

--	--	--	--	--

--	--	--	--

0653/61

October/November 2016

1 hour

No Additional Materials are required.

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 **16** printed pages.

1 A student investigates the movement of molecules through a membrane.

- He places 2 cm^3 of starch solution inside each of two tubes made of clear and colourless artificial membrane. He ties both ends of each tube with a knot to enclose the starch solution inside. This makes two soft tubing bags.
- He places one bag into a beaker of water. This is beaker **A**.
- He places the other bag into a beaker of iodine solution. This is beaker **B**.
- Fig. 1.1 shows how the experiment is set up.

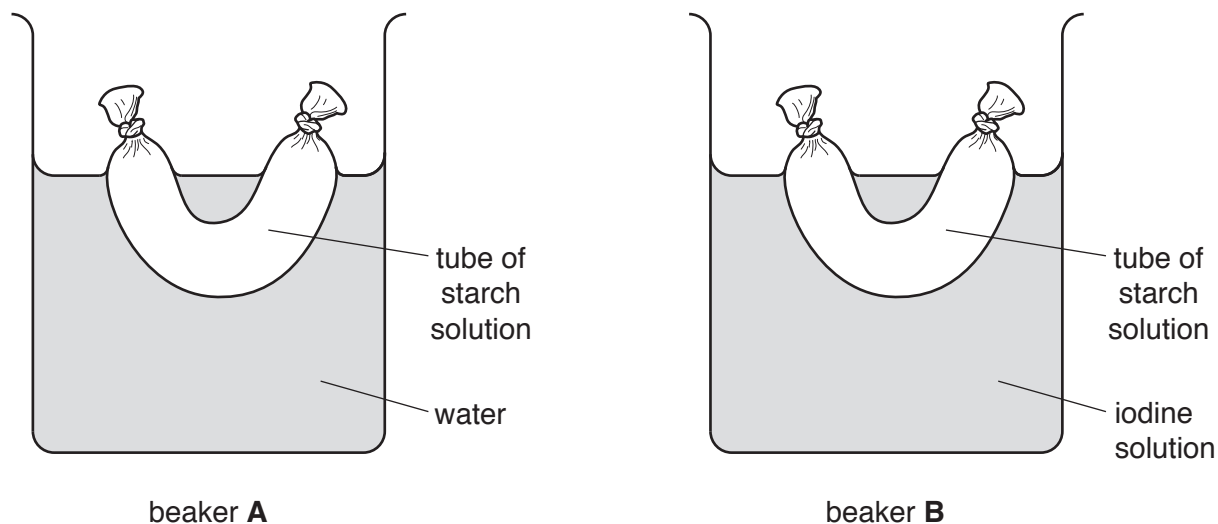


Fig. 1.1

- He starts the stopwatch and records the appearance of the starch solution inside the tubes every 2 minutes for 10 minutes. His results are shown in Table 1.1.

(a) Complete the headings in Table 1.1.

Table 1.1

..... /		
	beaker A	beaker B
0	cloudy	cloudy
2	cloudy	cloudy
4	cloudy	cloudy
6	cloudy	cloudy with some black areas
8	cloudy	black
10	cloudy	black

[2]

- (b) The artificial membrane allows some molecules to pass through it, but starch molecules are too large to pass through. Use this information and Table 1.1 to explain the observations for beaker **B**.

.....

.....

.....

.....[3]

- (c) (i) Amylase is an enzyme that breaks down starch into reducing sugar. The student now adds amylase to the contents of the tube in beaker **B** and leaves in a warm place for a few minutes.

Predict what he will observe.

.....

.....[1]

- (ii) Explain your answer to (c)(i).

.....

.....[1]

- (iii) Describe a test you could carry out to confirm that reducing sugar has been produced. Include the observation for a positive result in your answer.

.....

.....

.....

.....[3]

- 2 A student is given a pale green solution **J** containing a dissolved salt and a grey solid **L**, which is an element. He carries out some experiments to identify the ions of the salt in **J** and to identify the element **L**.

- (a) He chooses from the following solutions to carry out tests to identify the cation and the anion in solution **J**.

barium nitrate solution
dilute nitric acid
silver nitrate solution
sodium hydroxide solution

- (i) State the details of the test and the observations which allow him to identify the cation as Fe^{2+} .

cation

test

.....

observations

.....

[2]

- (ii) State the details of the test and the observations which allow him to identify the anion as SO_4^{2-} .

anion

test

.....

observations

.....

[3]

- (b) (i) • The student places solid **L** in a test-tube. He adds dilute hydrochloric acid.
• He warms the test-tube gently for a short time to increase the rate of reaction.
• He stirs carefully and tests the gas produced.
• He records in Table 2.1 his observations and the test which identifies this gas.

Table 2.1

test	observation
add dilute hydrochloric acid	fizzing and colourless solution is formed
lighted splint at mouth of test-tube	popping sound

Identify the gas produced.

gas produced[1]

- (ii) • The student filters the mixture from **(b)(i)** into a test-tube.
 • To the filtrate in the test-tube he slowly adds sodium hydroxide solution until there are no further changes.
 • He identifies the element **L** as zinc.

Suggest the observations which lead him to this conclusion.

observations

[2]

- (c) The student then places magnesium powder in a test-tube. He adds solution **J** to the magnesium powder and records his observations.

observations test-tube becomes warmer

After three minutes, he filters the mixture into another test-tube and records the appearance of the filtrate.

appearance of filtrate colourless

He then adds sodium hydroxide solution slowly to a portion of the filtrate until there is no further change. He records his observations.

observations faint white ppt

- (i) Using your answers to **(a)** and this information, suggest what has happened to the **cation** in solution **J**.

.....
[1]

- (ii) State the name given to a reaction that gives out heat.

.....[1]

- 3 A student investigates how the period of a simple pendulum depends on its length.

The period of a pendulum is the time for one complete swing (oscillation) of the pendulum. This is shown in Fig. 3.1, where the period is the time taken for the bob to swing from **P** to **Q** and back to **P** again.

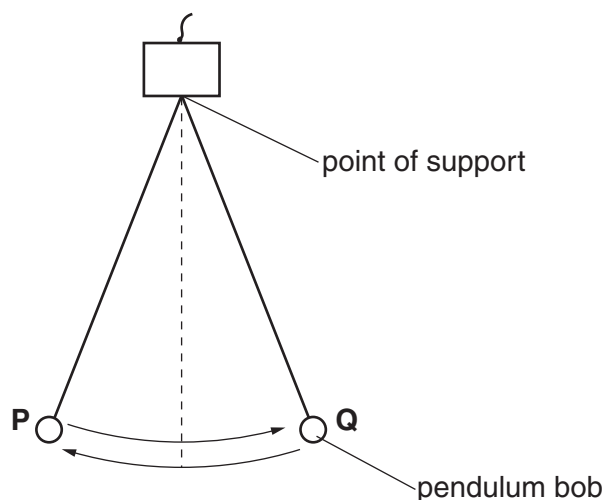


Fig. 3.1

She sets up the pendulum as shown in Fig. 3.2.

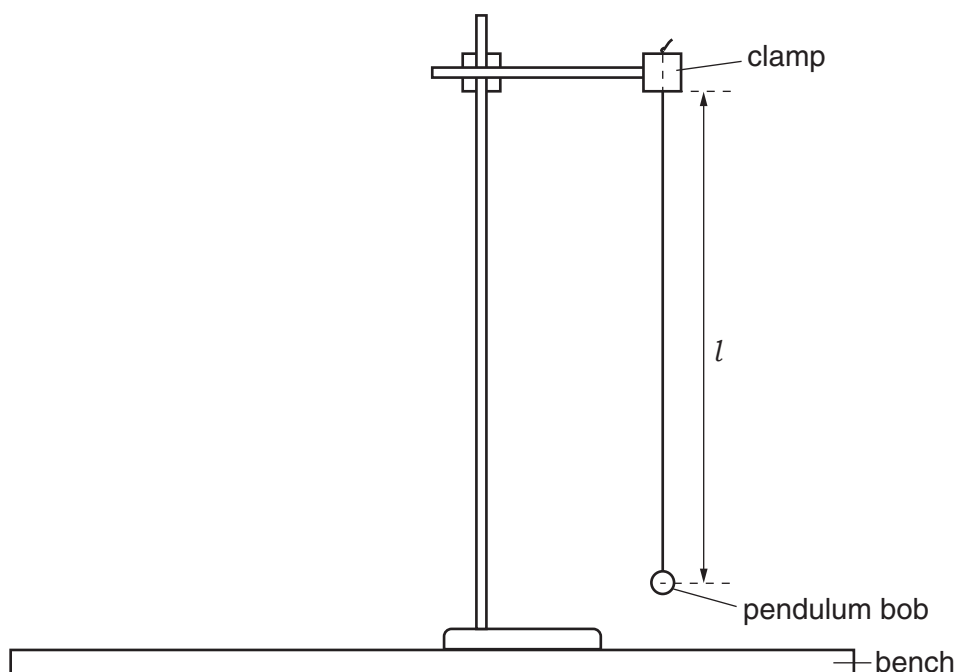


Fig. 3.2

Fig. 3.2 is drawn to a scale of **one-tenth full size**.

- (a) (i) Measure the length l of the pendulum in Fig. 3.2 to the nearest 0.1 cm.

length l = ... cm [1]

- (ii) Calculate the actual length l_A of the pendulum she uses. Record your answer below and in Table 3.1 in **(b)**.

actual length $l_A =$ cm [1]

- (iii) The actual length l_A of the pendulum is the distance from the point of support to the centre of the pendulum bob.

Describe a precaution that the student should take to measure l_A as accurately as possible. You may draw a diagram if you wish.

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

- (b) The student then moves the pendulum bob to position **P** and releases it so that it oscillates. She records the time taken for 20 oscillations. Fig. 3.3 shows the reading on the stopwatch.

00 : 30 . 98

Fig. 3.3

Record in Table 3.1 the reading on the stopwatch to three significant figures.

[1]

Table 3.1

l_A / cm	time for 20 oscillations / s	period T / s	T^2 / s ²
50.0	28.4	1.42	2.0
40.0	25.4	1.27	1.6
30.0	22.0	1.10	1.2
20.0	18.0	0.90	0.8

She repeats the procedure described in (b) for lengths l_A of 50.0 cm, 40.0 cm, 30.0 cm and 20.0 cm.

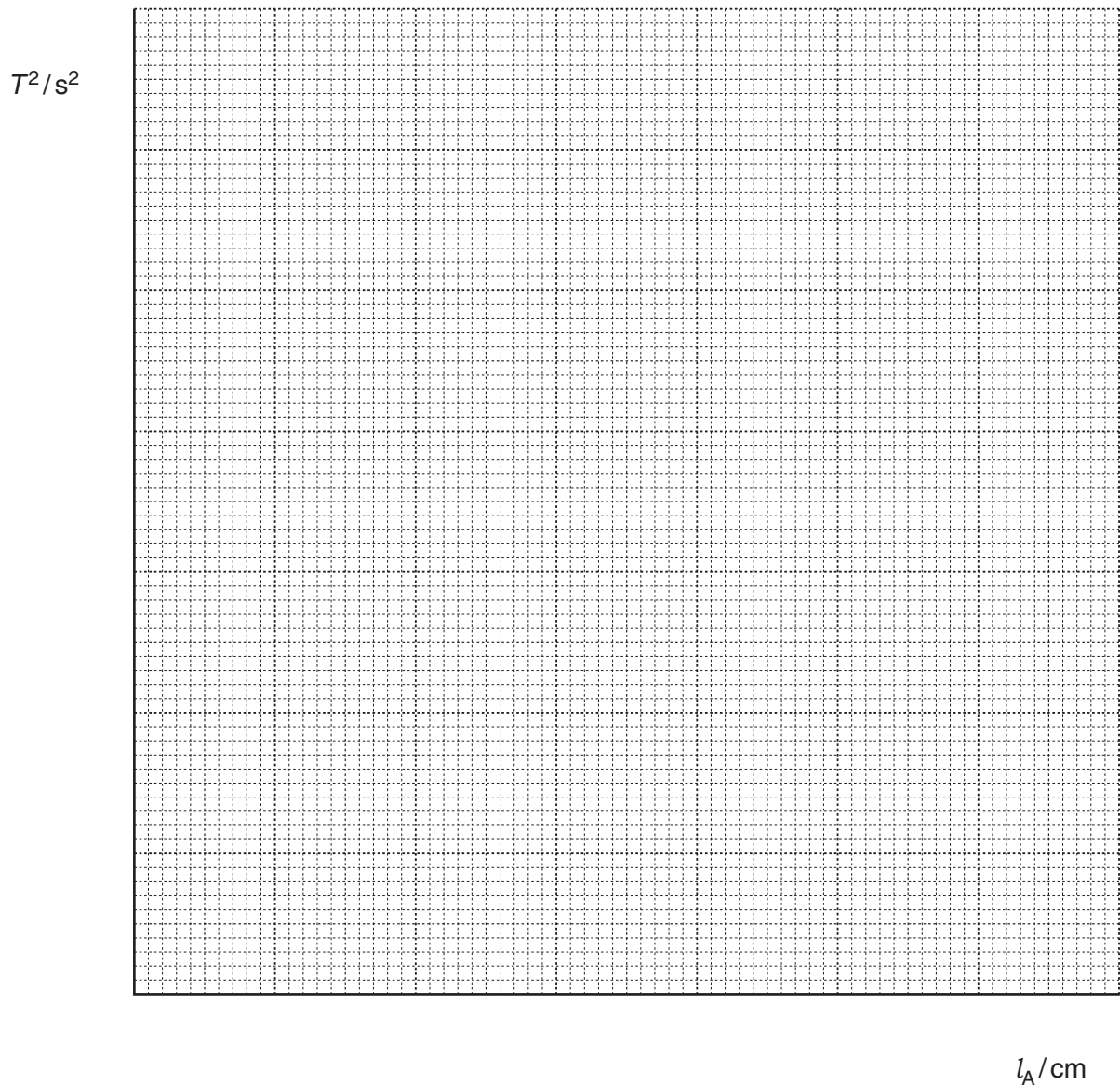
Her values are shown in Table 3.1.

- (c) Complete Table 3.1 by calculating the period T of the pendulum and T^2 for the first set of results. Remember that the period is the time for **one** oscillation.

[2]

- (d) On the grid provided, use the information in Table 3.1 to plot a graph of T^2 against l_A .

Start both axes of your graph from the origin (0, 0). Draw the best-fit straight line.



[3]

- (e) Another student suggests that T^2 is directly proportional to l_A .

State whether your graph supports this suggestion. Give a reason for your answer.

.....

[1]

- 4 Three students investigate the effect of acid on the growth of some seedlings.

Each student sets up three petri dishes. One of the dishes is shown in Fig. 4.1.

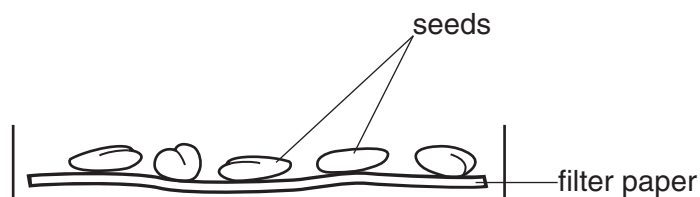


Fig. 4.1

Dish **A** is watered with distilled water. Dishes **B** and **C** are watered with dilute acid. The acid used in dish **C** is more concentrated than the acid used in dish **B**.

The dishes are left in a warm place for a week and then the height of the tallest seedling in each dish is measured to the nearest millimetre. The results for dishes **B** and **C** are shown in Table 4.1.

Table 4.1

dish	seedling height / mm			average seedling height / mm
	student 1	student 2	student 3	
A	32			
B	14	18	16	
C	2	3	1	

- (a) (i) Measure to the nearest millimetre, the height of each of the seedlings in Fig. 4.2 from the top of the filter paper to the top of the seedling.

Record these for dish **A** for students **2** and **3** in Table 4.1.

[2]

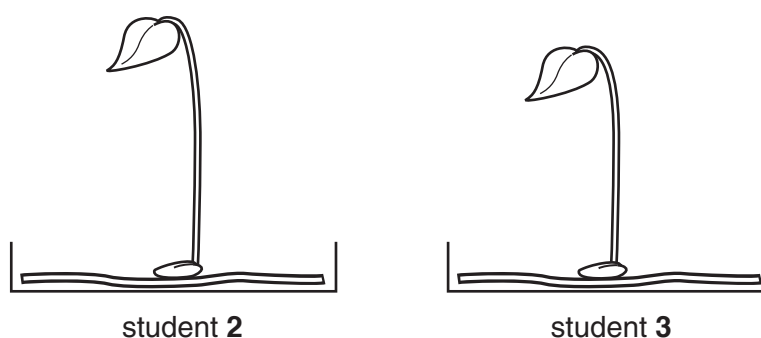
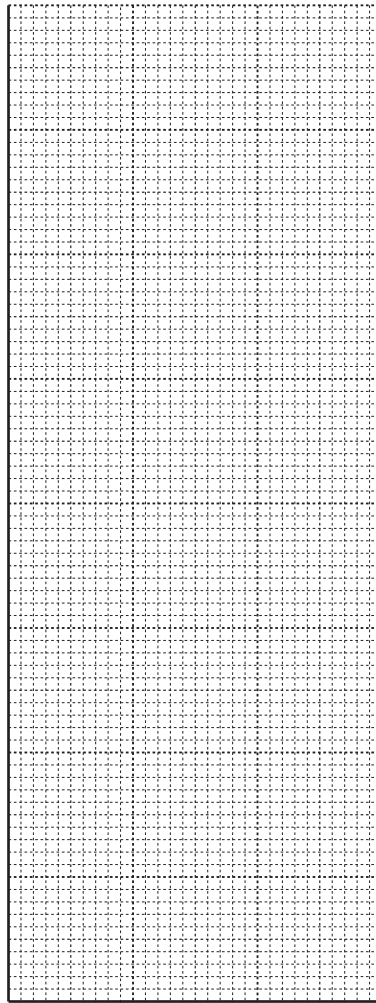


Fig. 4.2

- (ii) Calculate the average heights for the seedlings in dishes **A**, **B** and **C** and record these in Table 4.1.

[1]

- (b) (i) On the grid below, draw a bar chart to show the data collected by **student 1**.



[3]

- (ii) Explain why it would be better to draw a bar chart using the average heights instead of just the results from one student.

.....
[1]

- (c) Describe the effect of the acid solutions on the growth of the seedlings.

.....
[2]

- (d) State **one** environmental factor that needs to be kept the same for each of dishes **A**, **B** and **C**.

.....[1]

- 5 A science class is investigating the properties of five different colourless gases.

The teacher has given them test-tubes containing the gases **V**, **W**, **X**, **Y** and **Z**. Each test-tube contains only one gas.

The students carry out different tests on the gases.

- (a) **Test 1.** A glowing splint is inserted into a test-tube of each gas. In gas **Z** the splint relights. Suggest the name of gas **Z**.

.....[1]

- (b) **Test 2.** Gases **V**, **W** and **Y** are tested to find out if they are acidic, alkaline or neutral.

- (i) Describe how a student can show that a gas is acidic or alkaline. Include any observations in your answer.

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

- (ii) Describe how a student can show that a gas is neutral.

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

- (c) **Test 3.** The teacher gives the students a bowl of water. They have no other apparatus except the test-tubes containing the gases.

Draw a diagram to show how the students could use only this to find out if the gases are soluble in water.

Show clearly what is seen if the gas is soluble in water.

[2]

- (d) The students find out that gases **V** and **W** are soluble in water. They also find out that gas **V** is alkaline and gas **W** is acidic.

Use these results to suggest a name for the gases **V** and **W**.

gas **V**

gas **W**

[2]

- (e) These tests may not be able to identify carbon dioxide gas.

Suggest a test to identify carbon dioxide gas and state the observations for a positive result.

test

.....

observations

.....

[2]

- 6 A student carries out an experiment to compare the electrical resistance of wires **L** and **M**. The wires are made of different metal alloys and are each 100 cm long.

The student connects wire **L** into the circuit shown in Fig. 6.1 so that the current and voltage can be measured when the switch is closed.

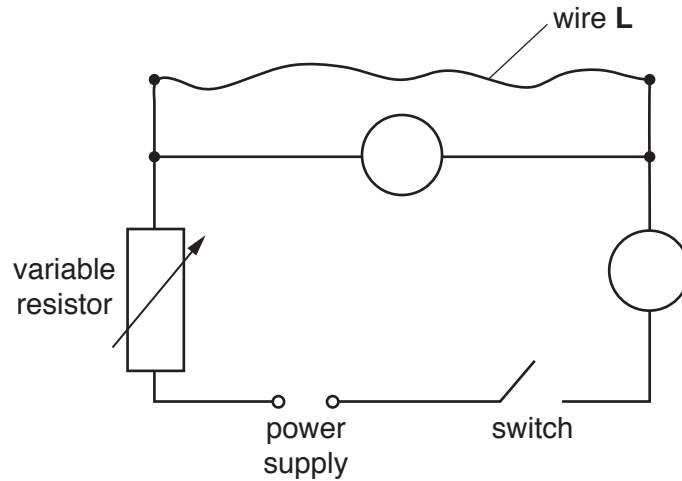


Fig. 6.1

- (a) Complete the symbols for the ammeter and voltmeter in Fig. 6.1. [1]
- (b) The student closes the switch. She adjusts the variable resistor until there is a small current in wire **L**. She reads the ammeter and voltmeter and records the readings in Table 6.1.

She opens the switch.

She repeats the experiment using wire **M**.

Table 6.1

wire	current / A	voltage / V
L	0.80	1.2
M		

Fig. 6.2 shows the ammeter and voltmeter readings for wire **M**.

Read the current to the nearest 0.05 A and the voltage to the nearest 0.1 V.

Record the values in Table 6.1.

[2]

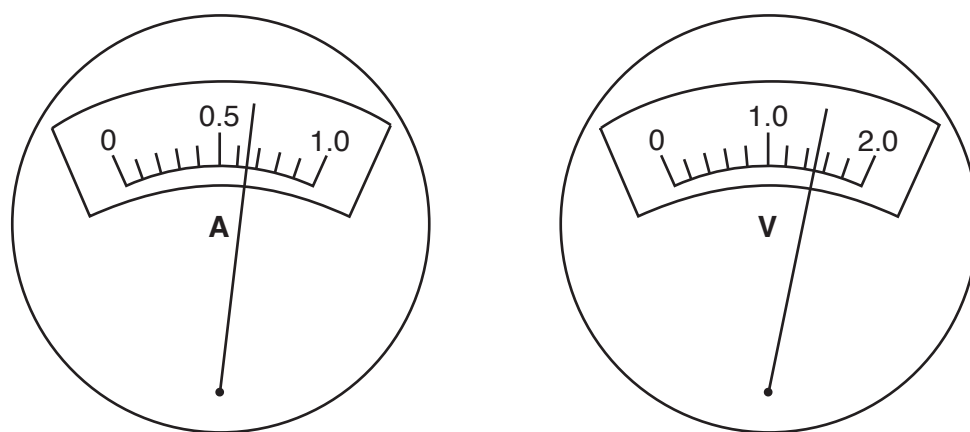


Fig. 6.2

(c) Calculate the resistances of wires **L** and **M** using the formula shown.

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

State the unit of resistance.

resistance of wire **L** = ...

resistance of wire **M** = ...

unit = ...

[3]

- (d) Using the circuit in Fig. 6.1, design an experiment to find out how the resistance of a wire changes with its length.

In your answer you should include the lengths of the wire to be used, the variables to be controlled and an appropriate circuit diagram.

State the results you would record and how you would present your results to show the relationship.

.....

.....

.....

.....

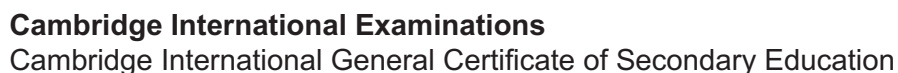
.....

.....[4]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.



--	--	--	--	--

--	--	--	--

0653/62

October/November 2016

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 **20** printed pages.

- 1 A student investigates an enzyme-catalysed reaction. Hydrogen peroxide is broken down by catalase, an enzyme found in living cells such as celery cells. Oxygen gas is released during the reaction.
- The student places 2 cm^3 of hydrogen peroxide solution in a test-tube, adds a drop of detergent and mixes these together.
 - She adds some chopped celery to the hydrogen peroxide solution.
 - The oxygen released causes a foam to be produced at the top of the liquid as shown in Fig. 1.1.
 - She starts a stopwatch and records the height of the foam and liquid every 2 minutes for 10 minutes.

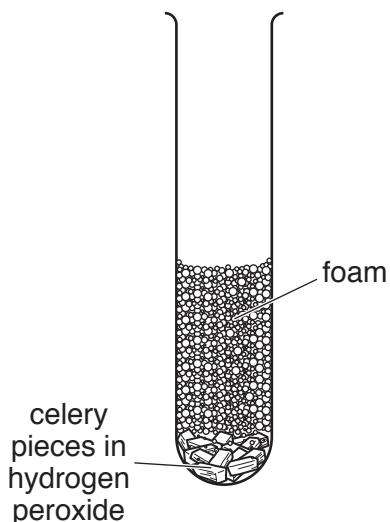


Fig. 1.1

(a) Table 1.1 shows some of the student's results.

Table 1.1

time / minutes	height of foam and liquid / cm
0	0.0
2	
4	4.6
6	
8	6.6
10	6.9
12	6.9

Use Fig. 1.2 to complete the rest of Table 1.1.

[2]

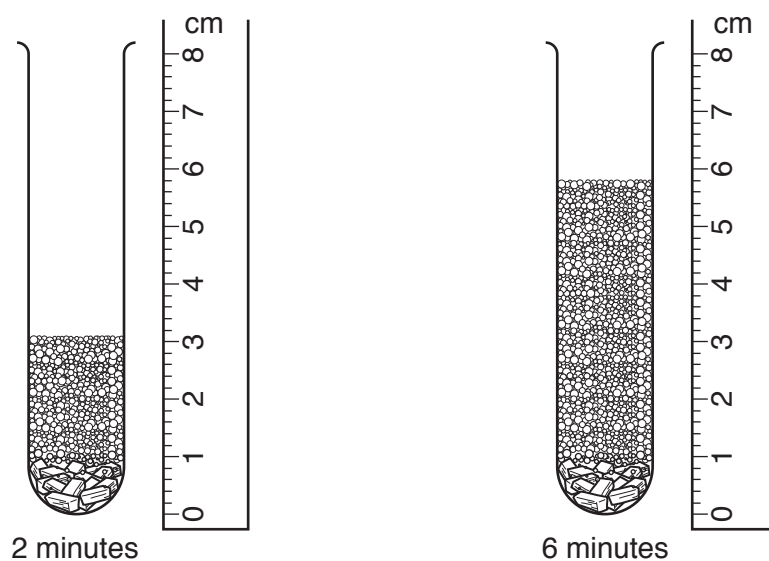
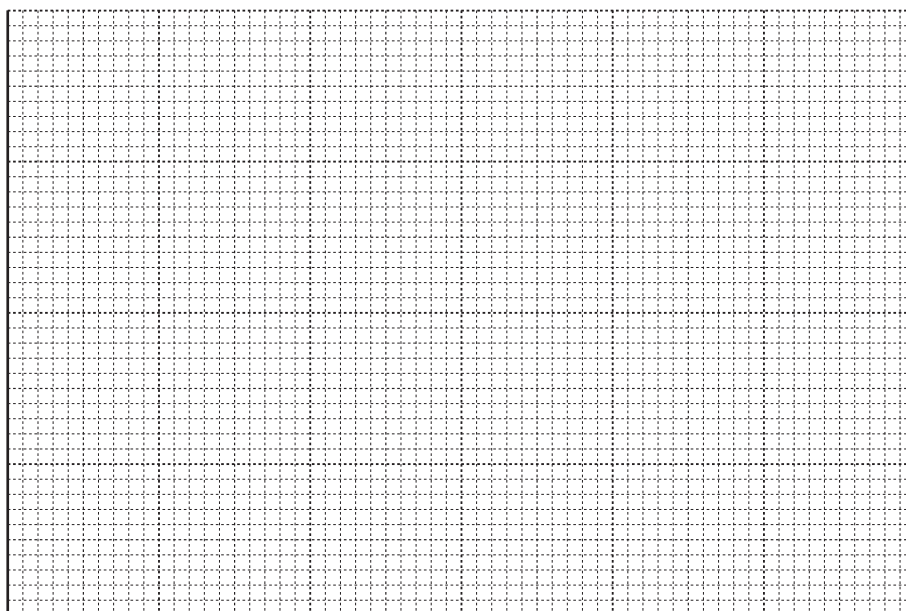


Fig. 1.2

- (b) On the grid provided, plot a graph of foam and liquid height (vertical axis) against time (horizontal axis).

Draw a best-fit curve.

[4]



(c) (i) Describe in detail the shape of the curve.

.....

.....

.....[1]

(ii) Explain what the shape of the curve tells you about the rate of reaction.

.....

.....[1]

(d) Describe how you could confirm that oxygen is produced in this reaction.

test

observation[2]

Please turn over for Question 2.

- 2 A student investigates the reaction between magnesium and copper sulfate solution. She wants to find out how the reaction depends on the concentration of the copper sulfate solution.

She is provided with copper sulfate solution of concentration 1.00X, where X is a unit of concentration.

- (a) The student uses a thermometer to measure the initial temperature T_i of the copper sulfate solution. She records in Table 2.1 T_i **to the nearest half degree** for concentration 1.00X.

Table 2.1

concentration of copper sulfate / X	initial temperature $T_i / ^\circ\text{C}$	highest temperature $T_h / ^\circ\text{C}$	temperature change $\Delta T / ^\circ\text{C}$
1.00	22.0	76.0	
0.75	22.0	63.5	
0.50	22.0	52.0	
0.25			

- The student transfers a sample of magnesium powder into a plastic cup.
- She measures 24cm^3 of copper sulfate solution and adds this quickly to the magnesium in the plastic cup.
- She stirs the mixture thoroughly and measures the highest temperature T_h reached.
- She records in Table 2.1 T_h **to the nearest half degree** for concentration 1.00X.
- She observes that the solid in the mixture turns brown.

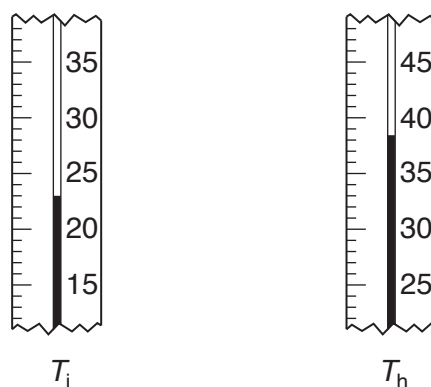
- (i) State the identity of the brown solid.

solid[1]

She then repeats the experiment using copper sulfate solutions of different concentrations, 0.75X, 0.50X, 0.25X.

She records in Table 2.1 the values of T_i and T_h **to the nearest half degree** for concentrations 0.75X and 0.50X.

- (ii) Read the thermometers in Fig. 2.1 and record **to the nearest half degree** in Table 2.1 the values of T_i and T_h for magnesium and 0.25X copper sulfate solution. [2]



thermometers for 0.25 X

Fig 2.1

- (b) (i) Calculate the temperature change ΔT during the reaction for each concentration of copper sulfate solution.

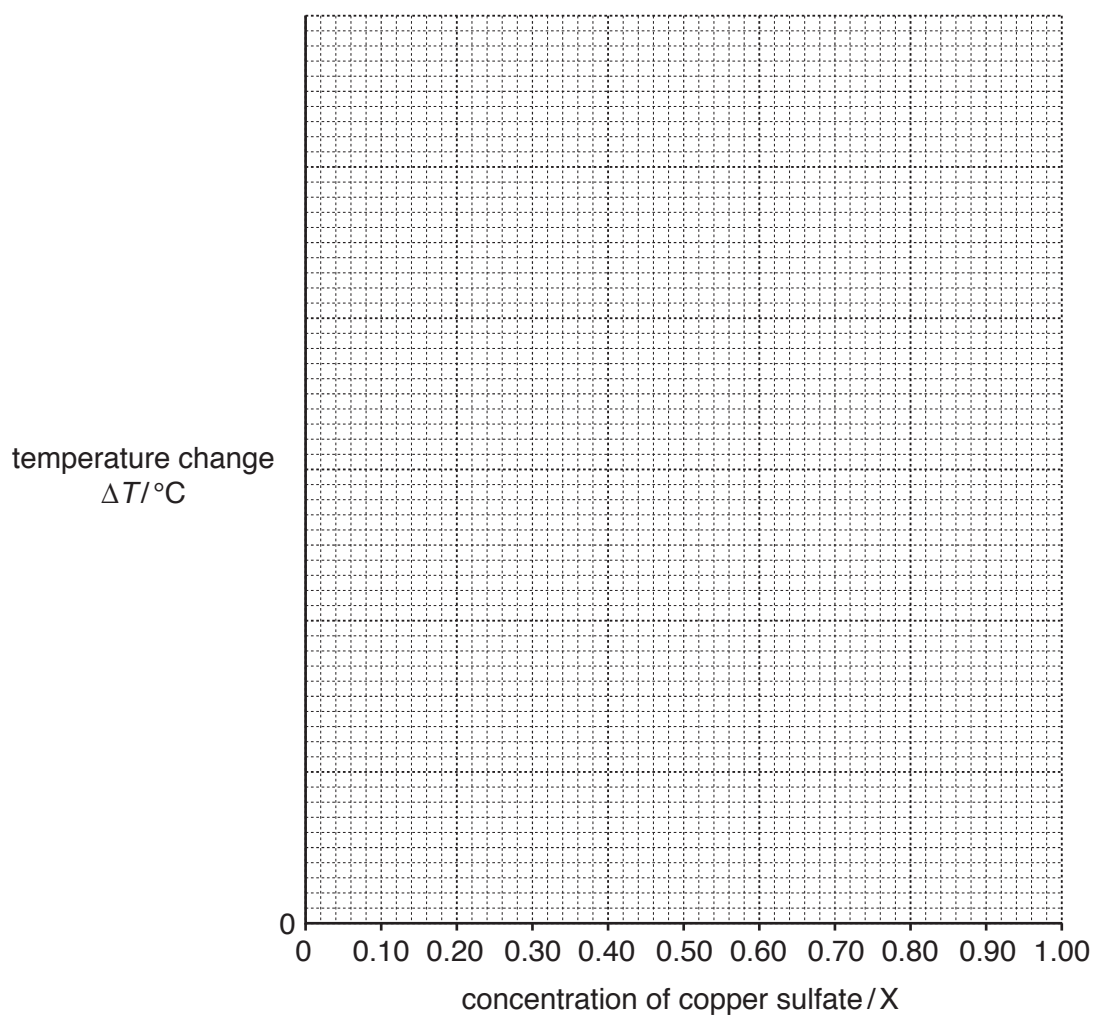
Record these values in the last column of Table 2.1.

[1]

- (ii) Plot a graph of temperature change ΔT against concentration of copper sulfate solution on the grid provided.

Draw the best-fit straight line through the origin.

[3]



- (iii) A student states that the temperature change ΔT for this experiment is directly proportional to the concentration of the copper sulfate solution used.

Suggest whether this statement is supported by the data and justify your answer.

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

- (c) (i) Using the data in Table 2.1, state the name of this type of chemical reaction.

.....[1]

- (ii) Suggest **one** change to this procedure to improve the accuracy of the results.

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

Please turn over for Question 3.

- 3 A student finds the mass of a piece of modelling clay using a balancing method.

She moulds the piece of modelling clay until it is roughly cube-shaped.

She places the modelling clay on a metre rule so that its centre is 15.0 cm from the zero end of the rule, as shown in Fig. 3.1.

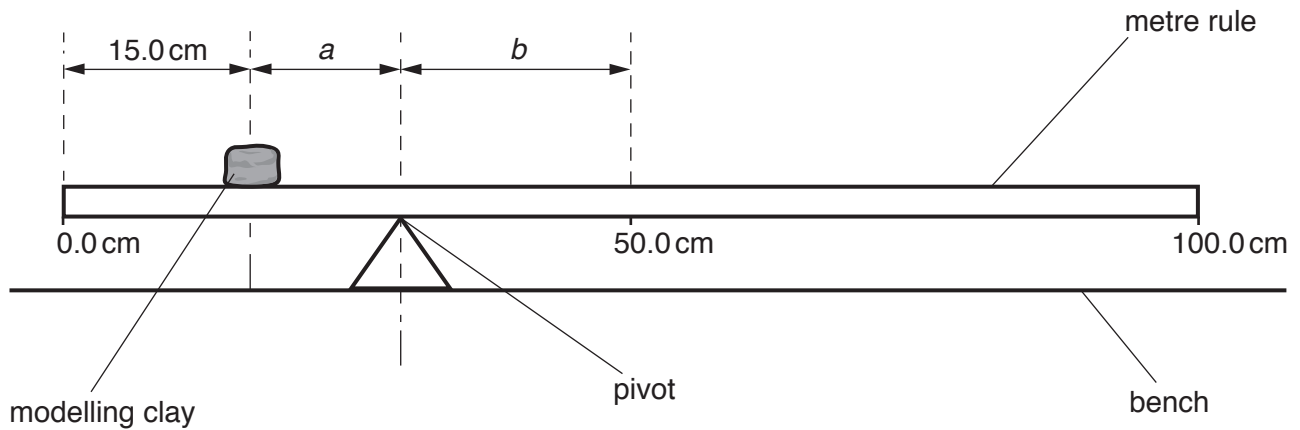


Fig. 3.1 (not to scale)

- (a) Describe how the student ensures that the centre of the modelling clay is directly above the 15.0 cm mark on the rule. You may draw a diagram to help your answer.

.....

.....

.....[1]

- (b) The student adjusts the position of the pivot so that the rule balances on it as shown in Fig. 3.2 (seen from above).

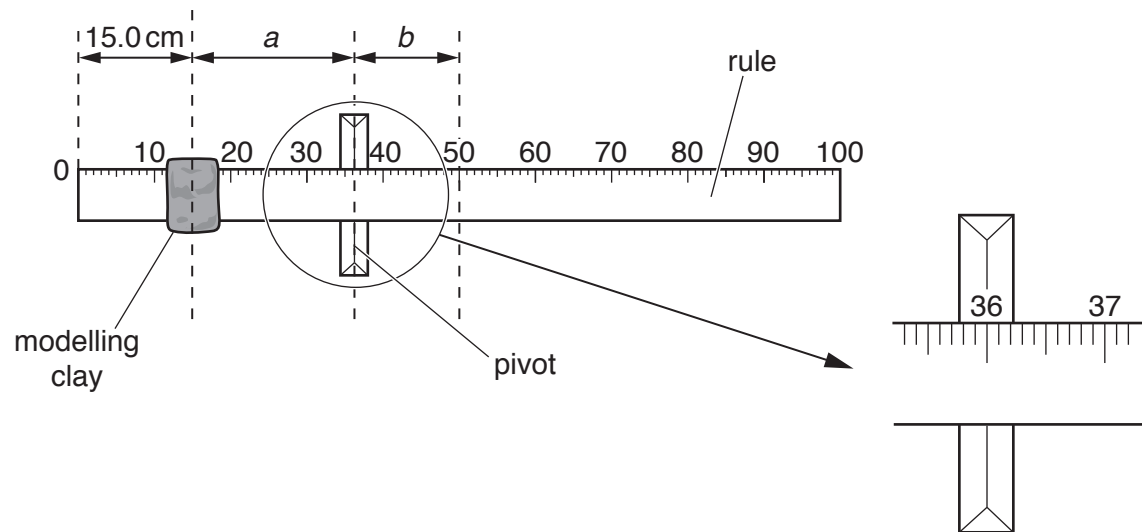


Fig. 3.2

- (i) Record the position of the pivot on the rule to the nearest 0.1 cm.

position of pivot = ... cm [1]

- (ii) Calculate the distance a .

a = ... cm [1]

- (iii) Calculate the distance b .

b = ... cm [1]

- (c) The student then uses a balance to measure the mass M of the metre rule. Fig. 3.3 shows the reading on the balance.



Fig. 3.3

- (i) Write down the mass M of the metre rule to the nearest 0.1 g.

$M =$ g [1]

- (ii) She uses the equation, shown below, to calculate the mass m of the modelling clay.

$$m = M \times \frac{b}{a}$$

Calculate the mass of the modelling clay, giving your answer to an appropriate number of significant figures.

$m =$ g [2]

- (d) Even if the student carried out the experiment very carefully, her value for the mass of the modelling clay will only be approximate.

Suggest **two** reasons, based upon the practical method used, why this might be so. Assume that the balance used to find the mass of the rule is accurate.

1

.....

2

.....

[2]

- (e) The experiment is repeated with a heavier piece of modelling clay. State how the distances a and b will change.

.....

.....[1]

- 4 A student investigates the movement of water molecules through a membrane.

He sets up the apparatus shown in Fig. 4.1.

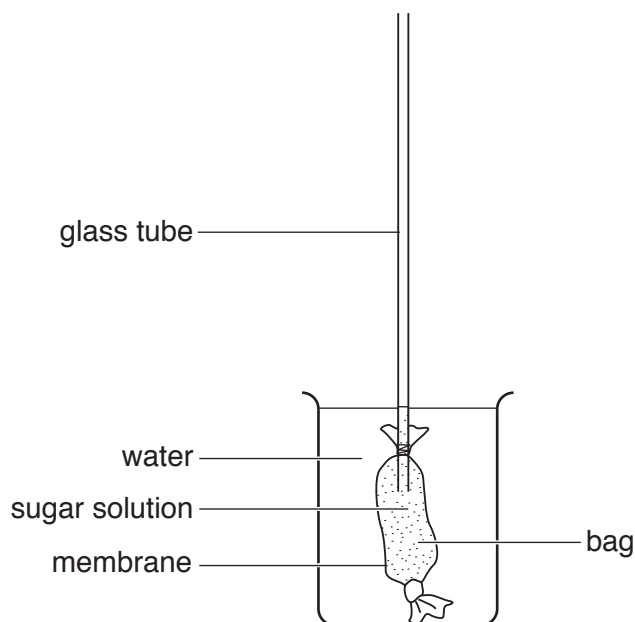


Fig. 4.1

The membrane allows water molecules to pass through it, but sugar molecules are too big to pass through.

The student takes measurements of the level of the sugar solution in the tube.

Fig. 4.2 shows the position of the sugar solution in the glass tube when he took his initial reading.

- (a) (i) Use Fig. 4.2 to read the initial position of the sugar solution in the glass tube and record this to the nearest 0.1 cm.

..... cm [1]

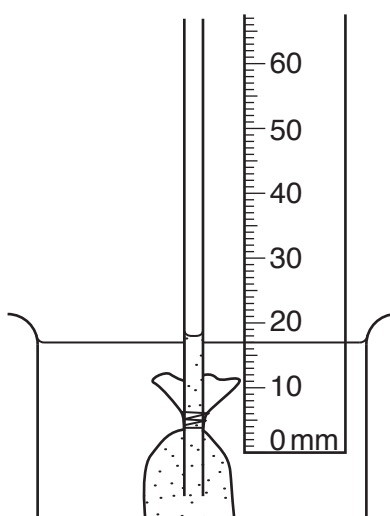


Fig. 4.2

- (ii) The apparatus is left for 2 hours. Fig. 4.3 shows the position of the sugar solution after this time. Use Fig. 4.3 to read the position of the sugar solution in the glass tube and record this to the nearest 0.1 cm.

..... cm [1]

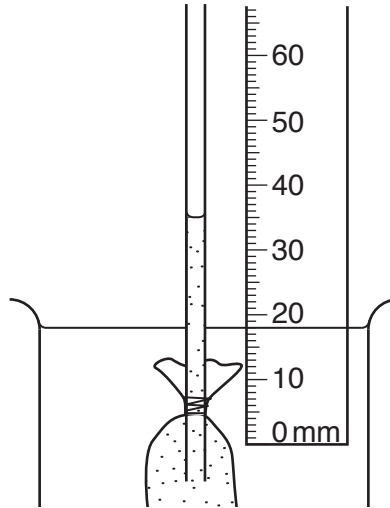


Fig. 4.3

- (b) (i) Use your answers to parts (a)(i) and (a)(ii) to calculate how far the water has moved in the two hours.

..... cm [1]

- (ii) Calculate the average speed of movement of the sugar solution up the glass tube in **mm/hour**.

speed = ... mm/hour [1]

- (iii) Suggest an explanation for the movement of the sugar solution up the tube.

.....
 [1]

- (c) Describe a chemical test to confirm that the sugar molecules have not passed out of the bag into the beaker of water.

sample tested

test procedure

.....

expected observation

[4]

- (d) Predict what would happen if the experiment is set up as in Fig. 4.4 with the water inside the bag and the sugar solution in the beaker.

.....

.....[1]

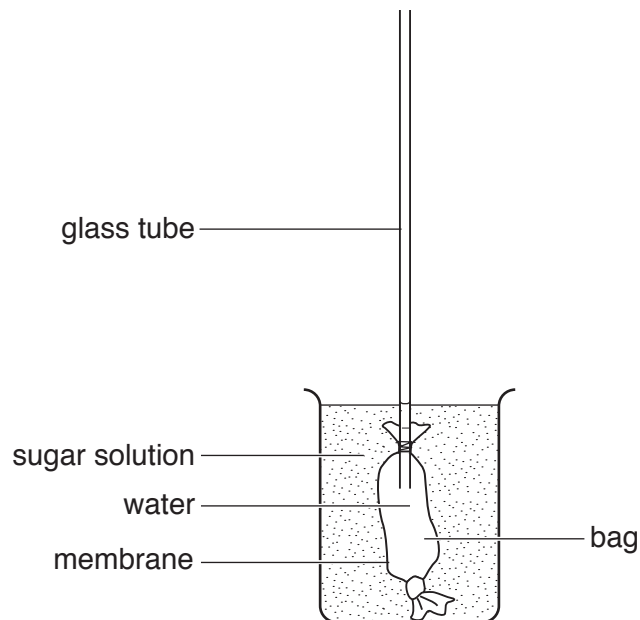


Fig. 4.4

- 5 The teacher gives a student five unlabelled bottles. The bottles contain dilute solutions of the following.

hydrochloric acid
 nitric acid
 sulfuric acid
 ammonia
 sodium hydroxide

(a) Identifying the solutions

The student must identify each solution.

- (i) The student is told that one of the solutions has a pungent smell.

Name the solution.

.....[1]

He carries out the following tests.

- (ii) The student adds barium nitrate solution to 1 cm^3 of each of the solutions and correctly identifies the bottle containing sulfuric acid.

State the observation that enables him to identify the sulfuric acid.

.....
[1]

- (iii) The student uses a chemical test to identify the hydrochloric acid.

Suggest the test that he uses and the observation that he makes.

test

observation

.....[2]

- (iv) The student puts 1 cm^3 of copper(II) sulfate solution into a test-tube. He then adds one of the remaining solutions drop by drop until it is in excess.

State the observation that proves that this solution is sodium hydroxide.

.....
[1]

(b) Making a salt

The teacher asks the student to prepare a solid sample of the salt, sodium chloride, from the hydrochloric acid and sodium hydroxide solutions.

- The student measures out 25cm^3 of hydrochloric acid and adds two drops of an indicator.
- He adds sodium hydroxide solution until the mixture is neutral.
- He records the volume of sodium hydroxide solution used as 18cm^3 .
- He washes out the glassware.
- He now adds 18cm^3 of sodium hydroxide solution to 25cm^3 of hydrochloric acid without any indicator.
- From this mixture the student obtains a solid sample of sodium chloride.

- (i) Name a piece of apparatus that the student can use to accurately measure 25cm^3 of hydrochloric acid.

.....[1]

- (ii) Suggest the name of an indicator that he can use and the colour change that takes place when the acid is neutralised.

name of indicator

colour change, from to
[2]

- (iii) Explain why the student repeated the reaction without the indicator.

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

- (iv) State how the student obtains the sample of solid sodium chloride from the reaction mixture.

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

6 A student is comparing the conduction of heat through two different materials. He has two containers labelled **F** and **G**. The containers are made from different materials.

- The student places 200cm^3 of water at about 85°C in container **F**.
- He allows the contents of container **F** to cool to 80°C .
- He places 400cm^3 of water at exactly 20°C in a large beaker.
- When the temperature of the water in container **F** is 80°C , he puts the container into the large beaker as shown in Fig. 6.1.

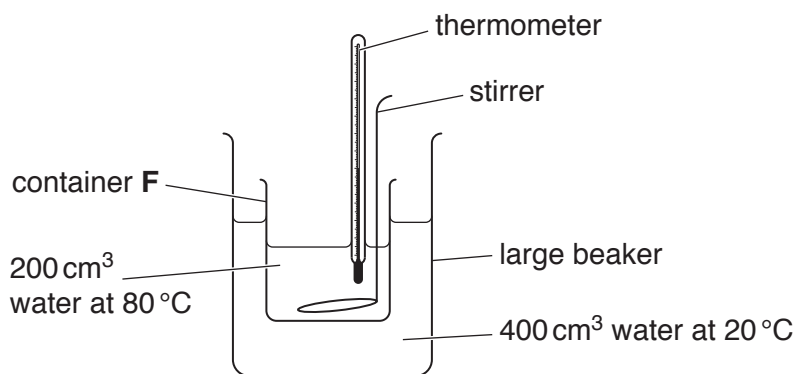


Fig. 6.1

- He immediately starts a stopwatch.
- Every 30 seconds he measures and records the temperature of the water in container **F**.
- He repeats this procedure using container **G**.
- Some of his results are shown in Table 6.1.

Table 6.1

	time / s						
	0	30	60	90	120	150	180
temperature in F / $^\circ\text{C}$	80	71		59	54	51	49
temperature in G / $^\circ\text{C}$	80	64	55		45	42	40

(a) Fig. 6.2 shows the thermometer readings for the temperatures missing from Table 6.1. Read the thermometer scales to the nearest 1°C and record these readings in Table 6.1. [2]

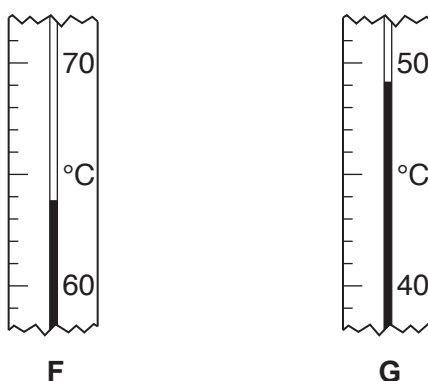


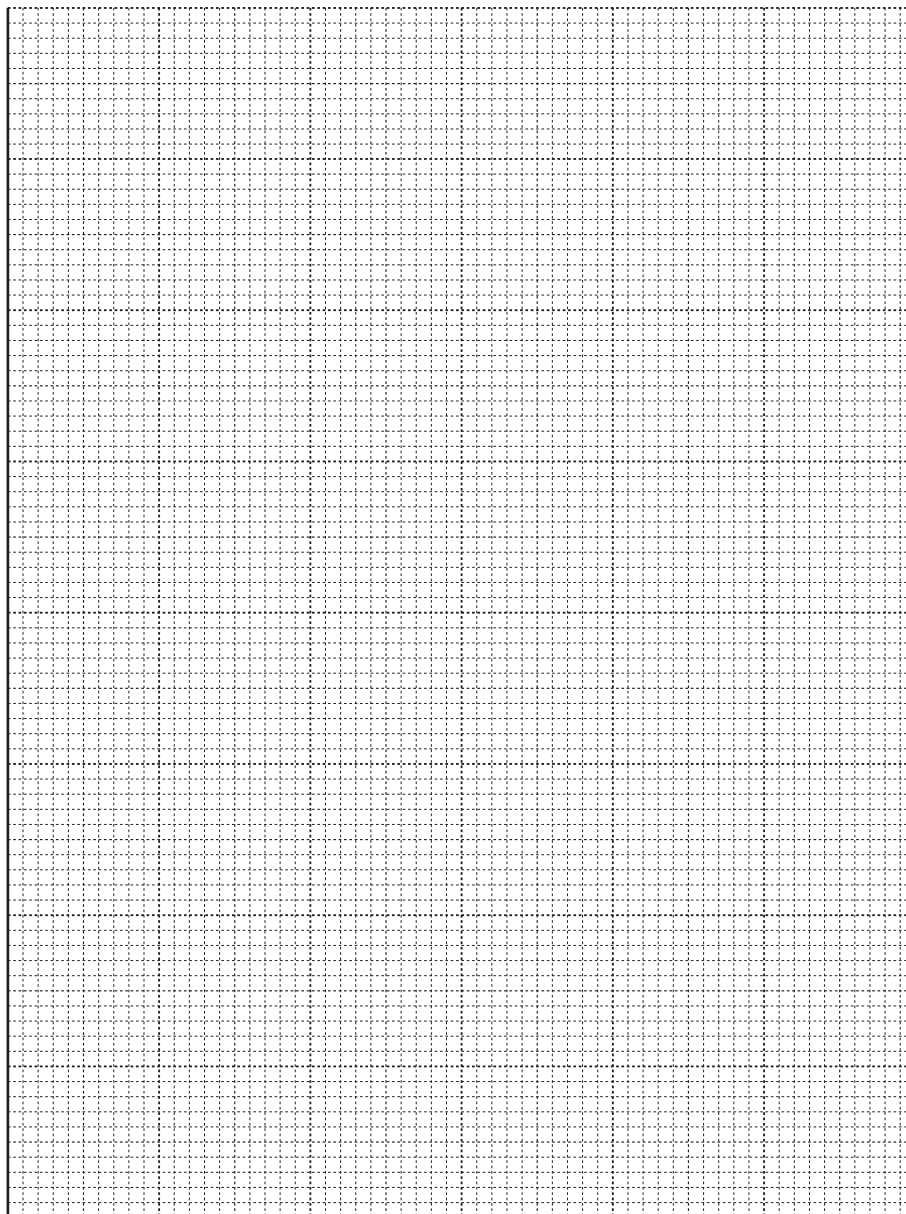
Fig. 6.2

- (b) Plot graphs of the temperatures (vertical axis) in containers **F** and **G** against time (horizontal axis) on the grid provided.

The temperature axis does not need to start at zero.

Draw a best-fit curve for each container.

[4]



- (c) (i) State which container, **F** or **G**, is made of a material that is the better conductor of heat. Explain your answer.

container

reason

[1]

- (ii) Use your knowledge of the conduction of heat to suggest possible materials from which containers **F** and **G** are made.

container **F**

container **G** [2]

- (d) Immediately after the final temperature reading in container **G**, the student measures the temperature of the water in the large beaker.

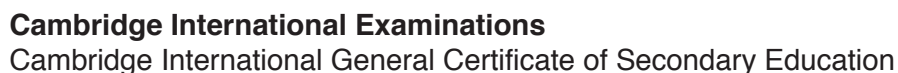
Suggest a value for this temperature.

..... °C [1]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.



--

--	--	--	--	--

--	--	--	--

0653/63

October/November 2016

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 nutrient content of soft cheese and tomatoes. He has access to three testing solutions.

Benedict's solution
 biuret solution
 iodine solution

He adds a small amount of distilled water to some soft cheese and stirs it with a stirring rod so that it loosens and can be poured.

He pours the cheese into each of three test-tubes and tests them for the nutrients shown in Table 1.1.

- (a) Complete Table 1.1 to show which solution he uses for each test and whether or not he needs to use heat for the test.

Table 1.1

nutrient tested for	testing solution	is heat required? (yes/no)
protein		
reducing sugar		
starch		

[3]

- (b) He obtains a positive result with the protein test only.

Complete Table 1.2 to show his observations.

Table 1.2

testing solution used	initial colour	colour after test
Benedict's	blue	
biuret	blue	
iodine	brown	

[2]

- (c) He chops the tomato flesh into small pieces and adds some to each of three clean test-tubes. He tests the tomato for the nutrients shown in Table 1.1.

He obtains positive results for starch and reducing sugar.

Complete Table 1.3 to show his observations.

Table 1.3

testing solution used	initial colour	colour after test
Benedict's	blue	
biuret	blue	
iodine	brown	

[2]

- (d) Plan an investigation to compare the reducing sugar content of lemon juice and lemonade (lemon soda). In your answer you should suggest the observations that would enable you to state which has the higher concentration of reducing sugar.

.....

.....

.....

.....

.....

.....[3]

BLANK PAGE

- 2 A student investigates how the concentration of hydrochloric acid affects the speed of reaction between calcium carbonate and hydrochloric acid.

She is provided with marble chips (calcium carbonate) and solutions of hydrochloric acid of concentration, 1.00 Q, 0.75 Q and 0.50 Q, where Q is a unit of concentration.

- (a)
- She places limewater in a test-tube.
 - She places a delivery tube in the limewater.
 - She places hydrochloric acid of concentration 1.00 Q in another test-tube.
 - She adds ten marble chips to the acid in the test-tube and starts a stopclock.
 - She quickly attaches the bung of the delivery tube so that the gas produced passes into the limewater as shown in Fig. 2.1.

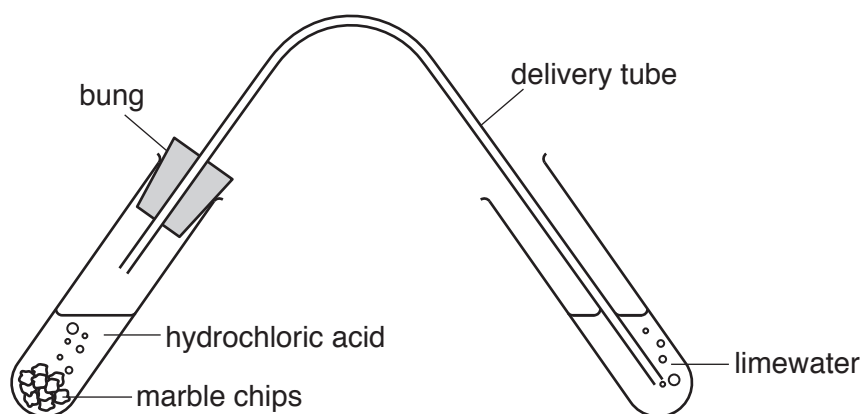
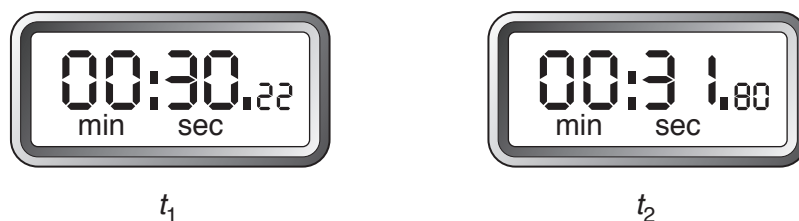


Fig. 2.1

- She stops the stopclock at the first appearance of a white precipitate in the limewater.
- She records in Table 2.1 this time t_1 to the nearest second for concentration 1.00 Q.
- She repeats the procedure above and records in Table 2.1 the time t_2 to the nearest second for concentration 1.00 Q.

The stopclock readings of t_1 and t_2 for concentration 1.00 Q are shown in Fig. 2.2. Read the stopclocks to the nearest second and record the values in Table 2.1 on page 6. [2]



readings for hydrochloric acid of concentration 1.00 Q

Fig. 2.2

Table 2.1

concentration of hydrochloric acid/Q	time t_1 for white ppt. to appear/s	time t_2 for white ppt. to appear/s	average time t_a for white ppt. to appear/s	speed of reaction, $\frac{1}{t_a}$
1.00				
0.75	49	57	53	
0.50	82	86	84	

- (b) She repeats the procedure in (a), firstly using hydrochloric acid of concentration 0.75 Q and then using concentration 0.50 Q.

The results of these experiments are shown in Table 2.1.

- (i) Calculate the average time t_a for the concentration of 1.00 Q and record the value in Table 2.1.

[1]

- (ii) For each concentration of hydrochloric acid calculate $\frac{1}{t_a}$.
 $\frac{1}{t_a}$ is a measure of the speed of reaction.

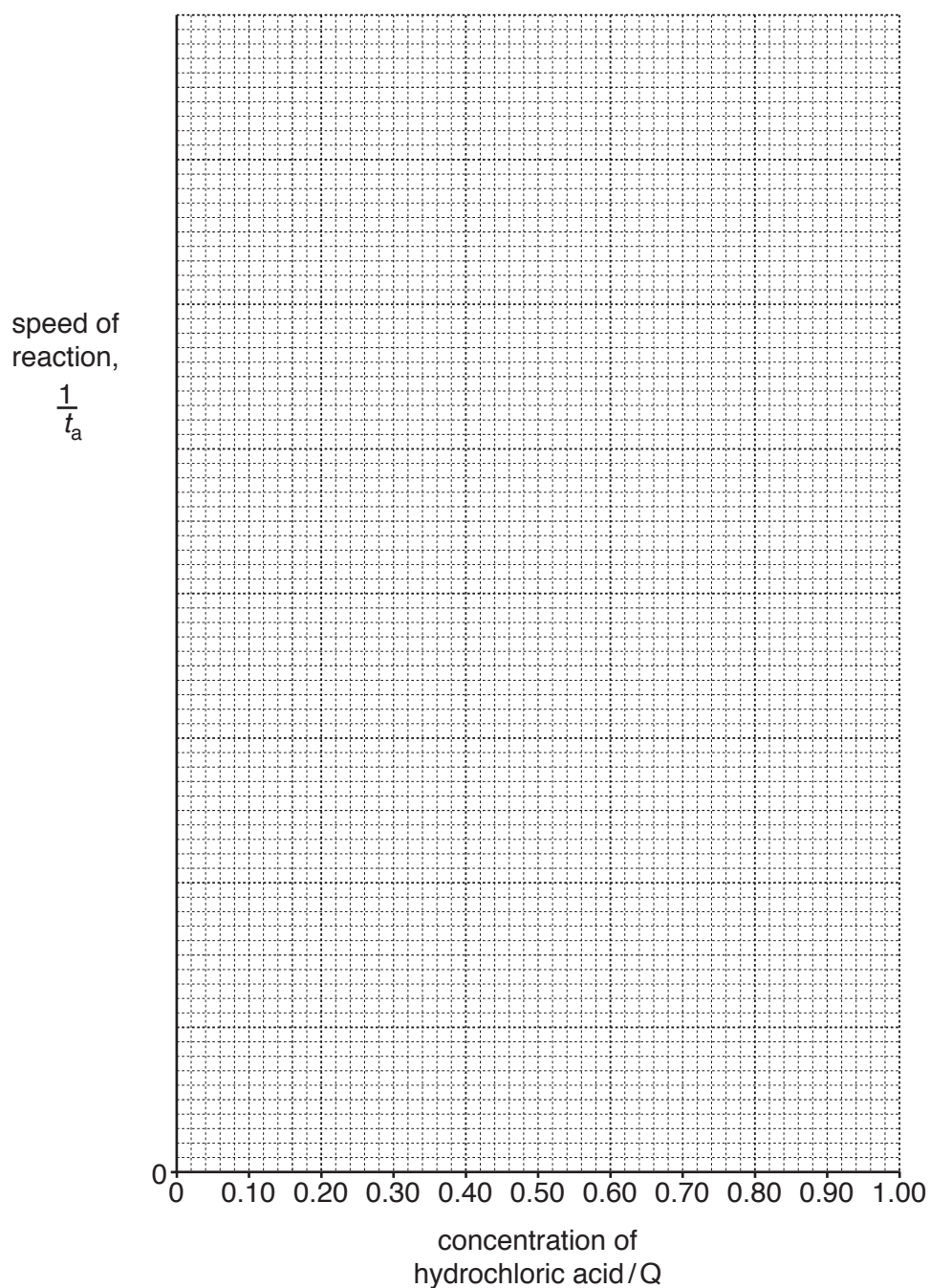
Record in Table 2.1 the values **to three decimal places**.

[1]

- (c) (i) On the grid provided, plot a graph of the speed of reaction against the concentration of hydrochloric acid used.

Draw the most appropriate straight line or curve **through the origin**.

[3]



- (ii) Using your graph state the relationship between the speed of the reaction and the concentration of hydrochloric acid.

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

- (d) The student considers the results in Table 2.1. She is unhappy about the results for one of the concentrations of hydrochloric acid.

Suggest which concentration and state why the times are less satisfactory than the other results.

concentration

reason

.....
[1]

- (e) Explain why it is important to replace the marble chips for each different experiment.

.....

.....[1]

- 3 A student investigates the total resistance of different combinations of identical resistors. She sets up the circuit shown in Fig. 3.1.

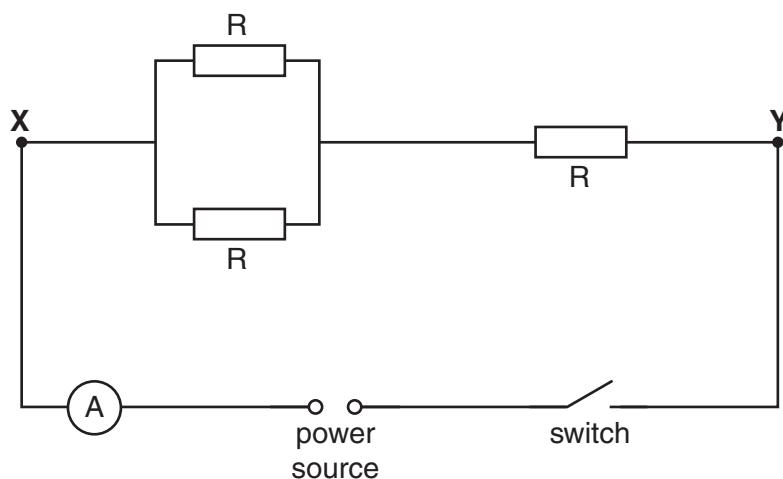


Fig. 3.1

- (a) She switches on the circuit by closing the switch and measures the potential difference V between **X** and **Y** and then switches off by opening the switch.
- (i) Complete Fig. 3.1, to show how the voltmeter is connected to measure the potential difference V . [2]
- (ii) Fig. 3.2 shows the voltmeter reading.

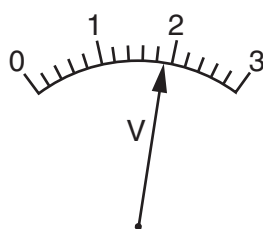


Fig. 3.2

Record the voltmeter reading V .

$V = \dots\dots\dots$ V [1]

- (iii) The student closes the switch, records the current I shown on the ammeter and then opens the switch. Fig. 3.3 shows the ammeter reading.

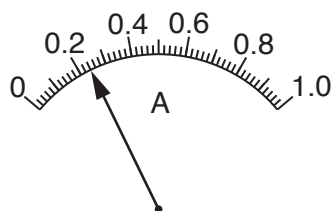


Fig. 3.3

Record the ammeter reading I .

$I = \dots\dots\dots$ A [1]

- (iv) Calculate the total resistance R_T of the combination of the three resistors in Fig. 3.1 using the equation:

$$R_T = \frac{V}{I}$$

Include the unit of resistance in your answer.

$R_T = \dots\dots\dots$ unit = $\dots\dots\dots$ [2]

- (b) The student disconnects the resistors from the circuit and reconnects the resistors in the circuit so that all three resistors are in series between points **X** and **Y** as shown in Fig. 3.4.

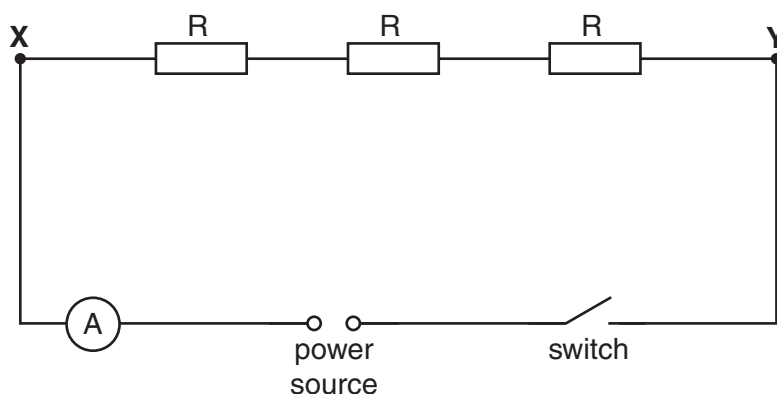


Fig. 3.4

She closes the switch and measures the potential difference V_S between **X** and **Y** and the current I_S . Her readings are shown in Table 3.1 on page 11.

Table 3.1

potential difference V_S/V	current I_S/A
1.8	0.12

Calculate the total resistance R_S of the series combination of the three resistors using the equation:

$$R_S = \frac{V_S}{I_S}$$

$$R_S = \dots\dots\dots[1]$$

- (c) Theory suggests that because the resistors are identical:

$$R_T = 0.5 R_S$$

State whether the student's results support the theory and justify your statement by reference to the results.

statement

justification

.....[1]

- (d) Explain why it is important to switch the circuit off between taking readings.

.....

.....[1]

- (e) Predict **how** the reading on the ammeter **changes** if the three resistors in Fig. 3.4 are replaced by just one of the resistors connected between **X** and **Y**. Assume that the potential difference between **X** and **Y** stays the same.

.....

.....[1]

4 A student investigates gas exchange in animals and plants.

She uses a bicarbonate indicator to detect changes in the concentration of carbon dioxide. The chart in Fig. 4.1 shows the colour of the indicator for different concentrations of carbon dioxide.

	concentration of carbon dioxide		
	low	medium	high
colour of bicarbonate indicator	purple	red	yellow

Fig. 4.1

- The student sets up four test-tubes as shown in Fig. 4.2.

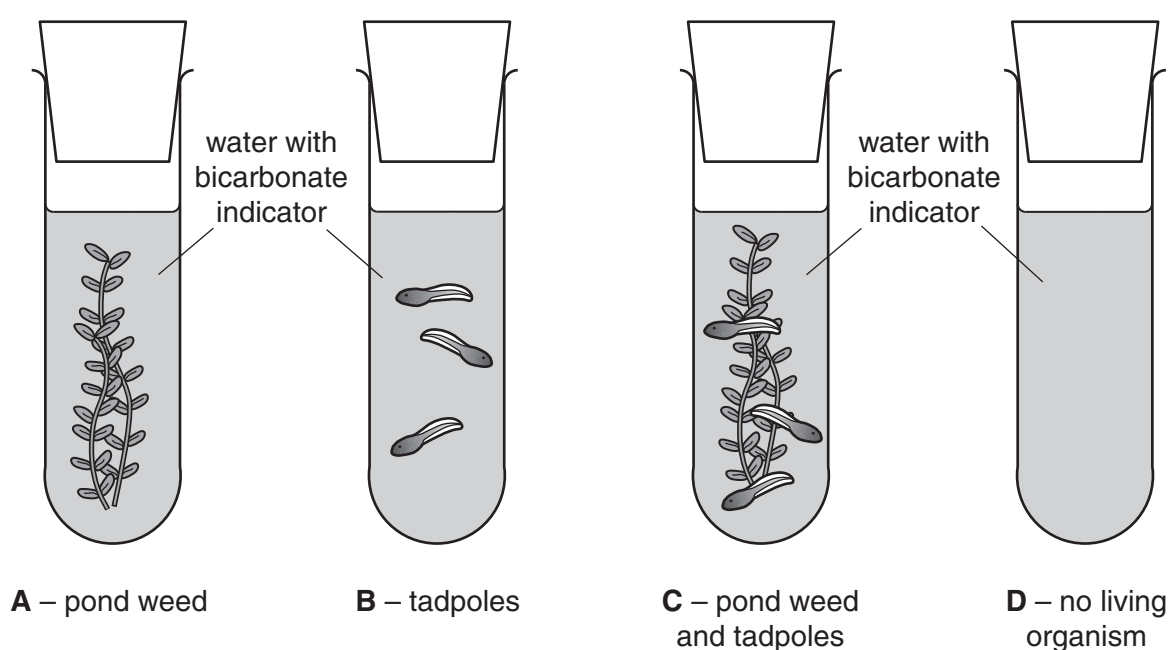


Fig. 4.2

- She places the test-tubes in the light.
- She returns 2 hours later and records her observations in Table 4.1.

Table 4.1

test-tube	initial colour	final colour	change in carbon dioxide concentration (increase / decrease / no change)
A	red	purple	
B	red	yellow	
C	red	red	no change
D	red	red	

- (a) Fill in the last column of Table 4.1 to show what happened to the carbon dioxide concentrations after 2 hours. [1]

- (b) (i) Explain why the concentration of carbon dioxide changes in test-tube **A**.

.....
[1]

- (ii) Explain why the concentration of carbon dioxide changes in test-tube **B**.

.....
[1]

- (iii) Suggest why the concentration of carbon dioxide remains the same in test-tube **C**.

.....
[1]

- (c) Explain the purpose of test-tube **D**.

.....
[1]

- (d) (i) The student keeps the four test-tubes at the same temperature.

State how this can be done and suggest a suitable temperature.

method

temperature

[2]

- (ii) Suggest **three** other factors that the student needs to keep constant when setting up this experiment.

1

2

3

[3]

5 The science class are investigating the properties of three oxides **J**, **K** and **L**.

J is a solid, **K** is a liquid and **L** is a gas. Fig. 5.1 shows the apparatus.

The teacher has not told the students the names of the oxides.

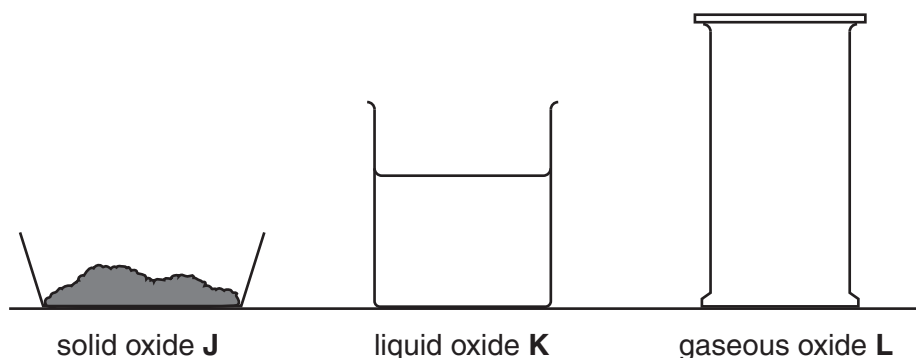
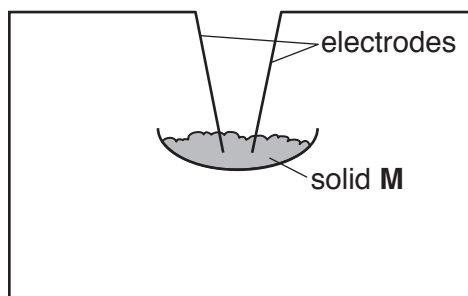


Fig. 5.1

(a) A student experiments with these three oxides. Oxide **J** is a black solid.

- He thinks that oxide **J** contains oxygen combined with a metal.
- He mixes the oxide with powdered charcoal and strongly heats the mixture in a crucible.
- The oxide turns from black to a brown-pink coloured solid **M**.
- The student is testing the brown-pink solid to see if it will conduct electricity.
- He has started to draw a circuit diagram as shown in Fig. 5.2.

(i) Complete Fig. 5.2 by adding **two** electrical (circuit) symbols for components that will allow the student to show that solid **M** conducts electricity.



[2]

Fig. 5.2

(ii) State the name of solid oxide **J**.

name[1]

(b) A student sets up apparatus to measure the boiling point of oxide **K**.

When heated, oxide **K** boils. The student wants the vapour to pass into the condenser.

Fig. 5.3 shows part of the apparatus he sets up.

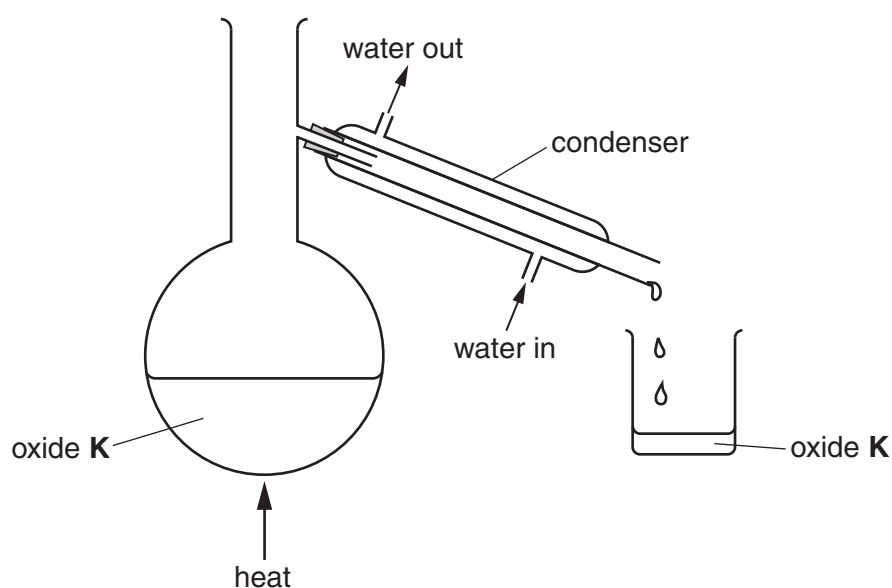


Fig. 5.3

- (i) Complete Fig. 5.3 including a thermometer. Draw the bulb of the thermometer in the correct place so that the accurate boiling point of the liquid will be shown on the scale. [2]

- (ii) Fig. 5.4 shows the thermometer scale when oxide **K** is boiling.

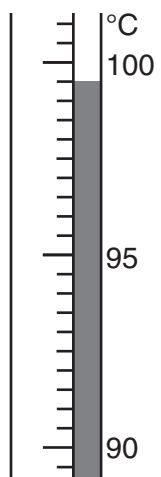


Fig. 5.4

Read the scale and record the boiling point of the oxide **K**.

boiling point = ...°C [1]

- (iii) The student concludes that oxide **K** is water. Another student says that it cannot be water because water boils at 100 °C.

Suggest how the student can justify his conclusion that the oxide **K** is water.

.....
[1]

- (c) A student adds some limewater to a gas-jar of oxide **L** and replaces the lid. He shakes the gas-jar and the limewater turns milky.

State the name of oxide **L**.

name [1]

- (d) The procedure used in (a) does not work for all metal oxides. An alternative procedure is to react the solid oxide with nitric acid to produce metal ions in solution.

State how a student can identify the metal ion in the solution produced from solid **M**. In your answer include the testing reagent and how the metal ion may be identified from the observations.

.....

[2]

Please turn over for Question 6.

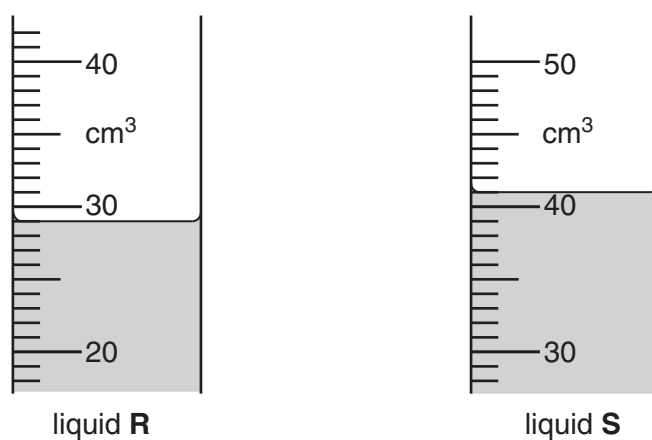
6 A student is given three liquids labelled **R**, **S** and **T**.

The student has a mass balance, a 50 cm³ measuring cylinder and samples of the three liquids.

- She places the measuring cylinder on the balance and weighs it. She records the mass in Table 6.1.
- She adds liquid **R** to the measuring cylinder until the total mass is approximately 60 g. She records the actual mass in Table 6.1.
- She measures the volume of liquid **R**.
- She repeats the procedure using samples of the other two liquids with the same measuring cylinder.

(a) (i) Fig. 6.1 shows the measuring cylinders for liquids **R** and **S**.

Read the volumes to the nearest 0.5 cm³ and record the values in Table 6.1.



[2]

Fig. 6.1

Table 6.1

	liquid		
	R	S	T
mass of measuring cylinder + liquid/g	60.1	59.9	60.0
mass of measuring cylinder/g	25.5	25.5	25.5
mass of liquid/g	34.6	34.4	34.5
volume of liquid in measuring cylinder/cm ³			34.5
density of liquid / g per cm ³			1.0

- (ii) Explain how the student makes sure that her readings from the measuring cylinder are as accurate as possible. You may draw a diagram to help your explanation.

.....
[1]

- (b) Use the data in Table 6.1 and the formula below to calculate the densities of liquids **R** and **S**.

Record the densities in Table 6.1 to **one decimal place**.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2]

- (c) (i) Name a piece of apparatus that the student could use to add the last few drops of liquid to the measuring cylinder so that the total mass is close to 60 g.

.....[1]

- (ii) Suggest a reason why the student does not need to make the total mass exactly 60.0 g to calculate density.

.....
[1]

- (iii) The student knows that her results for the densities of the liquids will be slightly inaccurate.

She repeats the experiment two more times, giving three results for the volumes and masses of each liquid.

Suggest how she can use the results of the three experiments to find more reliable values for the densities of the liquids.

.....
[1]

- (d) (i) Liquid **T** is water. Hydrocarbon oils float on water.

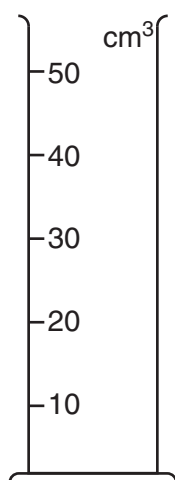
State which of the liquids, **R** or **S**, is a hydrocarbon oil and give a reason for your answer.

liquid because
[1]

- (ii) The third liquid is an aqueous solution of a salt.

The student pours 10 cm^3 of each of the liquids **R**, **S** and **T** into one new measuring cylinder. She stirs the mixture and allows it to settle.

Complete Fig. 6.2 to show what she would observe when the mixture has settled. Label your diagram.



[1]

Fig. 6.2

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.