



Oxford Cambridge and RSA

H

# Monday 15 November 2021 – 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 graphical calculator
- an HB pencil



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

Centre number

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

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 **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 (a) Diseases can be communicable or non-communicable.

Which statements describe **communicable** diseases and which statements describe **non-communicable** diseases?

Tick **one** box (✓) in each row.

| Statement                             | Communicable diseases | Non-communicable diseases |
|---------------------------------------|-----------------------|---------------------------|
| They are caused by alleles.           |                       |                           |
| They are caused by lifestyle choices. |                       |                           |
| They are caused by pathogens.         |                       |                           |
| They are caused by trauma.            |                       |                           |

[2]

(b) Measles is caused by a virus. White blood cells help protect us against measles.

Complete each sentence about how white blood cells protect us against measles.

Use the words.

You can use each word once, more than once, or not at all.

**abiotic      antibodies      antigens      digested      disabled      inflamed**

One type of white blood cell makes types of molecules called .....

These molecules bind to measles .....

Other white blood cells ingest the measles viruses and they are .....

[3]

(c) A vaccine can help prevent the spread of measles. Not all parents have their children vaccinated. Parents may have ethical reasons or may need more information before making a decision.

Which parents are talking about an ethical reason and which parents need more information before making a decision?

Tick **one** box (✓) in each row.

| Parents  | Ethical reason | More information |
|--|----------------|------------------|
| <b>Mia</b><br>“I’m worried about how safe the vaccine is.”                   |                |                  |
| <b>Sam</b><br>“It is up to me to decide what is best for my child.”          |                |                  |
| <b>Ali</b><br>“My faith does not allow vaccination.”                         |                |                  |
| <b>Jamal</b><br>“There is no risk. I don’t know anyone who has had measles.” |                |                  |

[3]

2 (a) A student is given a slide of a cross section of a plant stem. They clip the slide onto the stage of a light microscope and turn on the light.

Describe how they can focus the image to observe the xylem and phloem tissues.

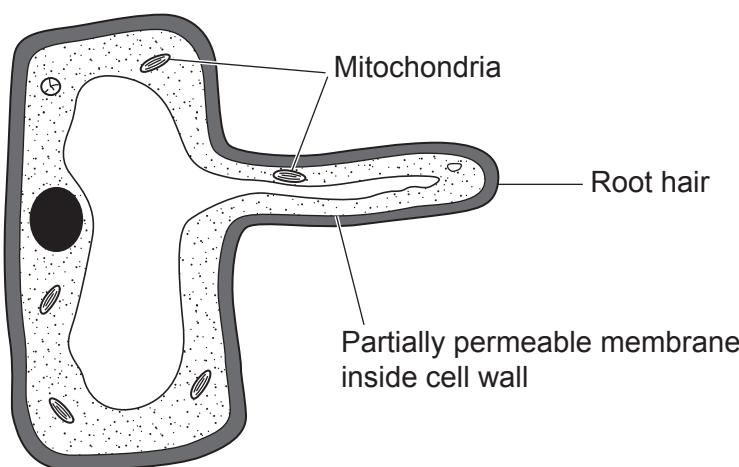
[4]

**(b)** Explain how the xylem is adapted to its function.

[2]

[2]

(c) The diagram shows the structure of a root hair cell.



(i) Explain how the 'root hair' is adapted to its function.

.....  
.....  
.....  
.....

[2]

(ii) Explain why **mitochondria** are required for the uptake of some mineral ions by root hair cells.

.....  
.....  
.....  
.....

[2]

(d) Which statement about diffusion across the partially permeable membrane of root hair cells is correct?

Tick (✓) **one** box.

Both water and nitrate ions can diffuse through the partially permeable membrane.

Nitrate ions can diffuse through the partially permeable membrane, but water ions cannot.

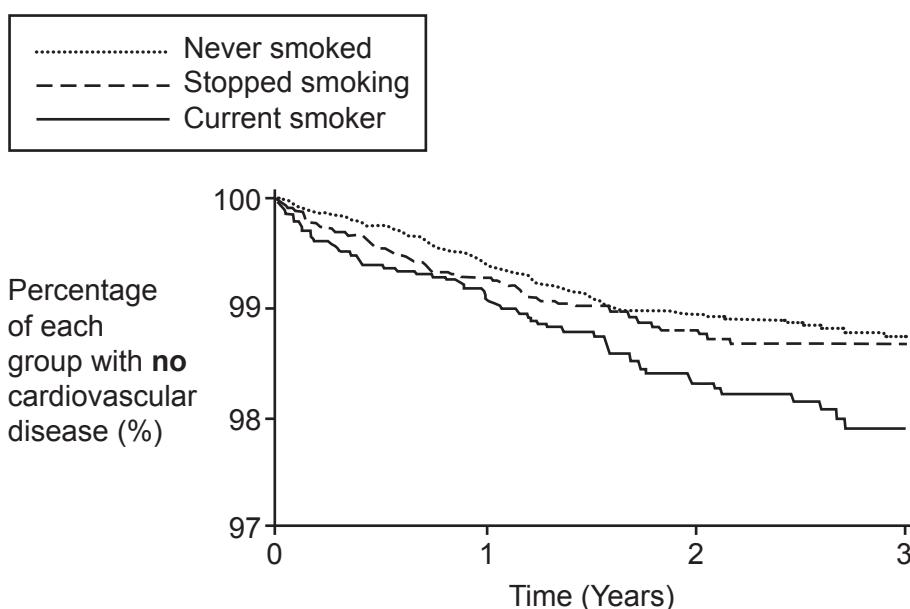
Both water and nitrate ions cannot diffuse through the partially permeable membrane.

Water ions can diffuse through the partially permeable membrane, but nitrate ions cannot.

[1]

3 The graph shows the results of a three-year study into the effect of smoking on the risk of cardiovascular disease.

None of the people at the start of the study had cardiovascular disease.



(a) Give **two** conclusions that can be made from the graph about the impact of smoking on a person's risk of cardiovascular disease.

1 .....

2 .....

[2]

(b) At the beginning of the study, the number of people in the 'stopped smoking' group was 3175.

After three years the percentage of this group with no cardiovascular disease was 98.8%.

Calculate the number of people in this group **with** cardiovascular disease after three years.

Number of people in the 'stopped smoking' group with cardiovascular disease = ..... [2]

(c) Data on cardiovascular disease was collected over three years and across nine different countries.

A sample of people were taken from each of the three groups:

- never smoked
- stopped smoking
- current smoker.

(i) Why do studies use samples?

.....  
.....

[1]

(ii) How can scientists be confident in the conclusions they make from **this** study?

.....  
.....

[1]

(d) Suggest **three** lifestyle changes, other than stopping smoking, which can reduce the risk of cardiovascular disease.

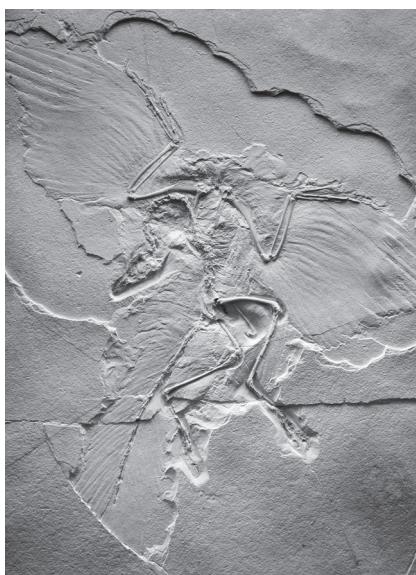
1 .....

2 .....

3 .....

[3]

4 The drawing shows an *Archaeopteryx* fossil.



*Archaeopteryx* lived at the same time as theropod dinosaurs.

*Archaeopteryx* fossils have features in common with theropod dinosaurs and modern birds. Some common features are shown in the table.

| Feature               | Theropod dinosaurs | <i>Archaeopteryx fossils</i> | Modern birds |
|-----------------------|--------------------|------------------------------|--------------|
| <b>Beak</b>           |                    | ✓                            | ✓            |
| <b>Feathers</b>       |                    | ✓                            | ✓            |
| <b>Long bony tail</b> | ✓                  | ✓                            |              |
| <b>Teeth</b>          | ✓                  | ✓                            |              |
| <b>Wing</b>           |                    | ✓                            | ✓            |
| <b>Wishbone</b>       |                    | ✓                            | ✓            |

(a) Scientists think *Archaeopteryx* fossils provide evidence of evolution.

Describe the evidence from the table which supports the theory that *Archaeopteryx* was the **first modern bird**.

.....  
 .....  
 .....  
 .....  
 ..... [2]

(b) No *Archaeopteryx* fossil DNA has been found.

Describe how DNA would help scientists to decide if the *Archaeopteryx* fossil was a bird or is a missing link between theropod dinosaurs and modern birds.

.....

.....

.....

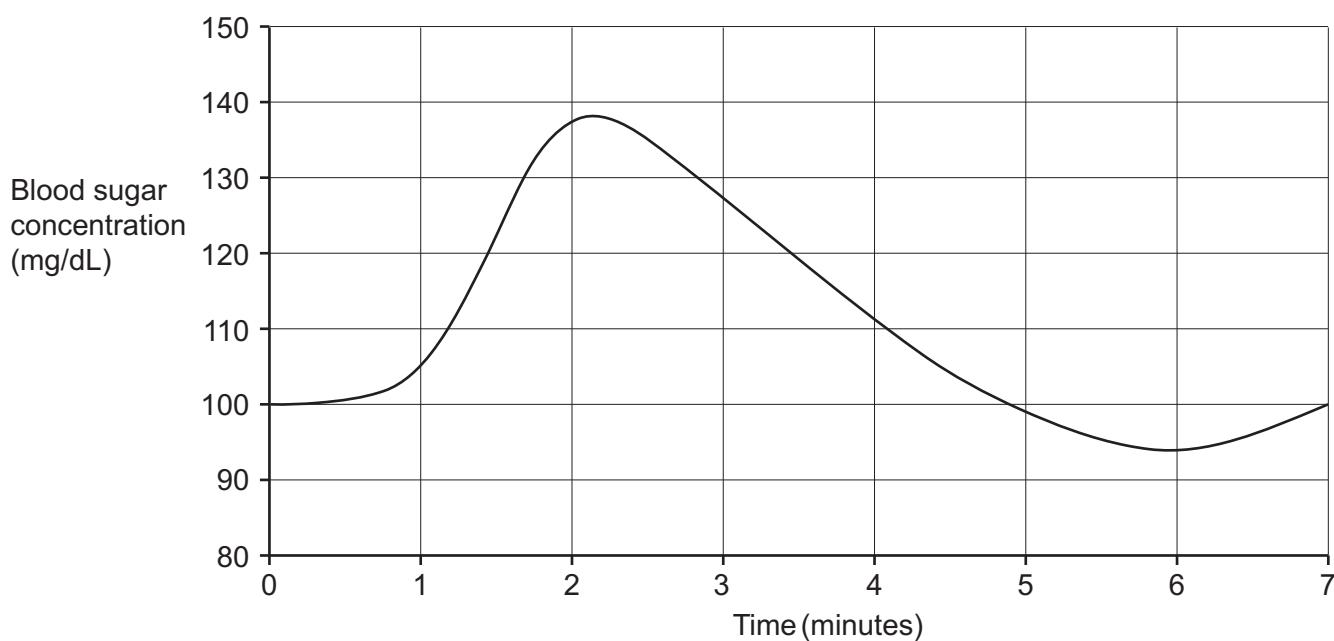
.....

[2]

10

5 A student is investigating the effect of eating sugar on blood sugar concentration.

The student eats 20g of glucose, and then measures their blood sugar concentration every minute for 7 minutes. **Fig. 5.1** shows their results.



**Fig. 5.1**

(a) Explain how insulin and glucagon work together to cause the observed changes to the blood sugar concentration, between **2 and 7 minutes**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(b) Two friends both have diabetes, but their diabetes is treated differently. Charlie has Type 1 diabetes. Taylor has Type 2 diabetes.

Draw lines to connect Charlie and Taylor to one correct **cause** and one correct **treatment** of their diabetes.

| Cause                                  | Treatment  |
|--|--|
| Cells stop being able to use glucagon. | Change in diet alone can be used.                |
| Cells stop being able to use insulin.  | Glucagon injection always needed.                |
| Pancreas stops making glucagon.        | Insulin injection is always needed in treatment. |
| Pancreas stops making insulin.         |  |

[2]

(c) Glycogen is a long-chain carbohydrate, which is stored in animal cells.

Explain how the partially permeable membrane allows the movement of glucose in and out of animal cells, but **not** glycogen.

.....

.....

.....

.....

[2]

Fig. 5.2 shows data on diabetes and cardiovascular disease in middle-aged Australian women, collected in eight surveys (S1 to S8) over a 20-year study.

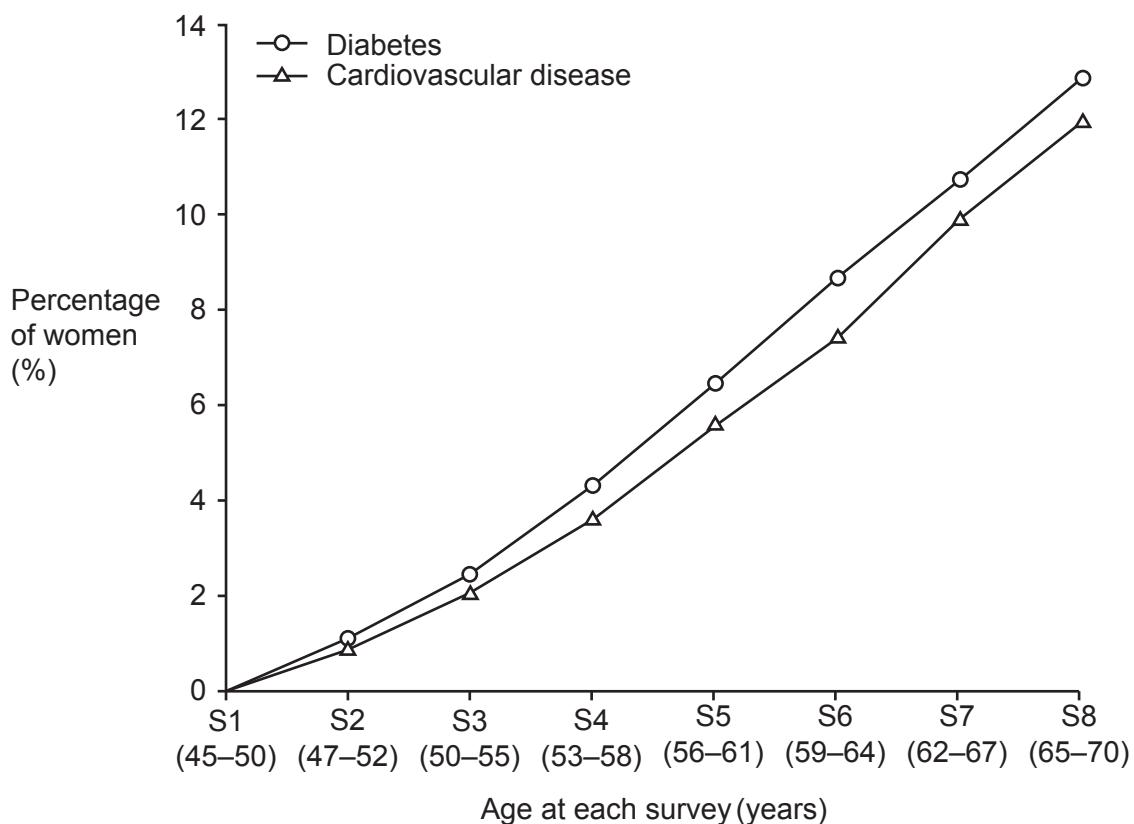


Fig. 5.2

(d) (i) What does the graph show about the relationship between diabetes and cardiovascular disease?

.....

.....

.....

.....

[2]

(ii) Suggest **two** further pieces of data that would give greater confidence that the relationship between diabetes and cardiovascular disease is valid.

1 .....

.....

2 .....

.....

[2]

6\* A student is reading an article on evolution.

# Evolution underground

In 1860 many underground tunnels were dug beneath London. Some *Culex pipiens* mosquitoes were trapped in these underground tunnels and for over 120 years the mosquitoes had no contact with any other mosquitoes.

In 2016 a scientist collected samples of mosquitoes which were found in the tunnels. She found that they had changed.

Underground mosquitoes feed on mammals; they also do not hibernate. Mosquitoes that live above ground feed on birds and hibernate in the winter. The two groups of mosquitoes can no longer breed with each other.

Explain how the new species of underground mosquito evolved.

- [6]

7 (a) Complete each sentence about how the genetic material of a eukaryotic cell relates to its function.

Use the words.

You can use each word once, more than once, or not at all.

allele      amino acids      carbohydrates      DNA      enzymes      FSH  
 genome      genus      lipid      proteins

The nucleus contains a copy of the entire genetic material. This is called the

..... . The genetic material is a molecule called .....

This is packaged into structures called chromosomes.

Genes in the nucleus tell the cell how to make chemicals called .....

Some of these chemicals are structural and some act as biological catalysts called

..... .

The structures and the catalysts allow the cell to carry out its function.

[4]

(b) Haemophilia is a rare condition that slows the process of blood clotting.

Haemophilia A is caused by a fault in a single gene. The haemophilia A gene is located on the X chromosome but not the Y chromosome.

A male without haemophilia and a female carrier of haemophilia have a child. The Punnett square shows the possible alleles of the offspring.

Key:  
 H = dominant allele  
 h = recessive allele

|                                 |       |           |
|---------------------------------|-------|-----------|
|                                 | $X^H$ | $Y$       |
| (female carrier of haemophilia) | $X^H$ | $X^H X^H$ |
| $X^H X^h$                       | $X^h$ | $X^H X^h$ |

(i) Calculate the probabilities of having:

- a child with haemophilia .....
- a female child with haemophilia .....
- a male child with haemophilia .....

[2]

15

(ii) Write down an example of a homozygous and heterozygous offspring from the Punnett square.

Explain your answers.

Homozygous offspring: .....

Heterozygous offspring: .....

.....  
.....  
.....  
.....

[4]

(iii) How is a gamete represented in the Punnett square?

Put a ring around the correct answer.

**X<sup>H</sup>**      **X<sup>H</sup>X<sup>h</sup>**      **X<sup>H</sup>Y**      **XY**

Give **one** reason for your answer.

.....  
.....

[2]

16

(iv) Haemophiliacs lack a protein which helps to make blood platelets active.

Which statement about the adaptations of platelets is correct?

Tick (✓) **one** box.

Platelets are cell fragments which trap red blood cells forming a clot.

Platelets are large cells which block wounds.

Platelets can stick to the edges of damaged blood vessels and start clot formation.

Platelets kill pathogens which enter wounds.

[1]

(c) Eye colour, like haemophilia, is only determined by genes.

Suggest **two** reasons why there are so many different eye colours.

1 .....

.....

2 .....

.....

[2]

8 The Amazon rainforest covers 670 000 000 hectares. In 2019, 906 000 hectares of rainforest were lost in fires.

(a) Calculate the percentage of the total rainforest area that was lost to fires in 2019.

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

Percentage of rainforest area lost = ..... % [3]

(b) Some fires are started in the Amazon rainforest to clear land for agriculture. This affects local and global biodiversity.

Suggest an ecological, moral, economic, and political issue which could affect the decisions made about starting fires in the Amazon rainforest.

Ecological .....

.....

Moral .....

.....

Economic .....

.....

Political .....

.....

[4]

(c) (i) The Amazon rainforest is a major carbon sink. This means it removes carbon dioxide from the atmosphere and stores it.

Describe the process of photosynthesis to explain how forests store carbon.

4

(ii) Photosynthesis is part of the carbon cycle.

Give **two** reasons why the carbon cycle is important to living things.

1 .....

2 .....

[2]

(iii) Complete each sentence about the role of microorganisms in the carbon cycle.

Use the words.

You can use each word once, more than once, or not at all.

enzymes photosynthesis hormones respire lipids transpire

Microorganisms are involved in decomposition. They secrete enzymes that break down dead organic matter.

which break down dead, organic matter. The products of digestion are absorbed into

their cells and the microorganisms ..... , producing carbon dioxide.

[2]

9 (a) Fig. 9.1 is a diagram of a plant cell. It is not to scale.

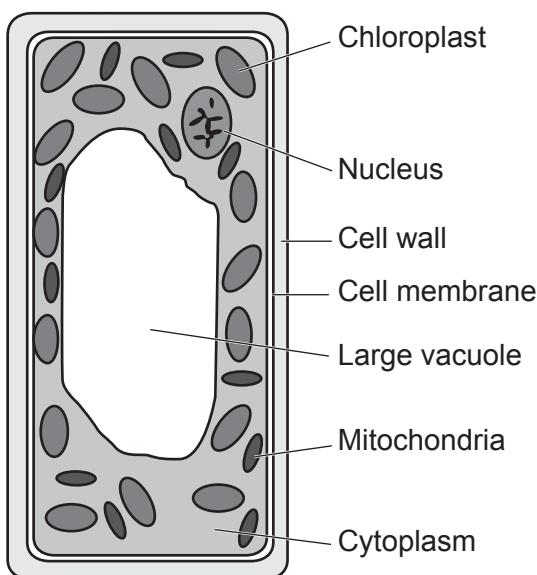


Fig. 9.1

Write down **one** structure in the plant cell used in cellular respiration.

..... [1]

(b) Starch is a large, insoluble, long-chain carbohydrate made from glucose molecules.

Explain the importance of synthesising and storing starch inside plant cells.

Use ideas about cellular respiration and osmosis in your answer.

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

(c) The table shows the approximate lengths of **three** plant cell components.

Complete the table by converting the approximate length of each component into metres.

$$1 \mu\text{m} = 1 \times 10^{-6} \text{ m}$$

$$1 \text{ nm} = 1 \times 10^{-9} \text{ m}$$

| Component    | Approximate length | Approximate length (m) |
|--------------|--------------------|------------------------|
| Chloroplast  | 5.0 $\mu\text{m}$  |                        |
| Nucleus      | 0.007 mm           |                        |
| Starch grain | 500 nm             |                        |

[3]

(d) Fig. 9.2 shows some apparatus that can be used to measure aerobic respiration by germinating seeds.

**Tube A** contains potassium hydroxide solution.

**Tube B** contains potassium hydroxide solution and germinating seeds.

Potassium hydroxide absorbs carbon dioxide.

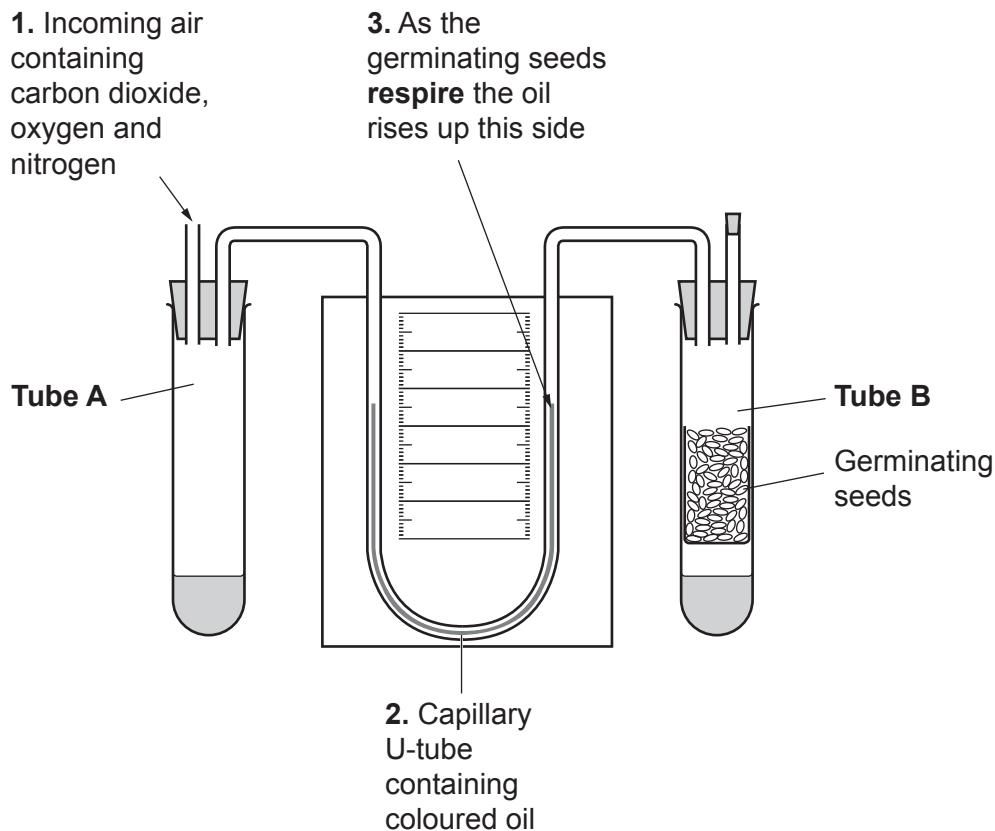


Fig. 9.2

21

(i) Explain why the oil rises up the right-hand side of the U-tube, as shown with **label 3** in **Fig. 9.2**.

.....  
.....  
.....  
.....

[2]

(ii) Changes in temperature will affect the **volume** of the gases in the tubes.

Why is this a problem when investigating respiration reactions?

.....  
.....

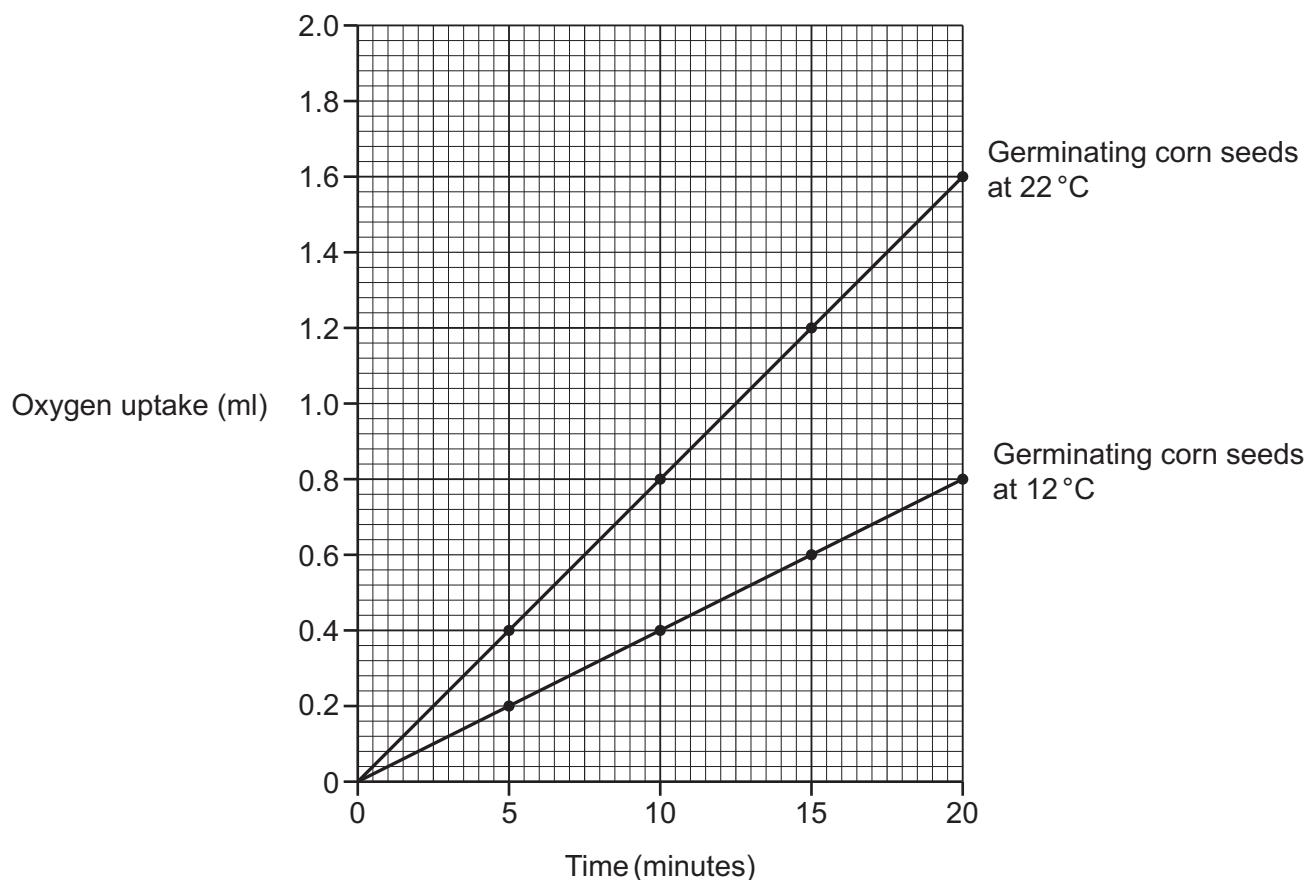
[1]

(iii) Suggest **one** way the experiment could be developed to maintain the temperature.

.....  
.....

[1]

(e) **Fig. 9.3** shows results from an investigation into the effect of temperature on oxygen uptake by germinating corn seeds.



**Fig. 9.3**

Calculate the increase in the rate of oxygen uptake per °C.

Give your answer in **standard form**.

$$\text{Rate of oxygen uptake per } ^\circ\text{C} = \dots \text{ ml/min/}^\circ\text{C}$$

[4]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).



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