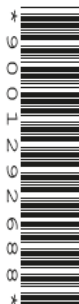


Tuesday 17 May 2022 – Morning

**GCSE (9–1) Combined Science B
(Twenty First Century Science)**

J260/05 Biology (Higher Tier)

Time allowed: 1 hour 45 minutes



You must have:

- a ruler (cm/mm)

You can use:

- a scientific or graph calculator
- an HB pencil



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

Centre number

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Candidate number

--	--	--	--

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 **95**.
- 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 **24** pages.

ADVICE

- Read each question carefully before you start your answer.

Answer **all** the questions.

1 Transpiration takes place in plants.

(a) Complete the sentences to describe transpiration.

Put a ring around each correct answer.

Water is **absorbed** / **lost** / **translocated** through the stomata in a plant's leaves.

This causes **sugars** / **water** / **water and sugars** to move up the
meristem / **phloem** / **xylem** tissue in the plant's stem.

[3]

(b) Fig. 1.1 shows one of the stomata from a leaf.

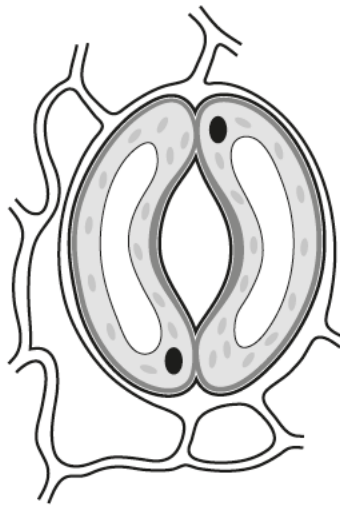


Fig. 1.1

Add **two** labels to Fig. 1.1.

Label 1 The pore through which water diffuses.

Label 2 A guard cell.

[1]

(c) Complete the sentences to describe how to set up a light microscope to look at a slide of stomata from a leaf.

Put a ring around each correct answer.

First, turn to the **×4** / **×10** / **×20** objective lens.

Use the coarse focus knob to move the objective lens to its **lowest** / **middle** / **highest** position.

Then clip the slide onto the **eyepiece** / **objective lens** / **stage**.

[2]

(d) Amir sets up a leafy twig in a bubble potometer as shown in Fig. 1.2.

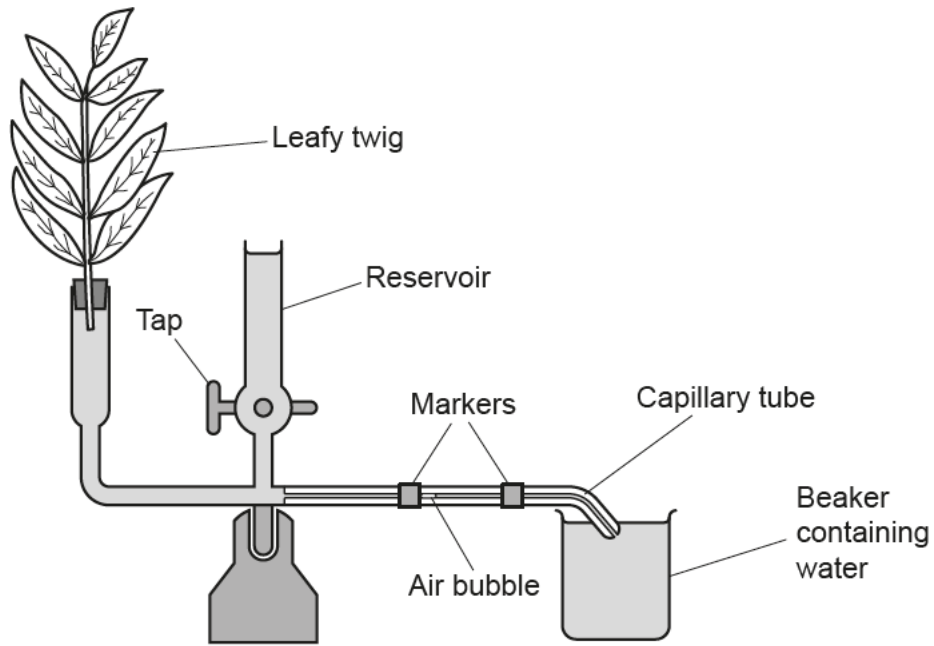


Fig. 1.2

Amir wants to use the bubble potometer to investigate the rate of transpiration in the leafy twig.

(i) Describe the **two** measurements Amir would need to make.

- 1
- 2 [2]

(ii) Suggest the purpose of the reservoir **and** tap.

-
-
-
- [2]

- (e) Amir investigated the rate of transpiration in the leafy twig in four different experiments.

The table shows Amir's results.

Experiment	Temperature (°C)	Wind speed (m/s)	Light level	Calculated mean rate (mm/s)
A	22	0.1	Dull	1.27
B	22	0.1	No light	0.61
C	20	4.8	Bright	1.54
D	28	0.3	Dull	

Amir has not yet calculated the mean rate for experiment **D**. The results from his three repeats of experiment **D** were 4.55, 4.17 and 0.75 mm/s.

- (i) Discuss arguments for and against ignoring the result of 0.75 mm/s for experiment **D**.

For

.....

Against

.....

[2]

- (ii) Amir decides to keep all three results for experiment **D**.

Calculate the mean rate for experiment **D**.

Give your answer to **two** decimal places.

Mean rate = ... mm/s [3]

- (f) Amir wants to make a conclusion about the effect of light level on the rate of transpiration.

Explain why he can **only** do this by comparing experiments **A** and **B**.

.....

..... [1]

- 2 Plants need to absorb nitrate ions to stay alive.

Complete the sentences to explain why a plant needs oxygen to absorb nitrate ions.

Use words from the list.

active transport	aerobic	anaerobic	ATP	diffusion
DNA	light	osmosis	oxygen	photosynthesis

The plant uses the process of to absorb nitrate ions.

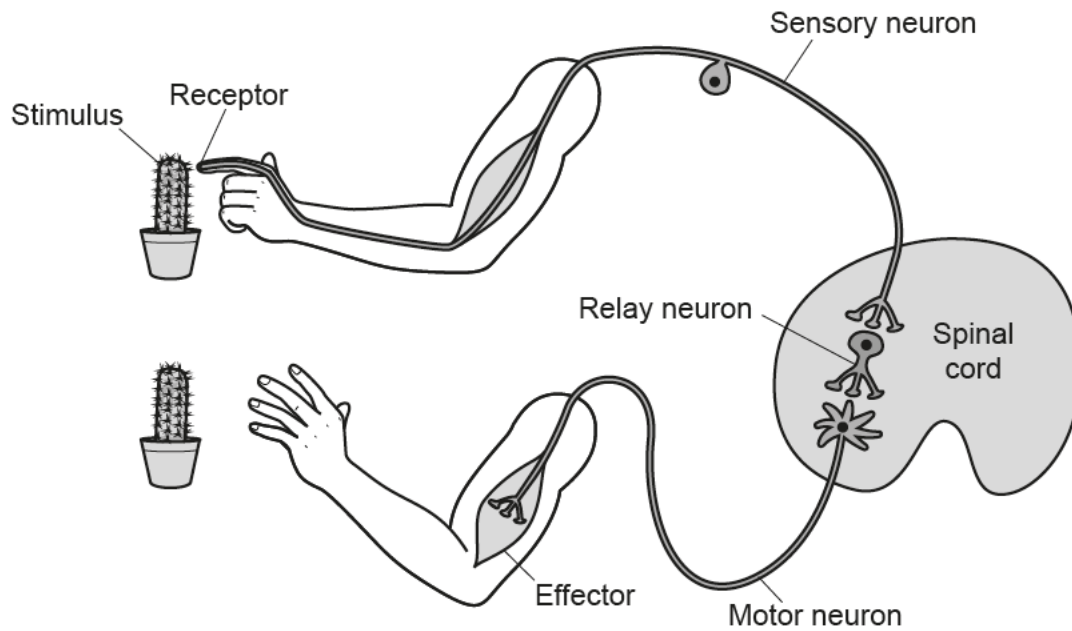
This process requires energy from molecules of

Oxygen is needed to make these molecules during cellular respiration.

[3]

3* Our body responds when we touch something sharp.

The diagram shows the reflex arc involved in this response.



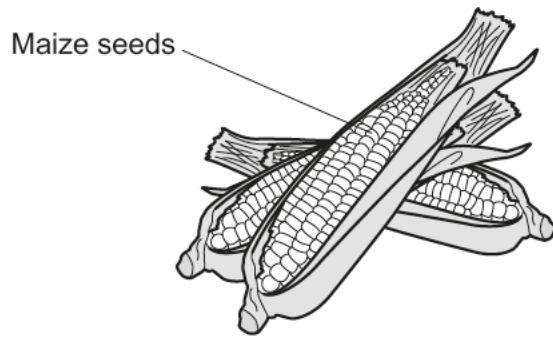
Explain the function of this reflex arc **and** how the structures of the reflex arc help it to function.

..... [6]

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PLEASE DO NOT WRITE ON THIS PAGE

- 4 Maize is an important food crop.



Folic acid helps the body to make healthy red blood cells, and is found in certain foods. However, maize seeds do not provide people with enough folic acid.

- (a) Beans have high levels of folic acid.

Scientists want to genetically engineer maize to produce more folic acid by using genes from beans.

- (i) Describe why this is an example of genetic engineering.

.....
..... [1]

- (ii) Describe the main steps in the process of genetically engineering the maize.

.....
.....
.....
.....
.....
..... [3]

- (b) Suggest the next step that the scientists should take to investigate whether the modified maize could improve people's diets.

.....
..... [1]

- (c) Suggest **one** benefit and **one** possible risk of genetically engineering maize in this way.

Benefit

.....

Risk

..... [2]

- 5 Scientists think that two species of a plant called small cordgrass and smooth cordgrass bred to produce a new species called Townsend's cordgrass.

(a) **Fig. 5.1** shows the number of chromosomes in the cells of three species of cordgrass.

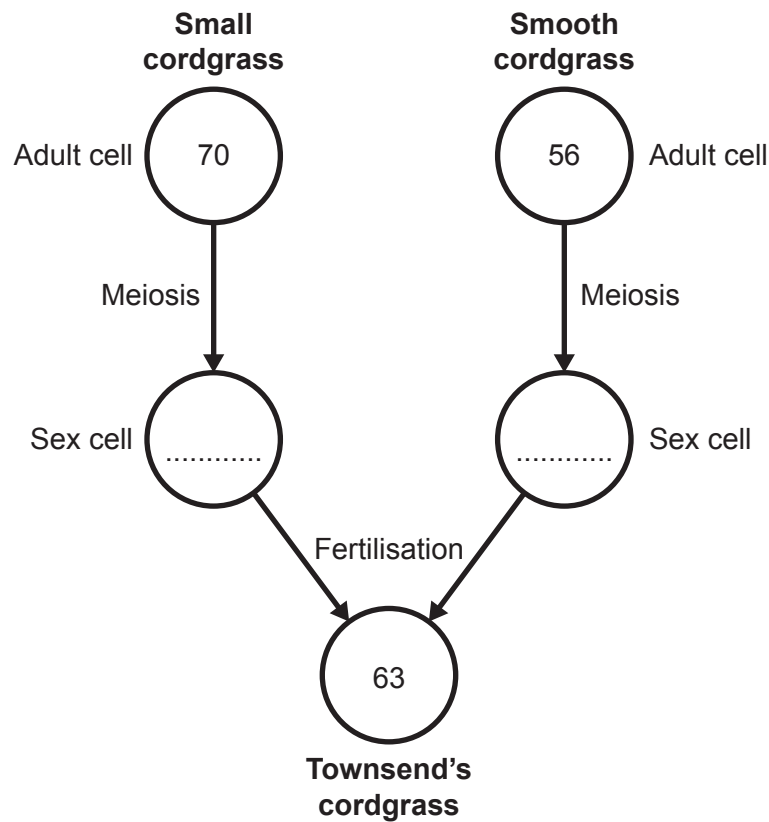


Fig. 5.1

- (i) Complete **Fig. 5.1** by writing in the number of chromosomes that would be found in each **sex cell**. [1]
- (ii) Explain why **Fig. 5.1** supports the idea that Townsend's cordgrass is produced when small and smooth cordgrass are bred.

.....

.....

.....

..... [2]

- (b) Another species called common cordgrass has evolved.

A survey in Ireland found common cordgrass in 156 of 200 salt marshes.

Calculate the percentage of salt marshes with common cordgrass found in Ireland.

Percentage = ... % [2]

- (c) In Ireland it is considered an invasive species which reduces biodiversity.

Define biodiversity.

.....
 [1]

- (d) Common cordgrass:

- reduces the populations of native salt marsh plants
- grows over open mudflats where birds feed.

Common cordgrass can be removed by:

- digging it up by hand
- use of poisonous chemicals.

Explain the benefits **and** challenges of maintaining the biodiversity of Irish salt marshes.

.....

 [3]

(e) **Fig. 5.2** is a flow diagram showing stages in an organism's development after fertilisation.

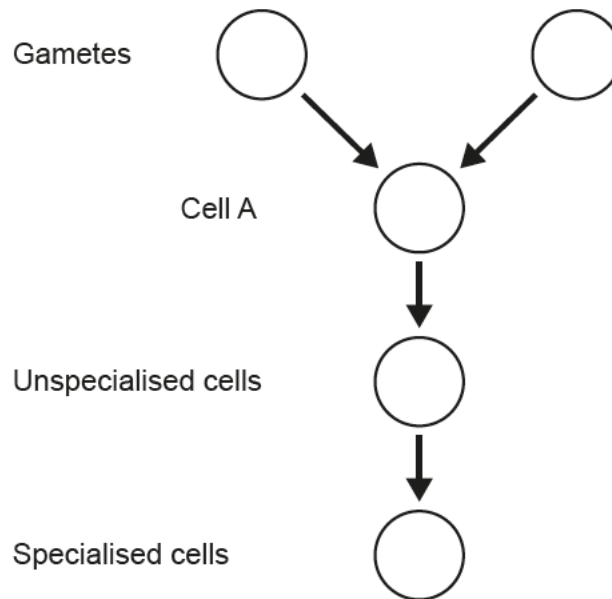


Fig. 5.2

(i) What is the scientific name for cell **A**?

Tick (✓) **one** box.

- | | |
|---------|--------------------------|
| Egg | ☐ |
| Nucleus | ☐ |
| Sperm | ☐ |
| Zygote | ☐ |

[1]

(ii) Label an **X** on **Fig. 5.2** to show where the process of differentiation occurs.

[1]

(iii) Which cells in **Fig. 5.2** will be genetically identical?

Tick (✓) **one** box.

- | | |
|---|--------------------------|
| All of the cells. | ☐ |
| All of the cells except the two gametes. | ☐ |
| Cell A and the unspecialised cells. | ☐ |
| Just the two gametes. | ☐ |

[1]

- 6 High blood cholesterol and high blood pressure increase the risk of cardiovascular disease (CVD).

(a) State **two** factors that can **reduce** risk of CVD.

1

2 [2]

(b) Statins are medicines which reduce blood cholesterol levels. Different medicines, called ACE inhibitors, can reduce blood pressure.

Suggest why statins and ACE inhibitors are **only** given to individuals with high cholesterol or blood pressure.

.....

.....

.....

..... [2]

(c) Scientists wanted to know if taking statins and ACE inhibitors would reduce the risk of developing CVD in people with average blood pressure. The scientists recorded the blood pressure and age of every person who took part in the study.

(i) Suggest **one** more piece of information that would be useful to know about the people in the study.

..... [1]

(ii) The people taking part in the study were put in two groups. One group was given a placebo. The other group was given statins and ACE inhibitors.

Explain why it was ethical to use a placebo in this study.

.....

.....

.....

..... [2]

- (d) The bar chart shows the percentage of people who died from cardiovascular disease (CVD) in each group during the study.

Link to material: <https://www.heart.org/en/news/2018/05/01/statins-lower-heart-attack-stroke-risk-in-people-at-average-risk>Item removed due to third party copyright restrictions.

- (i) In one year, 1 140 665 people went to hospital with CVD.
Treating these hospital patients cost the NHS £4291.5 million.

Calculate the cost per patient to the NHS.

Give your answer to **2** significant figures.

Cost per patient = £ [3]

- (ii) Calculate, for every 1000 people taking the placebo, how many more people would have survived if they had been taking the statins and ACE inhibitors.

Number of people = ... [3]

- (iii) The cost of statins and ACE inhibitors for one person for a year can be less than £30.

Evaluate the use of statins and ACE inhibitors for people with average blood pressure.

.....

 [3]

7 Cellular respiration provides ATP for cellular processes.

(a) Which processes need a supply of ATP?

Tick (✓) **two** boxes.

Absorption of water in the gut

☐

Breakdown and synthesis of molecules

☐

Muscle contraction

☐

Movement of oxygen into the blood from the lungs

☐

Movement of carbon dioxide into the air from the lungs

☐

[2]

(b) Substances involved in cellular respiration are transported by the blood.

Complete the sentences about the transport of these substances by the blood.

Use words and phrases from the list.

plasma	platelets	red blood cells	white blood cells
---------------	------------------	------------------------	--------------------------

Carbon dioxide is transported by the

Glucose is transported by the

Lactic acid is transported by the

Oxygen is transported by the

[4]

- (c) An athlete uses both aerobic and anaerobic respiration when they run a 400 m race.

The sketch shows changes in the athlete's body as their running speed increases during the race.

Link to material: <https://www.mcmillanrunning.com/mcmillans-six-step-training-system/><https://www.mcmillanrunning.com/mcmillans-six-step-training-system/>Item removed due to third party copyright restrictions.

- (i) What evidence from the sketch shows that anaerobic respiration increases as running speed increases?

.....
..... [1]

- (ii) Give **one** disadvantage of increasing anaerobic respiration for the athlete.

.....
..... [1]

- (iii) Explain the changes shown on the sketch when the athlete's running speed is higher than X.

.....
.....
.....
.....
.....
.....
.....
.....
..... [4]

- (d) Explain why the athlete's body temperature increases as they run.

.....

.....

.....

..... [2]

- (e) Explain why it is important that responses such as sweating reduce the temperature of the body and its cells back to normal.

.....

.....

.....

..... [2]

8 Humans have a gene that instructs cells how to make an enzyme called lactase.

(a) Mutations can happen in the lactase gene.

Give **two** reasons why most of these mutations will have no effect on the lactase protein.

- 1
-
- 2
-

[2]

(b) The probability of someone having the lactase mutation is 0.3.

In 2021 the human adult world population was estimated to be 5.85 billion.

Calculate the number of people **without** the mutation in 2021.

Number of people = ... billion [3]

(c) The enzyme lactase allows humans to digest milk.

Approximately 10 000 years ago:

- the lactase gene in most humans was switched on when they were a baby but then switched off permanently after that
- some humans had a mutation that caused the lactase gene to remain switched on
- humans started farming animals for milk.

Now, many humans have the mutation that causes the lactase gene to remain switched on.

Describe the evidence that suggests the spread of this mutation was an example of evolution by natural selection.

-
-
-
- [2]

-
- The diagram illustrates a feedback loop for blood sugar regulation. It consists of four main boxes arranged in a square, with arrows indicating the flow of the process and labels for the changes in blood sugar levels.
- Top Left Box:** Organ:
Secretes:
 - Top Right Box:** Glucose is absorbed from the blood by in tissues.
 - Bottom Right Box:** Organ:
Secretes:
 - Bottom Left Box:** Organ: Liver
breaks down carbohydrate to release glucose
- The flow of the loop is as follows:
- An arrow from the **Top Left** box points to the **Top Right** box.
 - An arrow from the **Top Right** box points to the **Bottom Right** box, labeled "Blood sugar level falls".
 - An arrow from the **Bottom Right** box points to the **Bottom Left** box.
 - An arrow from the **Bottom Left** box points to the **Top Left** box, labeled "Blood sugar level rises".
 - An additional arrow points from the **Bottom Left** box to the **Top Left** box, labeled "Blood sugar level rises".
- Intermediate boxes and labels:
- Between the **Top Left** and **Bottom Left** boxes is a box: "The person **eats** a sugary meal". An arrow points from this box to the **Top Left** box, labeled "Blood sugar level rises".
 - Between the **Top Right** and **Bottom Right** boxes is a box: "The person **exercises**". An arrow points from this box to the **Top Right** box, labeled "Blood sugar level falls".

(b) Explain the role of adrenaline in the human body.

..... [4]

(c) Explain the role of the hormone thyroxine in the body.

Include the role of negative feedback in your answer.

.....

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.....

.....

.....

.....

..... [4]

END OF QUESTION PAPER

[illegible]

Oxford Cambridge and RSA

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