

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Monday 9 June 2025 – Morning

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

J260/08 Combined Science (Higher Tier)

**Time allowed: 1 hour 45 minutes
plus your additional time allowance**

YOU MUST HAVE:

a ruler (cm/mm)

**the Data and Equation Sheet for GCSE (9–1) Combined
Science B (with this document)**

Loose Sheet for Question 9 (with this document)

YOU CAN USE:

an HB pencil

a scientific or graphical calculator

Please write clearly in black ink.

Centre number

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Candidate number

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First name(s)

Last name

READ INSTRUCTIONS OVERLEAF



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 75.

The marks for each question are shown in brackets [].

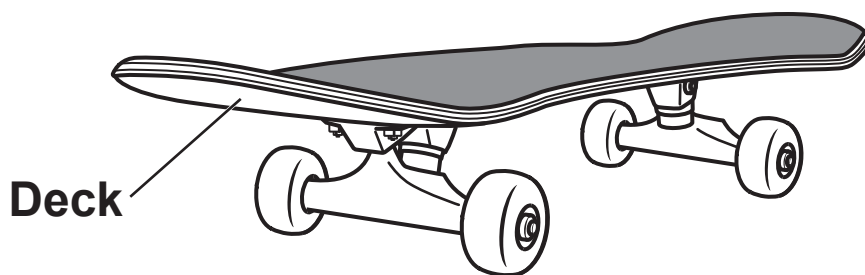
Quality of extended response will be assessed in questions marked with an asterisk (*).

ADVICE

Read each question carefully before you start your answer.

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1 A skater wants to buy a new skateboard.



The table shows information about three different skateboards.

Skateboard	Deck material	Tensile strength (MPa)	Stiffness (GPa)	Density (kg/m³)
A	Wood	4	10	700
B	Glass	3400	75	2500
C	Composite	350	10	900

(a) Suggest why the skater chooses to buy Skateboard C.

[2]

(b) State why the development of composite materials is beneficial when designing new products.

[1]

- (c) The skater decides to recycle the old skateboard so that it does not take up space in landfill.

State ONE other factor that should also be considered when disposing of a skateboard.

[1]

- (d) The skateboards are transported to shops in lorries that burn diesel.
- (i) One gas that forms when diesel burns is sulfur dioxide.

Explain ONE problem caused by increased amounts of sulfur dioxide in the atmosphere.

[2]

- (ii) Carbon monoxide and nitrogen monoxide are also formed when diesel burns.

Catalytic converters help to decrease these emissions into the atmosphere by converting:

nitrogen monoxide into nitrogen
carbon monoxide into carbon dioxide.

Complete the equation to show the reaction that occurs in a catalytic converter. [1]



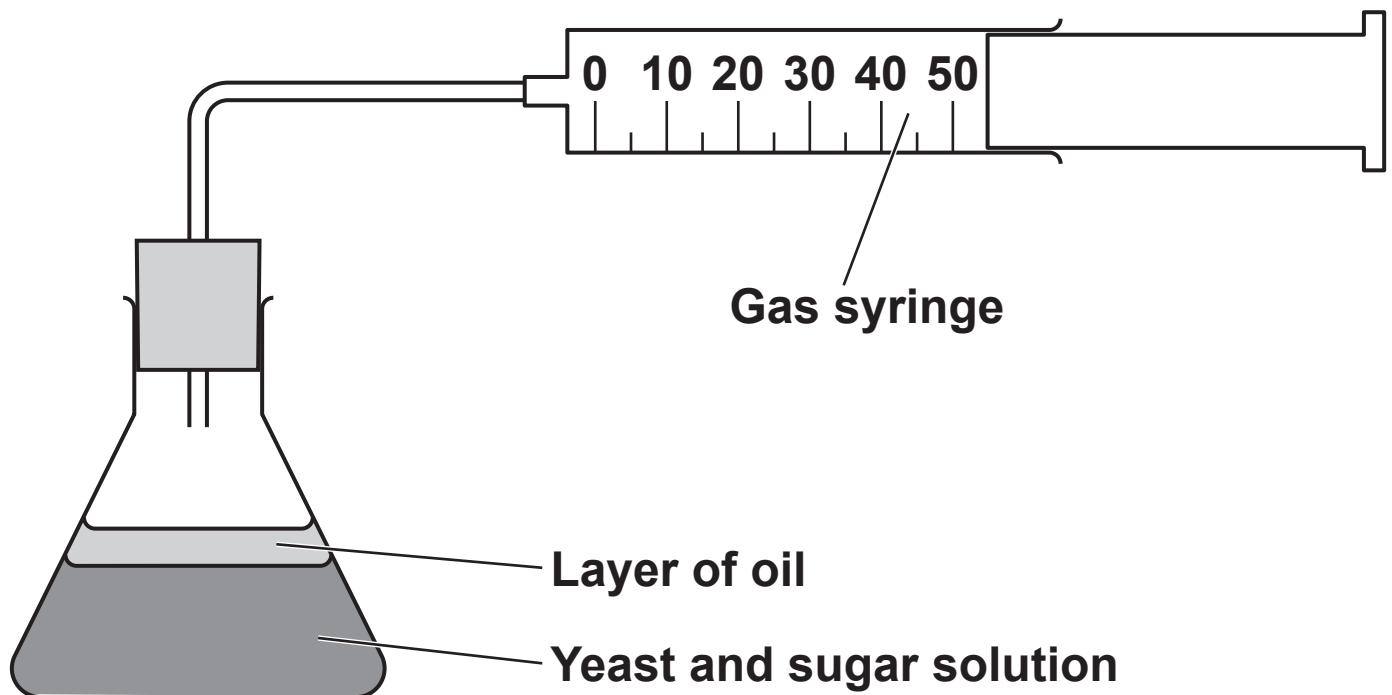
- 2 A student is investigating the rate of anaerobic respiration in yeast using this method and the apparatus shown:**

Add glucose to a yeast solution.

Add a layer of oil on top to prevent oxygen reaching the yeast.

Measure the volume of carbon dioxide made in 20 minutes.

Repeat using sucrose and maltose.



- (a) The student controls the temperature of the yeast and sugar solution to make sure their comparisons are valid.**

Describe HOW the student should control the temperature.

[1]

The student's results are shown in the table:

Type of sugar	Volume of carbon dioxide collected in 20 minutes (cm ³)
Glucose	35
Sucrose	25
Maltose	30

- (b) Explain how the student could improve the accuracy of the gas volume measurements.

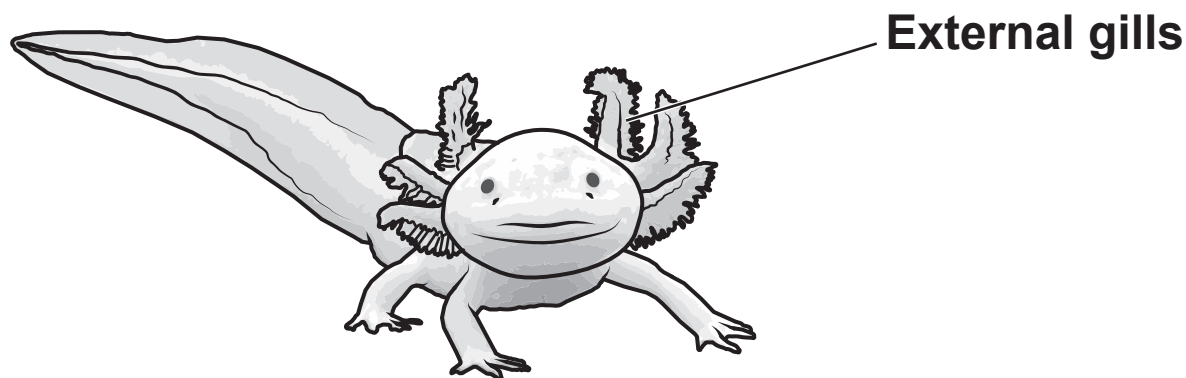
[2]

- (c) Calculate the rate of carbon dioxide production for the yeast and GLUCOSE solution.

Rate of carbon dioxide production = _____ cm³/minute [2]

- (d) Yeast cells absorb oxygen across their cell membranes.

An axolotl is a multicellular animal that lives in water. It has external gills for gas exchange.



Explain why an axolotl needs external gills for gas exchange.

Use ideas about surface area to volume ratios in your answer.

[3]

3 Radioactive isotopes have many uses in medicine.

- (a) When a person is injected with a radioactive medical isotope, they are contaminated.

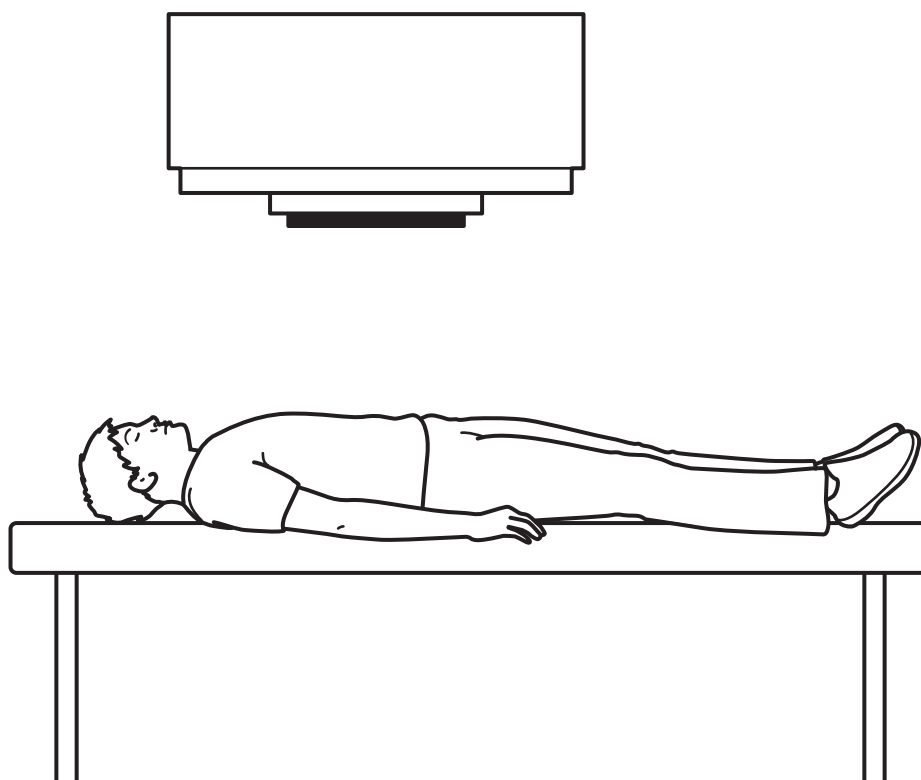
A person having an X-ray is irradiated.

State ONE difference between contamination and irradiation.

[1]

- (b)* Gallium-67 is a radioactive isotope that emits gamma rays when it decays. It is used in medicine for imaging and to help diagnose diseases. Gallium-67 has a half-life of 78.3 hours.

A radioactive tracer which contains gallium-67 is injected into a patient's arm. After a few hours, a set of images are taken on a gamma camera. The gamma camera uses the radiation emitted by gallium-67 to form these images.



[6]

11

(c) Sodium-24 can be used to identify blockages in blood vessels.

The activity of sodium-24 falls by $\frac{3}{4}$ in 30 hours.

Calculate the half-life of sodium-24.

Half-life = _____ hours [2]

4 This question is about the reactivity series of metals.

(a) Describe how dilute hydrochloric acid can be used to investigate the reactivity of metals.

[3]

(b) The reactivity of metals can also be investigated using copper sulfate solution.

A student uses this method:

Put some copper sulfate solution into an insulated cup.

Add a piece of metal.

Record the maximum temperature reached during the reaction.

Suggest TWO changes the student can make to improve the validity of the data that will be collected.

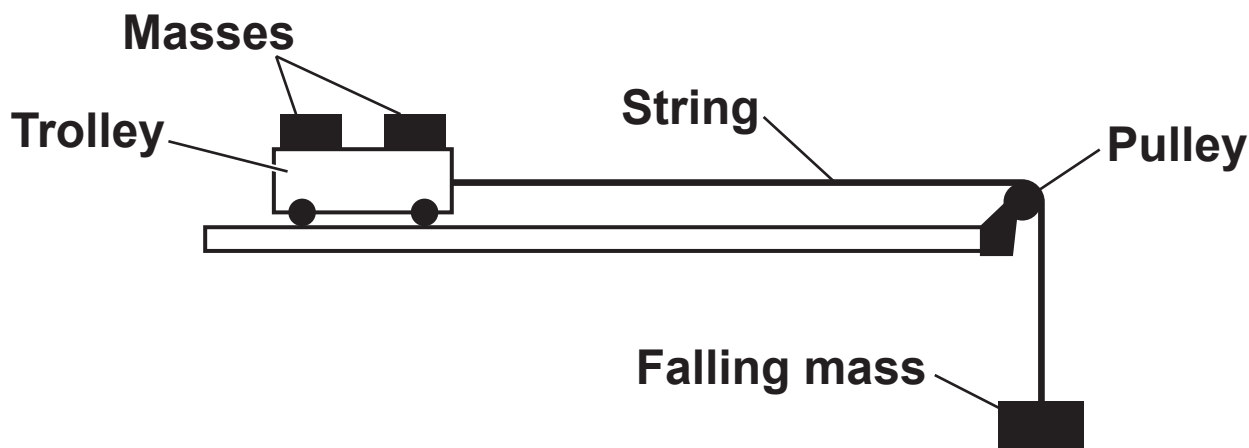
Improvement 1 _____

Improvement 2 _____

[2]

- 5 A student is investigating how the total mass of a trolley affects its acceleration when the force is constant.

The diagram shows the apparatus used.



- (a) The two horizontal forces acting on the trolley are the pulling force of the string and friction of the wheels of the trolley.

The manufacturer of the trolley claims that the trolley is frictionless however.

Explain how the student can calculate the resultant horizontal force acting on the trolley, if the manufacturer's claim is correct.

[2]

- (b) The student measures the time taken for the trolley to travel a distance of 1.0 m.
- (i) Why does the student repeat this time measurement three times and then calculate the mean?

Tick (✓) ONE box. [1]

To reduce the effect of air resistance on the result.

☐

To reduce the effect of friction on the result.

☐

To reduce the effect of random errors on the result.

☐

To reduce the effect of systematic errors on the result.

☐

- (ii) In one experiment, the acceleration of the trolley is 0.72 m/s^2 .

Calculate the final speed of the trolley after it travels a distance of 1.0 m.

Use the Data and Equation Sheet.

Final speed = _____ m/s [4]

6 This question is about the extraction of metals.

(a) Mining for metals can result in waste substances being released into rivers and into the soil.

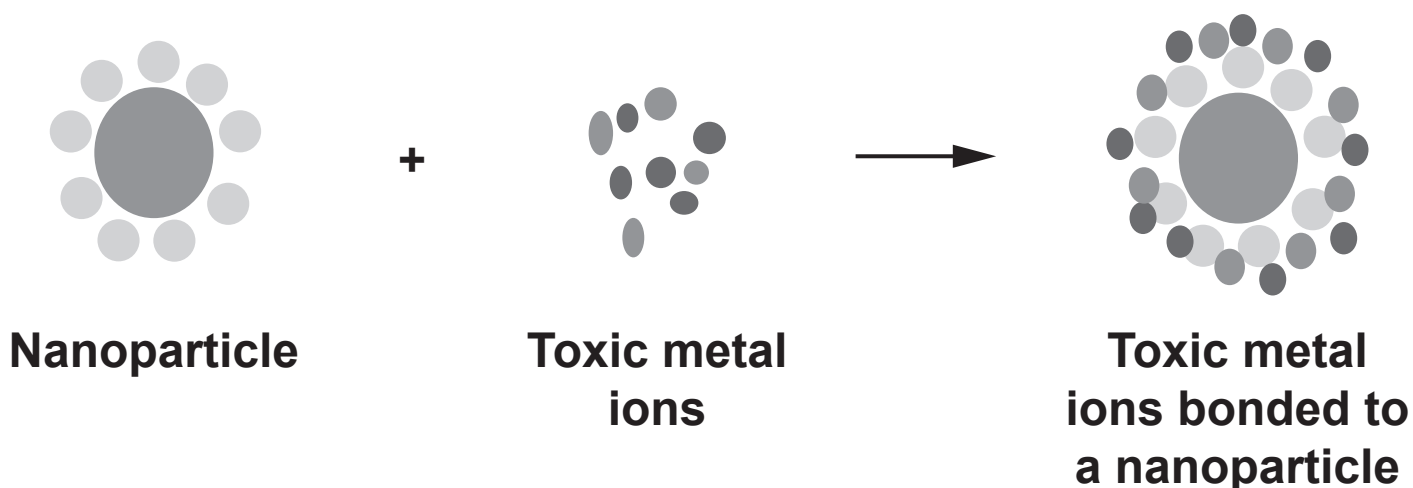
(i) Phytoextraction uses plants to remove metal contamination from soil.

Explain why there is LESS carbon dioxide emitted when phytoextraction is used compared to traditional mining.

[1]

(ii) Scientists have developed special filters to remove toxic metal ions from river water.

These filters use nanoparticles. The nanoparticles bond to the toxic metal ions to remove them.



Suggest ONE risk associated with using nanoparticles for this purpose.

[1]

(b) Some metals are extracted by electrolysis.

Potassium can be extracted by electrolysis of molten potassium chloride.

Potassium CANNOT be extracted by electrolysis of dilute potassium chloride solution.

Explain why.

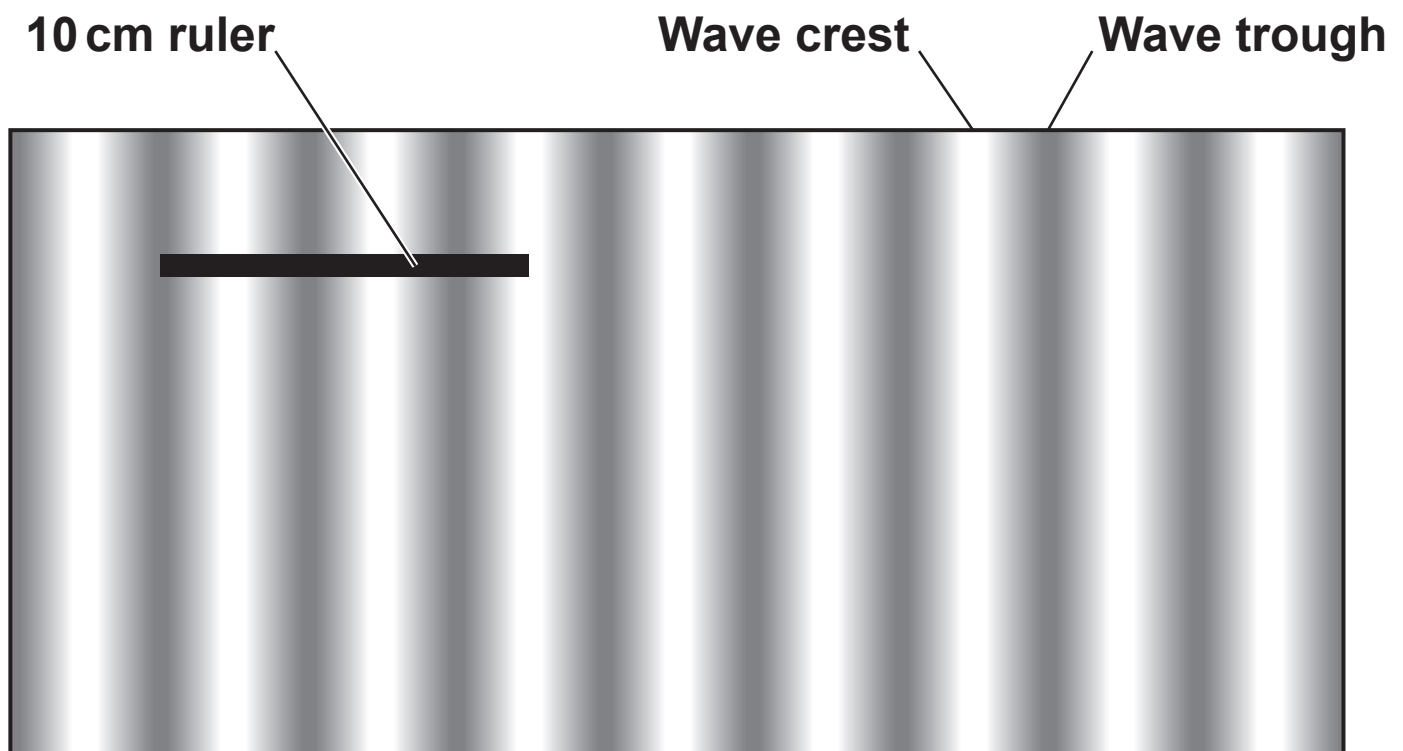
[3]

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- 7 A student is using a ripple tank to investigate how the speed of water waves depends on the depth of the water.

The waves in the ripple tank are generated by a vibrating bar.

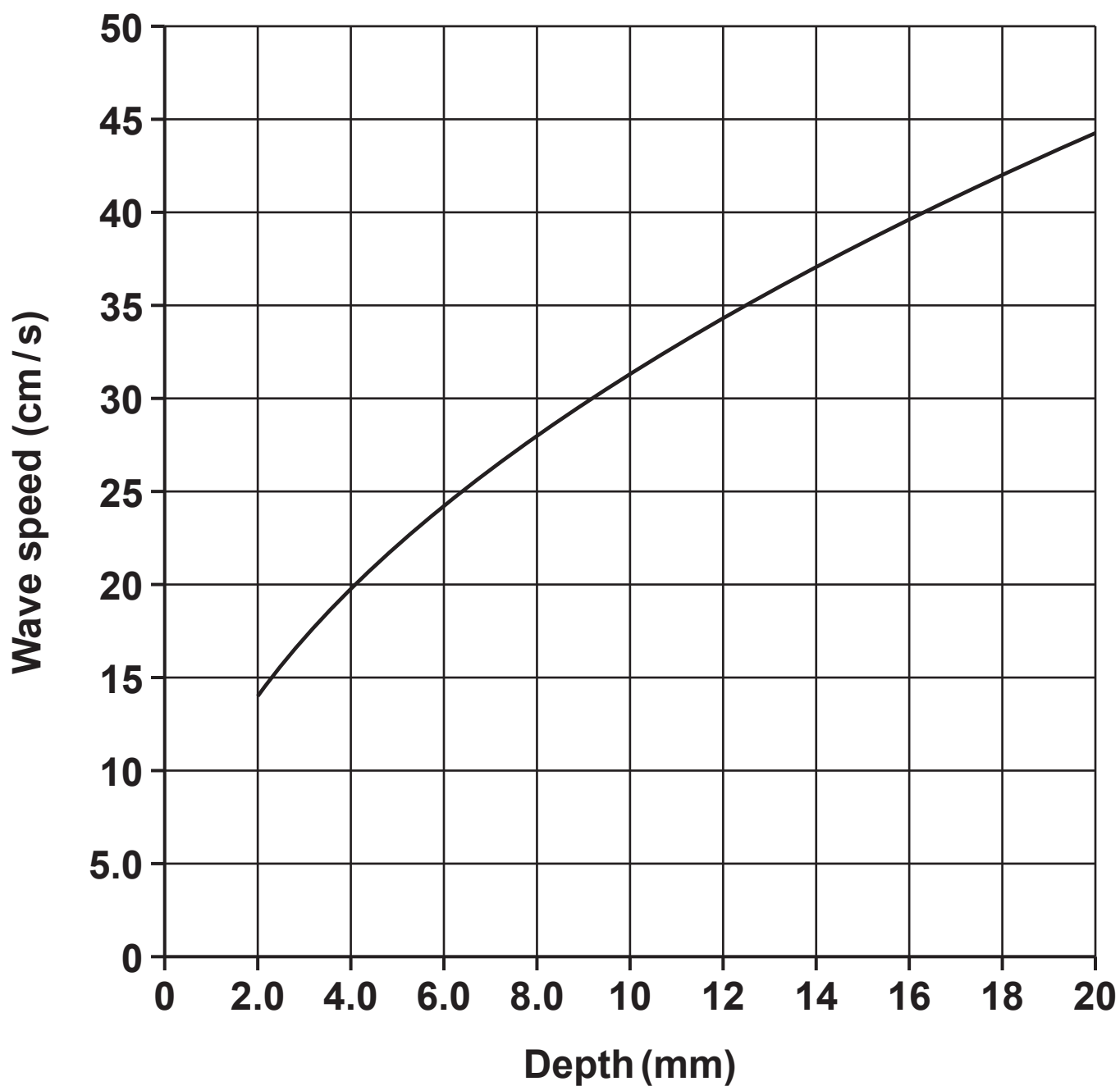
The image shows the observations from one experiment.



(a) Estimate the wavelength of the waves.

Wavelength = _____ cm [2]

(b) The graph shows how the speed of a water wave in the ripple tank varies with depth.



When the depth of the water is 14 mm the wavelength of the waves is found to be 3.9 cm.

Calculate the frequency of the vibrating bar when the depth of the water is 14 mm.

**Use the graph and the equation:
wave speed = frequency $\times$ wavelength.**

Give your answer to an appropriate number of significant figures.

Frequency = _____ Hz [5]

- 8 A student does an experiment to investigate the number of stomata on the upper and lower surfaces of leaves.**

This is their method:

Remove one leaf from a plant.

Spread clear nail varnish over a 1 cm by 1 cm square on the upper surface of the leaf.

Allow the nail varnish to dry.

Use clear sticky-tape to peel off the nail varnish.

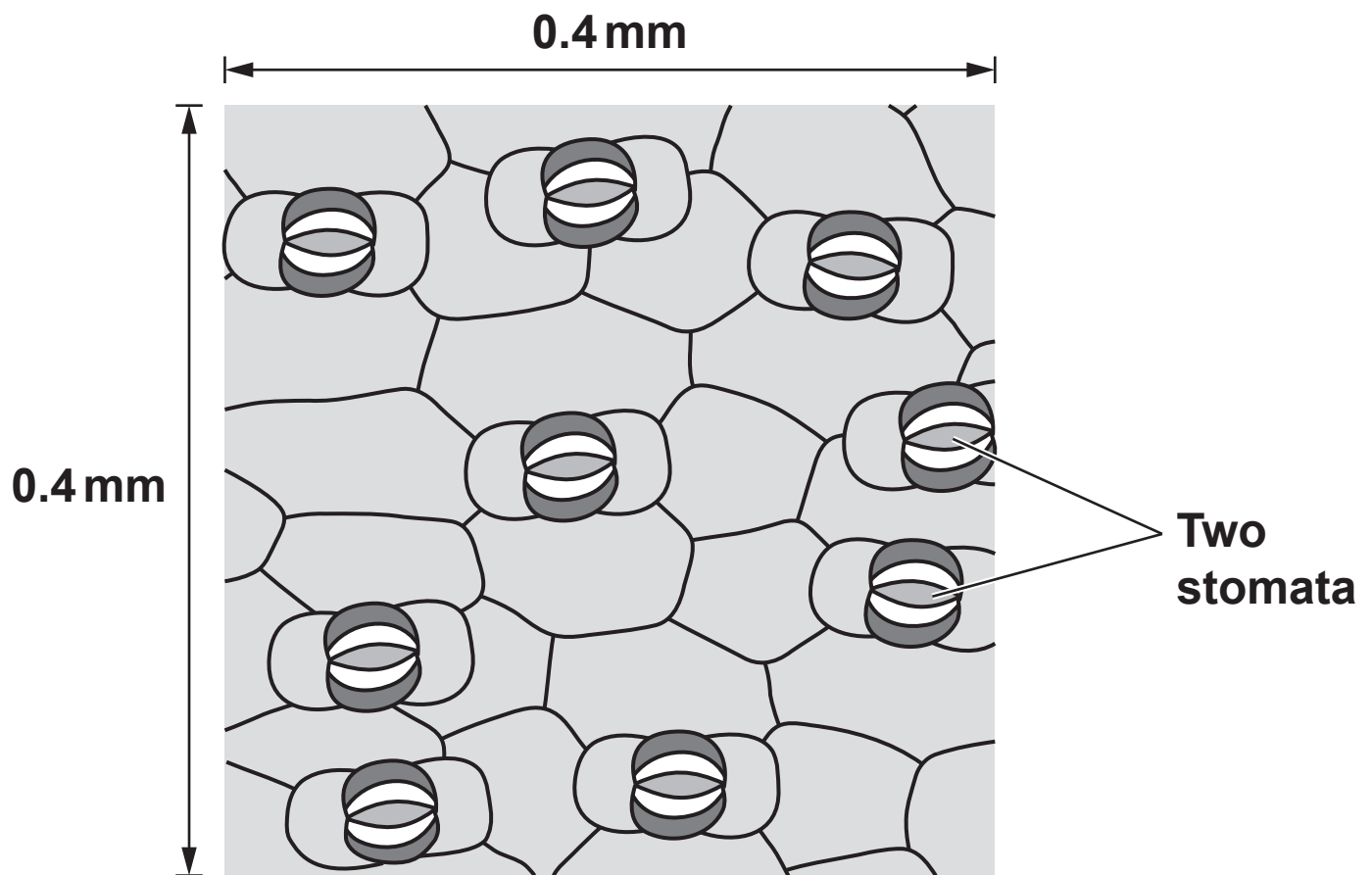
Spread the tape on a glass microscope slide.

Repeat method for lower surface of the leaf.

- (a) Describe how to use a light microscope to view the stomata on the slide using the highest magnification.**

[3]

(b) The image shows part of the view down the light microscope.



Calculate the stomatal density of the leaf.

Use the image and the formula for stomatal density:

$$\text{Stomatal density} = \frac{\text{Number of stomata in field of view}}{\text{Area of field of view}}$$

Give your answer to the NEAREST WHOLE NUMBER.

Stomatal density = _____ per mm² [4]

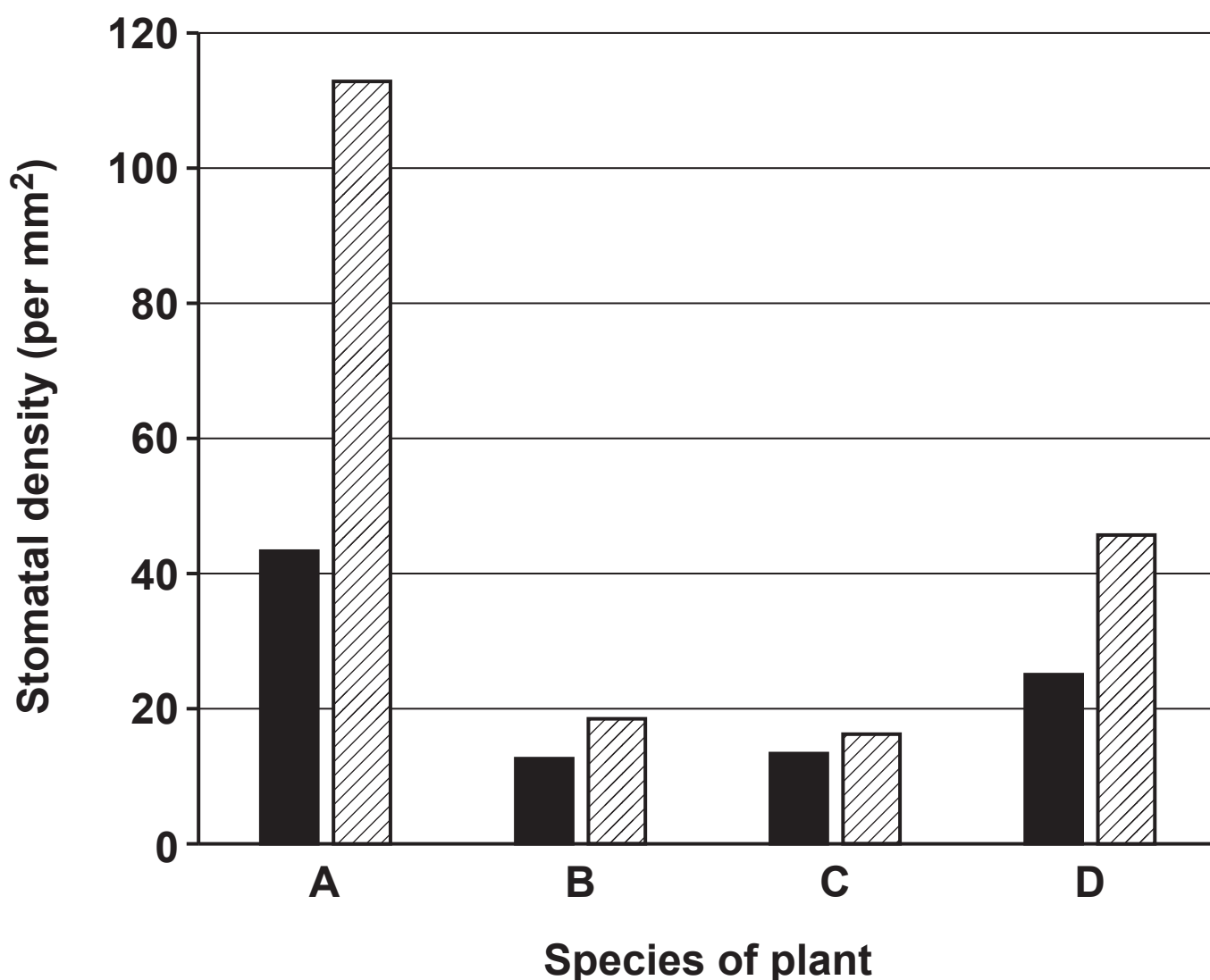
(c) The graph shows data collected by the student for stomatal density of 4 other plant species.

Species A is a plant that is found in **WOODLAND** in the UK.

Species B, C and D are plants from **DRY CLIMATES** around the world.

■ Upper surface

▨ Lower surface



(i) State ONE conclusion from the graph.

[1]

(ii) Explain why you can only have limited confidence in any conclusions made from the graph.

[2]

(d) Plant C is a species that is commonly found in HOT DESERTS in Central America.

Explain how natural selection can lead to a plant population having fewer stomata.

[3]

- 9 Some scientists say that human activities such as burning fossil fuels have affected the total area of arctic sea ice.**

FIG. 9.1 and FIG. 9.2 on the Loose Sheet show how some environmental factors have changed over many years.

- (a) Evaluate the scientists' theory that human activities have affected the total area of arctic sea ice.**

Use information from FIG. 9.1 and FIG. 9.2 in your answer.

[4]

- (b) Pentane is a fossil fuel. It is part of the hydrocarbon mixture in petrol and in aircraft fuel.

This is the equation for the complete combustion for pentane:



Calculate the mass of carbon dioxide formed when 28.8 g of pentane is burned.

Use the relationship:

$$\text{number of moles} = \frac{\text{mass of substance}}{\text{relative formula mass}}$$

Mass of carbon dioxide formed = _____ g [5]

10 Cardiovascular disease (CVD) is a general term for a group of diseases affecting the heart or blood vessels.

(a) Red blood cells are specialised cells which have no nucleus.

Explain why this is a useful adaptation.

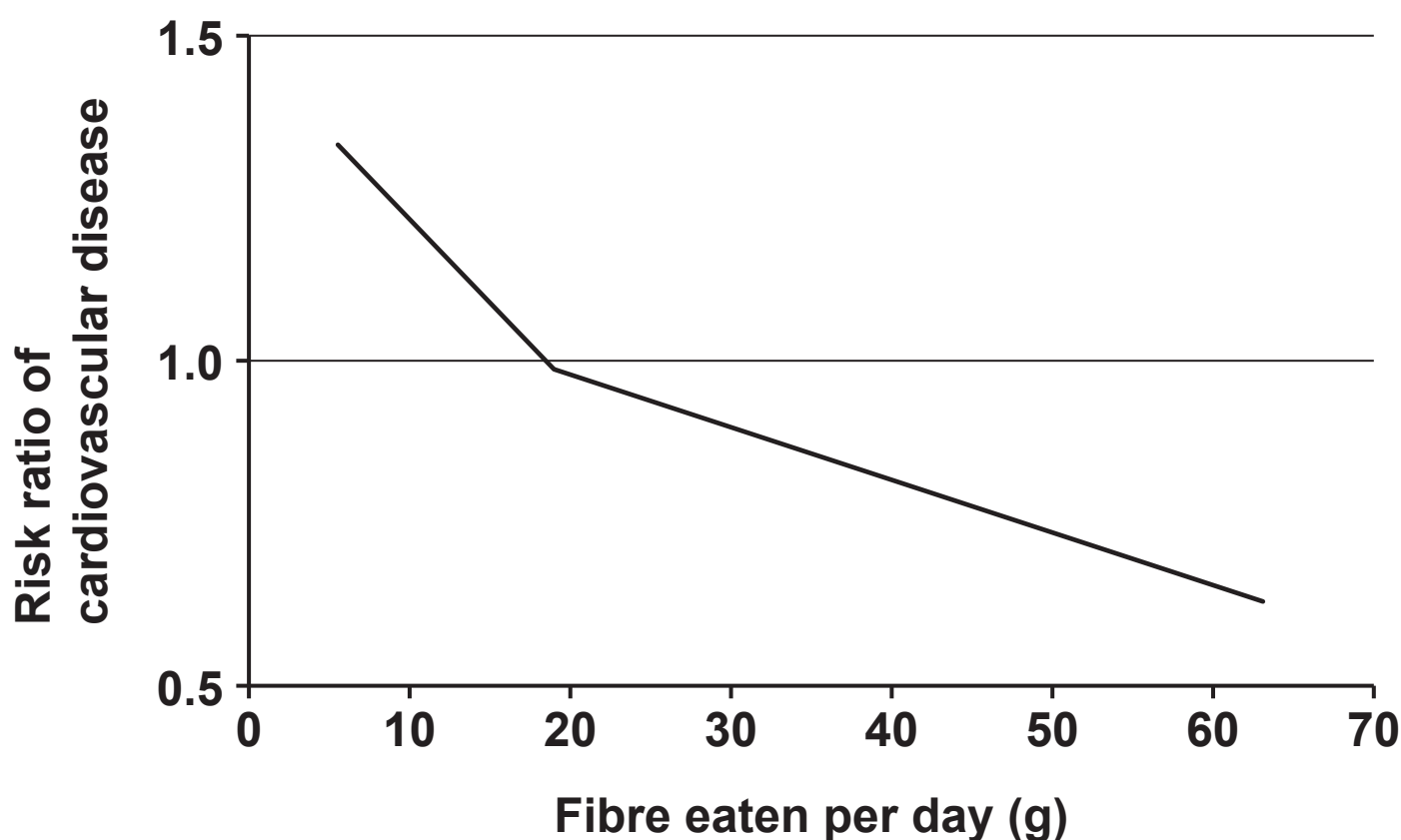
[1]

- (b) Some scientists produced a graph from 50 studies on the effect of fibre on the risk of CVD.

Fibre is food that cannot be digested and absorbed.

The graph shows the risk ratio of developing CVD based on the mass of fibre in a person's diet.

A risk ratio of 1.0 means that the risk of developing CVD is equal to the mean risk of the general population.



Describe the trend shown by the graph.

[1]

- (c) The recommendation from the study is that everyone should increase their fibre intake by 7 g per day.

Scientists suggested people could increase their fibre intake by eating another four portions of fruit or vegetables each day.

Evaluate this as a strategy to lower the risk of CVD.

Use the graph to help you.

[3]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

[illegible]

[illegible]

[illegible]



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