Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3410U10-1

S17-3410U10-1

CHEMISTRY – Unit 1:
Chemical Substances, Reactions and Essential Resources

FOUNDATION TIER

FRIDAY, 16 JUNE 2017 – MORNING

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**13**	
3.	**7**	
4.	**8**	
5.	**8**	
6.	**6**	
7.	**10**	
8.	**9**	
9.	**11**	
Total	**80**	

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01

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

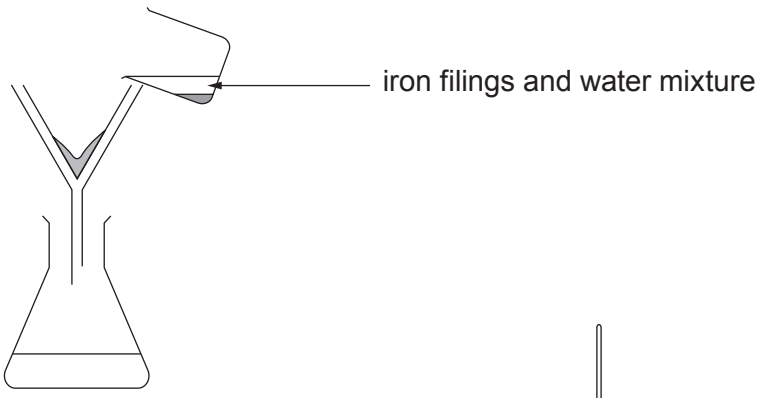
Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

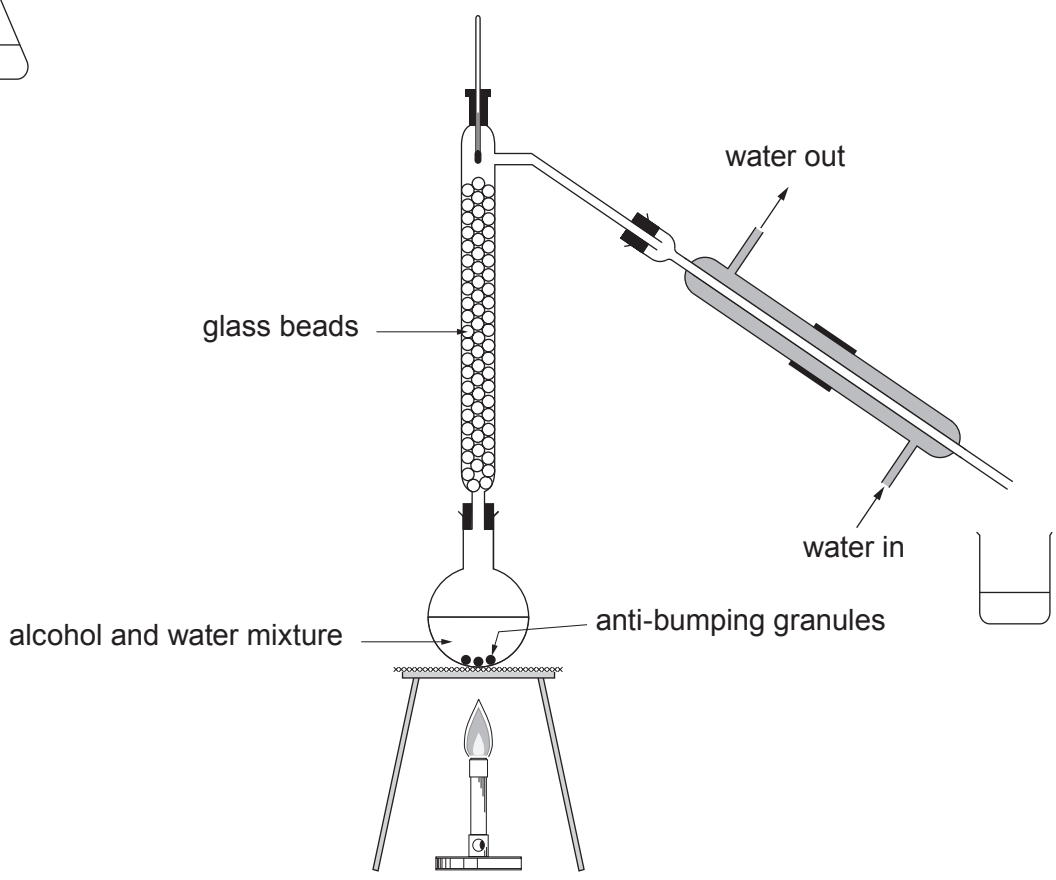
Answer **all** *questions*.

1. *(a)* The diagrams show three methods used to separate mixtures.

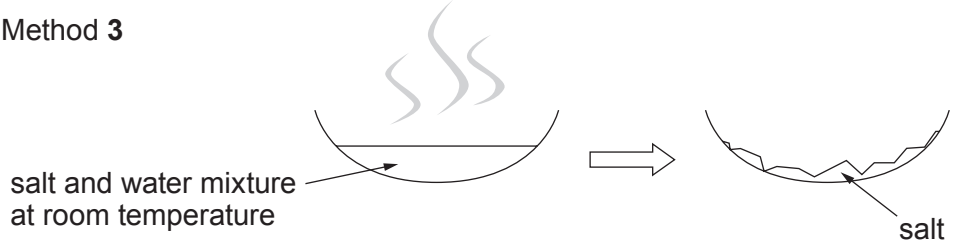
Method **1**



Method **2**



Method **3**



Examiner only

(i) Underline the property of iron filings which allows method **1** to be used to separate the mixture. [1]

magnetic **insoluble in water** **silvery grey colour**

high melting point **more dense than water**

(ii) Tick (✓) the box that shows the reason why method **2** can be used to separate alcohol and water. [1]

alcohol and water both boil when heated ☐

alcohol and water have different boiling points ☐

alcohol and water have the same boiling point ☐

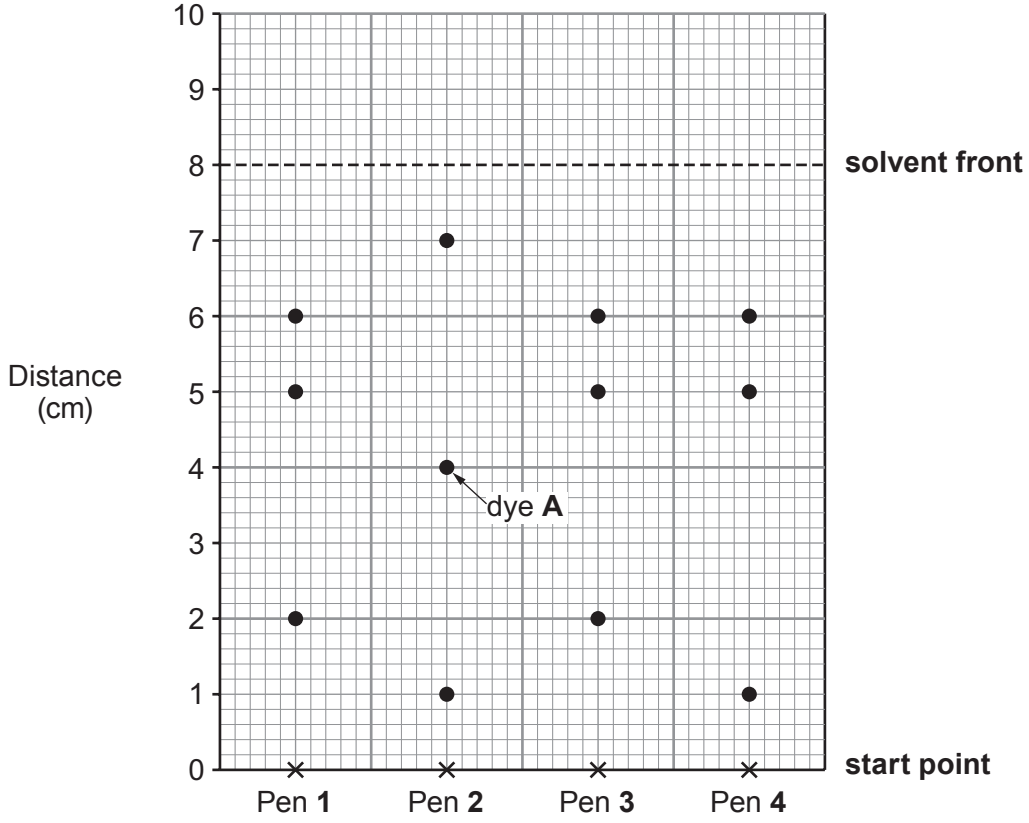
alcohol and water are both liquids ☐

(iii) Name the process of removing water in method **3**. [1]

.....

Examiner only

(b) A group of students were asked to investigate the dyes in four different water soluble blue pens, **1**, **2**, **3** and **4**. The results are shown below.



(i) Which **two** pens contain the same three dyes? [1]

Pens ..... and .....

(ii) Which pen contains the **most** soluble dye? [1]

Pen .....

(iii) The R_f value of a substance can be used to identify that substance.

The R_f value is given by the formula:

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent front}}$$

Calculate the R_f value for dye **A**. [2]

R_f = ...

Examiner only

(iv) The box contains methods for separating mixtures.

distillation	**chromatography**	**filtration**

Complete the sentence using a method from the box.

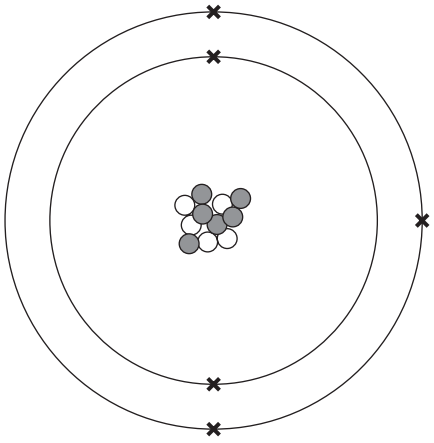
The method used to separate the coloured dyes in the blue pens is called

.....[1]

8

Examiner only

2. *(a)* Atoms contain particles called electrons, protons and neutrons. The diagram shows an atom of boron.



Complete the sentences. [4]

The nucleus of a boron atom contains five ..... and

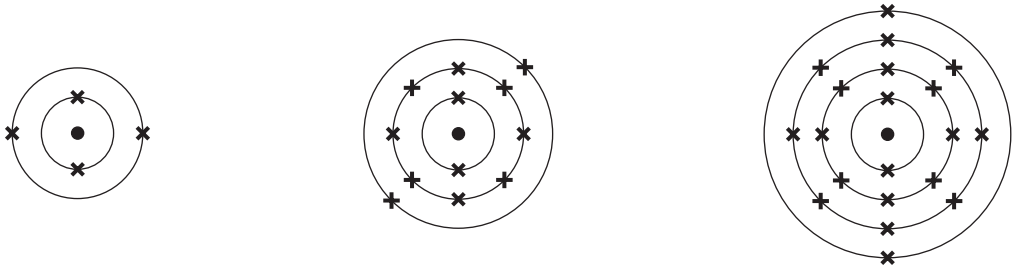
six .....

There are five ..... in the shells around the nucleus.

The particles in the atom which have a positive charge are called

.....

(b) The diagrams show three different atoms labelled **A**, **B** and **C**.
These letters are **not** chemical symbols.



A **B** **C**

Complete the sentences.

(i) Atoms **A**, **B** and **C** can be found in Group ..... [1]

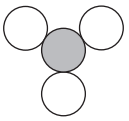
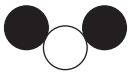
(ii) The atomic number of atom **A** is ..... [1]

(iii) The electronic structure of atom **C** is (2, ...). [1]

(iv) Atom **B** can be found in Period ..... [1]

Examiner only

(c) The following table shows three substances, their formulae and diagrams that can be used to represent them.

Substance	Formula	Diagram
nitrogen trioxide	NO_3	
methane	CH_4	
water	H_2O	

(i) Use the information in the table to work out the key being used to represent the different elements in the diagrams. [2]

 is .....

 is .....

 is .....

 is .....

(ii) **Using the same key** draw a diagram to represent a molecule of carbon dioxide, CO_2. [1]

(d) The chemical formula of phosphoric acid is H_3PO_4.

(i) State how many phosphorus atoms are present in the formula H_3PO_4. ..... [1]

(ii) Give the **total** number of atoms shown in the formula H_3PO_4. ..... [1]

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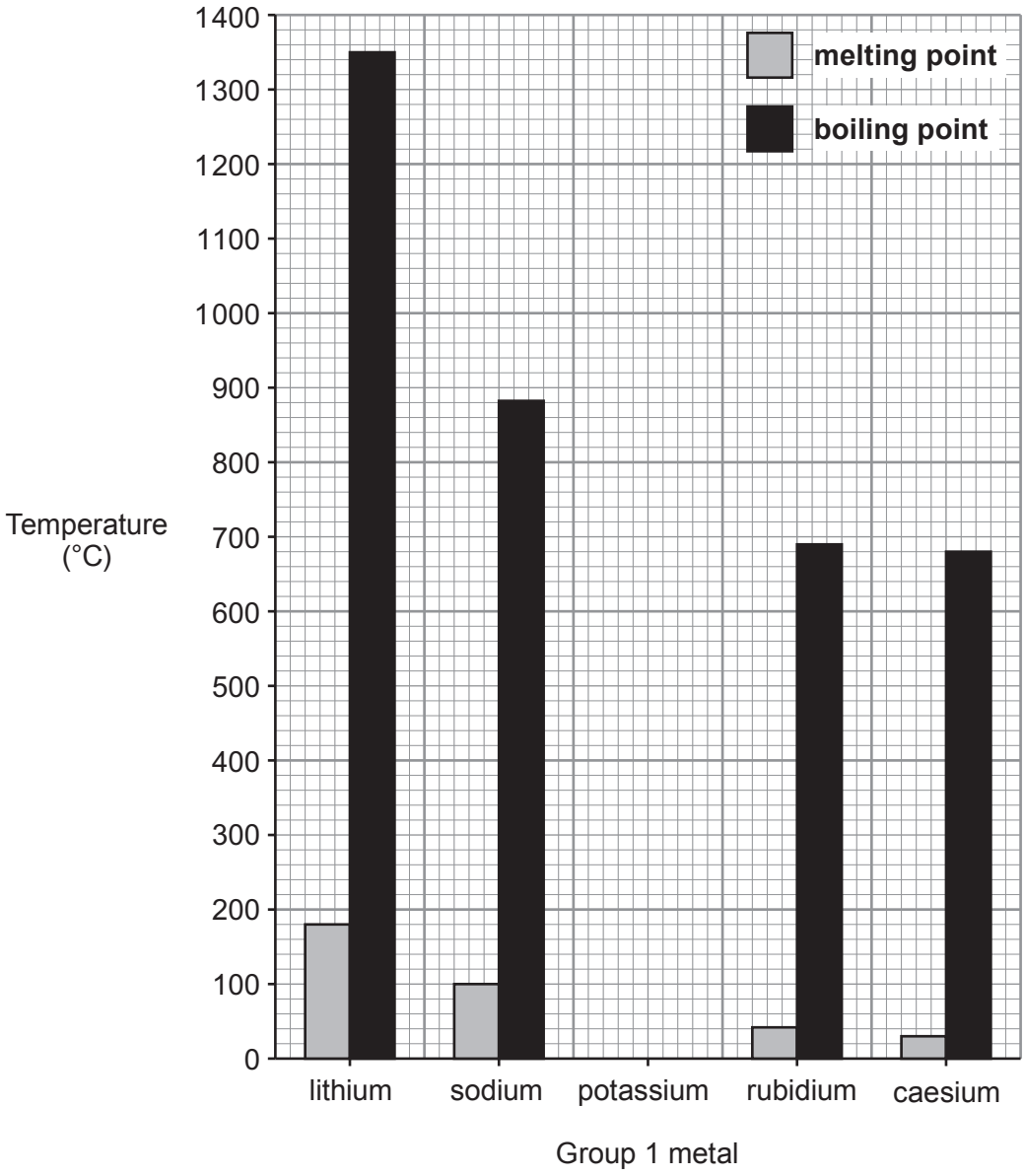
3. *(a)* The chart below shows the melting points and boiling points of some Group 1 metals. The data for potassium is missing.



Tick (✓) the box that shows the melting point and boiling point values for potassium which fit the trends shown in the chart. [1]

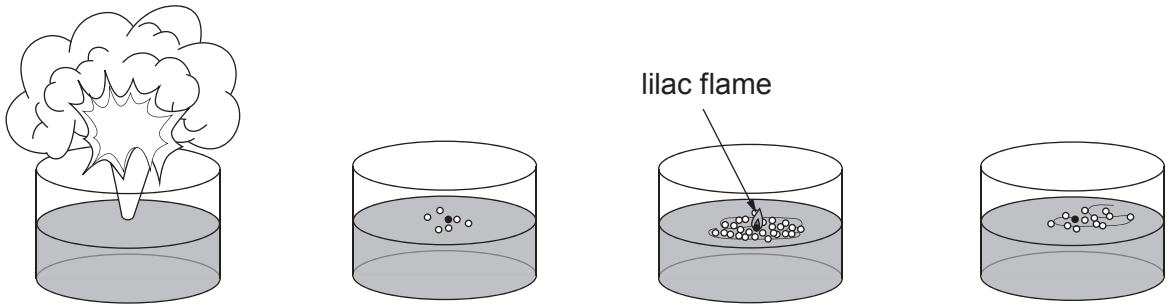
melting point = 40 °C
boiling point = 600 °C ☐

melting point = 60 °C
boiling point = 780 °C ☐

melting point = 20 °C
boiling point = 600 °C ☐

Examiner only

(b) The diagrams show lithium, sodium, potassium and rubidium, **but not necessarily in that order**, reacting separately with cold water.



A

Violent reaction with sparks spitting out of the trough

B

Gentle fizzing

C

Metal ball melts, moves around on the surface and burns

D

Metal ball fizzes and moves around on the surface

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(i) Use the information in the diagrams to give the **letter** which represents: [2]

lithium .....

sodium .....

potassium .....

rubidium .....

(ii) Caesium lies below rubidium in Group 1. Suggest how its reaction with water would be different from those above. [1]

.....

(iii) Describe **one** safety precaution taken when adding a Group 1 metal to water. [1]

.....

Turn over.

Examiner only

(c) Group 1 metals react with oxygen to form metal oxides.

Sodium oxide contains the ions Na^+ and O^{2-}.

Underline the correct formula of sodium oxide. [1]

2NaO **NaO_2** **Na_2O** **Na^2O**

(d) Group 1 metals react with chlorine, Cl_2, to form metal chlorides.

Give the **letter** for the balanced symbol equation for the reaction between sodium and chlorine. [1]

A $Na + Cl \longrightarrow NaCl$

B $2Na + 2Cl \longrightarrow 2NaCl$

C $2Na + Cl_2 \longrightarrow 2NaCl$

D $Na + Cl_2 \longrightarrow NaCl_2$

Letter .....

7

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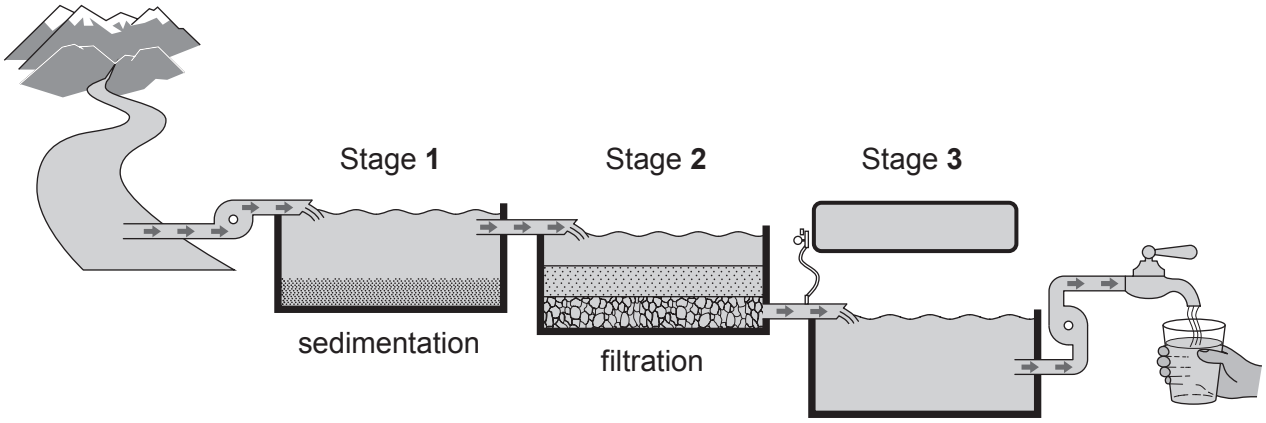
Examiner only

4. *(a)* Most water in Wales is sourced from surface water and ground water. Ground water is the water beneath the surface of the Earth, consisting mainly of surface water that has filtered through the rocks. It is the source of water found in springs and wells. Human activity causes surface water to be more contaminated than ground water.

The diagram below shows the three main stages in the treatment of surface water before it enters the mains water system on its way to the taps in your home.



(i) Tick (✓) the box that describes what occurs in stage **1**. [1]

large insoluble particles sink to the bottom ☐

soluble particles are removed ☐

small fine insoluble particles are removed ☐

fluoride is added to the water ☐

(ii) Stage **3** makes water safe to drink. Name the substance added to water in stage **3**. State why this makes the water safe to drink. [2]

Substance .....

.....

(iii) Describe **one major** cause of surface water pollution. [2]

.....

.....

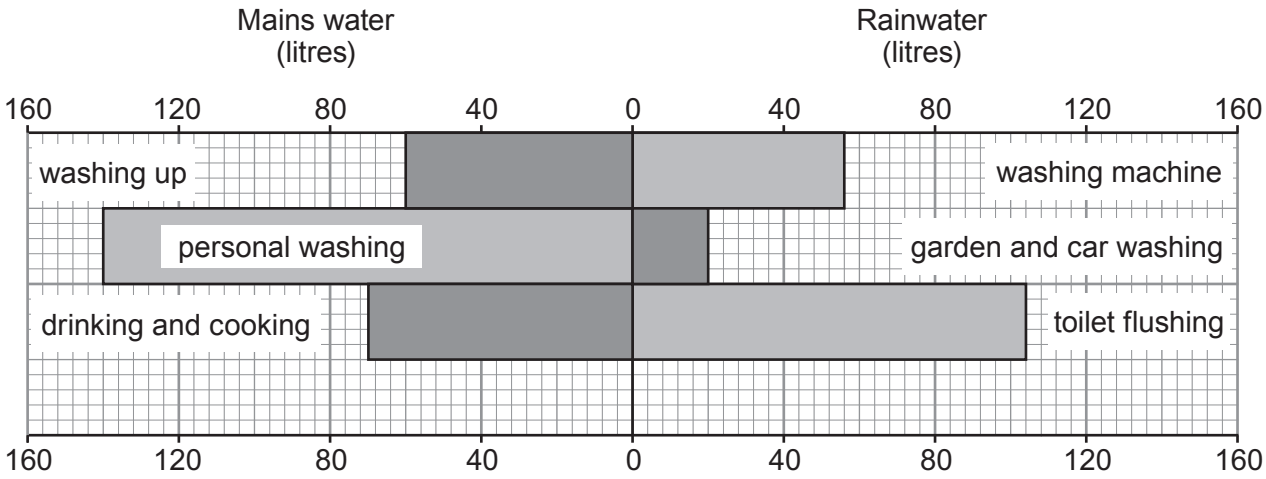
.....

.....

Examiner only

(b) A family uses a water butt to collect rainwater in order to reduce their use of mains water.

They use a total of 450 litres of water on a given day. The chart shows the volumes of mains water and collected rainwater used for various purposes on that day.



(i) What percentage of the total water used on that day is rainwater? [2]

percentage rainwater = ... %

(ii) Suggest why it is safe to use rainwater for the uses shown on the right hand side of the chart. [1]

.....

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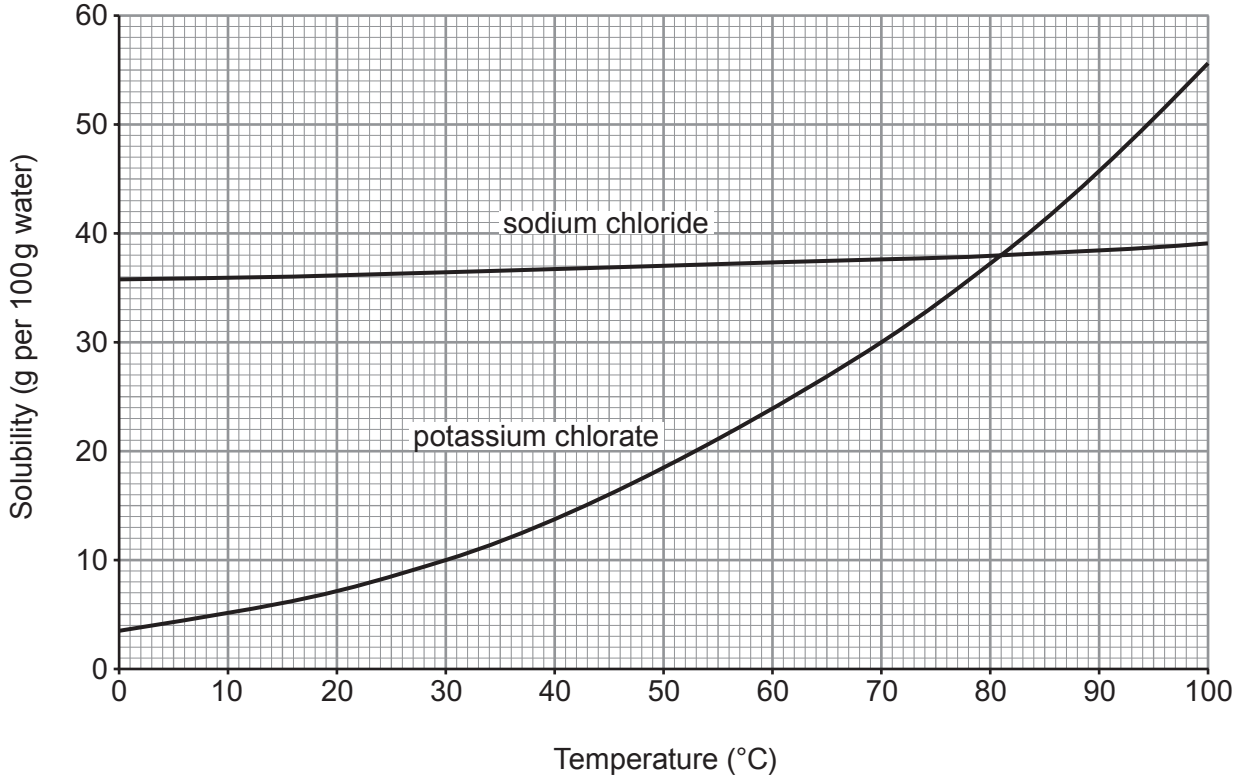
8

Examiner only

5. *(a)* The graphs below show the solubilities of sodium chloride and potassium chlorate in water at different temperatures.



(i) State the temperature at which the two compounds have the same solubility. [1]

..... °C

(ii) Calculate the mass of solid potassium chlorate that forms when a saturated solution in 100 g of water at 70 °C cools to 30 °C. [2]

mass = ... g

Examiner only

(b) (i) Calculate the relative formula mass (M_r) of potassium chlorate, $KClO_3$. [2]

relative formula mass = ...

(ii) Calculate the percentage by mass of potassium in potassium chlorate. [2]

percentage by mass = ... %

(c) Potassium chlorate forms potassium chloride and oxygen on heating.

Balance the symbol equation that represents the reaction taking place. [1]

$2KClO_3 \longrightarrow$ ☐ KCl + ☐ O_2

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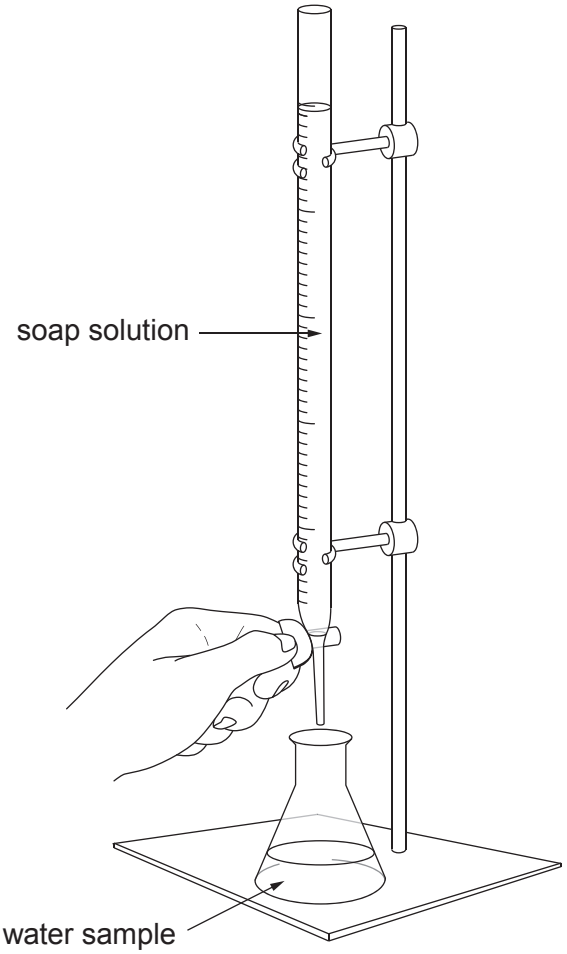
6. Olivia investigated the relative hardness of three samples of water, **A**, **B** and **C**.



She added soap solution to each sample separately and recorded the volume of soap solution needed to get a permanent lather. Her results are shown in the table.

Water sample	Volume of soap solution needed to get a permanent lather (cm^3)
A	1.0
B	14.0
C	11.0

Examiner only

Describe how you would repeat this investigation, including enough detail to show that you will be carrying out a fair test. Assuming that you get similar results to Olivia, state and explain the conclusion you would reach. [6 QER]

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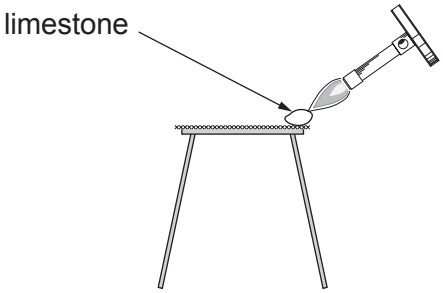
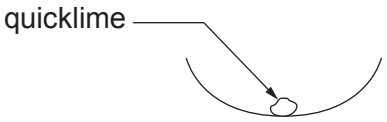
7. The flow chart shows the stages a student carried out to change calcium carbonate (limestone) into calcium hydroxide solution (limewater).

Stage 1



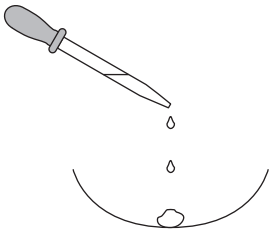
Limestone is roasted for 15 minutes to make quicklime

Stage 2



Quicklime is cooled for 20 minutes

Stage 3

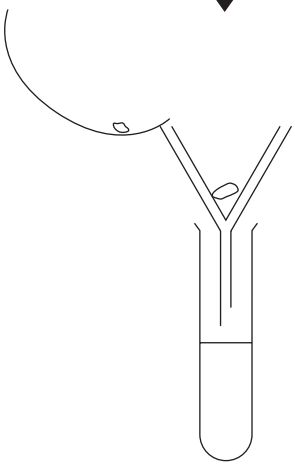


A few drops of water are added to the cold quicklime to make slaked lime

Stage 4

Excess water is added to the slaked lime to make limewater

Stage 5



Limewater is filtered

Examiner only

(a) Use the information in the flow chart to answer parts (i) to (iii).

(i) Name the type of reaction taking place in stage **1**. [1]

.....

(ii) Give the **number** of the stage which shows an exothermic reaction. [1]

.....

(iii) I. Describe what you would expect to **see** happen in stage **3**. [2]

.....

.....

.....

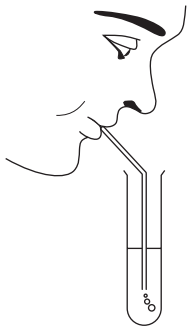
II. The reaction taking place in stage **3** is shown by the following word equation.

calcium oxide + water ⟶ calcium hydroxide

Write a balanced **symbol** equation for this reaction. [2]

..... + ... ⟶ .....

(b) The student blew gently through a straw placed in a test tube containing limewater.



Describe what you would expect to happen to the limewater. Give a reason for your answer. [2]

Observation .....

Reason .....

Examiner only

(c) Quicklime is manufactured from limestone in a lime kiln. A manufacturer expected to obtain 5.6 tonnes per 10 tonnes of limestone used. The actual mass of quicklime produced was 5.1 tonnes.

Calculate the percentage yield of quicklime for this manufacturing process. [2]

percentage yield = ... %

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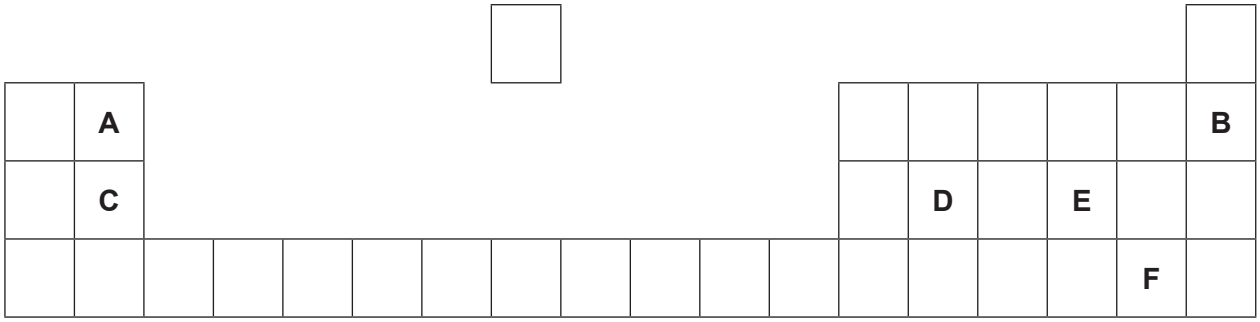
Examiner only

8. *(a)* The following diagram shows an outline of part of the Periodic Table.

The letters shown are NOT the chemical symbols of the elements.



Choose **letters** from the diagram to complete the table below. [5]

	Letter(s)
Two elements in the same group	..... and .....
The element which has 12 protons in its nucleus	.....
The element with a full outer shell of electrons	.....
The element in Group 2 and Period 2	.....
The element with the electronic structure 2,8,4	.....

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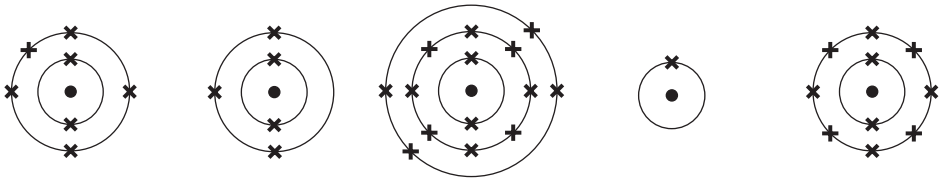
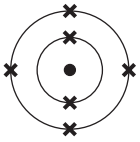
(b) Diagrams **1**-**5** show the electronic structure of five elements in the Periodic Table.



1 **2** **3** **4** **5**

Give the **number** of the diagram which shows the electronic structure of the element which lies

(i) directly **below**  in the Periodic Table, ... [1]

(ii) to the **left** of  in the Periodic Table. ..... [1]

(c) Nitrogen has two stable isotopes – nitrogen-14 and nitrogen-15.

Describe how these isotopes are similar to one another and how they are different. [2]

.....

.....

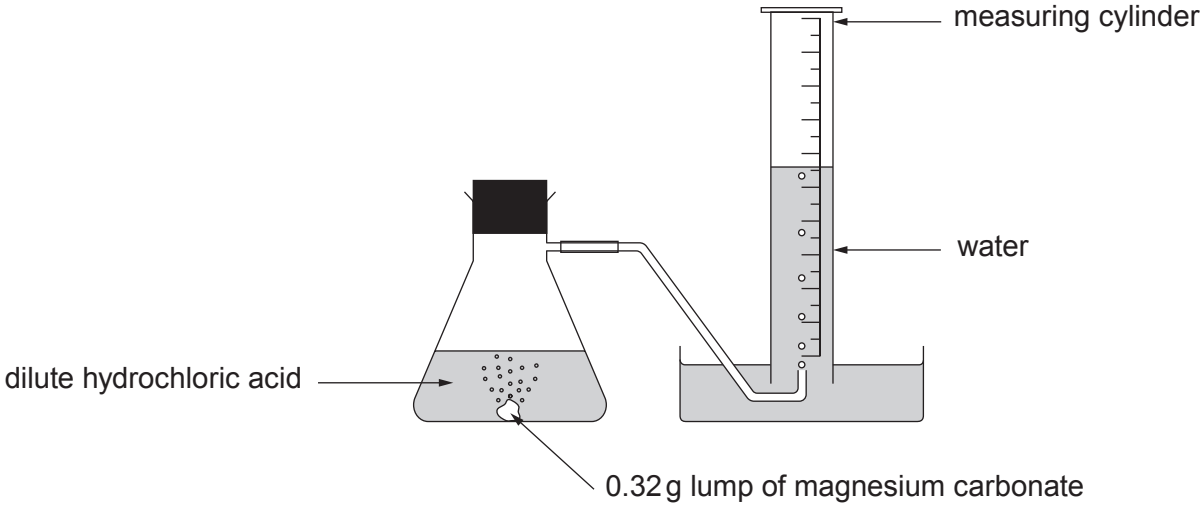
.....

9

Examiner only

9. A student carried out an experiment to investigate the speed of the reaction between a **lump** of magnesium carbonate of mass 0.32 g and excess dilute hydrochloric acid at 20 °C.

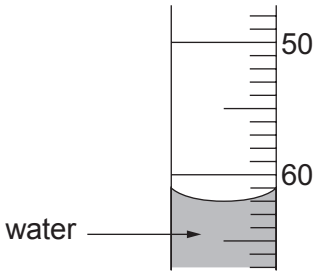
Magnesium carbonate reacts with dilute hydrochloric acid forming carbon dioxide gas. The total volume of carbon dioxide formed was recorded every 5 minutes for 40 minutes.



The results are shown below. The result for 15 minutes is missing.

Time (minutes)	0	5	10	15	20	25	30	35	40
Volume of carbon dioxide formed (cm^3)	0	20	41		79	83	90	90	90

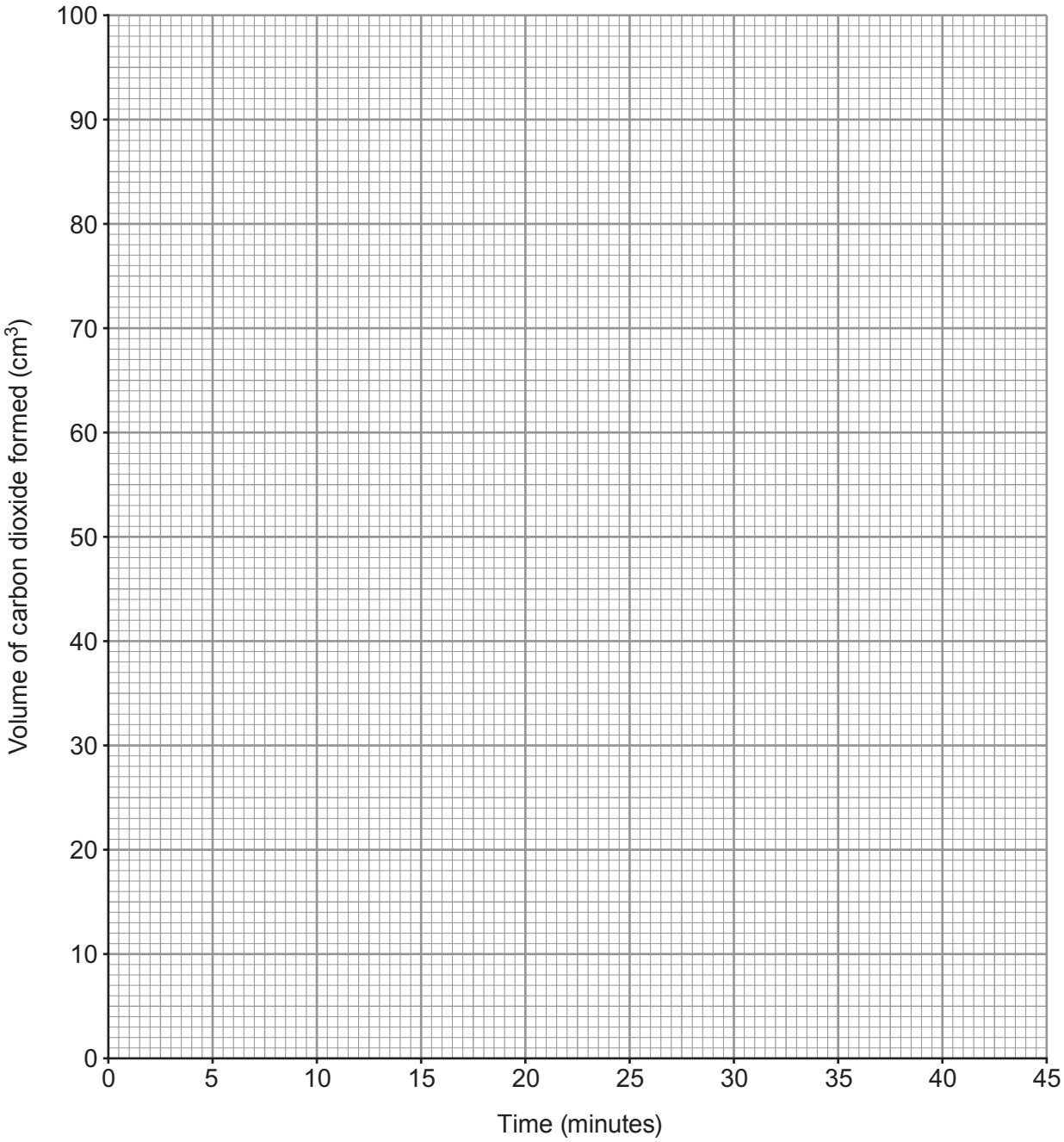
(a) Use the diagram below to find the volume of carbon dioxide gas formed after 15 minutes. [1]



volume of carbon dioxide = ... cm^3

Examiner only

(b) Plot the results from the table, including your answer to part *(a)*, on the grid below. Draw a suitable line and **label this graph X**. [3]



(c) Sketch the graph you would expect if the experiment were repeated using 0.32 g of magnesium carbonate **powder** instead of the lump of magnesium carbonate.
Label this graph Y. [2]

Examiner only

(d) State and explain, using particle theory, the effect of **increasing** the concentration of the hydrochloric acid. [3]

.....

.....

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.....

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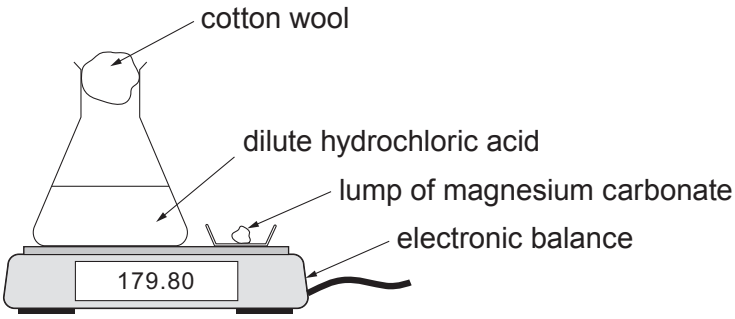
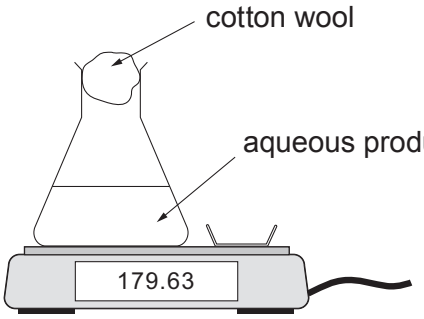
(e) The student investigated the same reaction using a different apparatus. A lump of magnesium carbonate was added to excess dilute hydrochloric acid at 20 °C.



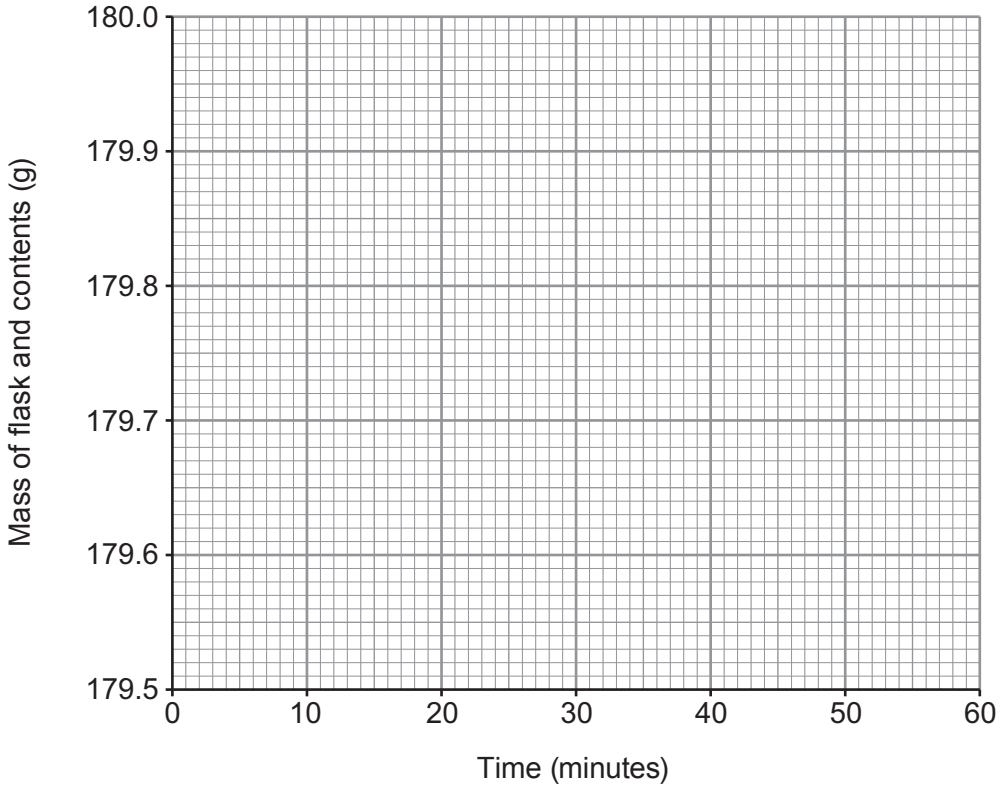
Apparatus at the start



Apparatus after 60 minutes

The change in mass was recorded for 60 minutes and displayed as a graph on a computer screen. The reaction took 40 minutes to complete.

Sketch the graph you would expect to see. [2]



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END OF PAPER

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For continuation only.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
aluminium	Al^{3+}	bromide	Br^{-}
ammonium	NH_4^{+}	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^{-}
calcium	Ca^{2+}	fluoride	F^{-}
copper(II)	Cu^{2+}	hydroxide	OH^{-}
hydrogen	H^{+}	iodide	I^{-}
iron(II)	Fe^{2+}	nitrate	NO_3^{-}
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^{+}	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^{+}		
silver	Ag^{+}		
sodium	Na^{+}		
zinc	Zn^{2+}		

Turn over.

THE PERIODIC TABLE