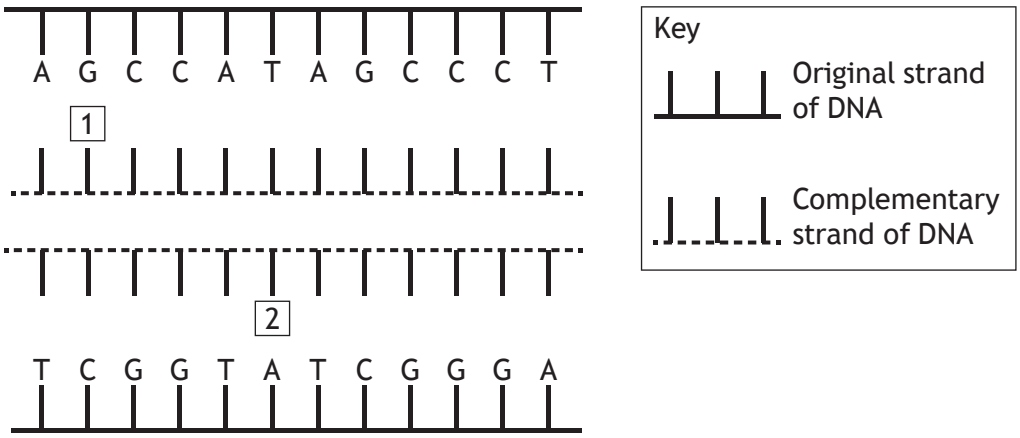
(b) During mitosis a pair of chromatids was pulled apart, each moving away from the equator, towards opposite poles, at a rate of 1 micrometre per second.

Calculate the distance between them after 20 seconds. **1**

Space for calculation

_____micrometres

3. (a) 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.



Give the full names of bases labelled 1 and 2 in the diagram above. **2**

1 _____

2 _____

(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**

_____

_____

(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**

_____

[Turn over

DO NOT WRITE IN THIS MARGIN

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, as shown in Diagram 1. As the oxygen was released the discs returned to the surface, as shown in Diagram 2.

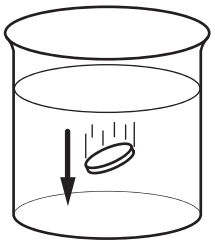


Diagram 1

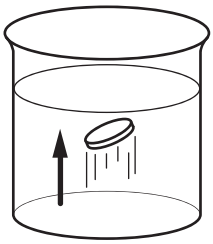


Diagram 2

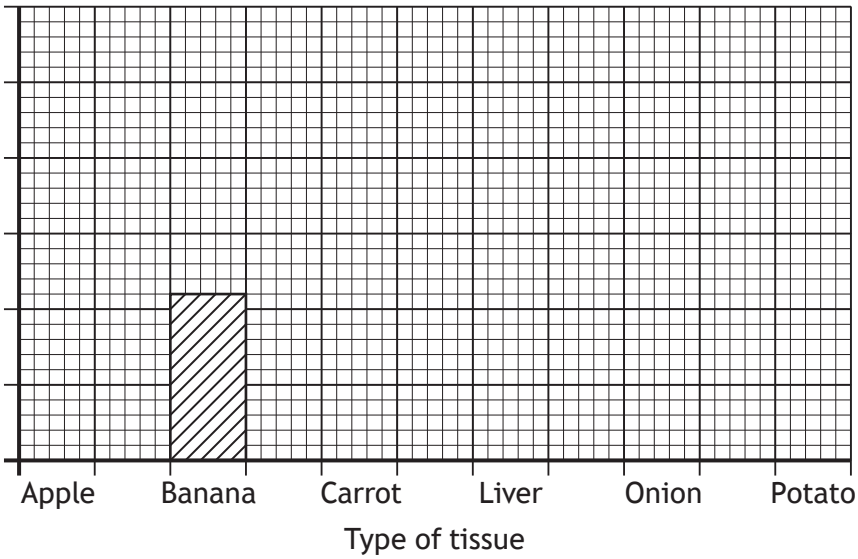
The time taken for these discs to return to the surface was recorded and shown in the table.

Type of tissue	*Time for disc to return to the surface* (s)
Apple	108
Banana	44
Carrot	68
Liver	8
Onion	70
Potato	72

4. (continued)

(a) On the grid below, complete the vertical axis and the remaining bars to show the time taken for the discs to return to the surface, for each tissue. **2**

(An additional grid, if required, can be found on *Page 26*)



(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**

Conclusion _____

_____

_____

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

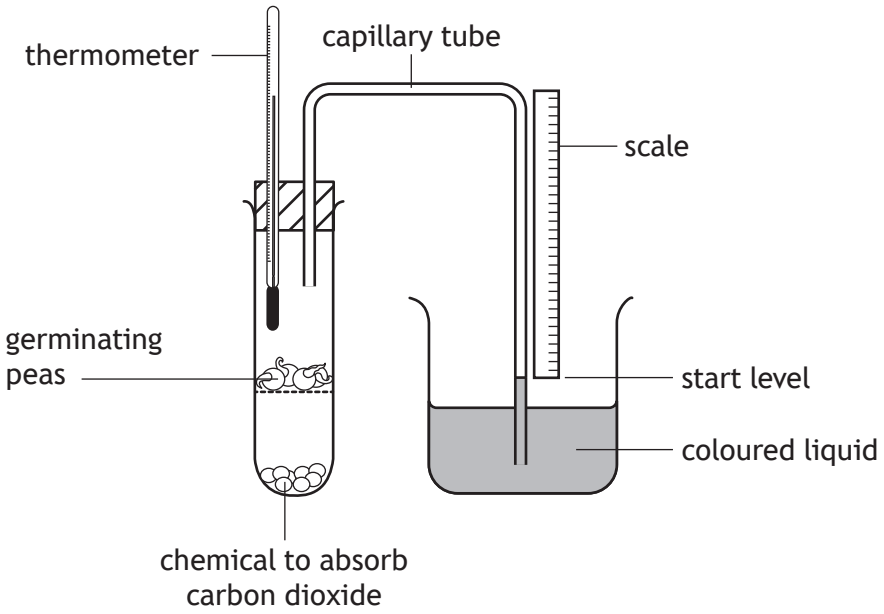
Complete the following sentence, using the words **increase, decrease** or **stay the same**, to predict what would happen if the experiment was repeated at pH 4. **1**

At pH 4, the rate of oxygen production would _____

in each tissue.

[Turn over

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



The level of the coloured liquid 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.

Respirometer	*Temperature* (ºC)	*Contents*	*Rise in liquid level* (mm)	*Rate of oxygen uptake* (mm per minute)
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) Complete the table above by calculating the rate of oxygen uptake per minute by the peas in respirometer C. **1**

Space for calculation

5. (a) (continued)

(ii) Using the results from the table complete the following conclusion by underlining one option in the bracket. **1**

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

(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**

_____

_____

_____

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

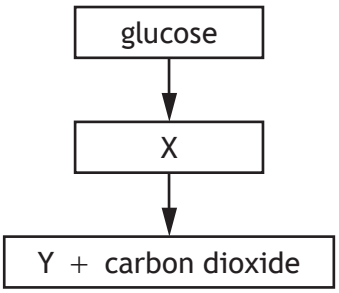
Describe the purpose of the controls in **this** investigation. **1**

_____

_____

_____

(b) The diagram below represents the fermentation pathway in a plant cell.



Choose either molecule X or Y and state its name. **1**

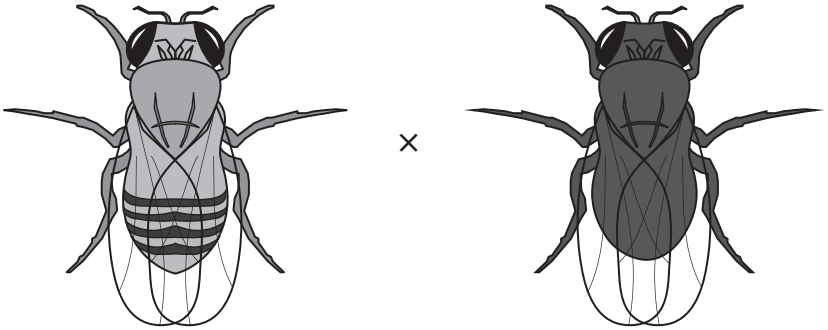
Molecule _____

Name _____

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.

The parent flies used in a cross are shown in the diagram.



Genotype:	GG	×	gg
Phenotype:	Grey body		Black body

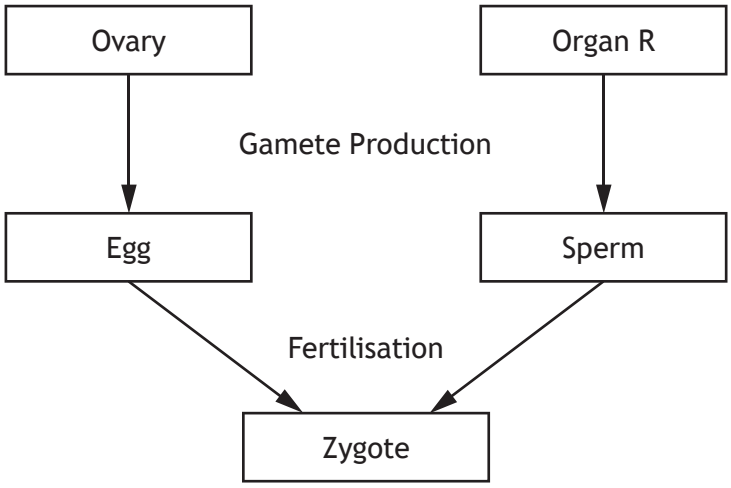
(a) Using the information given, underline one option in each bracket to complete the following sentences. **2**

Body colour in fruit flies is an example of { discrete / continuous } variation.

The F_1 flies produced from this cross will be { homozygous / heterozygous }.

6. (continued)

(b) The diagram relates to sexual reproduction in humans.



(i) Name organ R. **1**

_____

(ii) Describe what happens during fertilisation. **1**

_____

_____

_____

(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**

_____

_____

_____

_____

[Turn over

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

Cause of adult deaths	*Number of adult deaths* (per 100 000 population)	
	Males	*Females*
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**

Space for calculation

_____ : _____

Males *Females*

(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**

_____

(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**

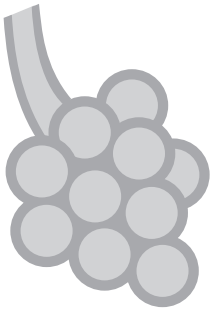
_____

7. (continued)

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

The diagrams represent lung tissues which have undamaged and damaged alveoli.

undamaged



damaged



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

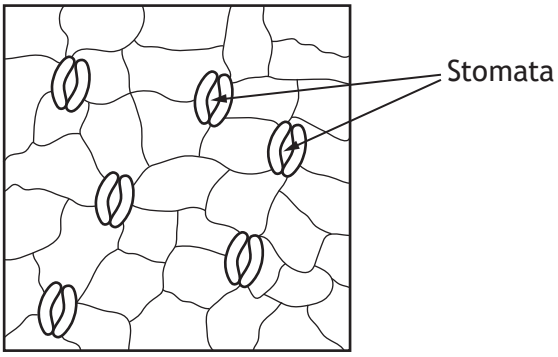
_____

[Turn over

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 as shown.

Plant species A



The area shown on the diagram above measures 0·04 mm^2.

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

Space for calculation

(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**

(ii) Tick (✓) one box below to show the environmental condition to which this plant has become best adapted. **1**

Dry ☐ Cool ☐ 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**

_____

(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**

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[Turn over

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

(a) (i) Name the organ which produces insulin. **1**

_____

(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**

_____

_____

_____

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

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

Type of insulin	*Time for insulin to start working*	*Time for insulin levels to peak*	*Duration in blood* (hours)
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**

_____

(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**

_____

10. (continued)

(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**

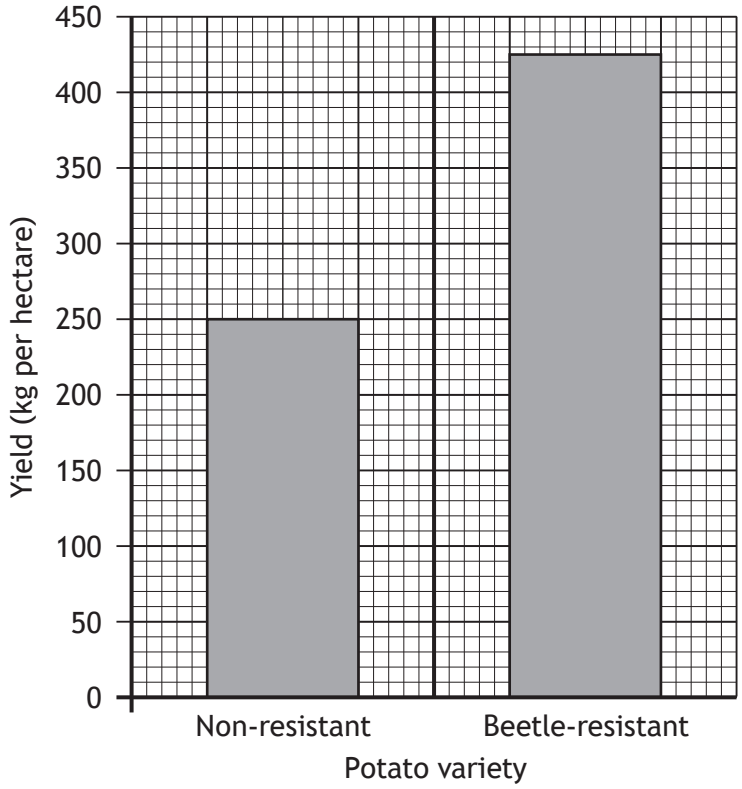
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[Turn over

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 below.



(a) Describe how the reliability of these results could be increased. **1**

_____

_____

(b) Calculate the difference in yield between the two varieties. **1**

Space for calculation

_____ kg per hectare

11. (continued)

(c) Identify a variable that would have to be kept the same between the two fields to ensure the results were valid. **1**

_____

(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**

_____

[Turn over

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**

_____

(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**

_____

(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**

_____

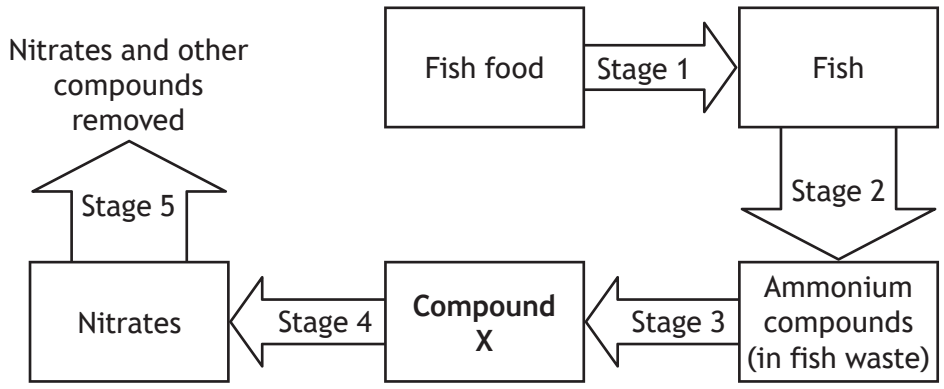
13. Decide if each of the following statements about evolution is **True** or **False** and tick (✓) the appropriate box.

If the statement is **False**, write the correct word in the **Correction** box to replace the word underlined in the statement. **3**

Statement	*True*	*False*	*Correction*
Genetic variation within a population allows the population to <u>adapt</u> in a changing environment.			
Isolation barriers can be geographical, <u>environmental</u> or reproductive.			
Sub-populations evolve until they become genetically <u>identical</u>.			

[Turn over

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



(a) (i) Name compound X. **1**

_____

(ii) Give the number of a stage in the process shown above, which involves nitrifying bacteria. **1**

Stage _____

(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**

_____

(ii) Nitrates supply organisms with nitrogen.

State why nitrogen is required. **1**

_____

(c) Decomposers, such as bacteria, help to break down waste and dead organisms.

Name another type of microorganism which carries out this role. **1**

_____

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

Air pollution level	*Most common type of lichen present*
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.

	Number of lichen species present		
Site	*Shrubby*	*Leafy*	*Crusty*
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**

_____

_____

(ii) Calculate the average number of leafy lichen species present at the four sites. **1**

Space for calculation

_____

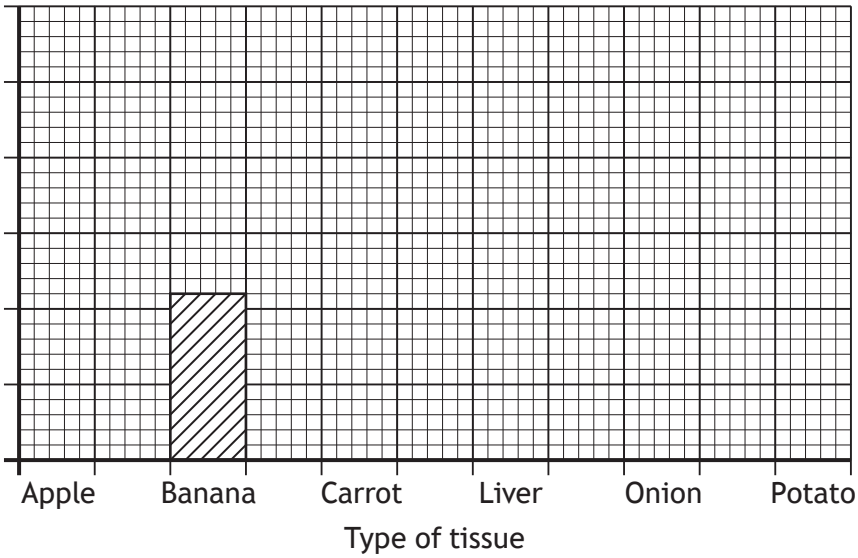
(b) State the name given to species, such as lichen, which are used to estimate levels of pollution. **1**

_____

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

ADDITIONAL GRID FOR QUESTION 4(a)



MARKS | DO NOT WRITE IN THIS MARGIN

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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