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| Candidate surname | Other names |
|---|---|
| | |

Centre Number | Candidate Number

# Pearson Edexcel International GCSE (9–1)

Friday 10 May 2024

Morning (Time: 2 hours)

Paper reference **4BI1/1BR 4SD0/1BR**

# Biology

**UNIT: 4BI1**
**Science (Double Award) 4SD0**
**PAPER: 1BR**

You must have:
Ruler, calculator

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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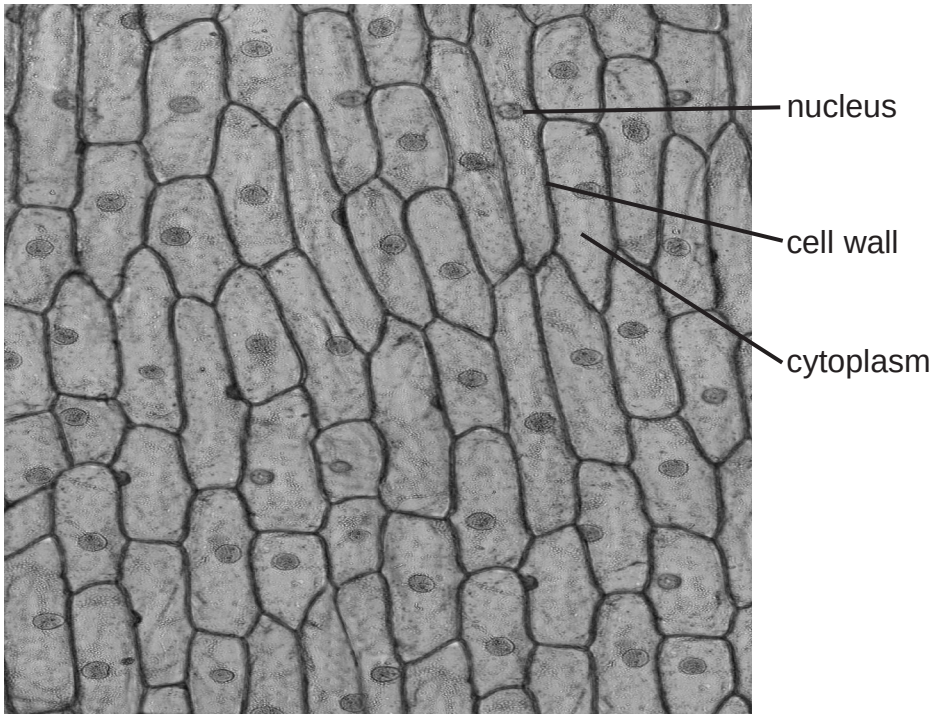
**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒.** If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The image shows some cells from onion epidermis.




(Source: © TED KINSMAN / SCIENCE PHOTO LIBRARY)

(a) (i) Some structures in these onion cells are also found in human red blood cells.

Which row in the table is correct for human red blood cells?

**(1)**

| | Cell wall | Cytoplasm | Nucleus |
|---|---|---|---|
| ☒ **A** | absent | absent | absent |
| ☐ **B** | absent | absent | present |
| ☐ **C** | absent | present | absent |
| ☐ **D** | present | present | absent |

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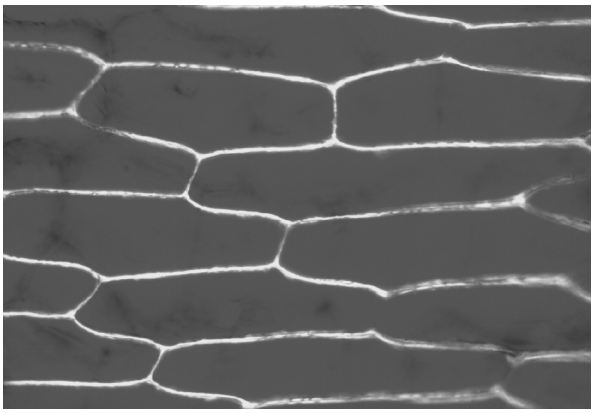
(ii) The onion cells in the image are all epidermis cells.

What is the term for a collection of cells of the same type?

**(1)**

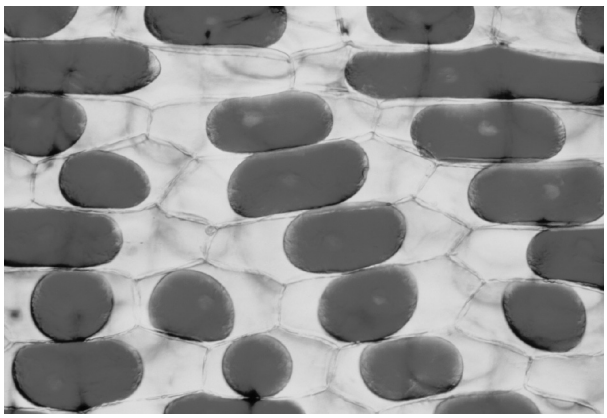
- ☒ A organ
- ☒ **B** organism
- ☒ **C** system
- ☒ **D** tissue

(b) The images show samples of red onion epidermis cells before and after being placed into a 5% sucrose solution for one hour.



(Source: © J.C. REVY, ISM / SCIENCE PHOTO LIBRARY)

**Before**



(Source: © J.C. REVY, ISM / SCIENCE PHOTO LIBRARY)

**After**

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(i) Describe how to make 10 $cm^3$ of a 5% sucrose solution from a 10% sucrose solution and pure water.

**(2)**

(ii) Explain the change in appearance of the onion cells shown in the images after being in the 5% sucrose solution for one hour.

**(3)**

**(Total for Question 1 = 7 marks)**

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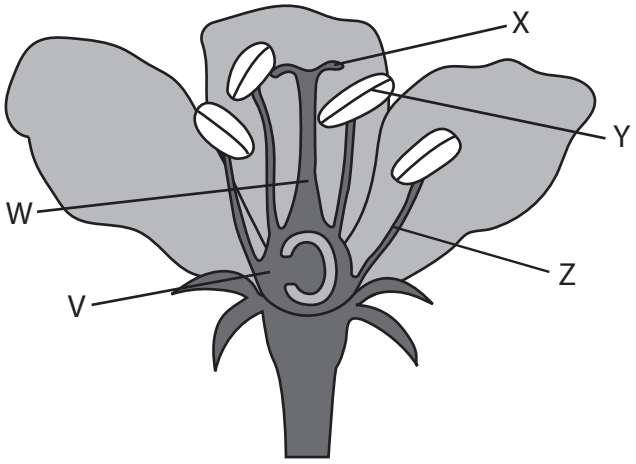
**2** The diagram shows the structure of an insect pollinated flower.




(a) (i) Which part of the flower produces pollen?

**(1)**

- ☒ A V
- ☒ **B** X
- ☒ **C** Y
- ☒ **D** Z

(ii) Which part of the flower becomes a fruit?

**(1)**

- ☒ A V
- ☒ **B** W
- ☒ **C** X
- ☒ **D** Y

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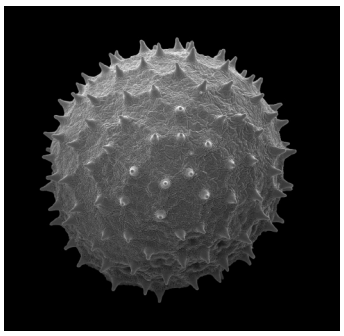
(b) The image shows a pollen grain produced by the plant.



(Source: © STEVE GSCHMEISSNER / SCIENCE PHOTO LIBRARY)

(i) The diameter of the pollen grain in the image is 30 mm.

The pollen grain has an actual diameter of 313 µm.

Calculate the magnification of the pollen grain in the image.

Give your answer to the nearest whole number.

[1 mm = 1000 µm]

**(3)**

magnification = × .....

(ii) State how the structure of the pollen grain is adapted to ensure insect pollination.

**(1)**

.....

.....

(c) Gardeners often reproduce plants by taking cuttings.

Explain why gardeners often reproduce plants by taking cuttings instead of growing the plants from seeds.

**(2)**

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**(Total for Question 2 = 8 marks)**

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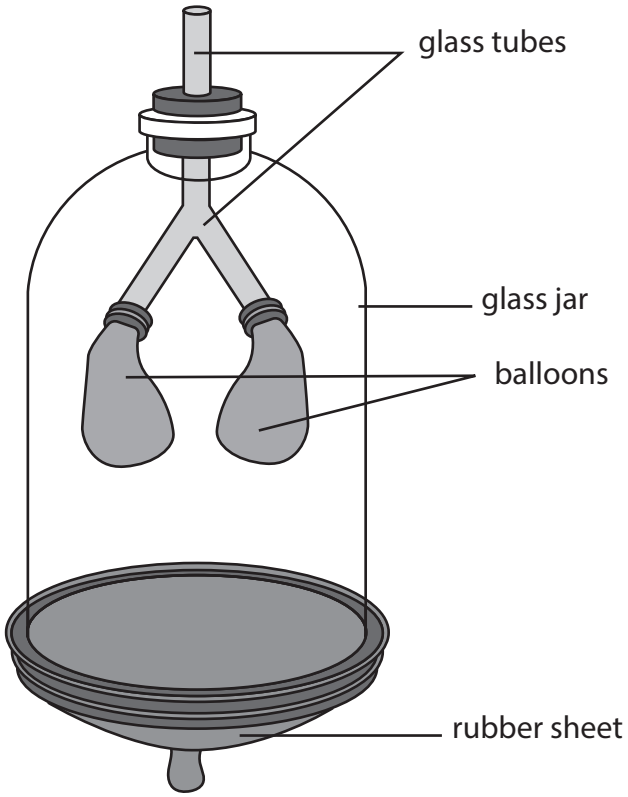
**3** The diagram shows a piece of apparatus used as a model for breathing.

The rubber sheet can be pulled down and pushed up to represent breathing.




(a) (i) Name the structure that the rubber sheet represents in a human.

**(1)**

.....

(ii) Which row in the table gives the changes in volume and pressure inside the glass jar when demonstrating inhalation?

**(1)**

| | Volume | Pressure |
|---|---|---|
| ☒ **A** | decreases | decreases |
| ☒ **B** | decreases | increases |
| ☒ **C** | increases | decreases |
| ☒ **D** | increases | increases |

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(iii) Give two reasons why the apparatus does not give an accurate representation of human ventilation.

**(2)**

1 .....

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2 .....

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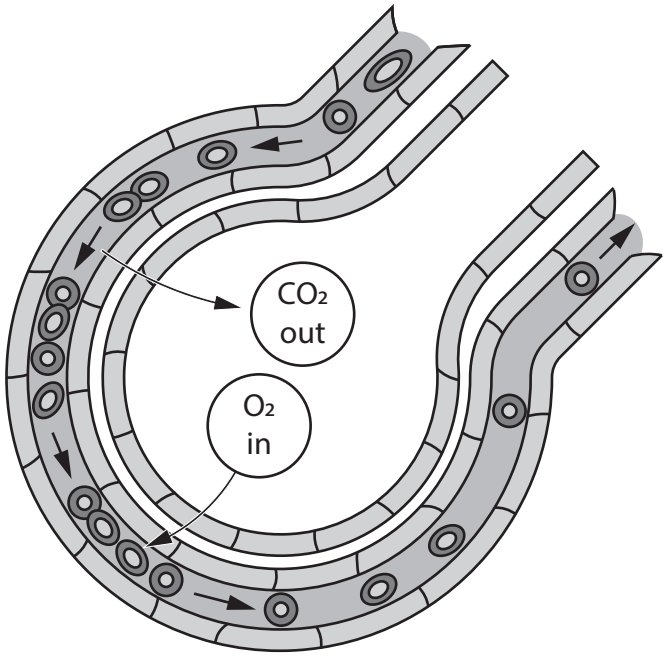
(b) The diagram shows the structure of an alveolus.




(i) Which of these is the order of the structures that air passes through, from the mouth to the alveolus, during inhalation?

**(1)**

- ☒ **A** bronchiole ➔ bronchus ➔ trachea ➔ alveolus
- ☐ **B** bronchus ➔ bronchiole ➔ trachea ➔ alveolus
- ☐ **C** trachea ➔ bronchiole ➔ bronchus ➔ alveolus
- ☐ **D** trachea ➔ bronchus ➔ bronchiole ➔ alveolus

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(ii) The total surface area of the alveoli in lungs is very large.

A typical human lung has 480 000 000 alveoli.

Each alveolus has a surface area of 0.0040 $mm^2$.

Calculate the total surface area, in $mm^2$, of the alveoli in one typical human lung.

Give your answer in standard form.

**(2)**

total surface area in one human lung = ..... $mm^2$

(iii) Explain two ways that a single alveolus is adapted to maximise gas exchange.

**(4)**

1 .....

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2 .....

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(iv) Describe a simple laboratory experiment to investigate the effect of exercise on the rate of carbon dioxide release from a human.

**(3)**

**(Total for Question 3 = 14 marks)**

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**4** A student uses this method to investigate the effect of temperature on the digestion of starch by the enzyme amylase.

- place 5 $cm^3$ of starch solution into a test tube
- place 1 $cm^3$ of amylase solution into a second test tube
- place both the test tubes into a water bath at 10 °C for 10 minutes
- then pour the amylase solution into the starch solution and mix
- test a sample of the mixture for the presence of starch every five minutes until no more starch is present
- repeat at temperatures of 20 °C, 30 °C, 40 °C and 50 °C.

The investigation is repeated two more times at each temperature.

(a) (i) What is produced when starch is digested by amylase?

**(1)**

☒ A amino acids

☒ **B** glycerol

☒ **C** maltose

☒ **D** sucrose

(ii) Which of these parts of the human alimentary canal produce amylase?

**(1)**

1 colon

**2** pancreas

**3** salivary gland

☒ **A** 1 and 2 only

☒ **B** 1, 2 and 3

☒ **C** 2 and 3 only

☒ **D** 3 only

(b) (i) State why the test tubes are placed in a water bath for 10 minutes before mixing the contents.

**(1)**

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(ii) Describe how the student could test a sample of the mixture for starch.

**(2)**

(c) The table shows the results of the student's investigation.

| Temperature in °C | Time taken for all starch to be digested in minutes | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | mean |
| 10 | 45 | 50 | 50 | 48 |
| 20 | 30 | 35 | 35 | 33 |
| 30 | 20 | 25 | 25 | |
| 40 | 10 | 10 | 15 | 12 |
| 50 | starch not digested | starch not digested | starch not digested | starch not digested |

(i) Calculate the mean time taken for all starch to be digested at 30 °C.

Give your answer to two significant figures.

**(2)**

mean time = ..... minutes

(ii) Explain the effect of increasing the temperature from 10 °C to 40 °C on the time taken for all the starch to be digested.

**(2)**

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(iii) Explain why the starch was not digested when the temperature was 50 °C.

**(2)**

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(iv) Explain how the student could modify the investigation to give a more accurate measure of the temperature at which the amylase activity is fastest.

**(2)**

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**(Total for Question 4 = 13 marks)**

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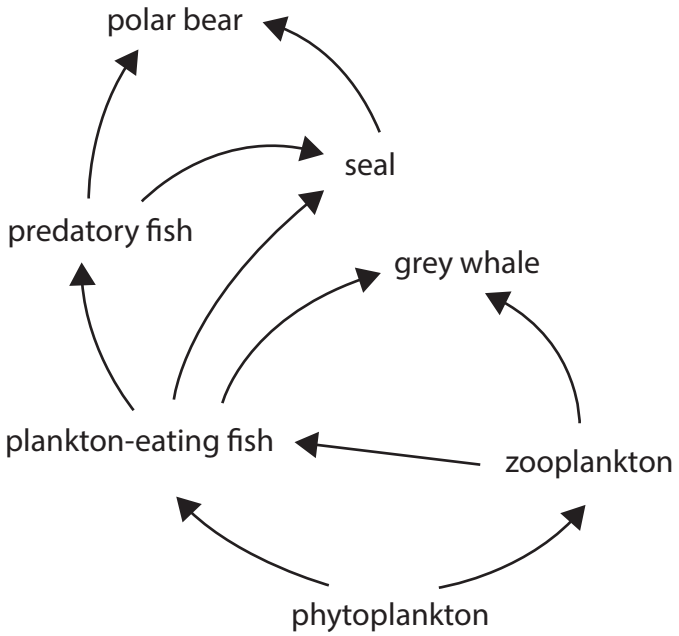
**5** The diagram shows part of a food web for the Arctic Ocean.




(a) (i) Phytoplankton are protoctists that photosynthesise.

Which of the following features do phytoplankton share with plants?

**(1)**

1 chitin cell wall

**2** chloroplast

**3** nucleus

- ☒ **A** 1 and 2 only
- ☒ **B** 1 and 3 only
- ☒ **C** 2 and 3 only
- ☒ **D** 2 only

(ii) Name two organisms in this food web that can feed as tertiary consumers.

**(1)**

1 .....

2 .....

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(iii) Draw the food chain with the most trophic levels in this food web.

**(2)**

(b) Scientists measure the changes in the biomasses of phytoplankton and zooplankton in one year.

(i) During a month in spring, the scientists found that the biomass of phytoplankton in the water increased from 1.2 mg per $dm^3$ to 12.6 mg per $dm^3$.

Calculate the percentage increase of these phytoplankton in this month.

**(2)**

percentage increase = ..... %

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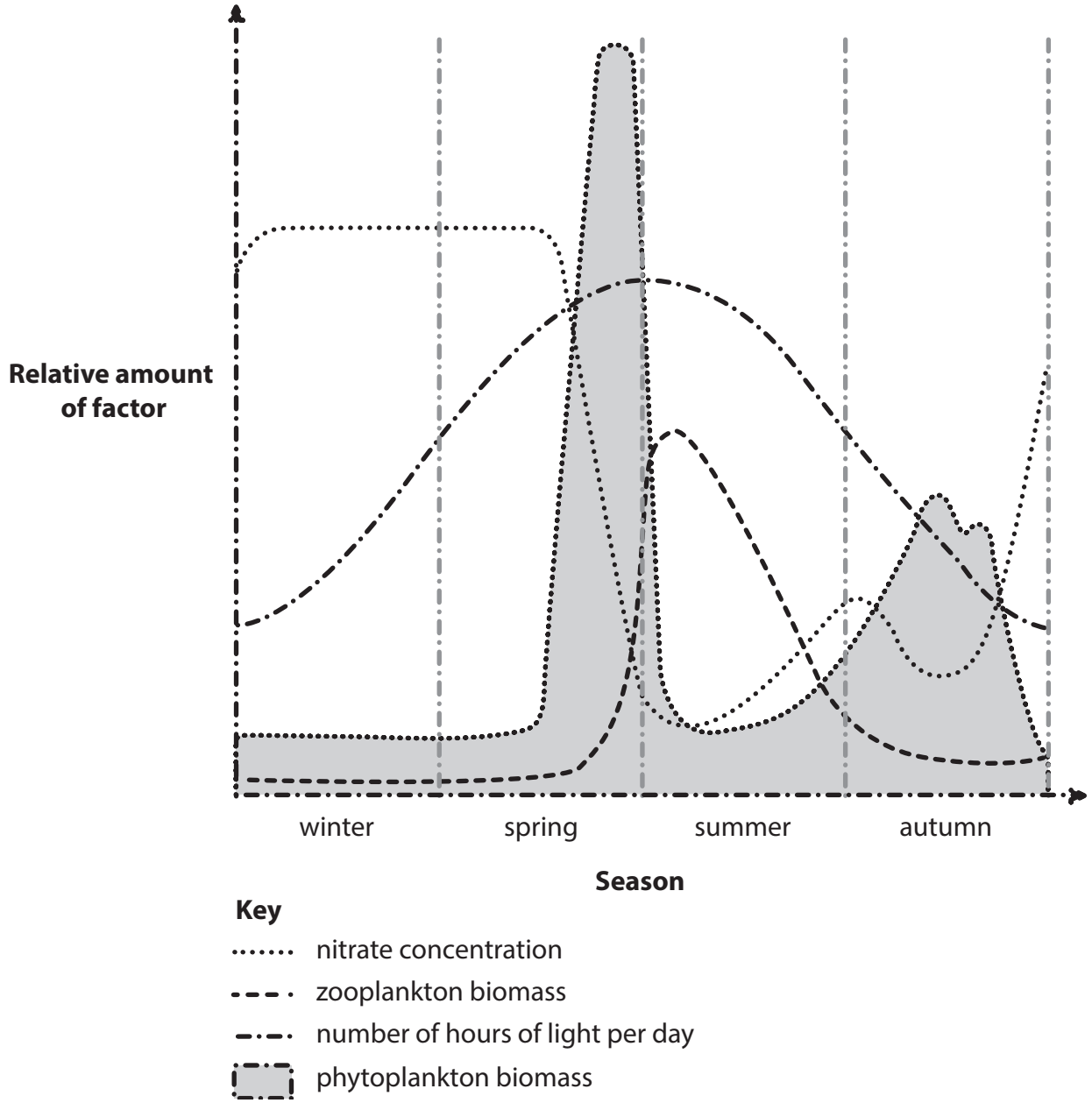
(ii) During the year, the scientists also measured the change in the number of hours of light each day and the change in nitrate concentration in the water near the surface of the ocean.

The graph shows their results.

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Discuss the reasons for the changes in the biomasses of phytoplankton and zooplankton during the year.

**(5)**

**(Total for Question 5 = 11 marks)**

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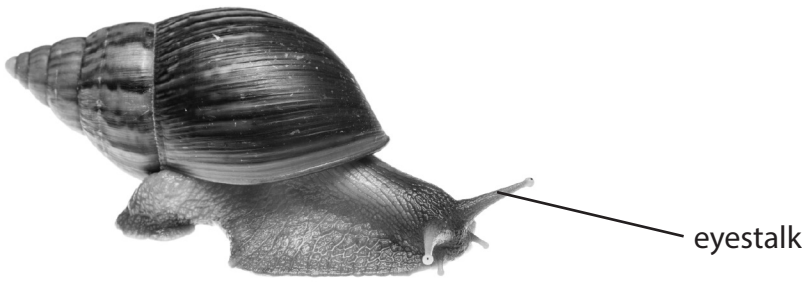
**6** A reflex is a rapid response to a stimulus.

(a) The withdrawal of a hand when a finger touches a hot object is an example of a reflex.

Describe the pathway of a nerve impulse in the reflex arc involved in this response.

**(4)**

(b) The photograph shows an African land snail.




(Source: © MYN / JORIS VAN ALPHEN / NATURE PICTURE LIBRARY / SCIENCE PHOTO LIBRARY)

When an African land snail is touched on its eyestalk, the snail goes back into its shell. The snail then remains in its shell for a period of time.

A student investigates the effect that repeatedly touching the eyestalk has on the time the snail remains in its shell.

This is the student's method.

- gently touch the eyestalk of a snail with a cottonwool bud so that the snail goes back into its shell
- measure the time the snail remains in its shell
- after the snail has come back out of its shell, touch the eyestalk again so that the snail goes back into its shell again
- measure the time the snail remains in its shell
- repeat the stimulus six more times

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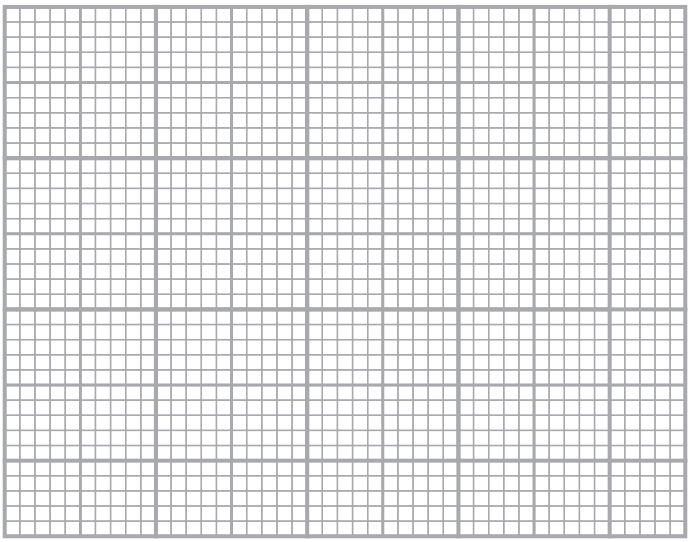
The student's results are shown in the table.

| Stimulus number | Time snail remains in its shell in seconds |
|---|---|
| 1 | 12 |
| 2 | 12 |
| 3 | 10 |
| 4 | 11 |
| 5 | 10 |
| 6 | 7 |
| 7 | 5 |
| 8 | 3 |

(i) Plot a graph to show the effect of stimulus number on the time the snail remains in its shell.

Join your points with ruled, straight lines.

**(5)**



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(ii) Describe the effect of increasing stimulus number on the time the snail remains in its shell.

**(2)**

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(iii) Suggest a benefit to the snail of the difference in response to the repeated stimulus.

**(2)**

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**(Total for Question 6 = 13 marks)**

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**7** Coronary heart disease (CHD) is caused by damage to the walls of the coronary artery.

(a) (i) Explain two differences between the structure of the wall of an artery and the wall of a vein.

**(4)**

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2 .....

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(ii) The diagram shows a cross-section of a coronary artery from a healthy person and from a person with CHD.



Artery from a healthy person

Artery from a person with CHD

The heart needs to respond to extra demands during exercise.

Explain why, during exercise, the heart of a person with CHD would not respond as efficiently as the heart of a healthy person.

**(3)**

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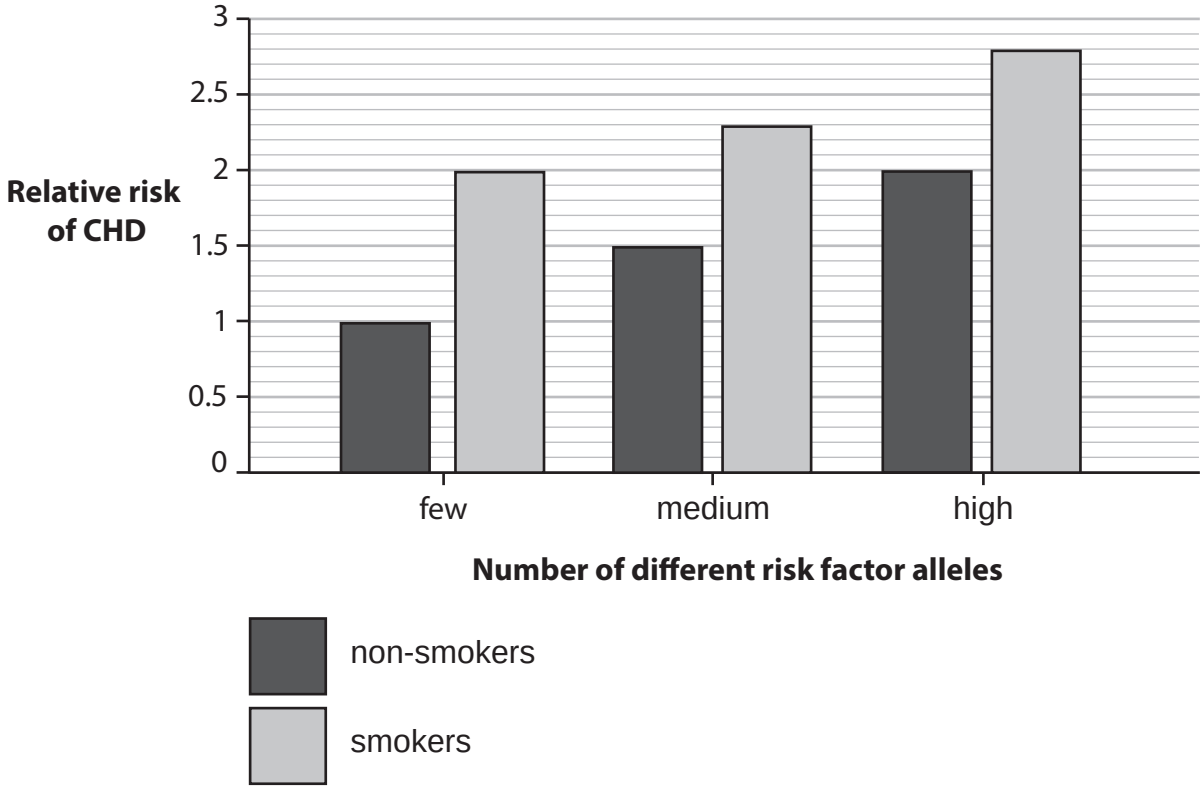
(b) Genetics and smoking are two risk factors for CHD.

The alleles of some genes increase the risk of developing CHD in people. These are known as risk factor alleles.

Scientists compared the relative risk of developing CHD in people with different numbers of these risk factor alleles.

The scientists also compared the risk of developing CHD for non-smokers and smokers.

The graph shows the scientists' results.




(i) Give one risk factor for CHD, other than genetics and smoking.

**(1)**

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(ii) Comment on the relationship between the number of risk factor alleles and smoking on the risk of developing CHD.

Use data from the graph to help your answer.

**(5)**

**(Total for Question 7 = 13 marks)**

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**8** Lactose is the sugar found in milk.

The lactose needs to be digested in humans by an enzyme called lactase so the products can be absorbed.

All human babies produce lactase in their intestines.

People who are lactose intolerant stop producing lactase and are unable to digest lactose sugar as adults.

Lactose intolerance is a genetic condition caused by a recessive allele, **d**.

The ability to digest lactose is caused by a dominant allele, **D**.

(a) (i) The diagram shows a family pedigree.

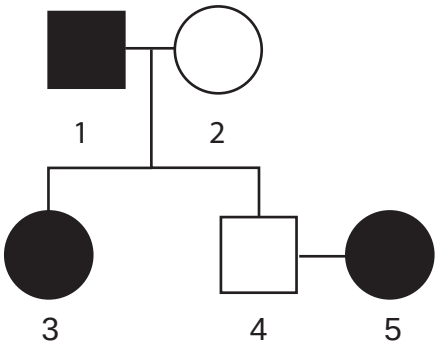
**Key**

male with lactose intolerance

male without lactose intolerance

female with lactose intolerance

female without lactose intolerance




Use a genetic diagram to determine the probability of individuals 4 and 5 having a child with lactose intolerance.

**(4)**

probability = .....

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(ii) People with lactose intolerance often get diarrhoea (production of faeces with high water content) if they drink milk.

Suggest why people who cannot digest lactose get diarrhoea if they drink milk.

**(2)**

(iii) Milk is a nutritious substance that provides several food groups.

In areas of the world where milk is a main part of the diet, fewer people are lactose intolerant.

Explain how natural selection has resulted in fewer people being lactose intolerant in areas of the world where milk is a main part of the diet throughout their lives.

**(4)**

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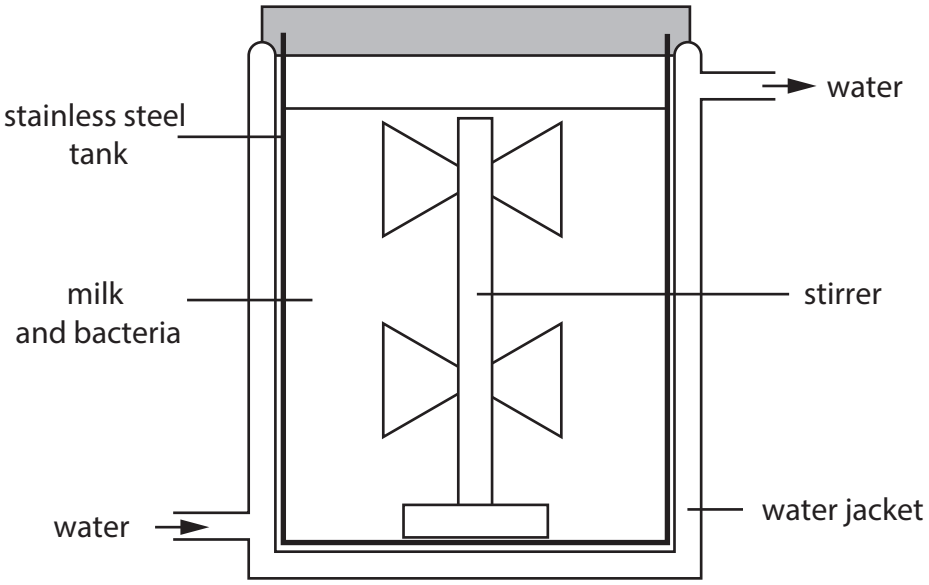
(b) Milk can be used to produce yoghurt.

The diagram shows a fermenter that can be used to produce yoghurt in industry.




(i) Explain the role of the stirrer in the fermenter.

**(2)**

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(ii) Explain the role of the water jacket in the fermenter.

**(2)**

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**(Total for Question 8 = 14 marks)**

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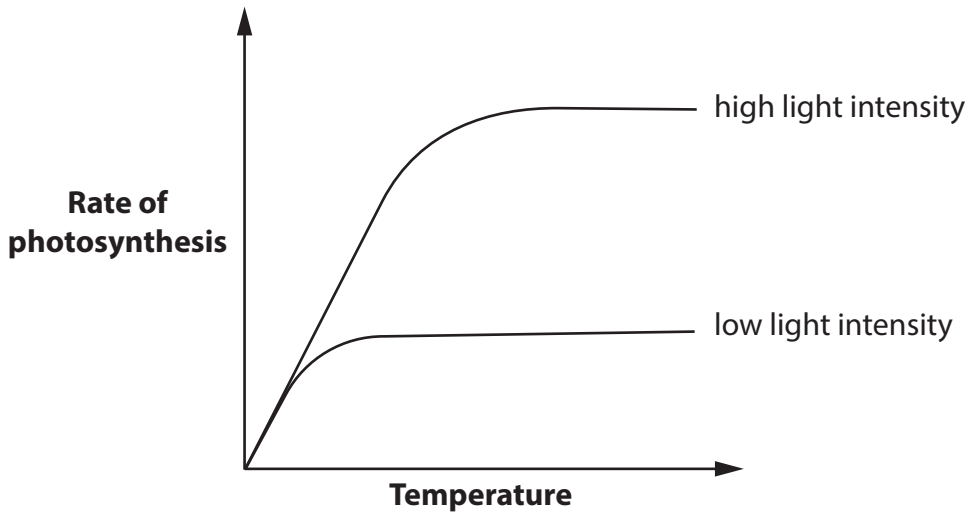
**9** Transgenic varieties of tomato plants have been produced that can photosynthesise more efficiently than natural varieties.

(a) To make the transgenic tomato plants, a gene is inserted into a vector that is then placed into tomato plant cells.

Describe how a recombinant vector containing a gene can be produced.

**(3)**

(b) The graph shows the effect of temperature on the rate of photosynthesis of tomato plants at two different light intensities.




Explain the effect of temperature on the rate of photosynthesis of the tomato plants at high and low light intensity.

**(3)**

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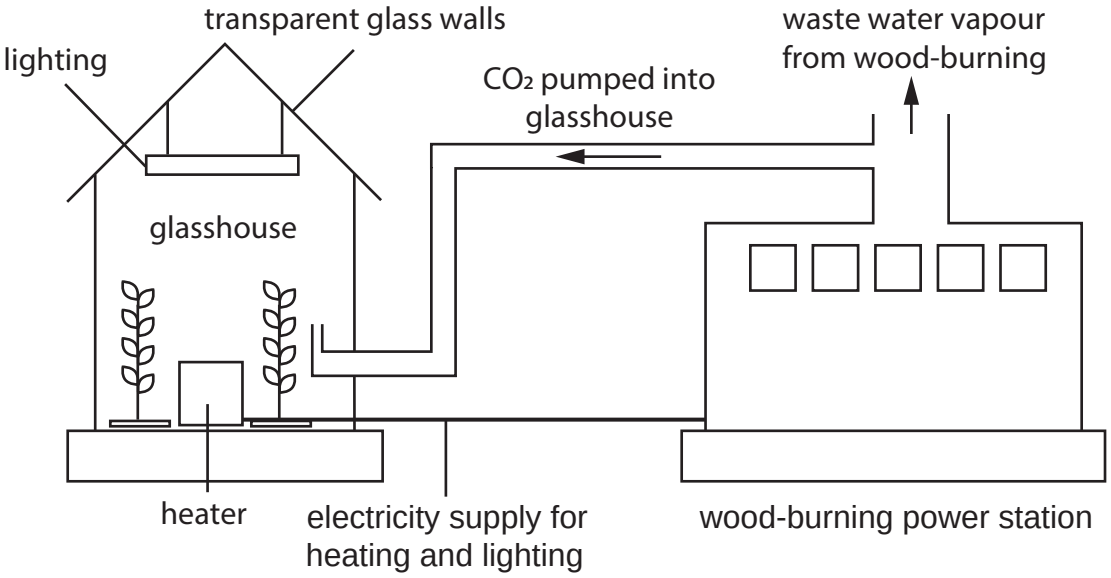
(c) The diagram shows a sustainable glasshouse system that is used in the United Kingdom to grow tomato plants throughout the year.

The glasshouse has artificial lighting and heating powered by electricity from a wood-burning power station.

Carbon dioxide is pumped from the power station into the glasshouse.

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Discuss the advantages of growing tomato plants in this glasshouse system.

In your answer include the benefits for farmers and for the environment.

**(5)**

**(Total for Question 9 = 11 marks)**

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**10** The photograph shows a scarecrow in a crop field.



(Source: © CONCEPTUAL IMAGES / SCIENCE PHOTO LIBRARY)

Scarecrows are models of humans placed into fields to stop birds eating crops.

Design an investigation to find out if changing the colour of the clothes the scarecrow is wearing alters how effective the scarecrow is at stopping birds eating crops.

Your answer should include experimental details and be written in full sentences.

**(6)**

**(Total for Question 10 = 6 marks)**

**TOTAL FOR PAPER = 110 MARKS**

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