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0653/61

October/November 2017

**1 hour**

No Additional Materials are required.

## READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **19** printed pages and **1** blank page.

- 1 A student investigates the action of different concentrations of an enzyme solution on milk protein. When the protein is broken down the milk becomes clear.

- The student adds 2 cm<sup>3</sup> of 4% enzyme solution to some milk in a test-tube and immediately starts a stopclock.
- He mixes the contents of the test-tube well.
- He times how long it takes for the protein to break down by observing the test-tube until the milk is clear.
- He records his result to the nearest whole second in Table 1.1.
- He repeats the procedure using different concentrations of enzyme solution by diluting the solution with distilled water, as shown in Table 1.1.

- (a) Suggest a suitable piece of apparatus the student could use to measure the small volumes of enzyme solution and distilled water.

.....[1]

- (b) The original enzyme solution has a concentration of 4%.

In Table 1.1, use the values given for volume of enzyme solution and volume of distilled water to calculate the new concentrations of enzyme.

Record these concentrations in Table 1.1.

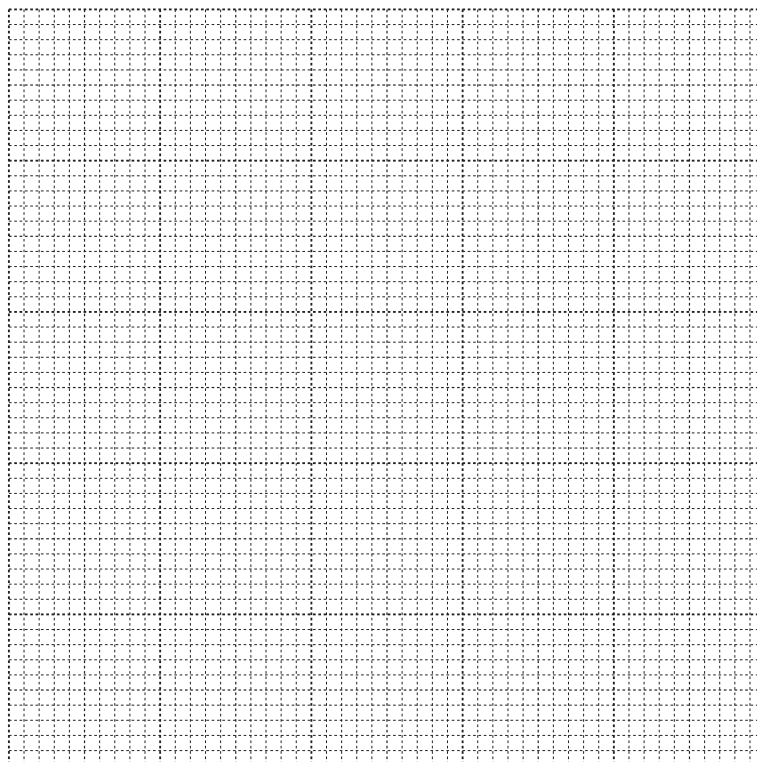
**Table 1.1**

| volume of enzyme solution / cm <sup>3</sup> | volume of distilled water / cm <sup>3</sup> | concentration of enzyme % | time taken for the milk to clear / s |
|---------------------------------------------|---------------------------------------------|---------------------------|--------------------------------------|
| 2.0                                         | 0.0                                         | 4                         | 63                                   |
| 1.5                                         | 0.5                                         |                           | 98                                   |
| 1.0                                         | 1.0                                         |                           | 144                                  |
| 0.5                                         | 1.5                                         | 1                         | 191                                  |

[1]

- (c) On the grid provided, plot a graph of time taken for the milk to clear (vertical axis) against concentration of enzyme.

Draw the best-fit straight line.



[4]

- (d) Use your graph to describe the relationship between the concentration of enzyme and the time taken for the milk to clear.

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

- (e) The student uses a similar method to investigate how the rate of this enzyme-catalysed reaction varies with temperature.

- (i) Suggest suitable temperatures for the student to use.

.....[2]

- (ii) State **two** variables that the student should keep constant in this experiment where the temperature is varied.

variable 1 .....

variable 2 .....

[1]

- 2 A student investigates the temperature change in the reaction between **H** and water. **H** is a white solid and is an oxide. **J** is a blue solution of a copper salt. The student carries out reactions to identify compounds **H** and **J**.

- (a)
- She places 25 cm<sup>3</sup> of distilled water into a beaker.
  - She measures the temperature  $T_1$  of this water.
  - She adds a sample of solid **H** to the water in the beaker, stirs the mixture and measures the highest temperature  $T_2$  of the mixture.

**Table 2.1**

| temperature<br>$T_1 / ^\circ\text{C}$ | temperature<br>$T_2 / ^\circ\text{C}$ | change in<br>temperature / $^\circ\text{C}$ |
|---------------------------------------|---------------------------------------|---------------------------------------------|
|                                       |                                       |                                             |

- (i) Read the thermometers in Fig. 2.1 and record in Table 2.1 the temperatures  $T_1$  and  $T_2$  to the nearest 0.5  $^\circ\text{C}$ .

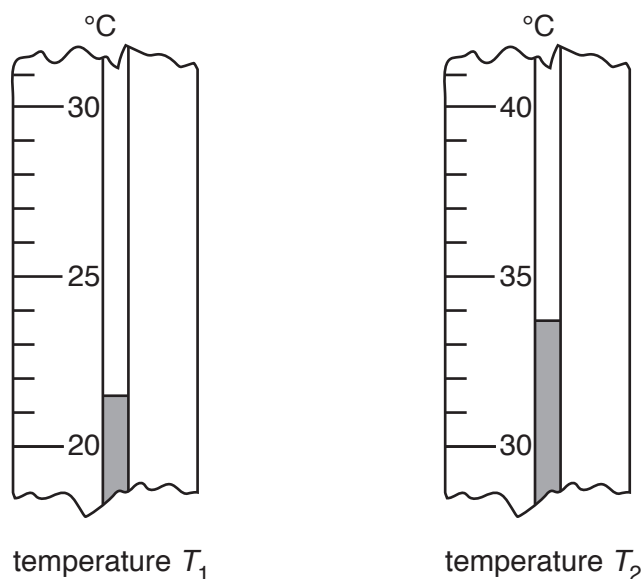


**Fig. 2.1**

[2]

- (ii) Calculate the temperature change in this reaction.

Record in Table 2.1 the value with a plus or minus sign as appropriate.

[1]

- (iii) Use this temperature change to state which type of reaction has taken place.

.....[1]

- (b) The student filters the mixture from (a) and the resulting filtrate **F** is treated as follows. Her observations and conclusions are shown in each case.

- Filtrate **F** is tested with Universal Indicator paper.

*The paper turns a colour that suggests pH12.*

- Dilute hydrochloric acid is added to marble chips (calcium carbonate) and the gas produced is passed into filtrate **F**.

*Filtrate **F** becomes milky, then becomes colourless.*

- An excess of **F** is slowly added to a small volume of solution **J**.

*A blue ppt. forms and does not disappear when excess **F** is added.  
This is like the test for copper ions.*

Use the student's observations and conclusions to answer the following questions about filtrate **F**.

- (i) State what the student can deduce from the Universal Indicator test.

.....[1]

- (ii) State which common reagent would behave like **F** when the gas produced from the reaction between the acid and marble chips is passed through it.

.....[1]

- (iii) In the reaction between **F** and **J**, **F** is behaving like a reagent used to test for cations.

Name this reagent.

.....[1]

- (c) Use all of the evidence from (a) and (b) to suggest a chemical name for **H**.

State how you have used the evidence to arrive at your answer.

**H** is ..... oxide

reason .....

.....

.....

[2]

- (d) The student now tries to identify the anion in **J**.

- She adds nitric acid to solution **J** and splits this into two portions.
- To one portion she adds barium nitrate solution. There is no change.
- To the other portion she adds silver nitrate solution and obtains a white precipitate.

Identify the anion in **J**.

anion in **J** .....

[1]

- 3 A student investigates how the power  $P$  of a filament lamp depends upon the current  $I$  flowing through it.

She uses the circuit shown in Fig. 3.1.

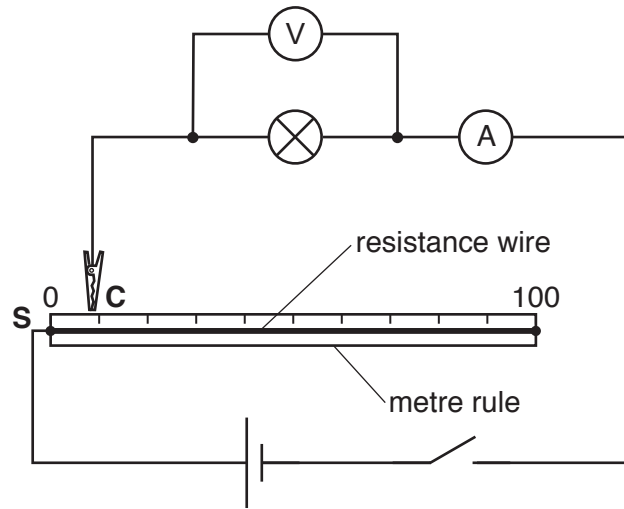


Fig. 3.1

She connects the crocodile clip **C** to the end **S** (0 cm) of the resistance wire.

She switches on the circuit.

She measures the potential difference  $V$  across the lamp and the current  $I$  flowing through the lamp.

The meter readings are shown in Fig. 3.2.

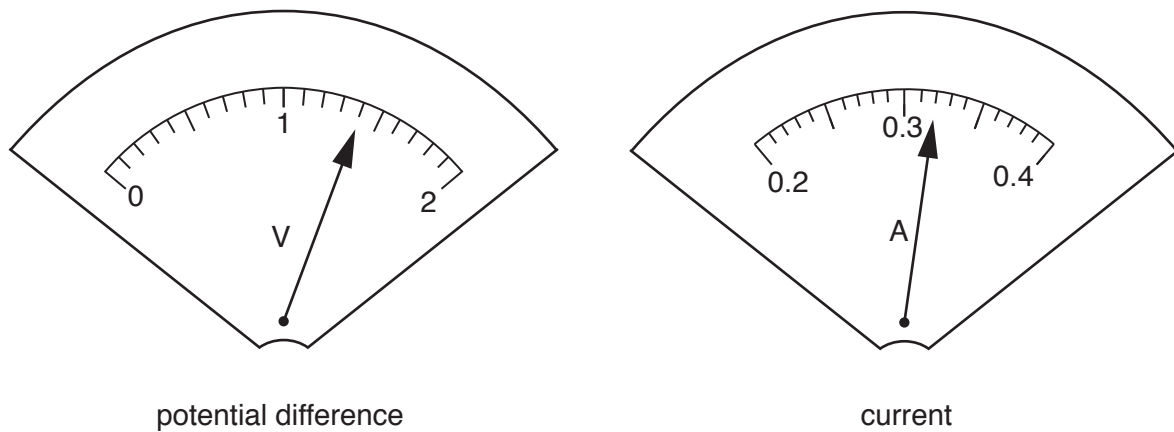


Fig. 3.2

- (a) Record in Table 3.1 the readings shown on the meters in Fig. 3.2.

**Table 3.1**

| position of crocodile clip <b>C</b> /cm | potential difference<br>$V/V$ | current<br>$I/A$ | power<br>$P/.....$ |
|-----------------------------------------|-------------------------------|------------------|--------------------|
| 0                                       |                               |                  |                    |
| 20.0                                    | 1.1                           | 0.28             | 0.31               |
| 40.0                                    | 0.9                           | 0.26             |                    |
| 60.0                                    | 0.7                           | 0.24             |                    |
| 80.0                                    | 0.4                           | 0.23             | 0.09               |

[2]

- (b) She repeats this procedure for different positions of the crocodile clip **C**, by connecting it at 20.0cm, 40.0cm, 60.0cm and 80.0cm from end **S**. Her results are shown in Table 3.1.

- (i) The student switches off the circuit between taking readings.

Explain why this is important.

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

- (ii) With the crocodile clip **C** at the 80.0cm mark, the glow of the filament lamp becomes too dim to see.

State how the student knows that the lamp is **not** broken.

.....[1]

- (c) (i) Add the unit of power to the heading of the fourth column in Table 3.1. [1]

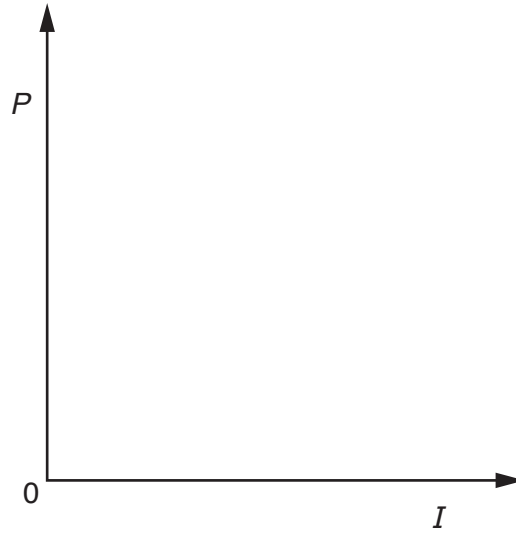
- (ii) Calculate the missing power  $P$  values of the filament lamp for each pair of readings using the equation shown.

$$P = V \times I$$

Record, in Table 3.1, your values of  $P$ . [2]

(d) The student suggests that the power  $P$  of the filament lamp is **directly** proportional to the current  $I$  flowing through it.

(i) Sketch, on the axes provided, the graph that the student would expect if this is correct.



[2]

(ii) **Without** plotting a graph, show that the results in Table 3.1 do **not** support the student's suggestion.

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

**Please turn over for Question 4.**

- 4 A student is studying cells using a light microscope.
- She prepares cells from a plant and stains them using iodine solution.
- Fig. 4.1 shows some of the cells from her microscope slide.

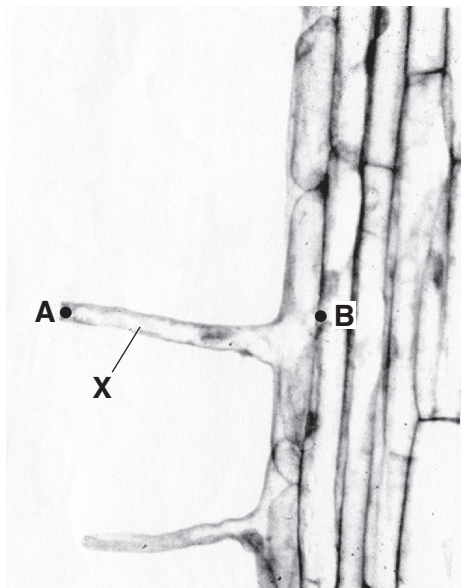


**Fig. 4.1**

- (a)** Name the type of cell labelled **X**.

.....[1]

- (b) (i)** Make an enlarged pencil drawing of cell **X** in the box provided.

Your drawing must be larger than cell **X** in Fig. 4.1.

**Label** the nucleus and cell wall.

- (ii) On cell **X** in Fig. 4.1, measure the length **A–B** in millimetres.

Record this length to the nearest millimetre.

length of cell **X** in Fig. 4.1 ..... mm [1]

- (iii) On your drawing, mark two points equivalent to **A** and **B** on Fig. 4.1.

Label these points **C** and **D**.

Measure the length **C–D** in millimetres to the nearest millimetre.

length of line on drawing ..... mm [1]

- (iv) Use your measurements in (b)(ii) and (b)(iii) to calculate the magnification of your drawing.

magnification = ..... [1]

- (c) Some parts of cell **X** stain blue-black after the addition of iodine solution.

Explain this observation.

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

- (d) The plant has a flower.

Describe the procedure you would use if you wanted to examine a sample of pollen from this flower.

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

5 A student investigates the electroplating of copper onto metals.

She uses a solution of copper sulfate.

Copper sulfate contains the copper ion,  $\text{Cu}^{2+}$ .  $\text{Cu}^{2+}$  ions make the solution blue in colour.

(a) In her first experiment, she investigates the plating of copper onto a copper strip.

- She takes two strips of copper metal and weighs them. She records their masses in Table 5.1.
- She sets up the apparatus shown in Fig. 5.1.

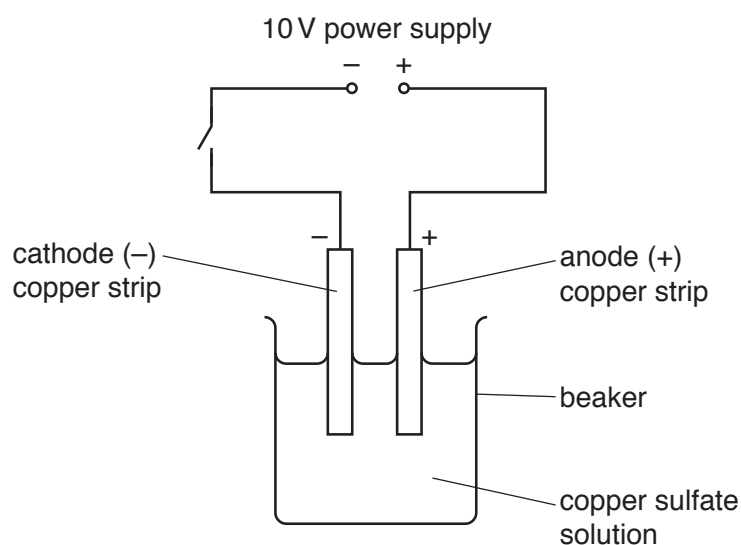


Fig. 5.1

- She closes the switch and leaves the circuit running for 10 minutes.
- She then opens the switch and removes the copper strips carefully.
- She lets the strips dry and weighs each one again.
- She **observes** that the copper sulfate solution is still as blue at the end as it was at the beginning.

Table 5.1

|                     | cathode (-)<br>copper strip | anode (+)<br>copper strip |
|---------------------|-----------------------------|---------------------------|
| mass at the start/g | 6.47                        | 7.34                      |
| mass at the end/g   |                             |                           |
| change in mass/g    |                             |                           |

- (i) The balance readings for the copper strips at the end of the experiment are shown in Fig. 5.2.

Record, in Table 5.1, the masses of the copper strips to 2 decimal places.

|                                                |                                              |
|------------------------------------------------|----------------------------------------------|
| 6.957 g                                        | 6.852 g                                      |
| mass<br>of copper<br>cathode (–)<br>at the end | mass<br>of copper<br>anode (+)<br>at the end |

Fig. 5.2

[2]

- (ii) Calculate the change in mass of each copper strip and record these values in Table 5.1.

Your answers should include a '+' sign to show an increase in mass or a '–' sign to show a decrease in mass.

[2]

- (b) The student says that the  $\text{Cu}^{2+}$  ions from the solution are attracted to the negatively charged cathode and are deposited there as copper metal.

The teacher says that the student is correct but suggests that the student looks at her observations and her results as something else is happening in the beaker at the same time.

Use the **student's ideas**, her **observations** and her **results** in Table 5.1 to state how she knows that the copper ions in solution stay at the same concentration even though some are removed to coat the cathode and explain how this happens.

she knows copper ions stay at the same concentration because .....

.....

explanation .....

.....

.....

[2]

- (c) In her second experiment, the student plates copper onto an iron nail.

She looks at her results from the first experiment and sets up the apparatus as shown in Fig. 5.3.

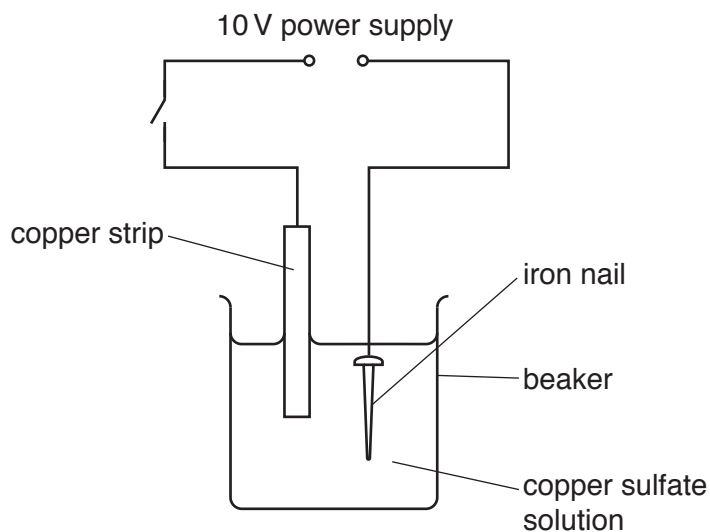


**Fig. 5.3**

- (i) State which metal should be the cathode and which should be the anode.

Explain your choice.

cathode .....

anode .....

explanation .....

.....  
.....

[1]

- (ii) State the name of the electrolyte shown in Fig. 5.3.

.....[1]

- (iii) The student closes the switch on the power supply and leaves it running for 10 minutes.

Suggest what happens to the appearance of the copper strip, the iron nail and the copper sulfate solution by the end of the experiment.

appearance of copper strip .....

.....

appearance of iron nail .....

.....

appearance of copper sulfate solution .....

.....

[2]

**Please turn over for Question 6.**

- 6 A student measures the acceleration  $g$  due to gravity by timing a small steel ball rolling down a slope.
- He places a 2 m long plank of wood on the bench.
  - He uses a metre rule and a marker pen to draw horizontal graduations on the plank at 20 cm intervals.
  - He places a wooden block under one end and adjusts the position of the block until the plank is inclined at an angle of  $10^\circ$  to the horizontal.

The experimental set-up is shown in Fig. 6.1.

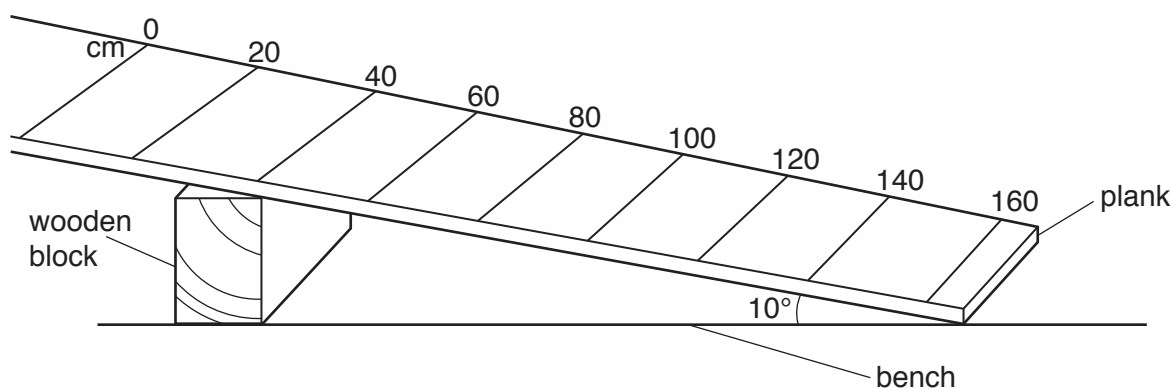


Fig. 6.1

The student uses a stopclock to time the ball rolling down the slope from rest, from the 0 cm mark to the 60 cm mark.

Fig. 6.2 shows the ball at rest at the 0 cm mark.

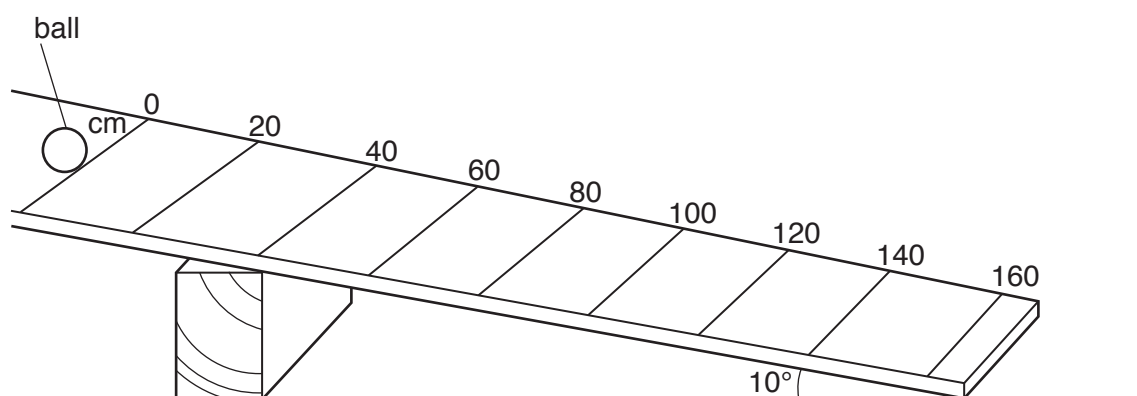


Fig. 6.2

- (a) (i) On Fig. 6.2, draw the ball to show its position when it has travelled 60 cm. [1]
- (ii) The student records the time it takes the ball to roll from the 0 cm mark to the 60 cm mark. He does this three times. His results are shown.

0.84 s

0.90 s

0.86 s

Calculate the average time  $t$  for the ball to travel a distance of 60 cm.

Give your answer to two significant figures.

average time  $t =$  ..... s [1]

- (iii) Suggest why your answer is **not** given to more than two significant figures.

.....

.....[1]

- (b) The student repeats this procedure and records the time it takes the ball to roll from rest down the slope for distances  $d = 80$  cm, 100 cm, 120 cm, 140 cm and 160 cm.

His results are shown in Table 6.1.

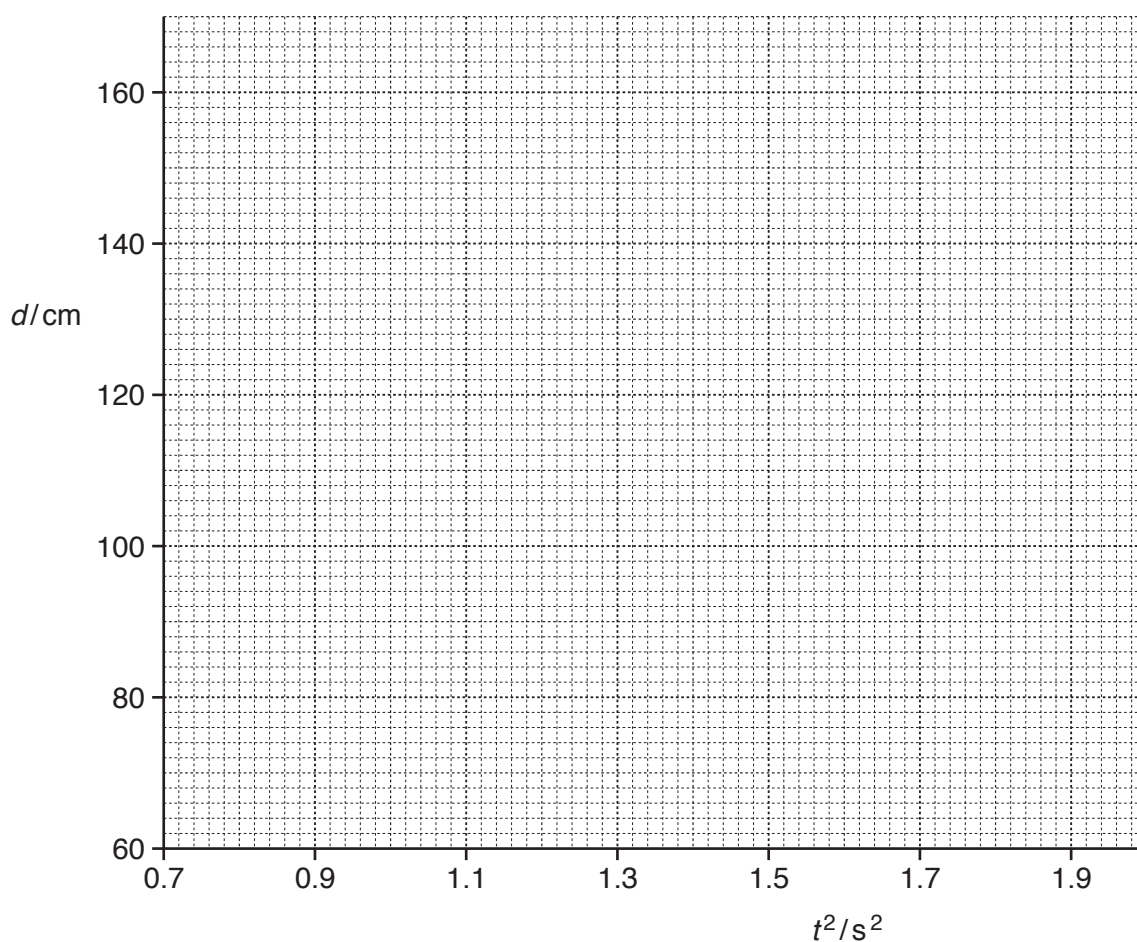
**Table 6.1**

| distance $d$ travelled<br>/cm | average time $t$<br>/s | $t^2$<br>/s <sup>2</sup> |
|-------------------------------|------------------------|--------------------------|
| 60                            |                        |                          |
| 80                            | 0.99                   |                          |
| 100                           | 1.10                   |                          |
| 120                           | 1.21                   | 1.46                     |
| 140                           | 1.31                   | 1.72                     |
| 160                           | 1.37                   | 1.88                     |

- (i) Record, in Table 6.1, your value of  $t$  from (a)(ii).

Calculate, and record in Table 6.1, the value of  $t^2$  for each value of average time  $t$  for the distances  $d = 60$  cm, 80 cm and 100 cm. [1]

- (ii) Plot a graph of  $d$  (vertical axis) against  $t^2$ . Draw the best-fit straight line.



- (iii) Calculate the gradient of your line.

**Show all working and indicate on your graph** the values you chose to enable the gradient to be calculated.

gradient = ..... cm/s<sup>2</sup> [2]

- (c) (i) A value for the acceleration  $g$  due to gravity can be calculated using the equation shown.

$$g = \frac{\text{gradient}}{8.7}$$

Calculate a value of  $g$ .

$g =$  ..... m/s<sup>2</sup> [1]

- (ii) Another student says that a more accurate value of  $g$  would be obtained if the ball was timed travelling over greater distances.

Explain why this student is correct.

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

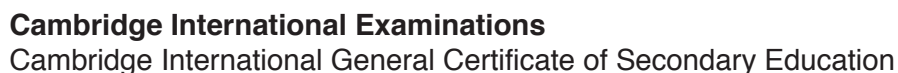
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0653/62

October/November 2017

**1 hour**

No Additional Materials are required.

## READ THESE INSTRUCTIONS FIRST

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This document consists of **18** printed pages and **2** blank pages.

- 1 Fig. 1.1 shows a bean seedling from a seed that has germinated and has started to grow.

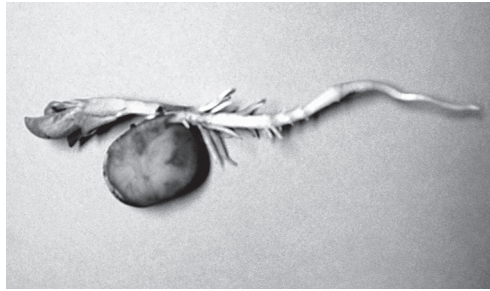


**Fig. 1.1**

- (a) In the box provided, make an enlarged pencil drawing of the seedling.

**Label** the root and stem.

[3]

- (b) (i) Measure the length of the bean **seed** in Fig. 1.1, excluding the root and stem.

Record this length, in millimetres, to the nearest millimetre.

length of seed in Fig. 1.1 ..... mm [1]

- (ii) Use a straight line to show this length on your drawing.

Record the length of this line, in millimetres, to the nearest millimetre.

length of seed in drawing ..... mm [1]

- (iii) Use your measurements in (i) and (ii) to calculate the magnification of your drawing.

magnification = ..... [1]

- (c) (i) A student wants to carry out an experiment on some germinated bean seeds.

Describe how the student can germinate the seeds.

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

- (ii) The student tests the bean seeds for their nutrient content.

Her results are shown in Table 1.1.

**Table 1.1**

|                 | Benedict's test | biuret test | iodine test |
|-----------------|-----------------|-------------|-------------|
| colour observed | clear blue      | purple      | blue-black  |

Use the information in Table 1.1 to identify the nutrients present in the bean seeds.

..... [2]

- 2 A student investigates the reactions of **H**, a solution of a sodium compound. He assesses whether **H** could be used as a reagent to identify cations in qualitative analysis. A good reagent in qualitative analysis gives positive and different results with different ions.

He adds **H** to each of the following solutions.

ammonium sulfate  
copper sulfate  
iron(III) sulfate  
zinc sulfate

He records his observations in Table 2.1.

**Table 2.1**

| solution          | observation         |
|-------------------|---------------------|
| ammonium sulfate  | no visible reaction |
| copper sulfate    | blue precipitate    |
| iron(III) sulfate | brown precipitate   |
| zinc sulfate      | white precipitate   |

- (a) (i) Use the observations in Table 2.1 to explain whether **H** could be used as a reagent to identify cations.

You should make comparisons with the usual reagents used for the analysis of cations.

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

- (ii) Suggest a solution, **not** shown in Table 2.1, which you could expect to give a different coloured precipitate with **H**.

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

- (iii) Describe another test, not involving **H**, and its observations that the student could carry out to identify the ammonium ion in ammonium sulfate solution.

test .....  
.....  
observations .....  
.....[2]

- (b) The student tests for sulfate ions in **H** but only adds barium nitrate solution. A white precipitate is produced.

He incorrectly concludes that **H** is sodium sulfate solution.

**H** is sodium carbonate solution.

- (i) State the full details of the test for a sulfate that the student should have carried out.

State what he observes if he carries out this full test on **H** (sodium carbonate).

details of test .....

.....

observations .....

.....

.....

[2]

- (ii) Draw a labelled diagram to describe a test to identify the carbonate ion in **H**.

[2]

- (iii) State the observation in (b)(ii) that would confirm the presence of the carbonate ion in **H**.

.....

.....[1]

- 3 A student investigates the cooling rates of different volumes of water.

The apparatus used is shown in Fig. 3.1.

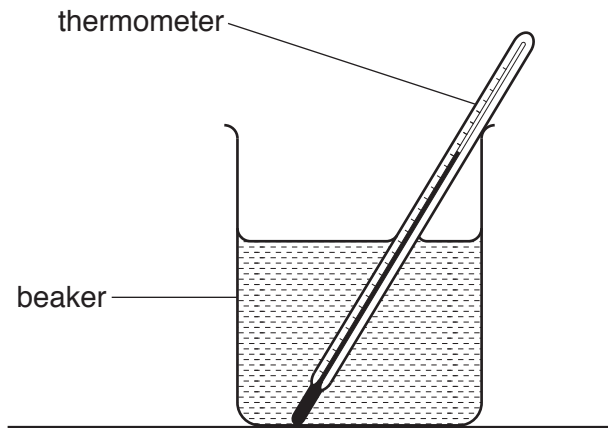


**Fig. 3.1**

The student labels a beaker **P** and pours  $200\text{ cm}^3$  of hot water into the beaker.

After waiting for a short while, he reads and records the temperature  $\theta$ .

**Table 3.1**

|                          | cooling of $200\text{ cm}^3$ of hot<br>water in beaker <b>P</b> | cooling of $100\text{ cm}^3$ of hot<br>water in beaker <b>Q</b> |
|--------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| time $t/\dots\dots\dots$ | temperature $\theta/\dots\dots\dots$                            | temperature $\theta/\dots\dots\dots$                            |
| 0                        |                                                                 |                                                                 |
|                          | 87.0                                                            | 89.0                                                            |
|                          | 85.0                                                            | 86.0                                                            |
|                          | 83.5                                                            | 83.5                                                            |
|                          | 82.0                                                            | 81.0                                                            |
|                          | 81.0                                                            | 78.5                                                            |
|                          | 80.0                                                            | 76.0                                                            |

- (a) (i) Read and record in Table 3.1 the temperature of the water in beaker **P** shown in Fig. 3.2 at time  $t = 0$ .

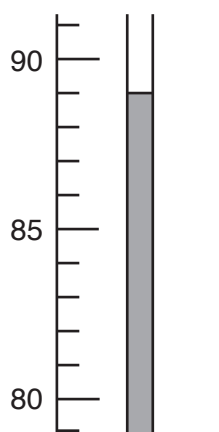


**Fig. 3.2**

[1]

- (ii) The student pours  $100\text{cm}^3$  of hot water into another beaker and labels it **Q**. The temperature rises to the value shown in Fig. 3.3.

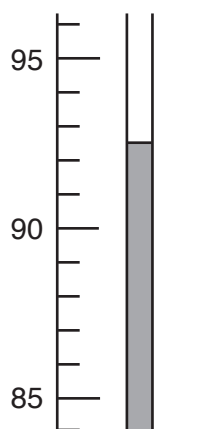


**Fig. 3.3**

Read and record in Table 3.1 the temperature of the water in beaker **Q** shown in Fig. 3.3 at time  $t = 0$ . [1]

- (b) The student measures the temperature of the water in each beaker at 30 second intervals for 3 minutes. These temperatures are shown in Table 3.1.
- (i) Complete the column headings in Table 3.1 by inserting the correct units. [1]
- (ii) Insert the values of  $t$  in Table 3.1. [1]

- (c) Suggest why it is important for the student to wait a short while before measuring the initial temperature of the hot water in both beakers.

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

- (d) The temperature of the water in both beakers decreases with time.

Give **one other** similarity in the way that the temperature of the water in both beakers decreases with time.

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

- (e) Another student suggests that the rate of cooling is slower for the larger volume of water than for the smaller volume of water.

Use the results in Table 3.1 to show that the results support this suggestion.

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

- (f) The experiment is repeated with the same apparatus to check the results.

Suggest **two** variables that should be kept constant.

variable 1 .....

variable 2 .....

[2]

**Please turn over for Question 4.**

- 4 A student investigates the effect of temperature on the movement of water through a plant.

He sets up the apparatus shown in Fig. 4.1.

- The student records the initial position of the air bubble.
- He leaves the apparatus at a low temperature for 10 minutes and records the new position of the air bubble.
- He repeats this at a high temperature.

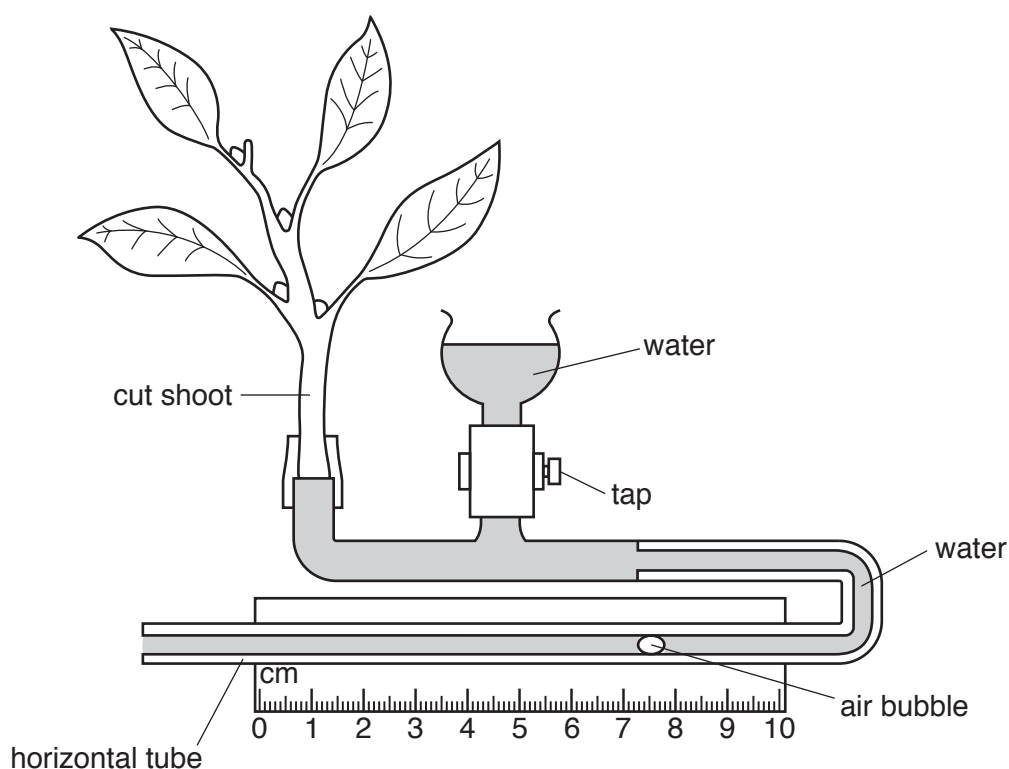


**Fig. 4.1**

- (a) The movement of the air bubble in the apparatus shows the uptake of water by the shoot.

Table 4.1 shows some of the results the student obtains.

**Table 4.1**

| temperature              | initial position of bubble /cm | position of bubble after 10 minutes /cm | distance moved in 10 minutes /cm | average distance moved in 10 minutes /cm | average distance moved per minute /cm |
|--------------------------|--------------------------------|-----------------------------------------|----------------------------------|------------------------------------------|---------------------------------------|
| low temperature trial 1  | 2.1                            | 3.6                                     | 1.5                              | 1.6                                      |                                       |
| low temperature trial 2  | 3.7                            | 5.4                                     | 1.7                              |                                          |                                       |
| high temperature trial 1 |                                |                                         |                                  |                                          |                                       |
| high temperature trial 2 | 3.8                            | 6.8                                     |                                  |                                          |                                       |

- (i) Fig. 4.2 shows the initial position of the air bubble for trial 1 at high temperature and its position after 10 minutes.

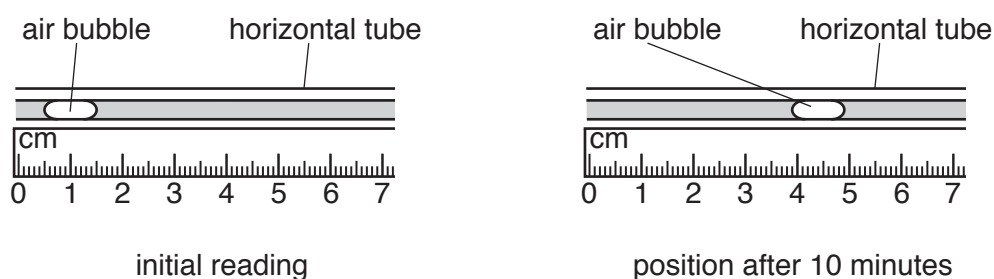


**Fig. 4.2**

**Measure the positions of the bubble at the right hand side of the bubble.**

Record these positions in Table 4.1. [1]

- (ii) Calculate the distances and the average distance moved in 10 minutes by the air bubbles for the high temperature trials.

Record these in Table 4.1. [2]

- (iii) Calculate and record, in the last column of Table 4.1, the average distances moved per minute at each temperature.

[1]

- (iv) Use the information in Table 4.1 to state the effect of temperature on the rate of water uptake by the plant.

.....[1]

- (b) The teacher suggests that the student should carry out a third trial at each temperature.

Explain why this improves the investigation.

.....

.....

.....[2]

- (c) (i) Name the process by which water is lost by evaporation from the leaves of the shoot.

.....[1]

- (ii) Suggest why the amount of water taken up by the shoot may **not** be the same as the water lost by the shoot.

.....

.....[1]

- (d) Predict **and** explain the effect on the rate of bubble movement if the experiment is repeated with two of the leaves removed from the cut shoot in Fig. 4.1.

.....

.....[1]

**Please turn over for Question 5.**

- 5 Copper sulfate is a salt.

A student uses the following method to make a pure sample of copper sulfate crystals.

**step 1**

Place some acid in a beaker.

**step 2**

Add copper carbonate solid to the acid while stirring, until the copper carbonate no longer reacts.

**step 3**

Filter the mixture to remove excess copper carbonate.

**step 4**

Heat the blue filtrate until its volume is halved.

**step 5**

Pour this remaining liquid into an evaporating dish.

**step 6**

Allow the water in the remaining liquid in the dish to evaporate at room temperature.

- (a) (i) Name the acid used in **step 1**.

.....[1]

- (ii) Suggest how the student knows when there is no further reaction in **step 2**.

.....

.....[1]

- (iii) Suggest how the student can test the mixture to make sure that all of the acid has reacted.

test .....

observation .....

[2]

- (b) (i) Draw a diagram of the apparatus used in **step 3**.

Label the excess copper carbonate and the filtrate.

[2]

- (ii) State which property of copper carbonate allows the excess copper carbonate to be removed from the mixture.

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

- (c) Explain why it is important in **step 4 not** to heat the filtrate to dryness.

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

- (d) Another student says that the same method may be used to make a sample of sodium chloride from hydrochloric acid and sodium hydroxide.

When she carries out the reaction she cannot separate the excess sodium hydroxide by filtration.

- (i) Using your knowledge of sodium hydroxide in Qualitative Analysis, state why filtration cannot be used to separate excess sodium hydroxide from the sodium chloride solution.

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

- (ii) Describe briefly an alternative method to make a sample of sodium chloride from hydrochloric acid and sodium hydroxide.

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

6 A student measures the mass of a metre rule using a balancing method.

- She places a pivot directly under the 60.0 cm mark of a metre rule so that the distance  $d$ , measured from the end of the metre rule to the pivot, is 60.0 cm.
- She places a load of 200 g on the metre rule.
- She adjusts the position of the load carefully, until the rule is just balanced.

Fig. 6.1 shows the rule when balanced.

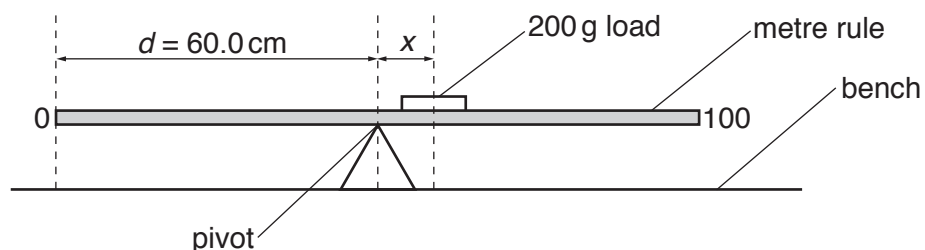


**Fig. 6.1**

- She determines the scale reading at the centre of the 200 g load.

Fig. 6.2 shows part of the scale of the rule when balanced.

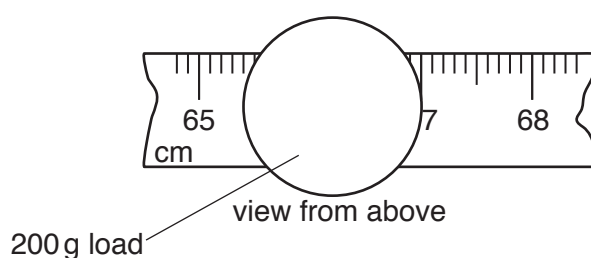


**Fig. 6.2**

- (a) Use the information in Fig. 6.2 to determine the position  $p$  of the centre of the load when balanced.

Show your working and record  $p$  in Table 6.1.

[2]

**Table 6.1**

| distance $d$ of pivot / cm | position $p$ of centre of load when balanced / cm | distance of load from pivot $x = (p - d) / \text{cm}$ |
|----------------------------|---------------------------------------------------|-------------------------------------------------------|
| 60.0                       |                                                   |                                                       |
| 65.0                       | 74.0                                              |                                                       |
| 70.0                       | 81.8                                              | 11.8                                                  |
| 75.0                       | 90.0                                              | 15.0                                                  |
| 80.0                       | 97.9                                              | 17.9                                                  |

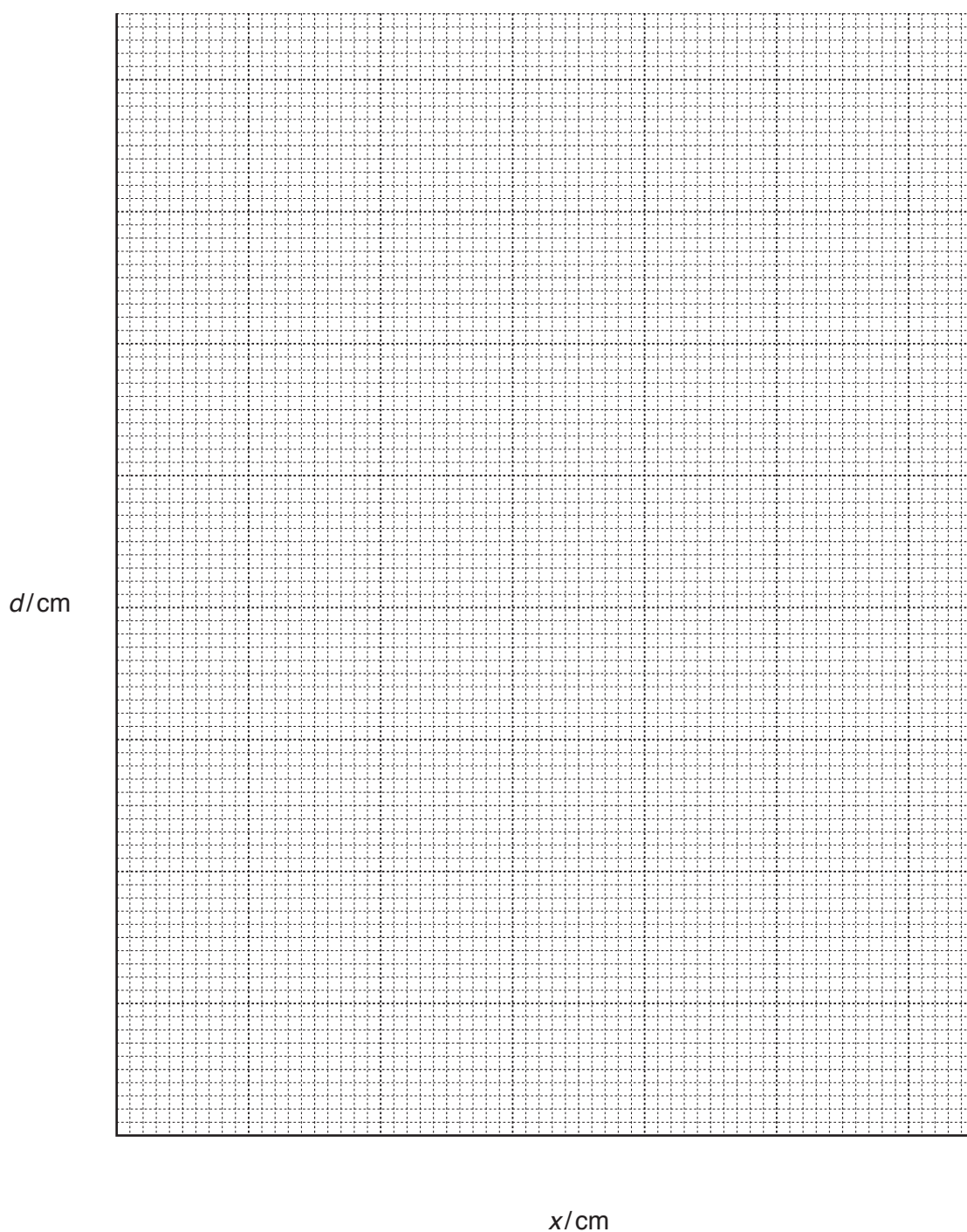
- (b) The student repeats this procedure to balance the load when the pivot is placed at distances  $d = 65.0\text{ cm}$ ,  $70.0\text{ cm}$ ,  $75.0\text{ cm}$  and  $80.0\text{ cm}$  from the end of the metre rule. She records the positions  $p$  for each value of  $d$  in Table 6.1.

Calculate the distance  $x$  of the load from the pivot, using  $x = (p-d)$ , for values of  $d = 60.0\text{ cm}$  and  $65.0\text{ cm}$ .

Record these values in Table 6.1.

[1]

- (c) (i) On the grid provided, plot a graph of  $d$  (vertical axis) against  $x$ . You do **not** need to start the axes from the origin (0, 0). Draw the best-fit straight line.



[3]

- (ii) Calculate the gradient of your line.

Show all working and indicate on your graph the values you chose to enable the gradient to be calculated.

gradient = ..... [2]

- (iii) The gradient of your line is related to the mass  $m$  in grams of the metre rule, by the equation shown.

$$m = \frac{200}{\text{gradient}}$$

Calculate the mass  $m$  of the metre rule.

$m = \dots\dots\dots$  g [1]

- (d) When carrying out the experiment, the student decided **not** to place the pivot at distances greater than 80.0 cm from the end of the rule.

Suggest why this was a sensible decision.

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



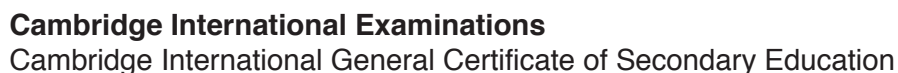
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**0653/63**

October/November 2017

**1 hour**

No Additional Materials are required.

## READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You may lose marks if you do not show your working or if you do not use appropriate units.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **18** printed pages and **2** blank pages.

**1** A student investigates an enzyme-catalysed reaction.

Hydrogen peroxide is broken down by catalase, an enzyme found in living cells such as potato cells. Oxygen gas is released during the reaction.

- The student cuts two cubes without any skin from the same potato of dimensions  $1\text{ cm} \times 1\text{ cm} \times 1\text{ cm}$ .
- She places one cube of potato into a test-tube.
- She adds  $5\text{ cm}^3$  of hydrogen peroxide and then starts a stopclock.
- After 2 minutes 30 seconds she measures the distance  $d$  from the surface of the liquid to the top of the foam produced, as shown in Fig. 1.1.
- She records this distance, in centimetres, in Table 1.1.
- She repeats the procedure using smaller pieces cut from the second cube of dimensions shown in Table 1.1.

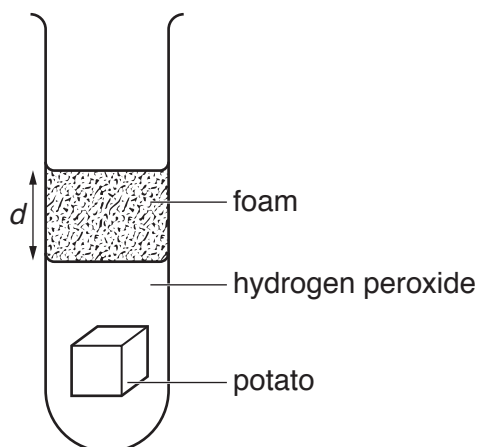


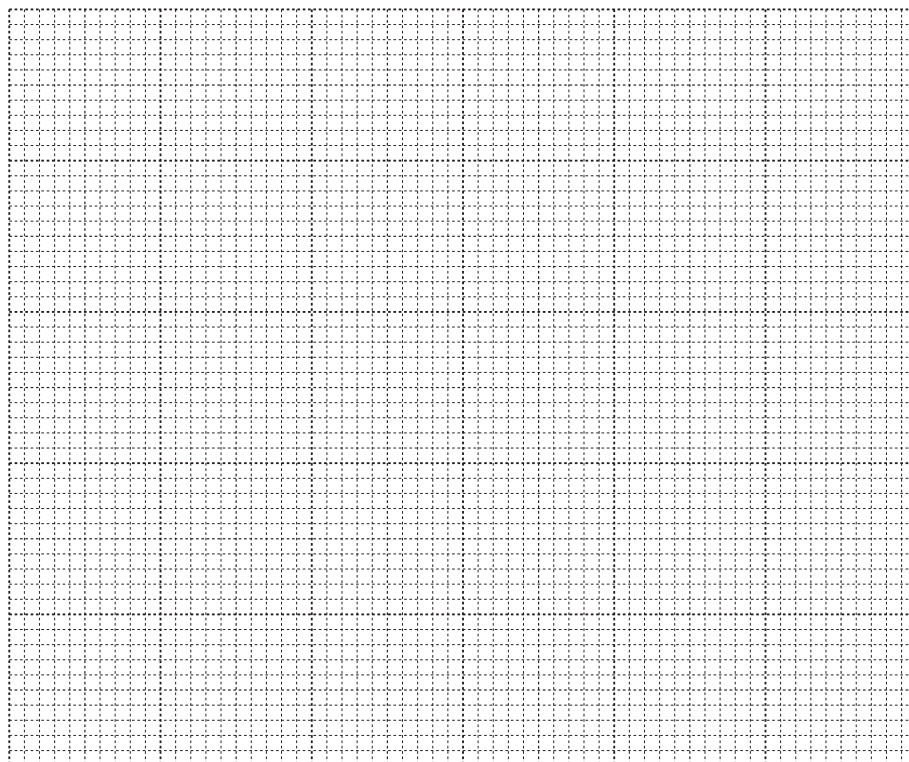
**Fig. 1.1**

**Table 1.1**

| dimensions of potato piece<br>/cm | surface area of potato piece<br>/cm <sup>2</sup> | distance $d$<br>/cm |
|-----------------------------------|--------------------------------------------------|---------------------|
| $1 \times 1 \times 1$             | 6.0                                              | 1.8                 |
| $1 \times 1 \times 0.5$           | 4.0                                              | 1.1                 |
| $1 \times 0.5 \times 0.5$         | 2.5                                              | 0.8                 |
| $0.5 \times 0.5 \times 0.5$       | 1.5                                              | 0.5                 |

- (a) (i) On the grid provided, plot a graph of distance  $d$  (vertical axis) against surface area of potato piece.

Draw the best-fit straight line through the origin.



[4]

- (ii) Use your graph to state the relationship between the amount of enzyme and the rate of reaction.

.....[1]

- (iii) Use your graph to predict the distance  $d$  for a piece of potato with a surface area of  $3.0\text{ cm}^2$ .

Mark on the graph how you did this.

$d =$  ..... cm [2]

- (b) Name **two** variables that should be kept constant in this experiment to make the results as reliable as possible.

variable 1 .....

variable 2 .....

[2]

- (c) Describe how you could confirm that the gas produced in this reaction is oxygen.

test .....

observation .....

[1]

2 A student carries out reactions with compounds **H** and **J**.

- (a) She connects a hard glass test-tube containing a sample of solid **H** to a sample of limewater. She heats the test-tube containing solid **H** strongly with a Bunsen burner. She disconnects the apparatus before she stops heating.

Her observations are shown.

***H** changes from a white powder to yellow when hot and white again when cool.*

*The limewater becomes milky and then colourless.*

- (i) Draw a labelled diagram of the apparatus she uses.

[2]

- (ii) Suggest why she disconnects the apparatus before she stops heating.

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

- (iii) State what the student can deduce about the gas produced.

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

- (iv) State what the student can deduce about the anion in **H**.

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

- (v) The student recognises the colour changes of the powder as being a property of zinc oxide.

Suggest the identity of **H**.

**H** is .....[1]

- (b) To confirm the identity of the cation in solid **H** as zinc,  $\text{Zn}^{2+}$ , the student reacts **H** with dilute hydrochloric acid until there is a solution with no solid remaining.

- (i) She splits the solution into two portions.

- To one portion she slowly adds sodium hydroxide solution until it is in excess.
- To the other portion she slowly adds ammonia solution until it is in excess.
- In both cases, a precipitate is seen and this precipitate then dissolves.

State the colour of the precipitate.

.....[1]

- (ii) State the expected observation if the student adds dilute hydrochloric acid slowly to the final solutions in (b)(i).

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

- (c) **J** is a potassium salt which is **not** a nitrate.

- (i) Draw a suitable table **and** record the observations the student makes when mixing a solution of **J** with the acidified reagents shown.

- barium nitrate solution giving no visible reaction
- silver nitrate solution giving a yellow precipitate.

- (ii) She places a small volume of a solution of **J** in a test-tube and adds an equal amount of chlorine water.

She then adds a few drops of starch solution.

Her observations are shown.

*brown on adding the chlorine water*

*blue-black colour on adding the starch*

Use the observations in **(c)(i)** and **(ii)** to make **one** conclusion about the anion in **J**.

conclusion about the anion in **J** .....

.....[1]

**3** A student measures the focal length of a convex lens.

She sets up the apparatus as shown in Fig. 3.1. A metre rule is used for the distances.

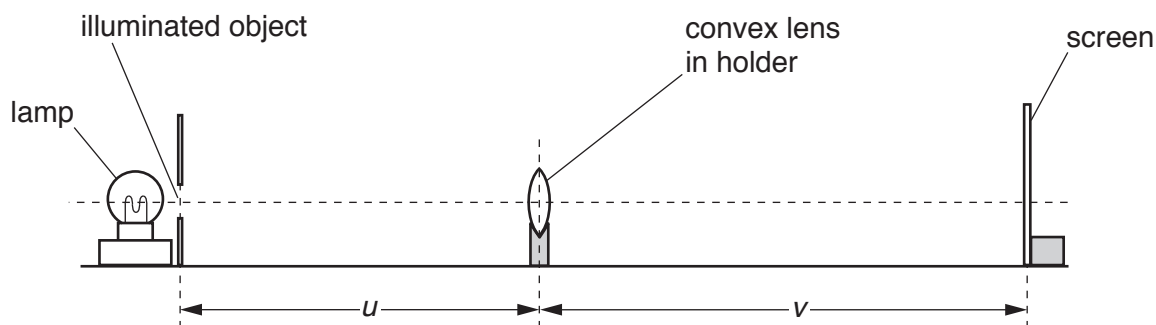


**Fig. 3.1**

- She switches on the lamp and places the lens a distance  $u = 30.0$  cm from the illuminated object.
- She adjusts the position of the screen by moving it backwards and forwards along the bench until a sharp triangular image of the illuminated object is formed on the screen.
- She measures the image distance  $v$  from the screen to the lens.

The student repeats this procedure for values of  $u = 35.0$  cm,  $40.0$  cm,  $45.0$  cm and  $50.0$  cm.

**(a) (i)** Fig. 3.2 shows the rule and the positions of the lens and the screen when  $u = 30.0$  cm.

Read the scale of the rule and write down the position of the screen in the space provided.

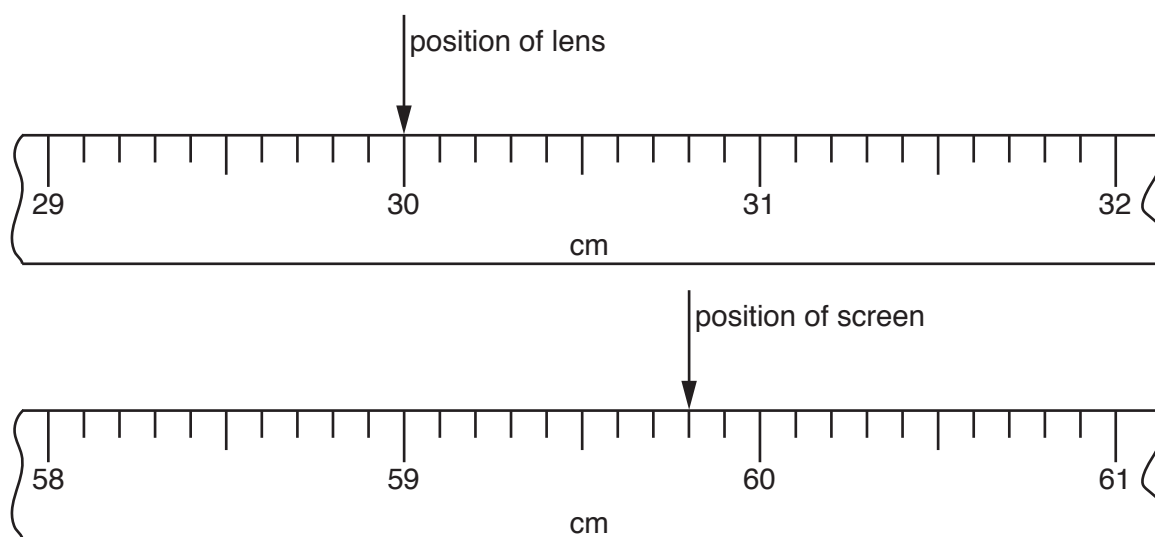


**Fig. 3.2**

position of lens = 30.0 cm

position of screen = ..... cm [1]

**(ii)** Use your answer from **(a)(i)** to calculate the image distance  $v$ .

Record your answer in the space provided in Table 3.1.

[1]

Table 3.1

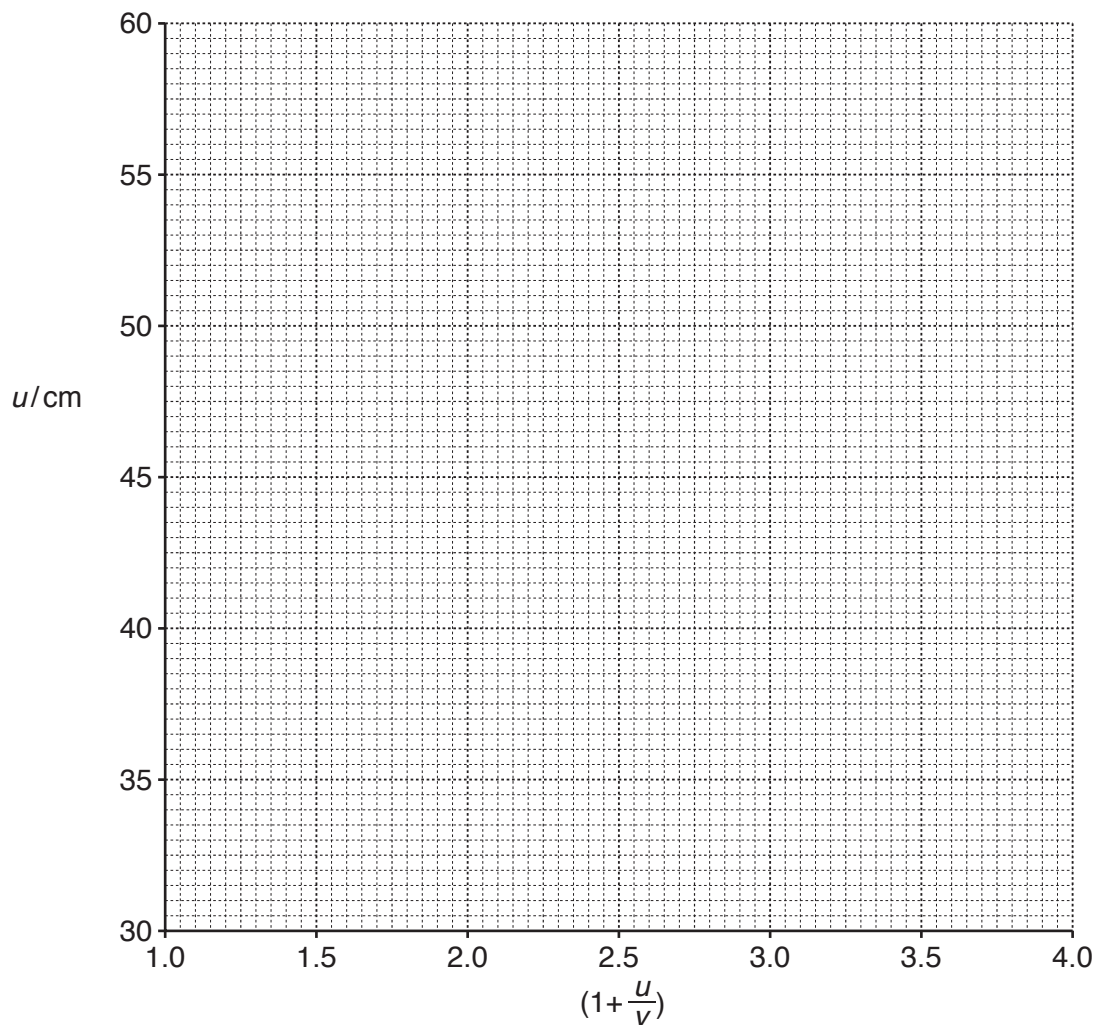
| $u/\text{cm}$ | $v/\text{cm}$ | $\frac{u}{v}$ | $(1 + \frac{u}{v})$ |
|---------------|---------------|---------------|---------------------|
| 30.0          |               |               |                     |
| 35.0          | 26.4          | 1.3           | 2.3                 |
| 40.0          | 24.1          |               |                     |
| 45.0          | 22.4          | 2.0           | 3.0                 |
| 50.0          | 21.5          | 2.3           | 3.3                 |

(iii) Calculate the missing ratios  $\frac{u}{v}$  **and** record these in Table 3.1. [1]

(iv) Calculate the missing values of  $(1 + \frac{u}{v})$  **and** record these in Table 3.1. [1]

(b) (i) On the grid provided, plot a graph of  $u$  (vertical axis) against  $(1 + \frac{u}{v})$ .

Draw the best-fit straight line.



[2]

- (ii) Calculate the gradient of your line.

Show all your working and indicate on your graph the values you chose to enable the gradient to be calculated.

gradient = ..... cm [2]

- (iii) The gradient of your graph is equal to the focal length  $f$  of the lens.

Write down the value of  $f$  to an appropriate number of significant figures.

$f$  = ..... cm [1]

- (c) State **one** precaution that you should take in this experiment to obtain accurate results.

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

- 4 A student investigates the effect of temperature on the growth of seedlings.

She places five seedlings onto some cotton wool in each of three dishes, **A**, **B** and **C**.

She keeps dish **A** at 5 °C, dish **B** at 15 °C and dish **C** at 25 °C.

- (a) Describe how the student can germinate the seeds to form the seedlings for this experiment.

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

- (b) Complete Fig. 4.1 to predict the appearance of the seedlings in each dish after five days.

Dish **B** has been completed for you.

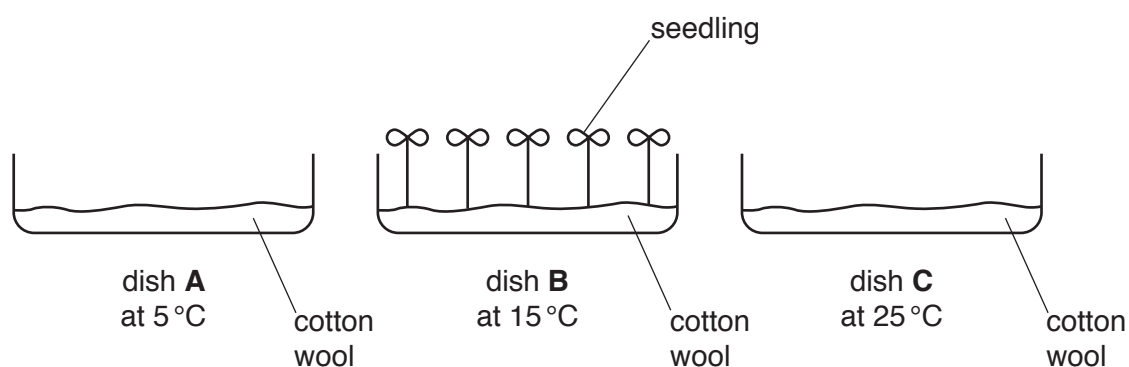


Fig. 4.1

[2]

- (c) Describe how the student could test the seedlings for the presence of reducing sugar and state the observation for a positive result.

procedure .....

.....

observation .....

[3]

(d) Describe an experiment to show that these seedlings grow towards the light.

In your plan you should include:

- details of the lighting
- a suitable control
- how you would show your results are **not** due to chance.

.....

.....

.....

.....

.....

.....[3]

5 A class is investigating the rusting of iron and steel. Steel is an alloy of iron.

- (a) The teacher places a small sheet of steel on the table. The steel has had any sign of rust removed. He then pours a small amount of water containing phenolphthalein indicator onto the steel. This forms a pool of colourless liquid.

Phenolphthalein is an acid-alkali indicator like litmus.

The colour changes for litmus and phenolphthalein are shown in Table 5.1.

**Table 5.1**

| indicator       | colour in acid | colour in alkali |
|-----------------|----------------|------------------|
| litmus          | red            | blue             |
| phenolphthalein | colourless     | pink             |

After a few minutes, a pink colour is observed at the edge of the pool of water containing phenolphthalein indicator.

Rusting has begun but at this point there is **no** sign of rust.

- (i) Suggest which type of substance is formed in the early stages of rusting.

.....[1]

- (ii) The teacher now adds water containing a different chemical to a piece of clean steel.

After a short time the teacher tells the class that  $\text{Fe}^{2+}$  ions have been made.

Suggest what would be seen if these  $\text{Fe}^{2+}$  ions react with the substance identified in (i).

.....[1]

- (iii) When the steel in (ii) is left for a day, it becomes covered with an orange-brown solid which is insoluble in the pool of water.

Describe how you could prove the presence of  $\text{Fe}^{3+}$  ions in the orange-brown solid.

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

- (b) The students now set up the experiments **H**, **J**, **K** and **L** shown in Fig. 5.1 to investigate the effects of air and water on the rusting of iron.

The air contains water vapour.

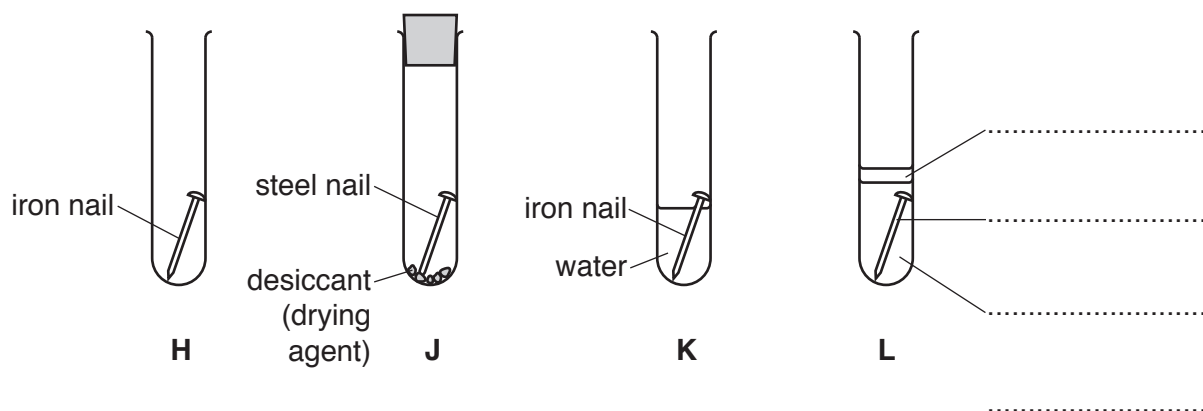


Fig. 5.1

- (i) Complete the labels for test-tube **L**, which is used for studying the effect of water only (no air) on iron. [2]
- (ii) Suggest **one** change to this experiment (test-tubes **H**, **J**, **K** and **L**) that would allow a fairer comparison of the conditions needed for the rusting of iron.

.....

.....[1]

- (c) The experiment in Fig. 5.1 is left for a week.

- There is **no** sign of rust on the nails in test-tubes **J** and **L**.
- There is a small amount of rusting on the nail in test-tube **H**.
- There is very noticeable rusting of the nail in test-tube **K**, especially near the surface of the water.

Explain why the result for test-tube **K** is **not** enough to demonstrate that both air and water are required for iron to rust.

You must refer to the other test-tubes in your answer.

.....

.....

.....

.....[2]

**Please turn over for Question 6.**

- 6 A student investigates the force needed to make objects move.

When the force **P** pulling an object is greater than the force **F** resisting the pull, the block moves as shown in Fig. 6.1.

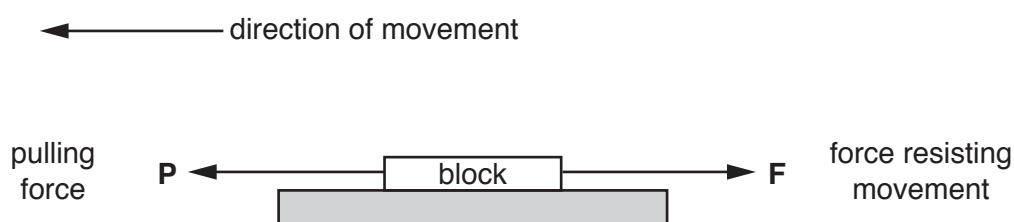


**Fig. 6.1**

- (a) The student places a block onto a surface, attaches a newton meter and measures the force needed to make the block just move, as shown in Fig. 6.2.

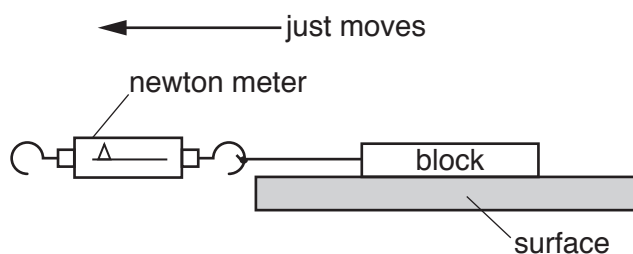


**Fig. 6.2**

She uses blocks of the same size.

She varies the material of the block and the surface that it sits on.

She records her results in Table 6.1.

**Table 6.1**

| test number | block     | surface | pulling force/N |
|-------------|-----------|---------|-----------------|
| 1           | brick     | carpet  | 20.8            |
| 2           | aluminium | glass   | 3.8             |
| 3           | wood      | wood    | 5.8             |
| 4           | brick     | glass   |                 |
| 5           | aluminium | sand    |                 |
| 6           | brick     | wood    | 17.5            |
| 7           | wood      | sand    | 15.6            |
| 8           | brick     | sand    | 21.6            |

- (i) The newton meter readings for two of her tests are shown in Fig. 6.3.

Read the values and record them in Table 6.1.

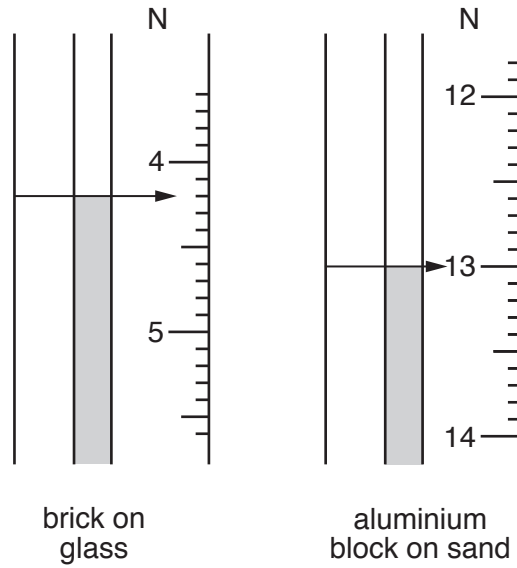


Fig. 6.3

[2]

- (ii) The student wants to place all the surfaces she used in order of resistance to movement (friction).

Suggest which test results she should use and explain your choice.

test numbers .....

explanation .....

.....

[3]

- (iii) Place the surfaces in order of resistance to movement (friction).

most resistant to movement .....

.....

.....

least resistant to movement .....

[1]

- (b) Explain why each test should have been repeated three times **and** the average pulling force calculated.

.....

.....[1]

- (c) The student says that a road surface should be made of a material with a small resistance to movement so that a car uses less petrol.

The teacher says that this would be unsafe.

Explain the teacher's answer.

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

- (d) On some steep hills there are safety tracks (called escape lanes) at the side of the road, as shown in Fig. 6.4.

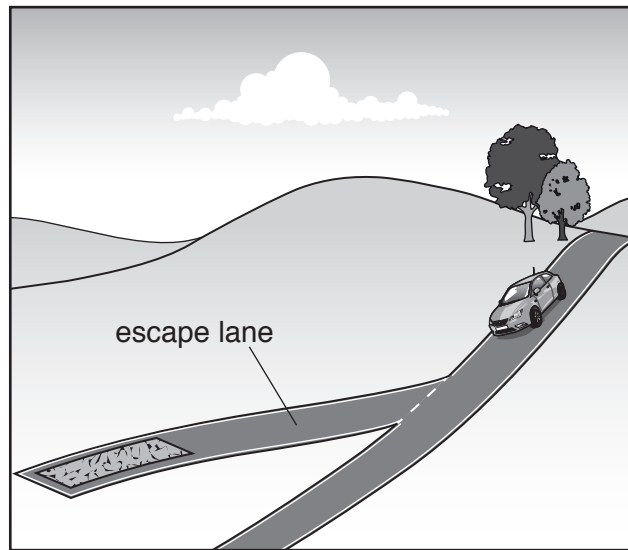


**Fig. 6.4**

If a car is going too fast and the driver cannot brake strongly enough to stop the car, then he can drive onto the escape lane. The escape lane slows down the car quickly and brings it to a stop.

Suggest a suitable material for the surface of the escape lane and explain your answer.

surface .....

explanation .....

.....[2]



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