



Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 2

Life and Environmental Sciences

8465/2F

Wednesday 22 May 2024 Morning

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and forenames, your centre number, your candidate number and add your signature.

[Turn over]



J U N 2 4 8 4 6 5 2 F 0 1

MATERIALS

For this paper you must have:

- **a ruler**
- **a protractor**
- **a scientific calculator**
- **the periodic table (enclosed)**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**



- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO



0	1
---	---

Nuclear radiation is dangerous to humans.

0	1	.	1
---	---	---	---

Nuclear radiation can change atoms into ions.

Which type of particle is lost when an atom changes into an ion? [1 mark]

Tick (✓) ONE box.

Electron

Neutron

Proton

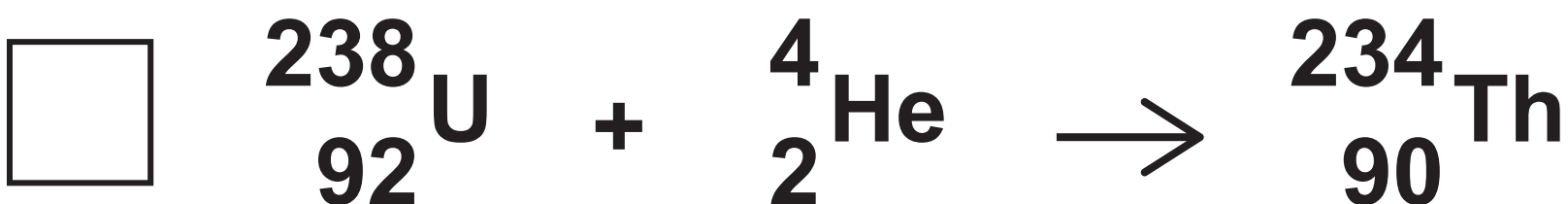
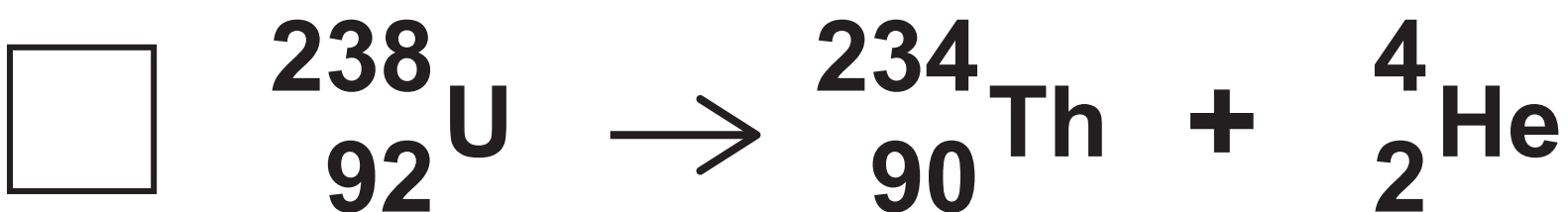
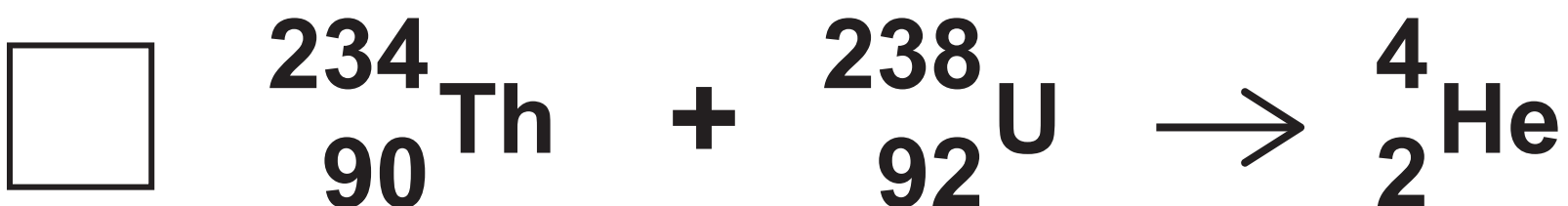


01.2

A nucleus of uranium-238 $\left(\begin{smallmatrix} 238 \\ 92 \end{smallmatrix} \text{U} \right)$ emits an alpha particle $\left(\begin{smallmatrix} 4 \\ 2 \end{smallmatrix} \text{He} \right)$ and decays into thorium $\left(\begin{smallmatrix} 234 \\ 90 \end{smallmatrix} \text{Th} \right)$.

Which nuclear equation shows this decay? [1 mark]

Tick (✓) ONE box.



[Turn over]



0 1 . 3

How does the penetrating power of alpha particles compare with the penetrating power of beta particles? [1 mark]

Tick (✓) ONE box.

Alpha particles are less penetrating than beta particles.

Alpha particles have the same penetrating power as beta particles.

Alpha particles are more penetrating than beta particles.



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[Turn over]



01.4

Uranium is dug out of the ground in a process called mining.

Uranium mining is hazardous because uranium is radioactive.

The radioactive decay of uranium produces radon gas which is also radioactive.

TABLE 1 compares the properties of uranium and radon.

TABLE 1

	URANIUM	RADON
STATE OF MATTER	Solid	Gas
TYPE OF RADIATION EMITTED	Alpha	Alpha
COLOUR	Grey	Colourless



People who work in uranium mines are more at risk of harm from radon gas than from uranium.

Give TWO reasons why.

**Use TABLE 1, on the opposite page.
[2 marks]**

1 _____

2 _____

[Turn over]



01.5

Scientists collected data about lung diseases in the population of one country.

The scientists used the data to predict the number of people with lung diseases who worked in uranium mines.

TABLE 2 shows the predicted data and the actual data for people who worked in uranium mines.

TABLE 2

	PREDICTED NUMBER OF PEOPLE	ACTUAL NUMBER OF PEOPLE
LUNG CANCER	74	405
OTHER LUNG DISEASES	41	142



Give TWO conclusions that can be made from the data in TABLE 2, on the opposite page. [2 marks]

1 _____

2 _____

[Turn over]



0	1	.	6
---	---	---	---

Suggest ONE reason why people who work in uranium mines should be told that uranium is a hazard. [1 mark]

8



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[Turn over]



0	2
---	---

Carbon monoxide is an atmospheric pollutant.

0	2	.	1
---	---	---	---

**How is carbon monoxide formed?
[1 mark]**

Tick (✓) ONE box.

Incomplete combustion of hydrocarbons

Photosynthesis by plants

Purification of water



Carbon monoxide changes the amount of oxygen that blood can transport.

0 2 . 2

Which part of the blood transports oxygen? [1 mark]

[Turn over]

FIGURE 1

Concentration of oxygen in blood in arbitrary units

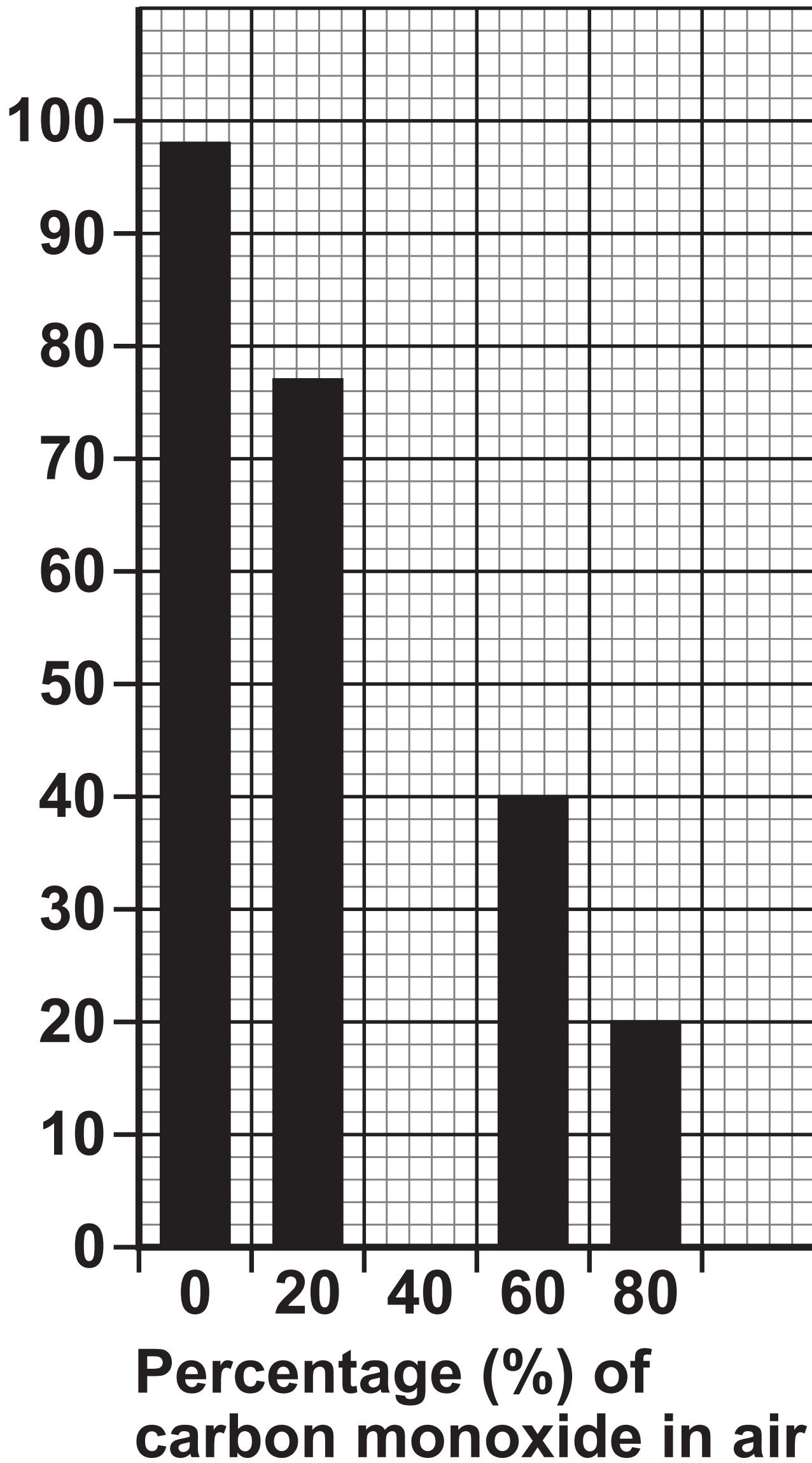


FIGURE 1, on the opposite page, shows how the percentage of carbon monoxide in air affects the concentration of oxygen in blood.

0 2 . 3

When the percentage of carbon monoxide in air is 40% the concentration of oxygen in blood is 64 arbitrary units.

Complete FIGURE 1 to show the result for 40% carbon monoxide in air. [1 mark]

[Turn over]



0 2 . 4

The percentage of carbon monoxide in air changes from 0% to 80%.

Determine the change in the concentration of oxygen in blood.

Use FIGURE 1, on page 16. [2 marks]

Change = _____ arbitrary units



0 2 . 5

Describe how increasing the percentage of carbon monoxide in air affects the concentration of oxygen in blood.

Use FIGURE 1, on page 16. [1 mark]

[Turn over]

0	2	.	6
---	---	---	---

Breathing in carbon monoxide can cause carbon monoxide poisoning.

Which of the following is a symptom of carbon monoxide poisoning? [1 mark]

Tick (✓) ONE box.

Burns on the skin

Faster heart rate

High temperature



0 2 . 7

Carbon monoxide can build up in a room.

The risk of carbon monoxide poisoning can be reduced by opening windows in the room.

**Suggest how opening windows reduces the risk of carbon monoxide poisoning.
[1 mark]**

8

[Turn over]



0 3

The electromagnetic spectrum is grouped into different types of wave.

0 3 . 1

Draw ONE line from each type of wave to a use of the wave. [3 marks]

**TYPE OF
WAVE**

USE

**Fibre optic
communications**

Gamma

**Radio programme
transmission**

Microwave

**Satellite
communications**

Ultraviolet

**Sterilising surgical
instruments**

Sun tanning



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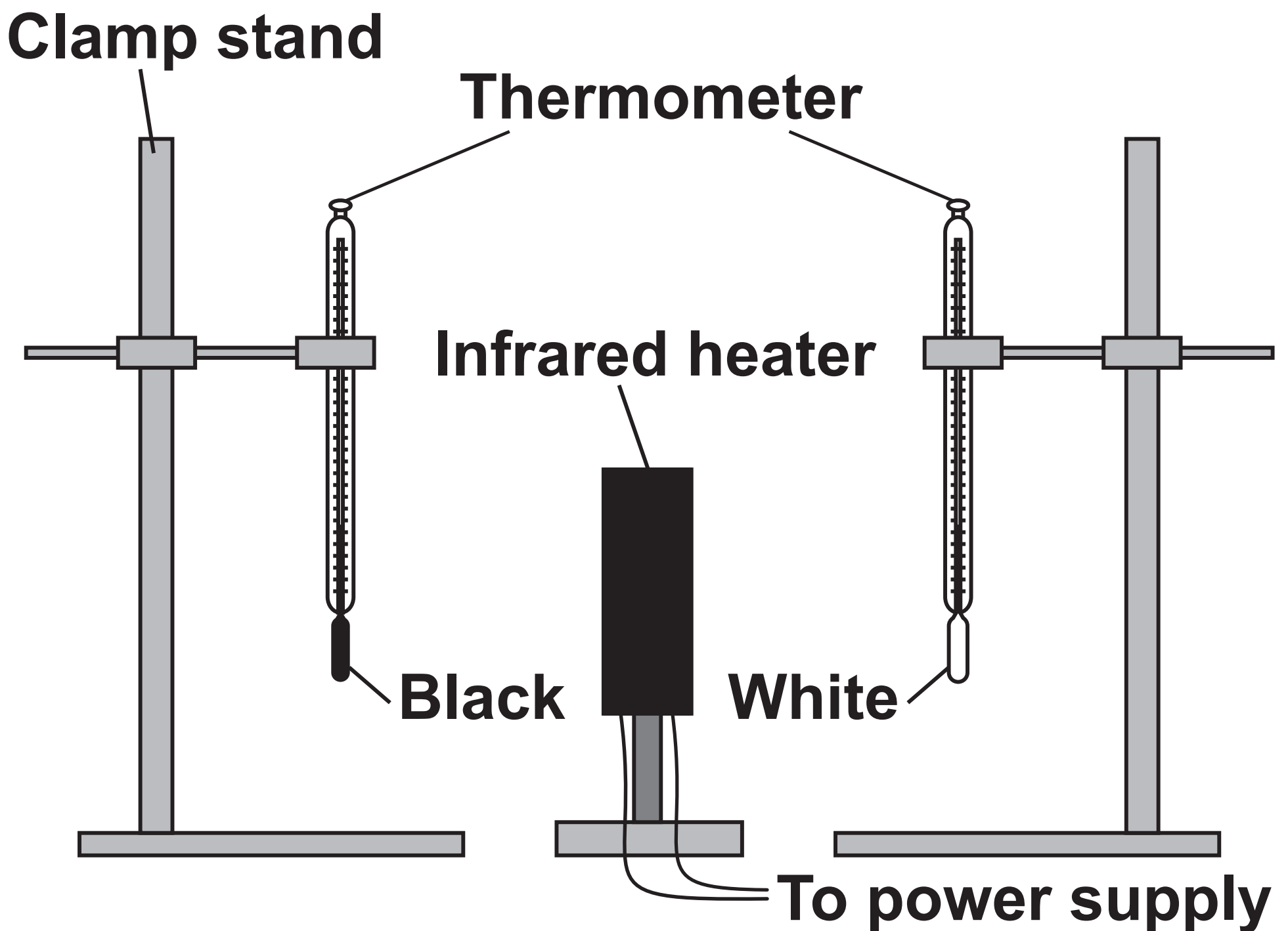


Infrared radiation is emitted by heaters.

A student investigated the absorption of infrared radiation by a black surface and by a white surface.

FIGURE 2 shows some of the equipment used.

FIGURE 2



This is the method used.

- 1. Ensure that the initial temperature shown on the thermometers is the same.**
- 2. Switch on the infrared heater.**
- 3. Record the temperature shown on each thermometer every 30 seconds for 5 minutes.**

[Turn over]



0	3	.	2
---	---	---	---

What equipment should the student have used to measure time? [1 mark]



0	3	.	3
---	---	---	---

The distance between the infrared heater and each thermometer was kept the same throughout the investigation.

What type of variable was the distance?
[1 mark]

Tick (✓) ONE box.

A control variable

A dependent variable

An independent variable

[Turn over]



0	3	.	4
---	---	---	---

What was a risk to the student in the investigation? [1 mark]

Tick (✓) ONE box.

Burns from the infrared heater

Misreading the thermometers

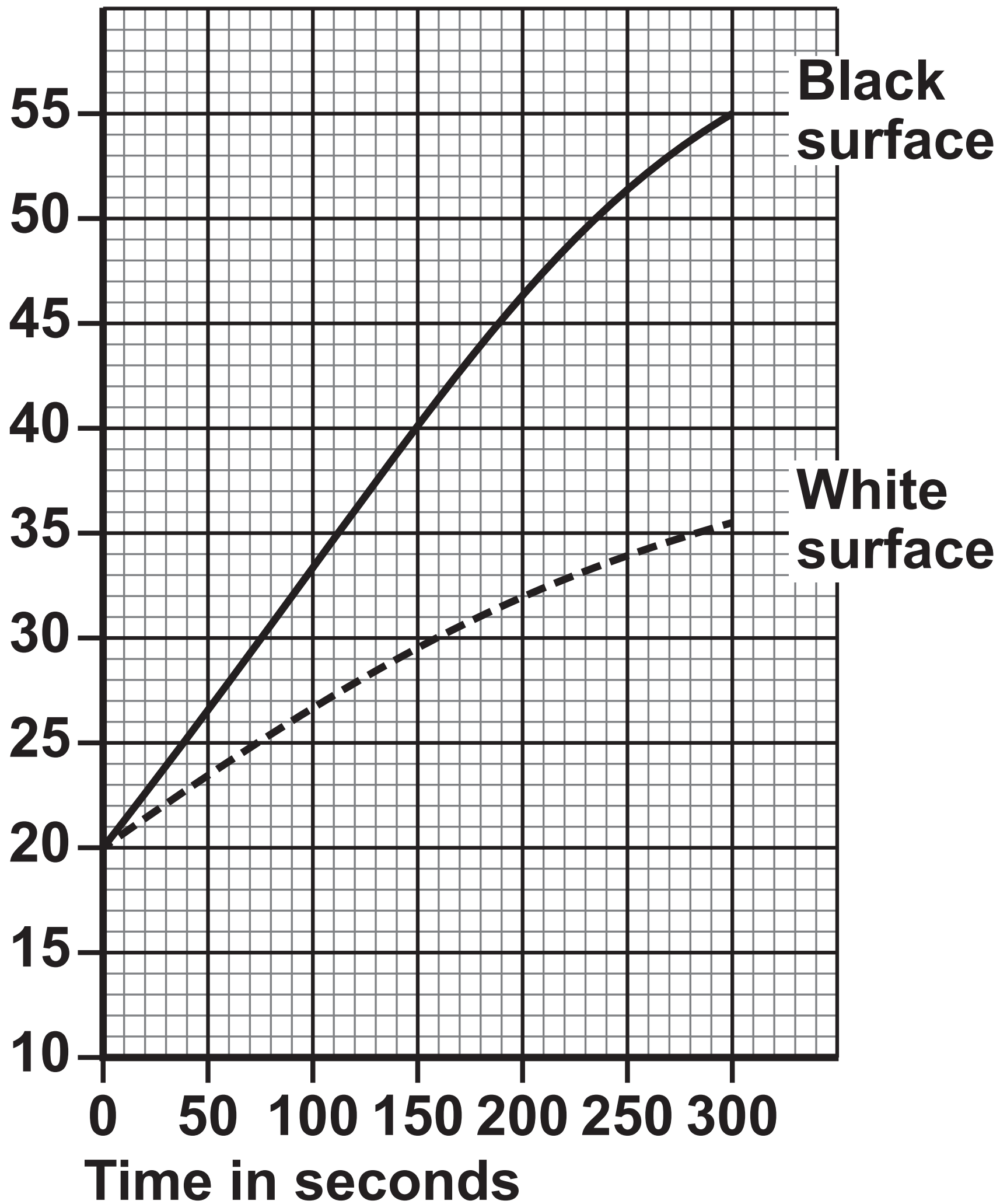
Wearing safety glasses



FIGURE 3 shows the results.

FIGURE 3

Temperature in °C



[Turn over]



0	3	.	5
---	---	---	---

What was the temperature of the room where the investigation took place?

Use FIGURE 3, on page 29. [1 mark]

Temperature = _____ °C



03.6

What TWO conclusions can be made from FIGURE 3, on page 29? [2 marks]

Tick (✓) TWO boxes.

The black surface absorbed all the infrared radiation.

The black surface had a greater temperature increase per second.

The black surface reflected all the infrared radiation.

The black surface was a better absorber of infrared radiation.

The black surface was a better reflector of infrared radiation.

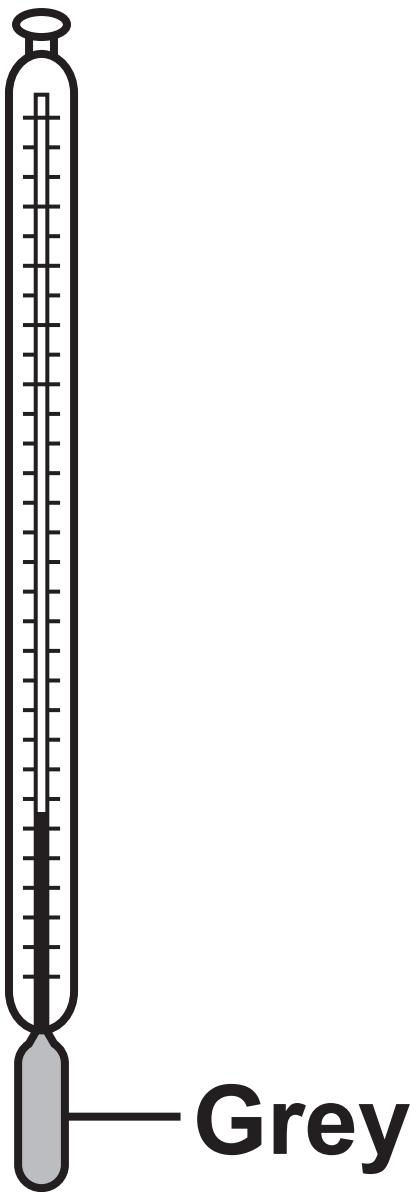
[Turn over]



0	3	.	7
---	---	---	---

FIGURE 4 shows a thermometer with a grey surface.

FIGURE 4



The investigation was repeated using this thermometer.

The distance between the thermometer and the heater was the same as in the first investigation.



The room temperature was the same as the first investigation.

Draw a line on FIGURE 3, on page 29, to predict the results for the thermometer shown in FIGURE 4, on the opposite page. [2 marks]



[Turn over]



Leaf



**Green
pepper**



04.1

Water is lost from the leaves.

Complete the sentences.

Choose answers from the list. [2 marks]

GUARD CELLS

STARCH

STOMATA

XYLEM

Water is lost through tiny holes in the leaves called

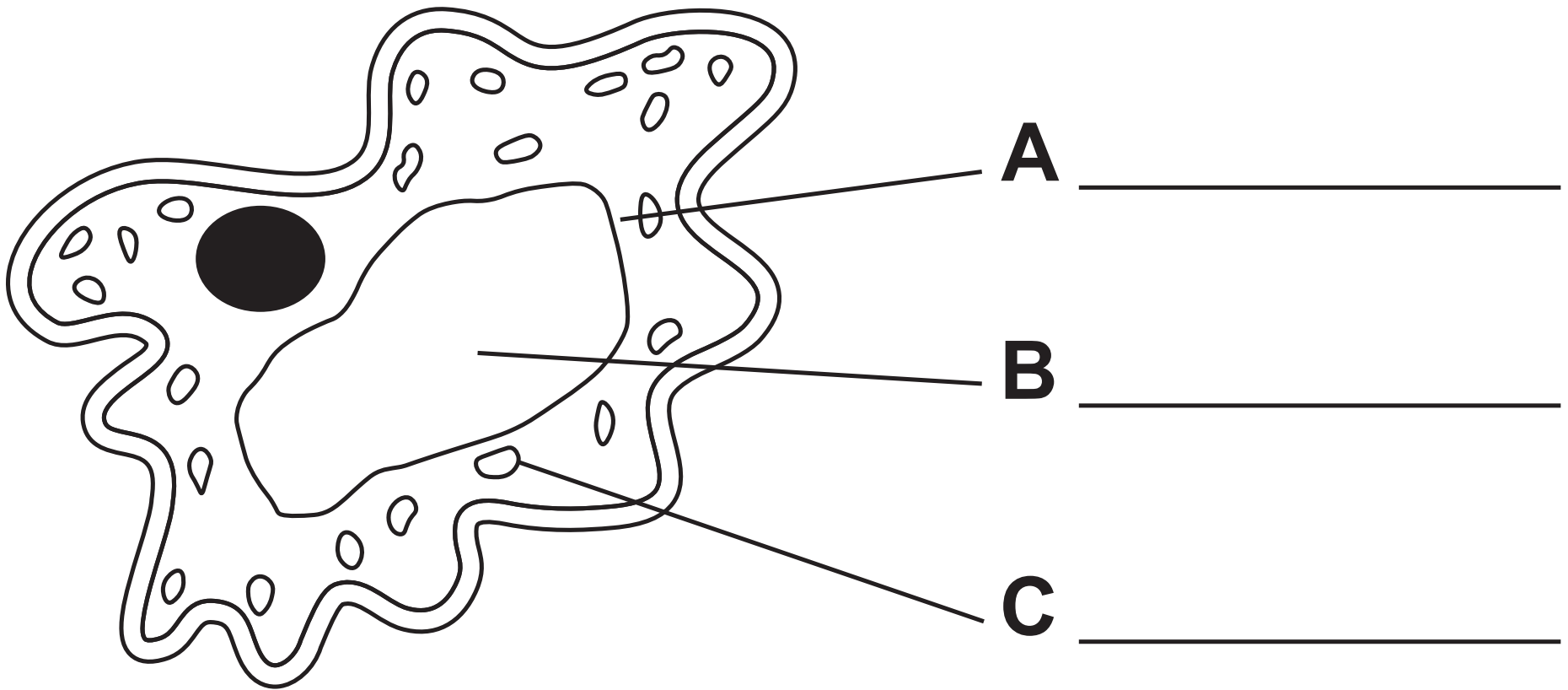
The size of each hole is controlled by

[Turn over]



FIGURE 6 shows a drawing of a cell from a pepper.

FIGURE 6



0 4 . 2

Cell part A contains a green pigment.

Label parts A, B and C on FIGURE 6, on the opposite page.

Choose answers from the list. [3 marks]

CELL MEMBRANE

CHLOROPLAST

CYTOPLASM

NUCLEUS

VACUOLE

[Turn over]



0 4 . 3

An image of one cell from a pepper has a width of 32 mm.

The real cell has a width of 0.08 mm.

Calculate the magnification of the image of the cell.

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real cell}}$$

[2 marks]

Magnification = × _____



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[Turn over]



Water can move into cells and out of cells.

A student investigated how different concentrations of sugar solution affect the mass of pepper tissue.

This is the method used.

- 1. Cut three pieces of pepper 1 cm wide and 1 cm long.**
- 2. Dry each piece.**
- 3. Record the mass of each piece.**
- 4. Leave each piece in sugar solution for 1 hour.**
- 5. Remove the pieces from the sugar solution and dry each piece.**
- 6. Record the mass of each piece.**
- 7. Repeat steps 1 to 6 using different concentrations of sugar solution.**



0	4	.	4
---	---	---	---

Before the investigation, the pepper was wrapped in plastic and kept at 5 °C.

**Which are TWO reasons for keeping the pepper wrapped in plastic at 5 °C?
[2 marks]**

Tick (✓) TWO boxes.

- To change the colour of the pepper**
- To decrease the size of the pepper**
- To increase growth of the pepper**
- To reduce water loss from the pepper**
- To slow down decay of the pepper**

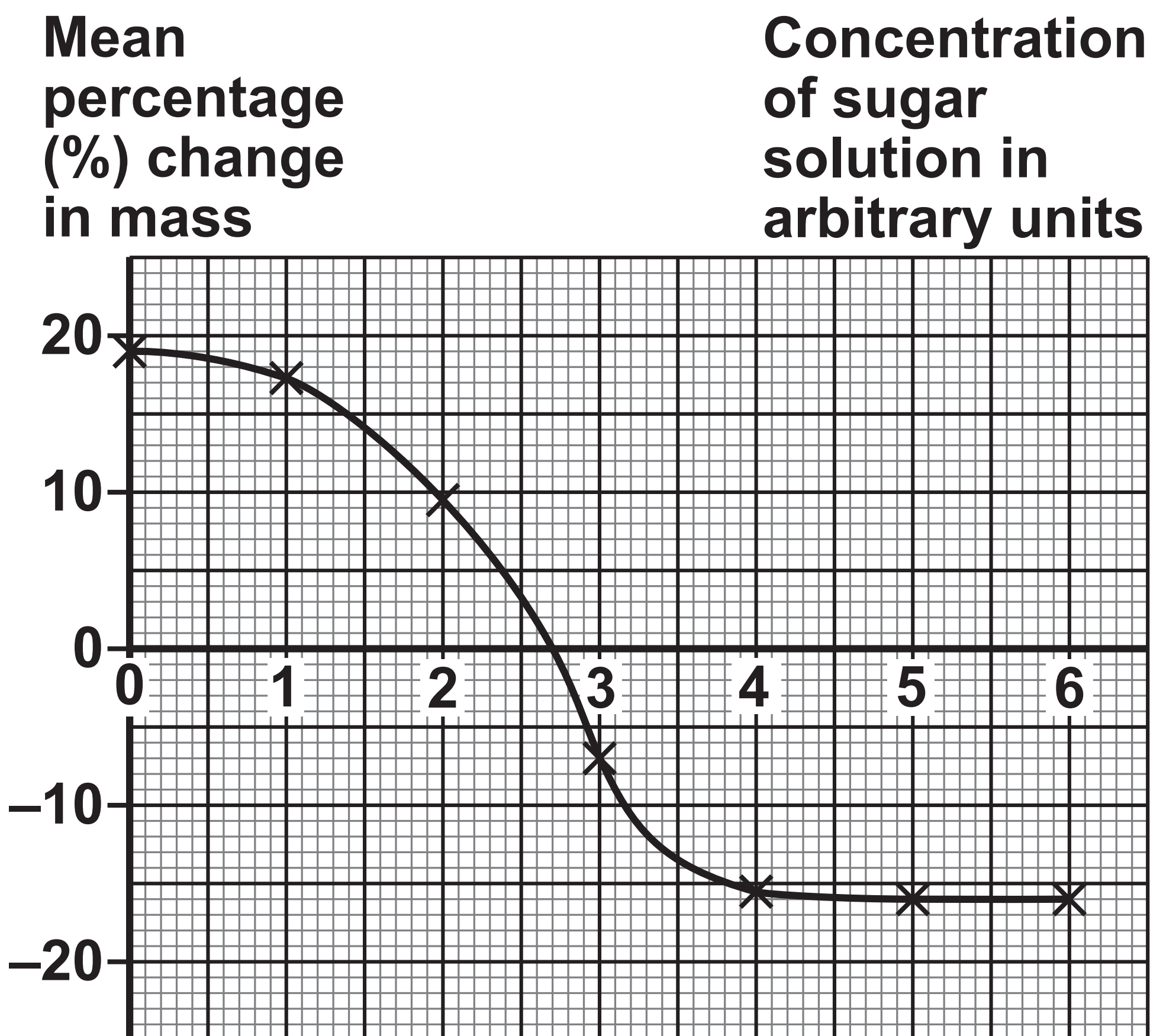
[Turn over]



The student calculated the mean percentage change in mass at each concentration of sugar solution.

FIGURE 7 shows the results.

FIGURE 7



0	4	.	5
---	---	---	---

In some concentrations of sugar solution, the mass of the pieces of pepper increased.

The mass increased because water moved into the cells.

**What process moved water into the cells?
[1 mark]**

[Turn over]



0	4	.	6
---	---	---	---

What concentration of sugar solution would cause a mean percentage change in mass of 0%?

**Use FIGURE 7 on page 42.
[1 mark]**

Concentration of sugar solution =

_____ arbitrary units



0	4	.	7
---	---	---	---

The cells of the pepper have wrinkled cell walls.

What is the advantage of wrinkled cell walls to the pepper plant? [1 mark]

Tick (✓) ONE box.

The cells can expand

The cells contain less cellulose

The surface area is smaller

[Turn over]



0 4 . 8

Tobacco mosaic virus (TMV) can infect pepper plants.

Infected plants have yellow patches on the leaves.

Explain why plants with TMV grow slower than plants that do NOT have TMV. [3 marks]



[Turn over]



0 5

This question is about genetics.

0 5 . 1

Draw ONE line from each term to the meaning of the term. [3 marks]

TERM**MEANING****Chromosome****A change in
the DNA****Genome****A structure made
of DNA and found
in the nucleus****Mutation****All the genes in
an organism****An inherited
disorder**

05.2

The inheritance of sex in humans is controlled by two chromosomes, X and Y.

Complete FIGURE 8 to show how sex is inherited. [3 marks]

FIGURE 8

FEMALE

MALE

	X	X
		XY

[Turn over]



In 2018 a scientist claimed to have genetically modified two human embryos.

0 5 . 3

**Why is genetic modification of human embryos illegal in most countries?
[1 mark]**

Tick (✓) ONE box.

Genetic modification technology is too expensive.

Specialist equipment is needed for genetic modification.

The side effects of genetic modification are not known.



0 5 . 4

The scientist claimed the genetic modification was made to embryos immediately after fertilisation.

**Why is genetic modification of embryos more of a concern than genetic modification of body tissues in an adult?
[1 mark]**

Tick (✓) ONE box.

Genetically modified body tissues are much larger than an embryo.

The genetic modification of an embryo would not affect all the body tissues.

The modified gene in an embryo could be passed on to future offspring.

[Turn over]



0	5	.	5
---	---	---	---

The scientist claimed that the embryos were genetically modified to be resistant to HIV infection.

**Why do some scientists think this use of genetic modification is NOT necessary?
[1 mark]**

Tick (✓) ONE box.

HIV infection can be treated with antiretroviral drugs.

Only adults are at risk of HIV infection.

Oral contraceptives reduce the risk of HIV infection.

9



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[Turn over]



0	6
---	---

This question is about respiration.

0	6	.	1
---	---	---	---

Complete the sentence.

Choose the answer from the list. [1 mark]

BALANCED

EXOTHERMIC

PHOTOSYNTHETIC

**Respiration releases energy, therefore
respiration is**



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[Turn over]

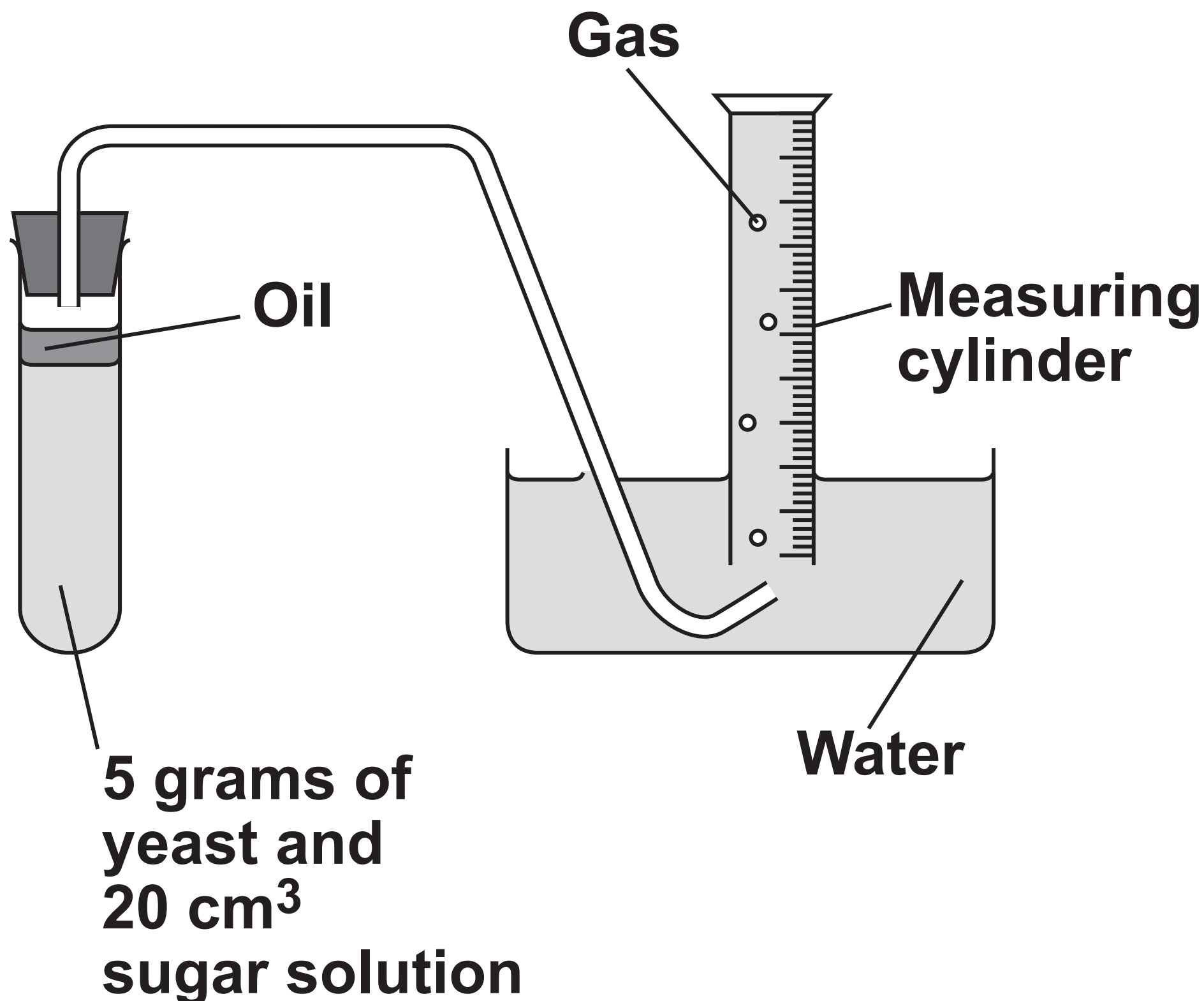


Yeast is a type of fungus.

A student investigated how temperature affects respiration in yeast.

FIGURE 9 shows some of the apparatus used.

FIGURE 9



The yeast produces a gas. The gas passes through the layer of oil and is collected in the measuring cylinder.

[Turn over]



0	6	.	2
---	---	---	---

The oil above the yeast and sugar solution prevents oxygen from entering the solution.

**What type of respiration occurs in the yeast when NO oxygen is present?
[1 mark]**



This is the method used.

- 1. Place yeast and sugar solution in a test tube.**
- 2. Add a thin layer of oil.**
- 3. Place the test tube in a water bath at 5 °C**
- 4. After 10 minutes set up the apparatus as shown in FIGURE 9, on page 56.**
- 5. Record the volume of gas collected in 1 hour.**
- 6. Repeat steps 1 to 5 at different temperatures.**

[Turn over]



0	6	.	3
---	---	---	---

Give TWO control variables the student used in the investigation. [2 marks]

1

2



TABLE 3 shows the results.

TABLE 3

TEMPERATURE IN °C	VOLUME OF GAS PRODUCED IN cm³
5	0.8
10	1.6
15	2.4
20	3.2
25	4.0

[Turn over]



0	6	.	4
---	---	---	---

Complete the sentence.

Choose the answer from the list. [1 mark]

DECREASED

STAYED THE SAME

INCREASED

**As the temperature increased, the volume
of gas produced _____ .**



0	6	.	5
---	---	---	---

Why should the data from TABLE 3, on page 61, be presented as a line graph and NOT as a bar chart? [1 mark]

Tick (✓) ONE box.

Bar charts are too simple

Temperature is a continuous variable

Volume of gas is a categoric variable

[Turn over]



TABLE 3 is repeated here.

TEMPERATURE IN °C	VOLUME OF GAS PRODUCED IN cm³
5	0.8
10	1.6
15	2.4
20	3.2
25	4.0

0 6 . 6

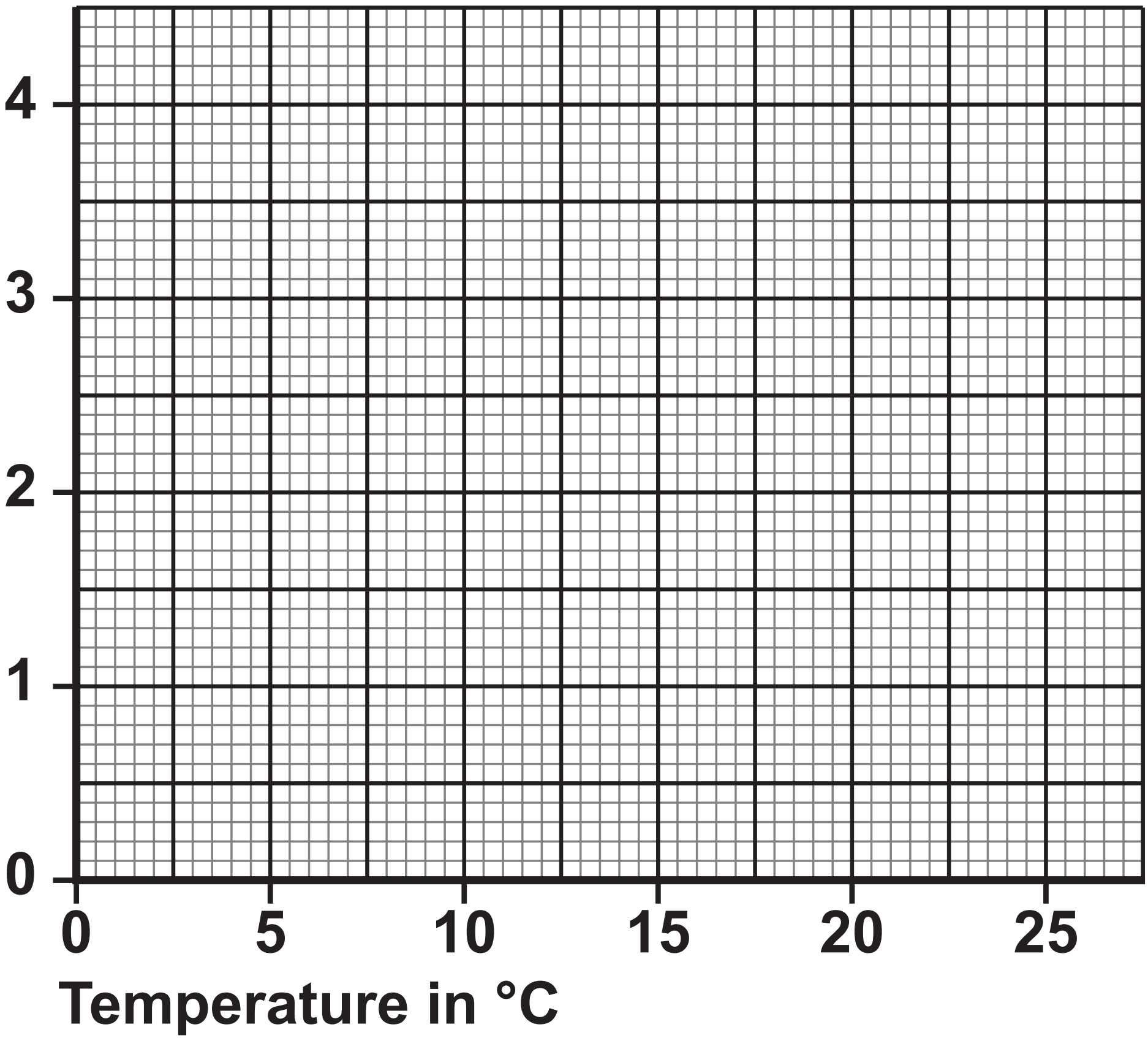
Complete FIGURE 10 on the opposite page. [4 marks]

You should:

- label the y-axis**
- plot the data from TABLE 3.**
- draw a line of best fit.**



FIGURE 10



[Turn over]



0	6	.	7
---	---	---	---

Predict the volume of gas that would be produced at 7 °C.

Use FIGURE 10 on page 65. [1 mark]

Volume = _____ cm³

0	6	.	8
---	---	---	---

The student repeated the investigation at 60 °C.

Suggest why gas was NOT produced by the yeast at 60 °C. [1 mark]

12



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[Turn over]



0	7
---	---

Funnel-web spiders produce poison to kill prey.

The poison enters the prey when the spider bites the prey.

The poison contains a protein.

0	7	.	1
---	---	---	---

What is a protein? [1 mark]

Tick (✓) ONE box.

A chain of glucose molecules

A long chain of amino acids

A small insoluble molecule



0	7	.	2
---	---	---	---

**What reagent is used to test for protein?
[1 mark]**

[Turn over]



The protein from the spider could be used in a new drug to treat patients having a heart attack.

When a person has a heart attack:

- **cells in the heart muscle do NOT receive enough oxygen**
- **cells in the heart muscle stop working.**

0 7 . 3

Why are heart attacks non-communicable? [1 mark]



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[Turn over]





07.4

The protein from the spider allows heart muscle tissues to function in low concentrations of oxygen.

Complete TABLE 4, on the opposite page, to show the risks and benefits of the new drug. [2 marks]



Tick (✓) ONE box in EACH row.

TABLE 4

STATEMENT	RISK	BENEFIT
The drug could be toxic		
The drug could keep hearts for transplantation functioning for more time		
The drug could treat coronary heart disease		
The drug could stop other drugs working		

[Turn over]

The drug made from the protein would be tested in a drug trial.

0 7 . 5

Part of the drug trial would involve a placebo.

Explain why a placebo is used in a drug trial. [2 marks]



07.6

The results of drug trials are peer reviewed.

Which are TWO advantages of peer review? [2 marks]

Tick (✓) TWO boxes.

People who are not experts simplify the results during peer review.

Scientists not involved in the drug trial assess whether the results are valid.

Scientists who planned the drug trial decide whether the results are published.

The peer reviewers decide the dose for testing the drug on animals.

The process of peer review reduces the chance of bias.

 9

[Turn over]



0	8
---	---

Two students analysed water from four rivers.

Each student measured the pH of the river water using a different method.

TABLE 5 shows the results.

TABLE 5

RIVER	pH OF RIVER WATER	
	Method A	Method B
W	7	7.4
X	6	6.5
Y	8	8.1
Z	7	7.6



0	8	.	1
---	---	---	---

Suggest what was used to measure the pH in each method. [2 marks]

Method A _____

Method B _____

[Turn over]



0 8 . 2

**Why is it NOT valid to calculate a mean of the two pH values for each river?
[1 mark]**

Tick (✓) ONE box.

A mean cannot be calculated from only two values.

Each method gives values to a different resolution.

The mean should be calculated for each method using all four samples.



0	8	.	3
---	---	---	---

Complete the sentence.

Choose the answer from the list. [1 mark]

ACCURATE

REPEATABLE

REPRODUCIBLE

Method A and Method B gave similar results.

This shows that the results are

[Turn over]



TABLE 5 is repeated here.

RIVER	pH OF RIVER WATER	
	Method A	Method B
W	7	7.4
X	6	6.5
Y	8	8.1
Z	7	7.6



0 8 . 4

Which river is most likely to be in an area with a high concentration of sulfur dioxide in the air?

**Use TABLE 5, on the opposite page.
[1 mark]**

Tick (✓) ONE box.

W

X

Y

Z

[Turn over]





BLANK PAGE

[Turn over]



0	9
---	---

Biodiversity is the variety of species within an ecosystem.

0	9	.	1
---	---	---	---

A student investigated the biodiversity in a field.

In part of the field, the living grass had been replaced with plastic grass.

Other plants grow between living grass plants and between pieces of plastic grass.



FIGURE 11 shows the field.

FIGURE 11



[Turn over]

The student used quadrats to randomly sample the biodiversity of plants in:

- **the area with living grass**
- **the area with plastic grass.**

Describe how the student could decide where to randomly place the quadrats in the area with plastic grass. [2 marks]



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[Turn over]



0	9	.	2
---	---	---	---

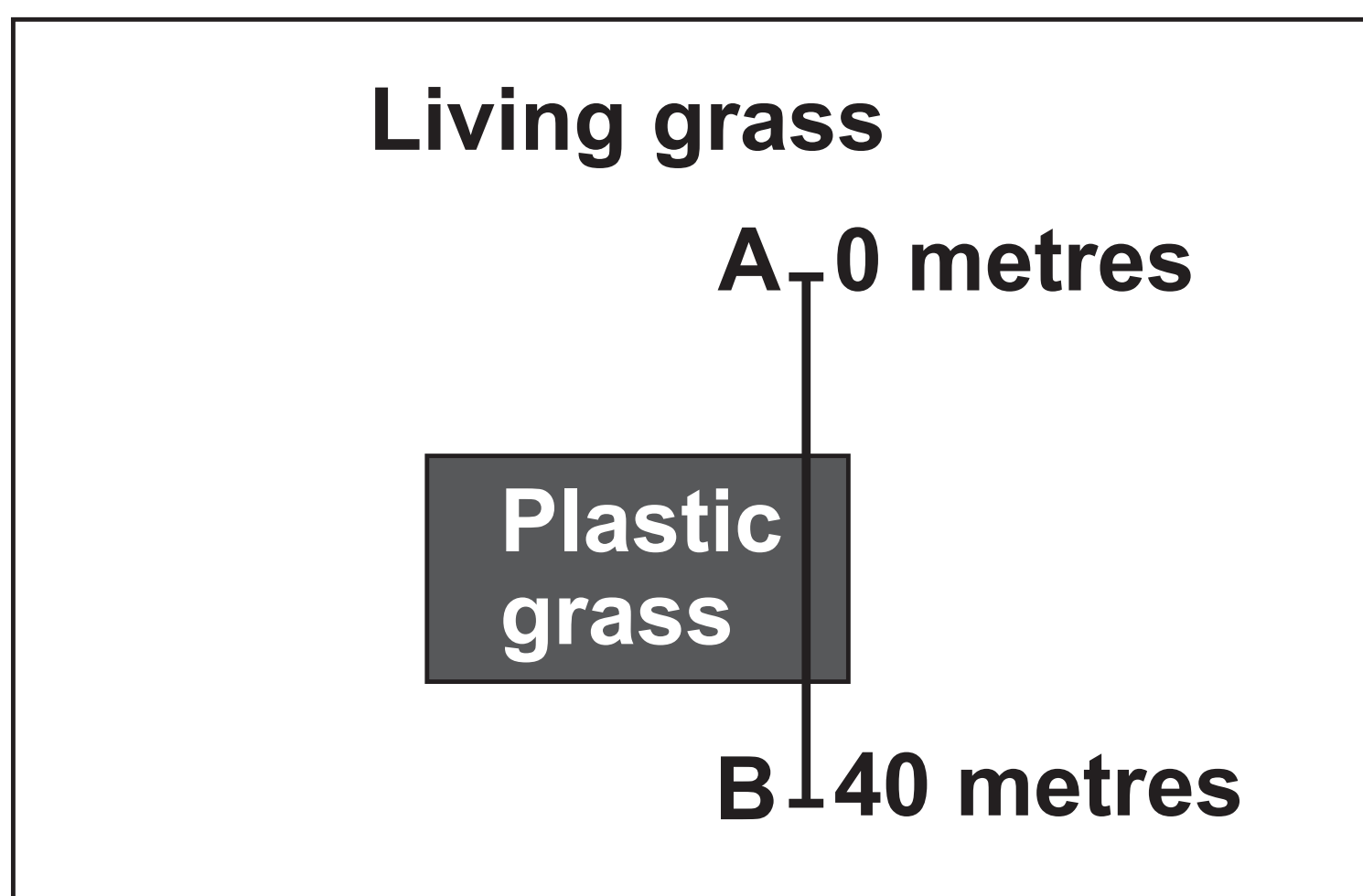
How would a greater number of different plant species affect the biodiversity of animals in the area? [1 mark]



Another student used a transect to place quadrats in the field.

FIGURE 12 shows the position of the transect.

FIGURE 12



[Turn over]



The student placed a quadrat every 5 metres from point A to point B.

TABLE 6 shows the results.

TABLE 6

DISTANCE FROM POINT A IN METRES	TYPE OF GRASS	NUMBER OF PLANT SPECIES
0	Living	4
5	Living	6
10	Living	5
15	Plastic	1
20	Plastic	0
25	Plastic	2
30	Plastic	2
35	Living	4
40	Living	5



0	9	.	3
---	---	---	---

Complete the sentence. [1 mark]

The relationship between the distance from point A and the number of plant species CANNOT be represented by the equation:

$$y = mx + c$$

This is because the relationship is NOT

[Turn over]



0	9	.	4
---	---	---	---

Describe the relationship between the type of grass and the number of plant species. [1 mark]



0 9 . 5

Which of the following are TWO improvements to the investigation that used a transect? [2 marks]

Tick (✓) TWO boxes.

Decrease the length of the transect to 20 metres.

Increase the distance between quadrats from 5 metres to 10 metres.

Record the number of plants of each species as well as the number of species.

Repeat three times at different times of the same day.

Repeat using three different transects that cross the two types of grass.

[Turn over]



09.6

Small pieces of plastic break off plastic grass and enter rivers and oceans.

Leaves from trees take longer to decompose on plastic grass than on living grass.

Other plants can grow between pieces of plastic grass.

Plastic grass CANNOT be recycled.

Explain how plastic grass affects biodiversity of ecosystems. [6 marks]



09.7

Ecosystems with low biodiversity may have small populations of some species.

**Why are small populations more likely to become extinct than large populations?
[1 mark]**

Tick (✓) ONE box.

A small population may be more varied genetically than a large population.

Large populations in the same habitat interact to form communities.

Less genetic variation is a greater risk if the ecosystem changes.

[Turn over]



09.8

Suggest TWO ways biodiversity in and around fields can be increased.

Do NOT refer to plastic grass. [2 marks]

1 _____

2 _____

16

END OF QUESTIONS



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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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1 0 4



2 4 6 G 8 4 6 5 / 2 F