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0653/61

October/November 2019

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

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

At the end of the examination, fasten all your work securely together.

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

This document consists of **11** printed pages and **1** blank page.

- 1 (a) A student investigates the effect of the concentration of a salt solution on the activity of the enzyme pepsin.

Pepsin breaks down the proteins in milk to produce a clear liquid.

- The student prepares a water-bath at 40 °C.
- She adds 2 cm³ of milk to each of four test-tubes, **A**, **B**, **C** and **D**.
- She then adds the volumes of water and salt solution shown in Table 1.1 to the four test-tubes.

Table 1.1

test-tube	volume of 15% salt solution /cm ³	volume of water /cm ³	final percentage concentration of salt solution	time taken for milk to become clear /s
A	2	0	15	
B	1	1		
C	0	2	0	
D	0	2	0	

- (i) Calculate the final percentage concentration of salt solution in test-tube **B**.

Record your answer in Table 1.1.

[1]

- (ii)
- The student places the four test-tubes into the water-bath.
 - She puts 1 cm³ pepsin solution into each of test-tubes **A**, **B** and **C** and mixes well.
 - She puts 1 cm³ water into test-tube **D** and mixes well.
 - She starts the stop-clock.
 - She records the time taken for the milk in each test-tube to become clear.
 - If the milk has not become clear after 5 minutes she records the time as **>300**.

Fig. 1.1 shows the student's results.

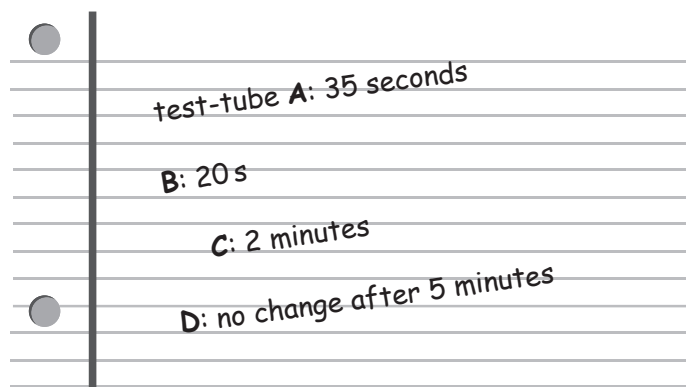


Fig. 1.1

Complete Table 1.1 using the student's results shown in Fig. 1.1.

[3]

- (iii) Use the results in Table 1.1 to place test-tubes **A**, **B**, **C** and **D** in order of speed of milk clearing.

fastest to clear

↓

slowest to clear

[2]

- (iv) Suggest the purpose of test-tube **D**.

.....

..... [1]

- (v) Explain why the test-tubes were placed in a water-bath.

.....

..... [1]

- (b) The method in (a) can be extended to find a more accurate value of the percentage concentration of salt solution needed for the pepsin to work the fastest.

Suggest additional values to those in Table 1.1 of the percentage concentration of salt solution that should be used.

.....

..... [2]

- (c) State how you could test the milk to find out if it contains protein.

Include the result for a positive test and a negative test.

test

positive test result

negative test result [3]

[Total: 13]

2 A student has samples of two different colourless aqueous solutions, **E** and **F**.

(a) (i) She adds one drop of each solution onto universal indicator paper.

E turns the paper red, pH 1 and **F** turns the paper dark blue, pH 12.

Suggest what **type** of substance is in each of **E** and **F**.

type of substance in **E**

type of substance in **F** [1]

(ii) She places some of solution **E** in a test-tube and adds a piece of magnesium ribbon.

She bubbles the gas released into limewater. The limewater does **not** go milky.

Draw the apparatus she should use for this test.

[1]

(iii) She adds magnesium to another sample of solution **E**. This time she tests the gas given off with a lighted splint and it pops.

State the identity of the gas.

..... [1]

(iv) She places some of solution **E** into each of two test-tubes and adds a little dilute nitric acid to each test-tube.

She adds aqueous barium nitrate to the first test-tube and a white precipitate forms.

She adds aqueous silver nitrate to the second test-tube and a colourless solution is seen.

Identify the anion contained in **E**.

..... [1]

(v) Suggest the identity of solution **E**.

..... [1]

- (b) She places some of solution **F** into a test-tube and slowly adds aqueous iron(II) sulfate. A green precipitate forms.

State **one** of the possible identities of solution **F**.

..... [1]

- (c) Suggest **one** other test which would confirm the identity of solution **F** given in (b). Give the result of this test.

test

test result [1]

[Total: 7]

- 3 Sea water contains a number of dissolved salts such as sodium chloride. The water may also contain small insoluble particles suspended in the water.

Plan an experiment to compare the amount of **dissolved** salts in samples of water from the Dead Sea and from the Baltic Sea.

You may use any common laboratory apparatus and samples of water from the Dead Sea and from the Baltic Sea.

Include in your answer:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including any safety precautions and why these are needed
- the measurements you will make
- what you will control
- how you will process your results
- how you will use your results to draw a conclusion.

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..... [7]

4 A student investigates the cooling of water in a drinks cup.

- (a) She adds 150 cm^3 of hot water to a cup. She puts a lid on the cup and lowers the thermometer into a hole in the lid, so that the bulb is in the hot water, as shown in Fig. 4.1.

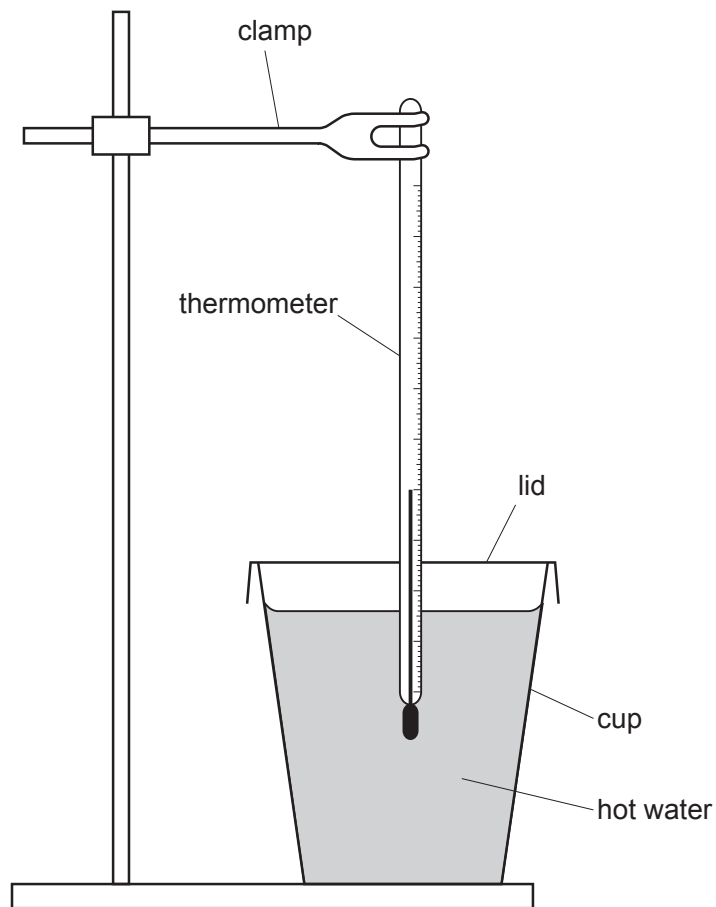


Fig. 4.1

She waits for the reading on the thermometer to stop rising and then starts the stop-clock.

- (i) Fig. 4.2 shows the maximum temperature reading on the thermometer at time $t = 0$.

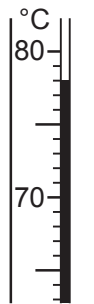


Fig. 4.2

Read and record this temperature in Table 4.1.

[1]

Table 4.1

time t /min	temperature of water /	
	cup with lid	cup without lid
0		78.0
1	76.0	75.0
2	74.5	72.5
3	73.0	70.0
4	72.0	67.5
5	71.0	

- (ii) She measures the temperature of the water every minute for five minutes and records the results in Table 4.1.

Complete the heading in Table 4.1.

[1]

- (iii) She empties out the hot water and repeats the experiment using the same cup **without** a lid.

Fig. 4.3 shows the thermometer reading after 5 minutes for the cup **without** a lid.

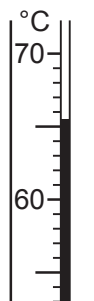


Fig. 4.3

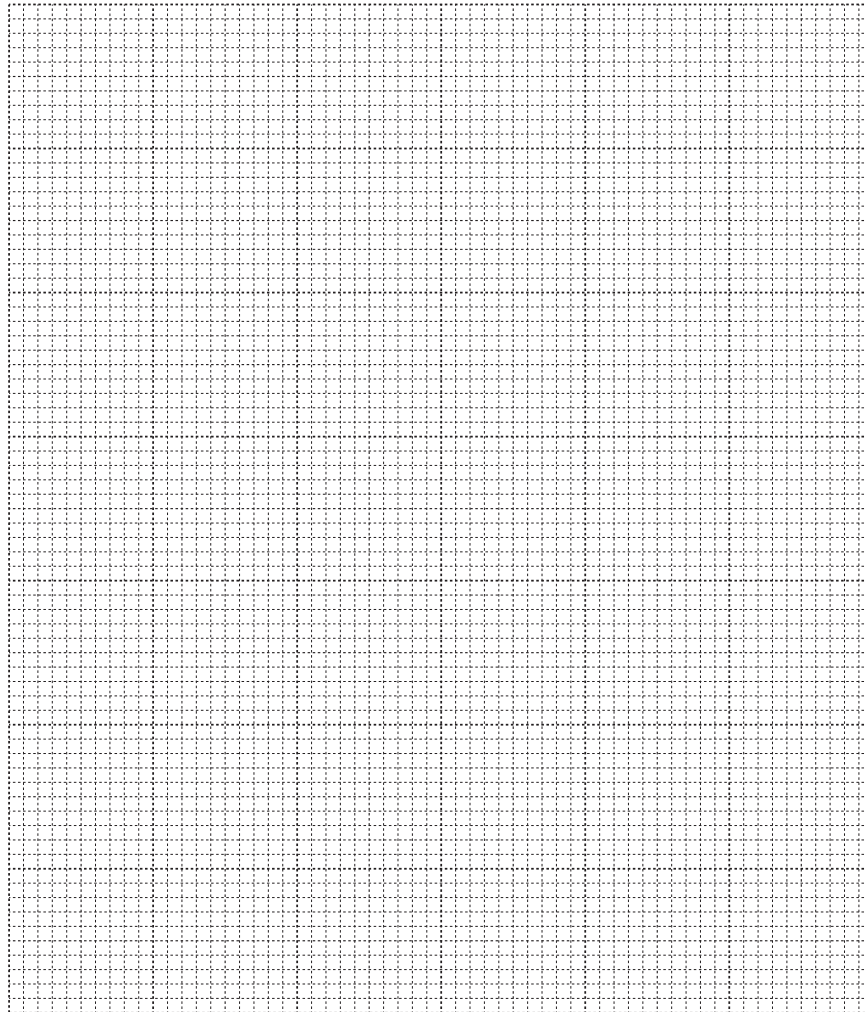
Read and record this temperature in Table 4.1.

[1]

- (iv) Suggest one practical precaution that she should take to ensure that her temperature readings are as accurate as possible.

.....
 [1]

- (b) (i) Use the results in Table 4.1 to plot a graph of temperature of water (vertical axis) against time t for each experiment. The vertical axis does not need to start at 0.



[3]

- (ii) Draw separate lines of best fit for each experiment. Label each line. [2]

- (c) (i) Describe **one** similarity and **one** difference in the way that the temperature of the water changes with time in the two experiments.

similarity

.....

difference

.....

[2]

- (ii) Predict the temperature of the water in the cup with a lid after 3.5 minutes.

Show on your graph how you arrived at your answer.

temperature = ... [2]

[Total: 13]

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0653/62

October/November 2019

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 **10** printed pages and **2** blank pages.

- 1 A student investigates the concentration of vitamin C in two samples of fruit juice, **A** and **B**.

Iodine solution and starch can be used to estimate the concentration of vitamin C in a sample of fruit juice. Iodine solution is added to a starch fruit juice mixture until the solution remains blue-black.

The more iodine solution that needs to be added to produce a permanent blue-black colour, the higher the concentration of vitamin C in the sample.

- (a)
- The student puts 20 cm^3 of fruit juice **A** into a beaker.
 - He adds 1 cm^3 starch solution to the fruit juice using a measuring cylinder and stirs.
 - He puts 10 cm^3 iodine solution into a second beaker.
 - He uses a pipette to add a few drops of the iodine solution to the fruit juice and starch mixture and stirs.
 - He continues adding iodine solution until the colour changes to blue-black.
 - He pours the remaining unused iodine solution into a measuring cylinder.
 - He records in Table 1.1 the volume of unused iodine solution **remaining** for experiment **1**.

Table 1.1

fruit juice A experiment	volume of unused iodine solution remaining $/\text{cm}^3$	volume of iodine solution added $/\text{cm}^3$	average volume, V_A , of iodine solution added $/\text{cm}^3$
1	8.0	2.0	
2	7.5	2.5	
3			

He repeats the experiment twice more. He records in Table 1.1 the volume of unused iodine solution **remaining** for experiment **2** and experiment **3**.

The reading on the measuring cylinder for the volume of remaining iodine solution for experiment **3** is shown in Fig. 1.1.

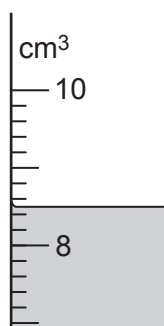


Fig. 1.1

- (i) Read and record in Table 1.1 the volume shown in Fig. 1.1 to the nearest 0.5 cm^3 . [1]

- (ii) Calculate the volume of iodine solution that has been **added** to the fruit juice in experiment **3**. Record this value in Table 1.1.

[1]

- (iii) Calculate the average volume, V_A , of iodine solution added to fruit juice **A**. Record this value in Table 1.1.

[1]

- (b) The student repeats (a) with fruit juice **B**. He records the volumes in Table 1.2.

Table 1.2

fruit juice B experiment	volume of unused iodine solution remaining /cm ³	volume of iodine solution added /cm ³	average volume, V_B , of iodine solution added /cm ³
1	9.5	0.5	
2	5.5	4.5	
3	9.5	0.5	

Calculate the average volume, V_B , of iodine solution added to fruit juice **B**. Record this value in Table 1.2.

[2]

- (c) State what can be concluded about the concentration of vitamin C in fruit juice **A** compared to fruit juice **B**. Use the results in Table 1.1 and Table 1.2.

.....
 [1]

- (d) (i) Calculate the concentration of vitamin C in fruit juice **A** using the equation shown.

$$\text{concentration} = \frac{V_A \times 0.025}{20}$$

Give your answer to an appropriate number of significant figures.

concentration = ...g/cm³ [2]

- (ii) Suggest **one** piece of apparatus that can be used to measure the 1 cm^3 of starch solution more accurately.

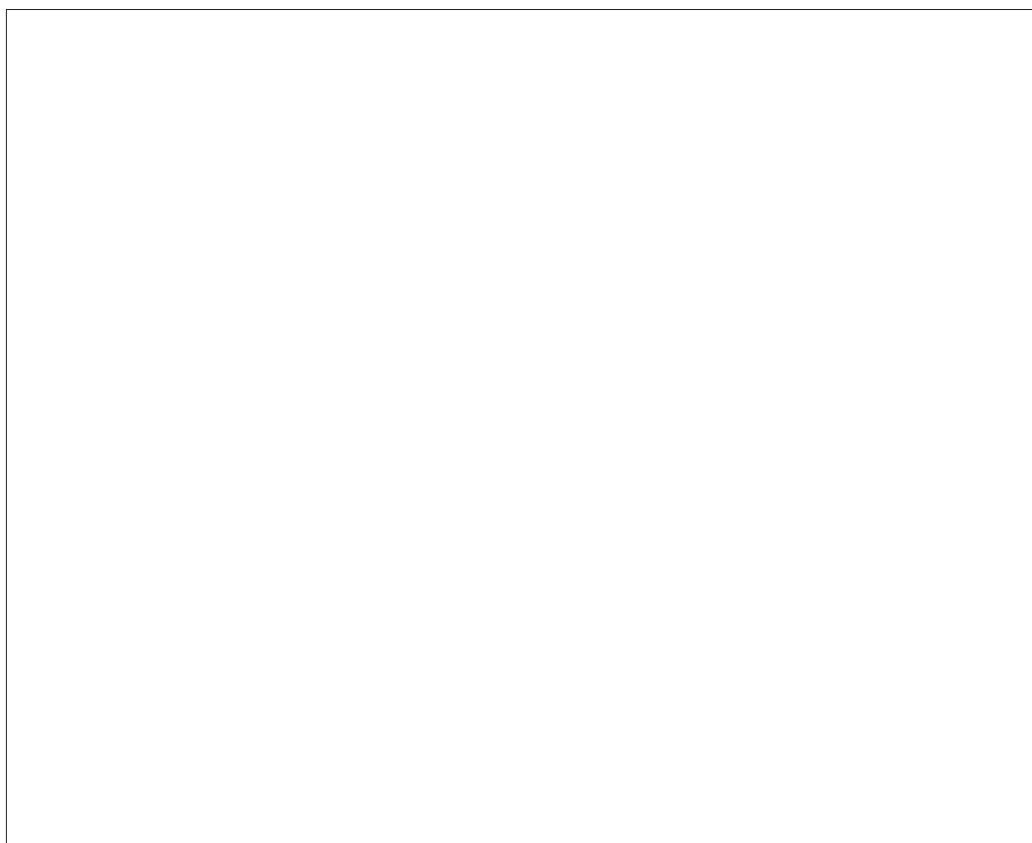
..... [1]

- (e) Fig. 1.2 shows half of a fruit that contains vitamin C.



Fig. 1.2

In the box below, make an enlarged detailed drawing of the cut surface of the fruit.



[3]

- (f) State the name of a reagent that could be used to test the fruit for the presence of protein.

..... [1]

[Total: 13]

2 A student has a sample of a green powder, **E**.

- (a)
- She places a small amount of powder **E** into a test-tube and heats it gently.
 - She bubbles the gas formed into limewater in a test-tube. The limewater turns milky.
 - The green powder changes into a black powder **F**.
- (i) Draw a labelled diagram of the assembled apparatus and chemicals she uses in (a).

[2]

(ii) State the identity of the gas formed.

..... [1]

(iii) State the identity of the anion in powder **E**.

..... [1]

- (b)
- The student places the black powder **F** into a beaker of dilute sulfuric acid and heats it.
 - She filters the mixture formed into two test-tubes.
 - The liquid in the two test-tubes is solution **G** and is blue in colour.
 - She adds aqueous sodium hydroxide to one test-tube of solution **G**.
 - A pale blue precipitate forms.
 - She performs a flame test on the sample of solution **G** in the other test-tube.
 - The flame colour she observes is blue-green.

State the identity of the cation in solution **G**, powder **E** and powder **F**.

..... [1]

(c) State the identities of black powder **F** and blue solution **G**. Use the results in (a) and (b).

identity of **F**

identity of **G**

[2]

[Total: 7]

3 Fizzy drinks are fizzy because they have carbon dioxide dissolved in them.

The carbon dioxide is dissolved under pressure. As soon as the top is taken off a bottle of fizzy drink, the carbon dioxide gas starts to bubble out of the drink.

If the top is left off the bottle, the carbon dioxide will start to leave the drink. The drink will eventually 'go flat' (not fizzy) when all of the carbon dioxide has left the drink. This will also happen if the drink is poured into a glass.

The drink will lose all of its carbon dioxide more quickly if it is heated.

Plan an experiment to compare the **amount** of dissolved carbon dioxide in the three fizzy drinks lemon soda, orange soda and sparkling water.

You may use any common laboratory apparatus and samples of lemon soda, orange soda and sparkling water.

Include in your answer:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including any safety precautions and why these are needed
- the measurements you will make
- what you will control
- how you will process your results
- how you will use your results to draw a conclusion.

.....

.....

.....

.....

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- 4 A student investigates how the period of a simple pendulum changes as its length changes.

Fig. 4.1 shows the apparatus used by the student.

The length of a pendulum is the distance from the point of support to the centre of the bob.

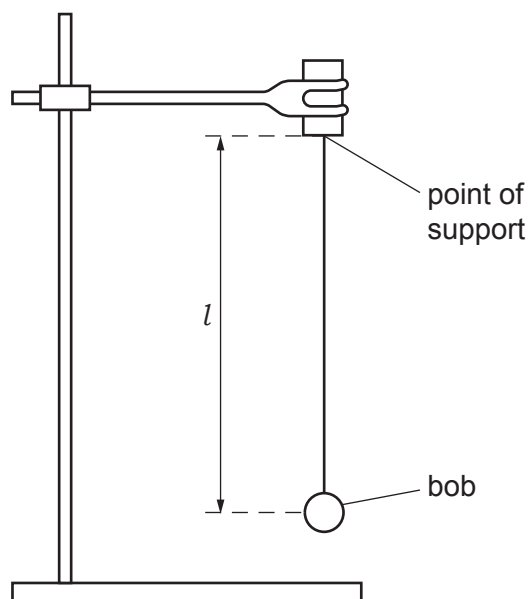


Fig. 4.1

- (a) (i) Measure the length l on Fig. 4.1 to the nearest 0.1 cm.

length l of pendulum in Fig. 4.1 = ... cm [1]

- (ii) Fig. 4.1 is drawn to a one-tenth scale.

Calculate the actual length L of the pendulum.
Record this length L in Table 4.1 on page 10.

[1]

- (b) (i) The student measures the time for 10 complete oscillations of the pendulum. She repeats this measurement.

Fig. 4.2 shows the two stop-clock readings for her measurements.

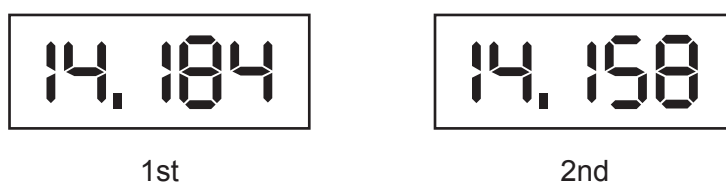


Fig. 4.2

Read and record in Table 4.1 the times for 10 oscillations of the pendulum to the nearest 0.01 s. [2]

Table 4.1

length L / cm	time for 10 oscillations / s		average time for 10 oscillations / s	period T / s	T^2 / s ²
	1 st	2 nd			
40.0	12.63	12.69	12.66	1.266	1.60
35.0	11.98	11.95	11.97	1.197	1.43
25.0	10.10	10.19	10.15	1.015	1.03
20.0	9.22	9.32	9.27	0.927	0.86

- (ii) Calculate the average time for 10 oscillations of the pendulum of length L . Record this time in Table 4.1.

[1]

- (iii) Calculate the period T and T^2 for the pendulum of length L .

Record these values in Table 4.1.

[1]

- (c) The student repeats the experiment for pendulums with length $L = 40.0, 35.0, 25.0$ and 20.0 cm. Her results are recorded in Table 4.1.

- (i) Describe one precaution that the student should take to ensure her timings of 10 complete oscillations are as accurate as possible.

.....

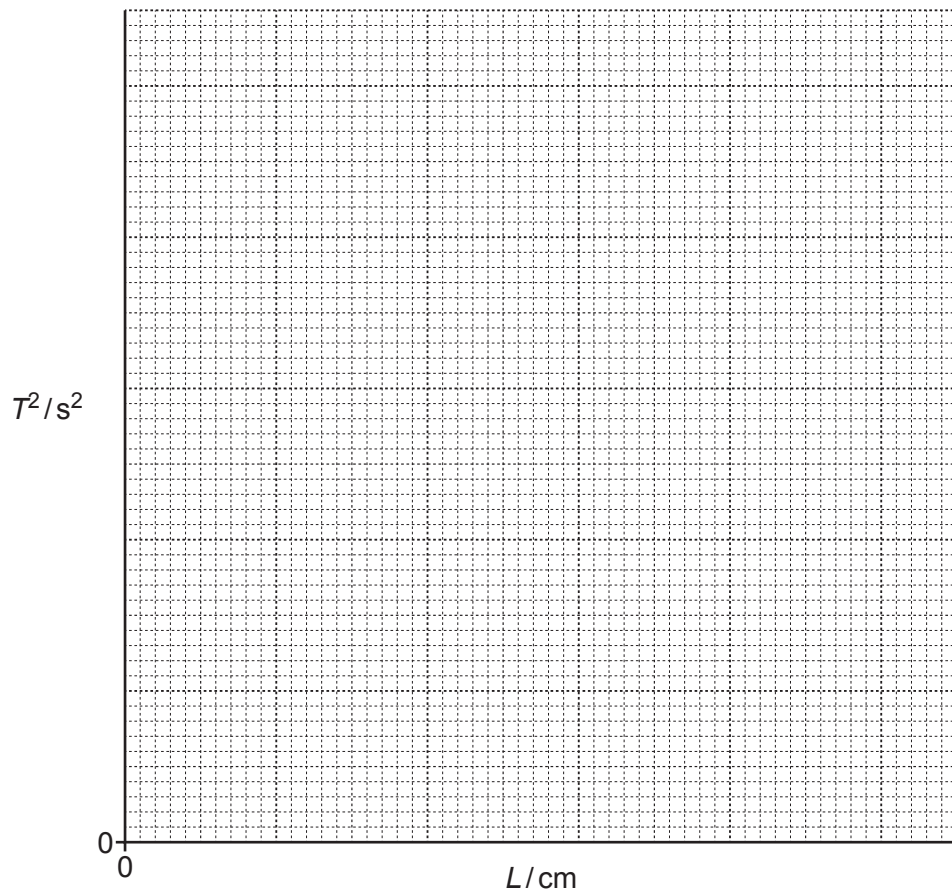
 [1]

- (ii) Explain why it is better to time 10 oscillations rather than one oscillation to determine the period T .

.....

 [2]

- (d) (i) On the grid plot a graph of T^2 against L .



[2]

- (ii) Draw the best-fit straight line.

[1]

- (e) Describe the relationship between the length L of the pendulum and T^2 .

.....

..... [1]

[Total: 13]

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0653/63

October/November 2019

1 hour

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This document consists of **14** printed pages and **2** blank pages.

- 1 (a) A student investigates the movement of water in potato cylinders.

Water moves from an area of lower sugar concentration to an area of higher sugar concentration.

The unit of concentration is mol/dm^3 .

He cuts six potato cylinders, each one 60 mm long and with a diameter of 10 mm.

He places two potato cylinders, **A** and **B**, into a test-tube and adds 0.1 mol/dm^3 sugar solution so that both cylinders are completely covered.

He repeats this using 0.3 mol/dm^3 and 0.5 mol/dm^3 sugar solution as shown in Fig. 1.1.

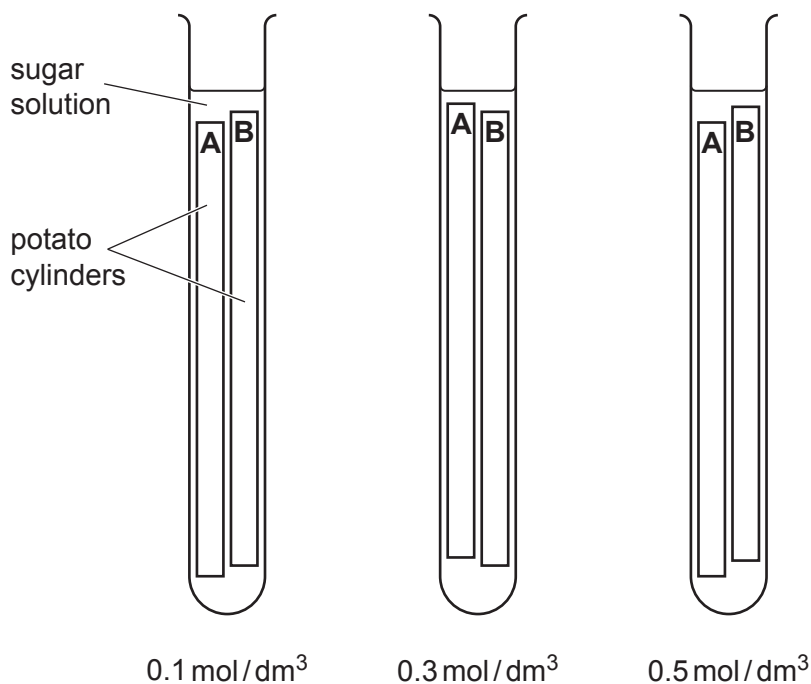


Fig. 1.1

He leaves the potato cylinders in the sugar solutions for 12 hours.

After 12 hours he removes the potato cylinders and dries them with a paper towel.

The final lengths of the potato cylinders after 12 hours are shown in Fig. 1.2.

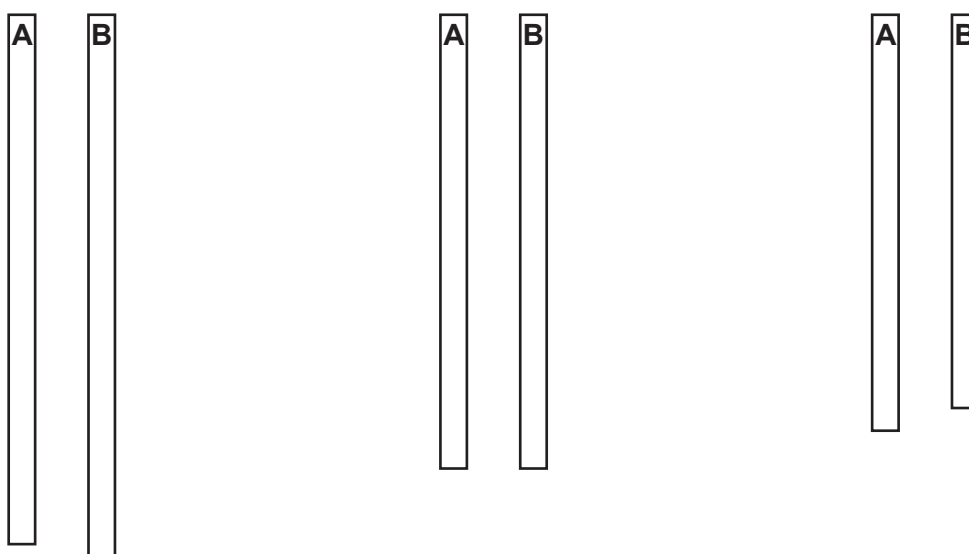
0.1 mol/dm³ sugar solution0.3 mol/dm³ sugar solution0.5 mol/dm³ sugar solution

Fig. 1.2

- (i) Explain why it is important that the potato cylinders are completely covered with the sugar solution.

.....
 [1]

- (ii) On Fig. 1.2, measure the final lengths of the two cylinders from the **0.5 mol/dm³** sugar solution.

Record these final lengths in Table 1.1.

[1]

Table 1.1

concentration of sugar solution mol/dm ³	potato cylinder	initial length /mm	final length /mm	change in length /mm	average change in length /mm
0.1	A	60	70	+10	+11
	B	60	72	+12	
0.3	A	60	60	0	0
	B	60	60	0	
0.5	A	60			
	B	60			

- (iii) Calculate the change in length for the potato cylinders in 0.5 mol/dm³ sugar solution. Include a plus (+) or a minus (–) sign as appropriate.

Record this value in Table 1.1.

[1]

- (iv) Calculate the average change in length for the potato cylinders in 0.5 mol/dm^3 sugar solution. Include a plus (+) or a minus (–) sign as appropriate.

Record this value in Table 1.1.

[1]

- (v) Calculate the average **percentage** change in length of the potato cylinders in 0.1 mol/dm^3 sugar solution.

Use the equation shown:

$$\text{average percentage change in length} = \frac{\text{average change in length}}{\text{initial length}} \times 100$$

$$\text{average percentage change} = \dots\dots\dots \% \quad [1]$$

- (b) (i) Explain why the potato cylinders increased in length in the 0.1 mol/dm^3 sugar solution.

.....
 [1]

- (ii) Explain why there were no changes in length of potato cylinders in the 0.3 mol/dm^3 sugar solution.

.....
 [1]

- (c) The student repeats the investigation but places two 60 mm long potato cylinders into a sugar solution of unknown concentration for 12 hours.
 He calculates the average change in length.

The results are shown in Table 1.2.

Table 1.2

concentration of sugar solution mol/dm^3	potato cylinder	initial length /mm	final length /mm	change in length /mm	average change in length /mm
unknown	A	60	62	+2	+3
	B	60	64	+4	

- (i) Use the results in Table 1.1 and Table 1.2 to suggest the concentration of the sugar solution of unknown concentration.

$$\text{concentration of sugar solution} = \dots\dots\dots \text{mol/dm}^3 \quad [1]$$

- (ii) The student states that to be able to predict the unknown concentration of the sugar solution, all other factors should be kept the same when the investigation is repeated.

Suggest **three** factors that should be kept the same.

1.
.....
2.
.....
3.
.....

[3]

- (d) Describe how the potato cylinder can be tested for the presence of starch.

Include the result for a positive test and the result for a negative test.

test
.....
positive result
negative result

[2]

[Total: 13]

- 2 A student has samples of two grey solids **E** and **F**.

Solid **E** is covered in oil and kept in a bottle with the top screwed on.

Solid **F** is in a bottle with the label 'Do not touch with bare hands'.

- (a) The student adds a small piece of **E** to cold water in a large beaker.

The solid skates around the surface of the water, fizzes violently and forms solution **G**.

She tests the gas and concludes that it is hydrogen.

- (i) Describe the test which confirms the gas is hydrogen and give the result for a positive test.

test

positive result

[1]

- (ii) She puts some of solution **G** into a test-tube and adds aqueous iron(II) nitrate. A green precipitate is formed.

Suggest the identity of solution **G** and solid **E**.

G is

E is

[1]

- (iii) Suggest an alternative reagent to iron(II) nitrate for identifying solution **G** in (a)(ii).

.....

..... [1]

- (b) She adds a small piece of solid **F** to cold water in a large beaker.

The solid moves up and down in the water, fizzes vigorously and forms solution **H**.

The gas given off is hydrogen.

She puts some of solution **H** into a test-tube.

She places marble chips in a separate test-tube, adds hydrochloric acid and bubbles the gas formed into solution **H**.

Solution **H** goes milky.

- (i) Draw a diagram of the assembled apparatus used to bubble the gas formed into solution **H**. Label the apparatus and the chemicals.

[2]

- (ii) Suggest the identity of solution **H**.

..... [1]

- (iii) Suggest the identity of solid **F**.

..... [1]

[Total: 7]

- 3 Hydrogen peroxide is used to bleach hair. Hydrogen peroxide slowly decomposes giving off oxygen gas.

When a catalyst is added to hydrogen peroxide, oxygen gas is given off more quickly.

Plan an experiment to find out which one of the three solid oxides, manganese dioxide, copper oxide and zinc oxide, is the best catalyst for this reaction.

You may use any common laboratory apparatus and samples of hydrogen peroxide, manganese dioxide, copper oxide and zinc oxide.

Include in your answer:

- the apparatus needed, including a labelled diagram if you wish
- a brief description of the method, including any safety precautions and why these are needed
- the measurements you will make
- what you will control
- how you will process your results
- how you will use your results to draw a conclusion.

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- 4 A student investigates how the size of the average force needed to move a door varies with its distance d from the hinge (pivot).

Fig. 4.1 shows the apparatus used in the investigation.

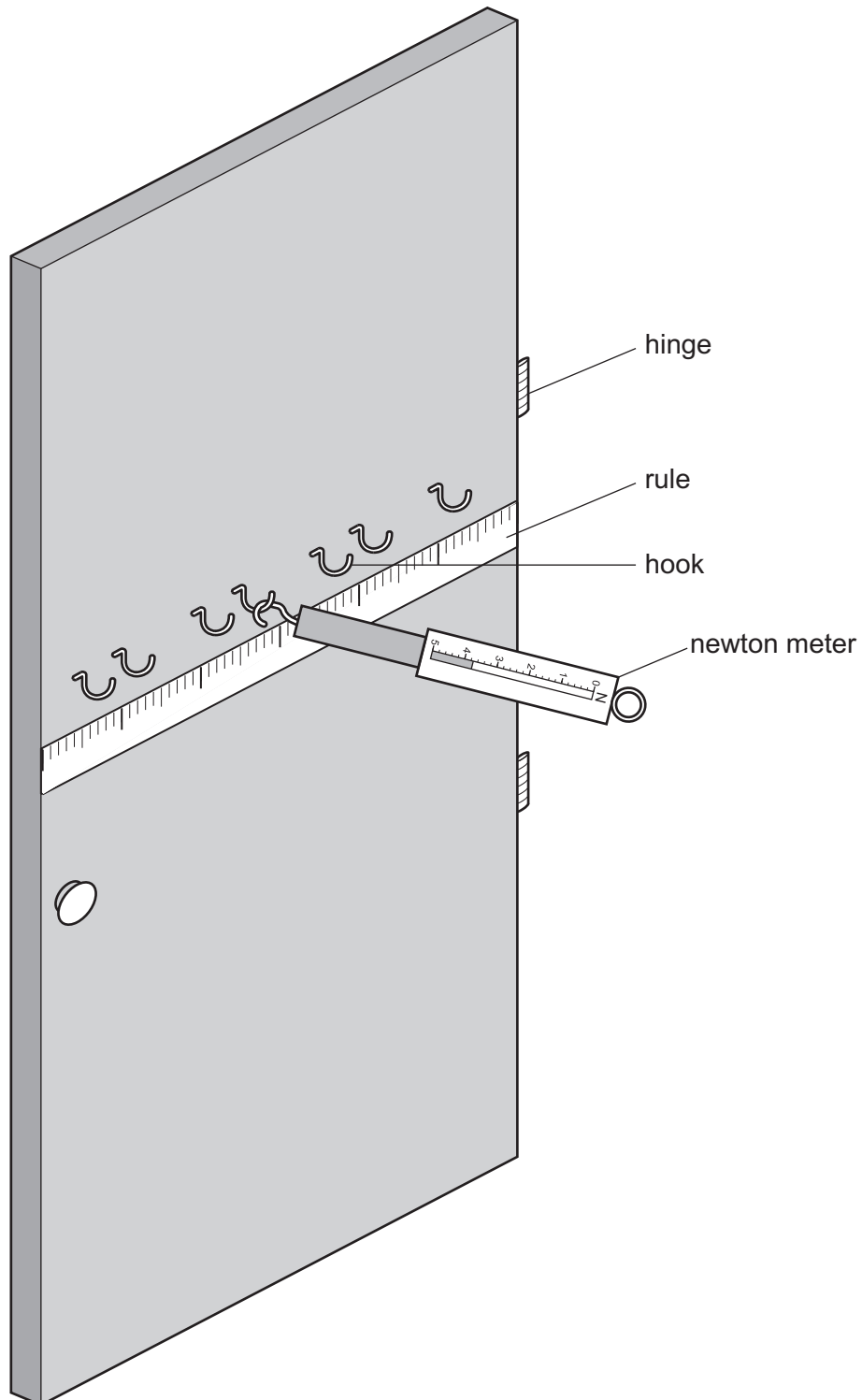


Fig. 4.1

- A newton meter is attached to the hook at distance $d = 0.10$ m from the hinge.
- The newton meter is pulled horizontally at right angles to the door until the door moves.
- The student measures the force needed to move the door.
- She repeats this measurement twice more.
- She then repeats this procedure using hooks at the distances shown in Table 4.1.
- Her results are recorded in Table 4.1.

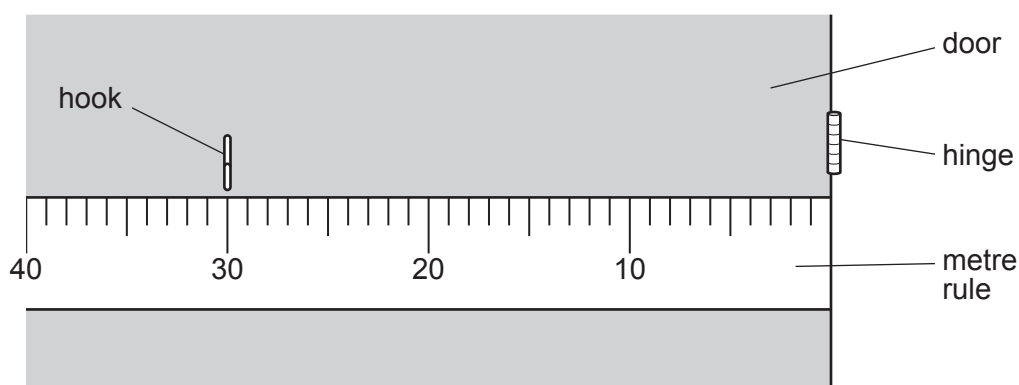
Table 4.1

distance d from hinge/m	force F required to move the door/N			average force to move door/N
	experiment 1	experiment 2	experiment 3	
0.10	4.20	4.35	4.25	4.27
0.20	2.40	2.50	2.00	2.30
0.25	1.80	1.75	1.90	1.82
	1.20	1.80	1.45	1.48
0.40	0.95	1.05	1.20	1.07
0.50	0.80	0.75	0.75	
0.55	0.65	0.75	0.70	0.70

(a) Read the distance d from the hinge to the hook shown in Fig. 4.2.

Record this value in Table 4.1.

[1]

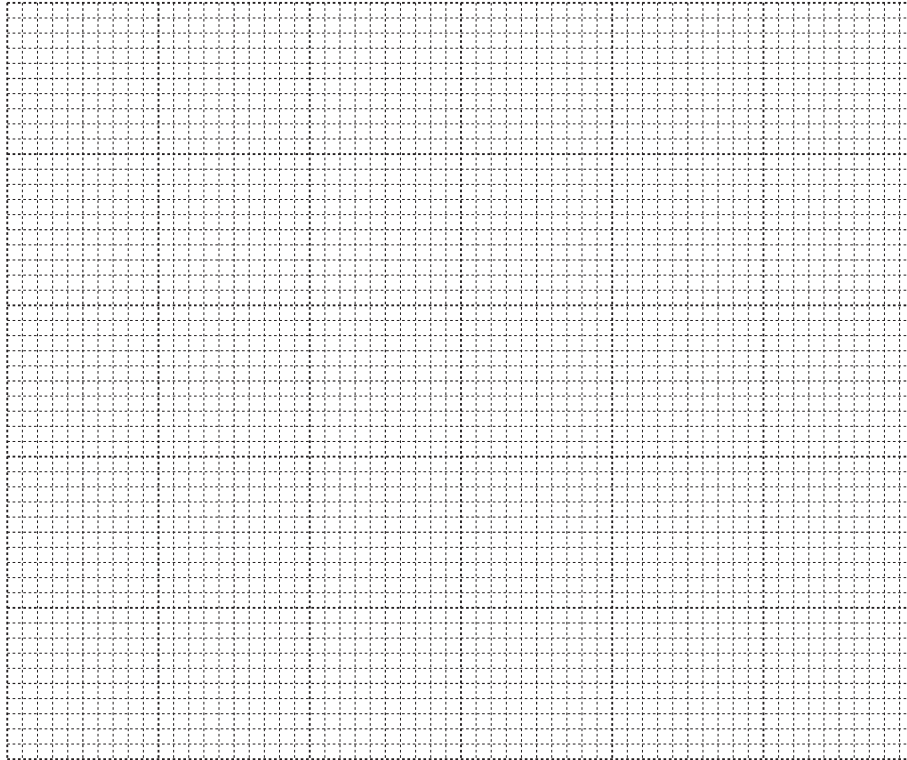
**Fig. 4.2**

- (b) Calculate the average force F needed to move the door when the newton meter is at a distance $d = 0.50$ m from the hinge.

Record this value in Table 4.1.

[2]

- (c) (i) Plot a graph of the average force F needed to move the door (vertical axis) against the distance d from the hinge (pivot).



[3]

- (ii) Draw the best-fit smooth curve.

[1]

- (d) Describe in detail the relationship between the average force F needed to move the door and the distance d .

.....
 [2]

- (e) (i) Fig. 4.3 shows three different newton meters, **A**, **B** and **C**.

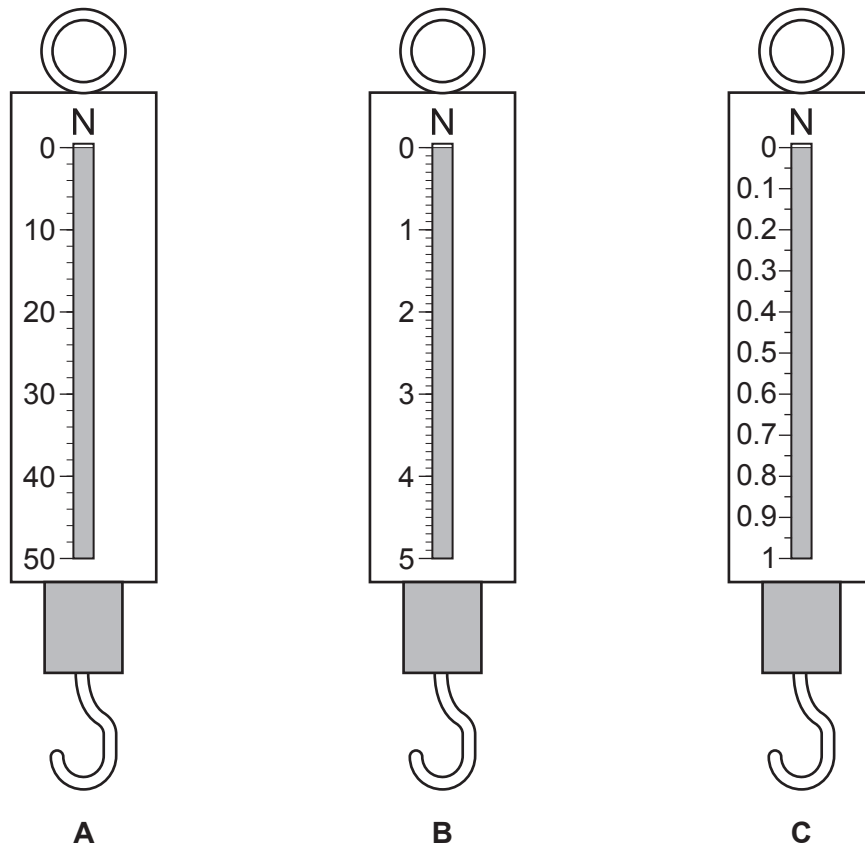


Fig. 4.3

The student uses newton meter **B** in her experiment.

Explain why **B** is more suitable than each of the other newton meters shown in Fig. 4.3.

.....

 [2]

- (ii) Draw a line on newton meter **B** in Fig. 4.3 to show the reading for distance $d = 0.25$ m in experiment 1. [1]

- (f) Suggest **one** practical difficulty that the student has in getting accurate results for the investigation.

.....

..... [1]

[Total: 13]

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