

Friday 26 November 2021 – Morning**GCSE (9–1) Biology B (Twenty First Century Science)****J257/02** Depth in Biology (Foundation Tier)**Time allowed: 1 hour 45 minutes****You must have:**

- a ruler (cm/mm)

You can use:

- an HB pencil
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE

- Read each question carefully before you start your answer.

Answer **all** the questions.

1 The health of humans can be affected by disease.

(a) Draw lines to connect each **disease** with the correct type of **pathogen** that causes it.

Disease	Pathogen
Athlete's foot	Bacteria
Influenza	Fungus
Malaria	Protist
	Virus

[3]

(b) Tuberculosis is a disease in humans. It is caused by the same type of pathogen that causes *Salmonella* food poisoning.

Suggest what type of pathogen causes tuberculosis.

..... [1]

(c) Blood cells in the human body help to protect us against pathogens.

Which type of blood cell makes antibodies?

Tick (✓) **one** box.

All types of blood cells

☐

Platelets

☐

Red blood cells

☐

White blood cells

☐

[1]

(d) Human diseases can be spread by coughs and sneezes.

Identify **three other** ways in which diseases can be spread in humans.

1

.....

2

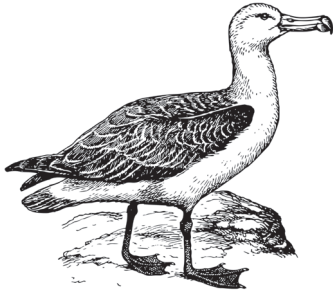
.....

3

.....

[3]

- 2 An albatross is a large sea bird.



- (a) Fish and squid are eaten by the albatross.
Albatross chicks are eaten by large mice.

Draw a food web for this community of organisms.

[2]

- (b) Read the article.

The albatross chicks on the island are hunted and eaten by large mice.

There were no mice on the island originally. They were brought to the island by human visitors in the 1800s. Since then, the average size of the mice has gradually increased, and most are now giants!

These albatross are now a critically endangered species.

- (i) The mice that were brought to the island were a new predator for the albatross. The new predator has caused the size of the albatross population to decrease.

Describe **two other** factors that could cause a decrease in the size of the albatross population.

1.
.....
2.
.....

[2]

- (ii) Statements **A** to **D** explain how natural selection caused the mice to become larger.

They are **not** in the correct order.

- A** These mice got more food, so were more likely to survive to reproduce.
- B** Big mice had an advantage when competing to eat albatross chicks.
- C** More mice in each generation inherited genes that allowed them to grow larger.
- D** When mice were brought to the island, some were large and some were small.

Write the letters in the boxes to show the correct order.

--	--	--	--

[3]

- (iii) The table shows how many albatross were counted on the island in five squares measuring 1 km² each, in 2020.

Square	1	2	3	4	5
Number of albatross	32	64	50	79	60

Calculate the mean number of albatross per km² in 2020 on the island.

Mean = [2]

- (iv) Scientists have estimated that:

- In 1980, the mean number of albatross per km² of the island was 1429.
- In 2000, the mean number of albatross per km² of the island was 159.

Scientists plan to kill all of the large mice on the island by poisoning them.

Suggest **two** reasons that could be used to justify the scientists' plan.

1.
-
2.
-

[2]

3 The circulatory system transports blood around the human body.

(a) Blood is transported in blood vessels.

Complete the table by identifying each type of blood vessel **and** explaining the function of each structure.

Type of blood vessel	Vessel's structure	Function of the vessel's structure
.....	Thick walls made of muscle and elastic tissue	
.....	Thin walls containing elastic tissue	Allows the vessel to be squashed, to push blood along
	Valves inside the vessel	

[4]

- organs that the blood travels to in the excretory system, the digestive system, and the gaseous exchange system.
- the correct order in which the blood travels to these systems.

[6]

4 Sarah and Ben are thinking about having a baby.

(a) Each body cell in Ben's body contains 46 chromosomes.

(i) How many chromosomes would you expect to find in one of Ben's sperm cells?

Number of chromosomes = [1]

(ii) How many chromosomes would you expect to find in one of Sarah's egg cells if it was fertilised by one of Ben's sperm cells?

Number of chromosomes = [1]

(b) Sarah and Ben decide they are not yet ready to have a baby.

(i) Explain how a contraceptive pill will help to prevent Sarah from becoming pregnant.

.....

 [3]

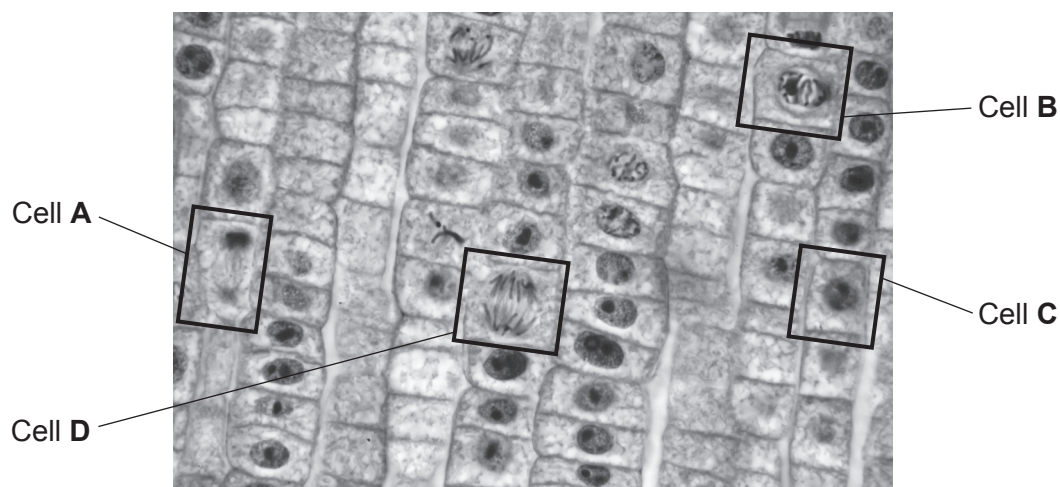
(ii) Explain the advantages of Ben wearing a condom during sex even if Sarah is taking the pill.

.....

 [3]

- 5 The photograph shown was taken using a light microscope.

Four cells have been labelled.



- (a) Cells **A**, **B**, **C** and **D** illustrate different stages and events during the cell cycle.

Complete the information in the table, using the photograph.

Name of stage of the cell cycle	Events that take place during the stage	Cell that illustrates the event
.....	Chromosomes are unwound and spread out inside the nucleus so that they can be copied.	C
.....	Chromosomes wind up like springs, and each one has a copy attached to it.	
	The nucleus breaks down. The chromosome copies separate and move to opposite ends of the cell.	
	Two new nuclei form at opposite ends of the cell. The cell divides in two.	

[5]

- (b) The photograph shows cells from the tip of a plant's root.

Suggest why cells in the root tip are dividing.

.....

.....

.....

.....

[2]

6 Plants take up water from soil.

(a) A scientist compared how much water was taken up by two plants.

The scientist set up the plants as shown in **Fig. 6.1**.



Plant A

- Bright light
- Plenty of air
- Given 200 ml of water each time the soil has dried out



Plant B

- Dim light
- Plenty of air
- Given 200 ml of water each time the soil has dried out

Fig. 6.1

(i) Identify **two** other factors that the scientist should have tried to keep the same for both plants.

1.

2.

[2]

(ii) Photosynthesis took place in the two plants.

Fig. 6.2 shows a summary of photosynthesis.

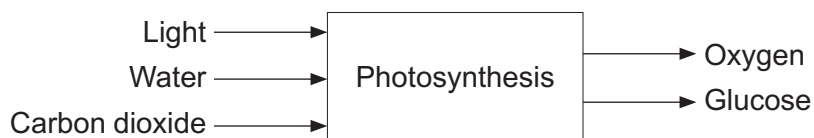


Fig. 6.2

The scientist found that plant **A** took up more water than plant **B**.

Explain the scientist's finding.

Use **Fig. 6.1** and **Fig. 6.2** to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[3]

- (b) **Fig. 6.3** shows an experiment that a class did, which involved growing a plant in a pot for one year.



Fig. 6.3

- (i) Water was added to the soil in the pot several times each week. The total amount of water added to the soil in each 7-day week was 280 ml.

Calculate the rate at which water was added to the soil, in **ml/day**.

Rate = ml/day [2]

- (ii) The rate at which water is added to the soil is **not** an accurate measurement of the rate at which the plant takes up the water.

Which piece of apparatus could be used to accurately measure the rate at which the plant takes up water?

Put a ring around the correct answer.

Balance

Measuring cylinder

Potometer

Thermometer
[1]

- (c) The class recorded the mass of the pot and soil at the start of the year and again at the end of the year. They also recorded the mass of the plant on its own. The results are shown in **Fig. 6.4**.

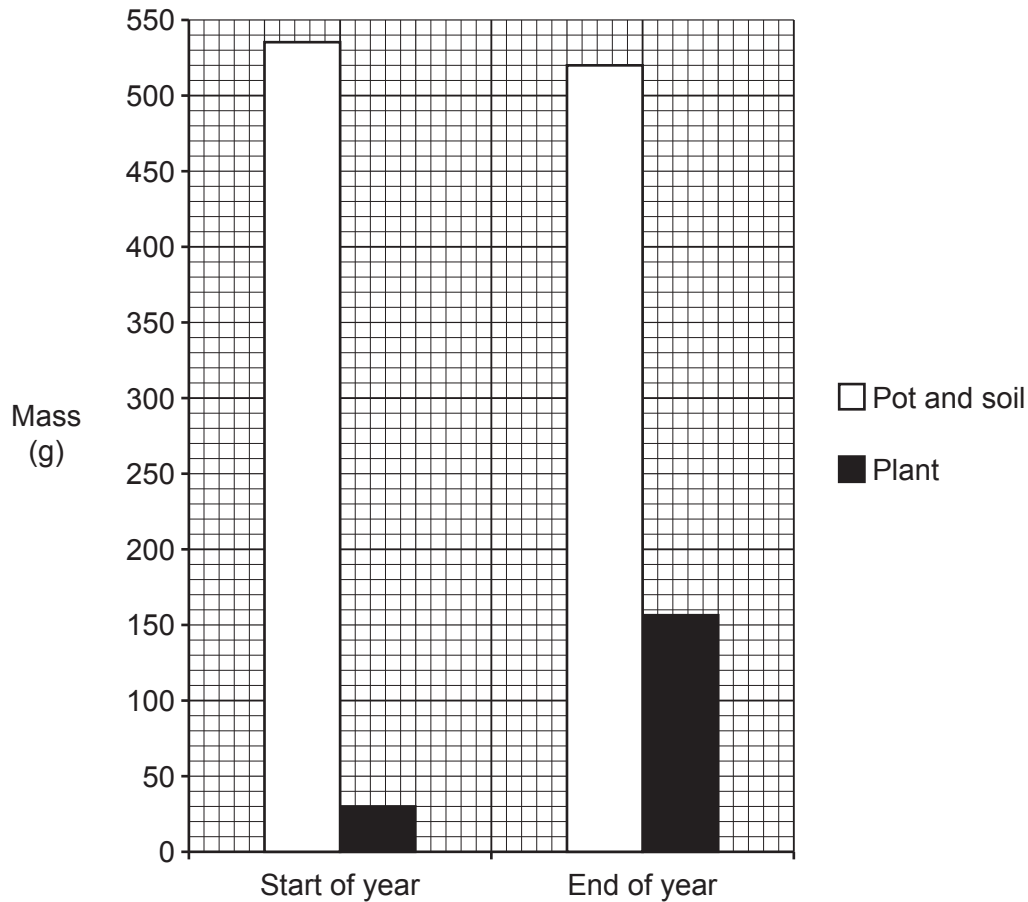


Fig. 6.4

- (i) What was the mass of the pot and soil at the end of the year, using **Fig. 6.4**?

Mass = g [1]

- (ii) The mass of the plant was 30g at the start of the year.
The mass of the plant was 156g at the end of the year.

Calculate the percentage change in the mass of the plant.

Use the equation: $\text{Percentage change} = \frac{\text{difference}}{\text{original}} \times 100$

Percentage change = % [2]

- (iii) Jamal suggests a conclusion for the class experiment.

Jamal

The plant gained all of that mass because it took in soil.



Explain why Jamal is wrong.

Use data from **Fig. 6.4** to support your answer.

.....

.....

.....

.....

[2]

- (iv) Sundip suggests a different conclusion.

Sundip

The plant's mass increased because it took in carbon dioxide as well as water.



Suggest why Sundip's conclusion is **not** supported by the data collected by the class.

.....

.....

.....

.....

[2]

- 7 The genome is the entire genetic material of an organism. A copy of an organism's genome is stored in each one of its cells.

(a) Explain how the genetic material is stored in an animal cell **and** how it is used to control what happens in the cell.

.....

.....

.....

.....

.....

..... [3]

(b) Give **two** ways in which the genetic material is stored in a prokaryotic cell such as a bacterium.

1.

.....

2.

.....

..... [2]

(c) Scientists have created an image of a human female who lived 5700 years ago, as shown. The image is based on information in her genome.

The scientists found her complete genome in the remains of some of her cells.



(i) Describe what evidence her genome would have contained to show that she was female.

.....

.....

.....

..... [2]

- (ii) The scientists worked out that she had blue eyes.

Suggest how they could have worked this out from her genome.

.....

.....

.....

..... [2]

- (iii) Even though scientists found her complete genome, they cannot be sure that she looked exactly like the image.

Her genome is **not** the only factor that would have affected her features.

Describe **three** things in her environment or her lifestyle that could have affected her features.

1.

.....

2.

.....

3.

..... [3]

- (iv) How many of our features are affected by both our genome **and** our environment?

Tick (✓) **one** box.

All of our features

☐

A small number of our features

☐

Most of our features

☐

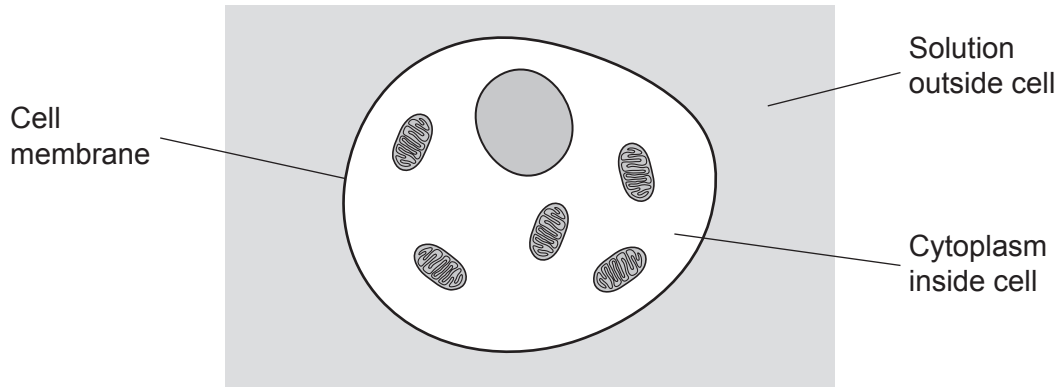
None of our features

☐

[1]

8 Substances can move into and out of cells.

(a) The diagram shows an animal cell.



(i) Osmosis is a type of diffusion.

Which type of particles move through the cell membrane by osmosis?

Tick (✓) **one** box.

Particles of all substances

☐

Particles of salt

☐

Particles of sugar

☐

Particles of water

☐

[1]

(ii) What would be the **net** movement of these particles by osmosis?

Draw **one** line to join the correct start of the answer to the correct end.

From where they
are concentrated...

...to where they are
less concentrated.

From where they
are **not** concentrated...

...to where they are
more concentrated.

...to where they have the
same concentration.

[1]

- (iii) Explain how the cell's membrane is able to let some particles move through it but prevents other particles from doing so.

.....

.....

.....

..... [2]

(b) Substances move into and out of plant cells.

A student investigated how the mass of raw pieces of potato is affected by soaking them in water containing different amounts of sugar.



The results of the investigation are shown in the table.

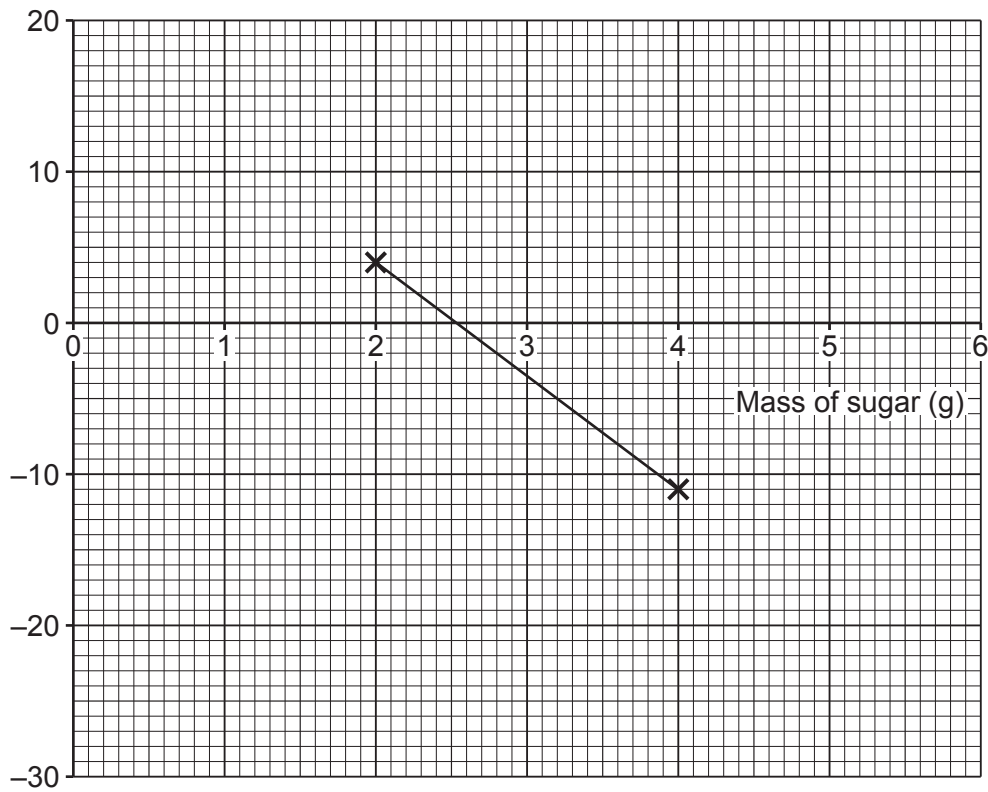
Volume of water (cm ³)	Mass of sugar (g)	Mean percentage change in mass of soaked potato pieces (%)
25	0	16
25	2	4
25	4	-11
25	6	-24

- (i)* At the start of the investigation the student was given:
- four cut pieces of potato ready to use
 - four beakers of water containing sugar, which were made using the volumes and masses stated in the table

Describe the apparatus **and** method the student could have used to collect the data in the final column of the table.

[6]

Some of the results of the investigation are shown in the graph.



(ii) Complete the graph by adding the missing axis name **and** plotting the missing results. [2]

(iii) Describe **and** explain the results of the investigation.
Use data from the graph to support your answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iv) Estimate the **concentration** of sugar inside the potato cells, using the graph.
Use the equation: $\text{concentration} = \frac{\text{mass}}{\text{volume}}$
Give your answer in g/cm^3 .

Concentration = g/cm^3 [2]

END OF QUESTION PAPER

This image shows a blank sheet of white paper designed for writing. It features a series of evenly spaced horizontal blue lines across its entire width. A single vertical blue line runs down the left side, creating a narrow margin. The paper is otherwise completely empty, with no text or markings.

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