

Surname	Centre Number	Candidate Number
Other Names		0


GCSE – NEW

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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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.

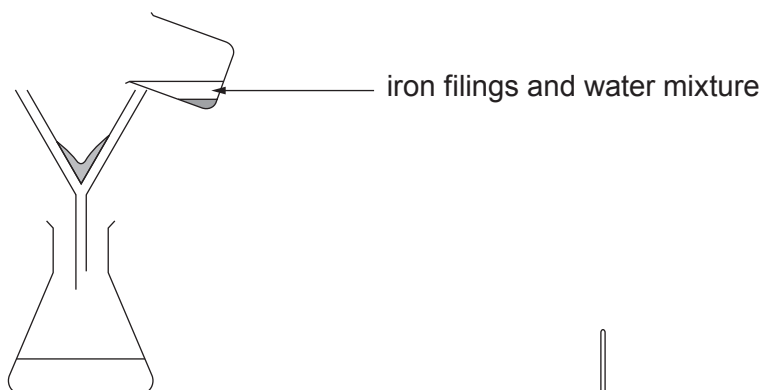
Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

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.

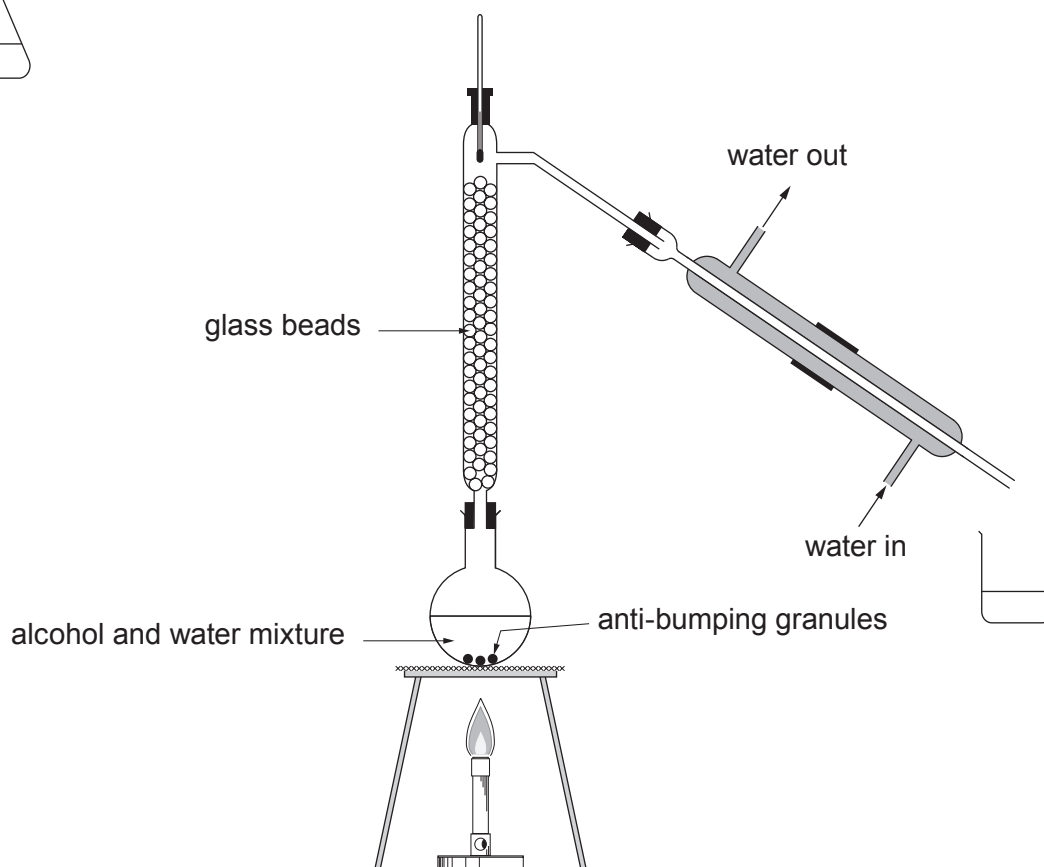
Answer **all** questions.

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

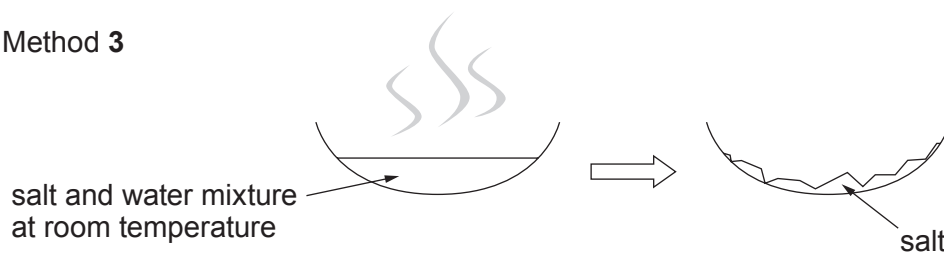
Method 1



Method 2



Method 3



- (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

☐

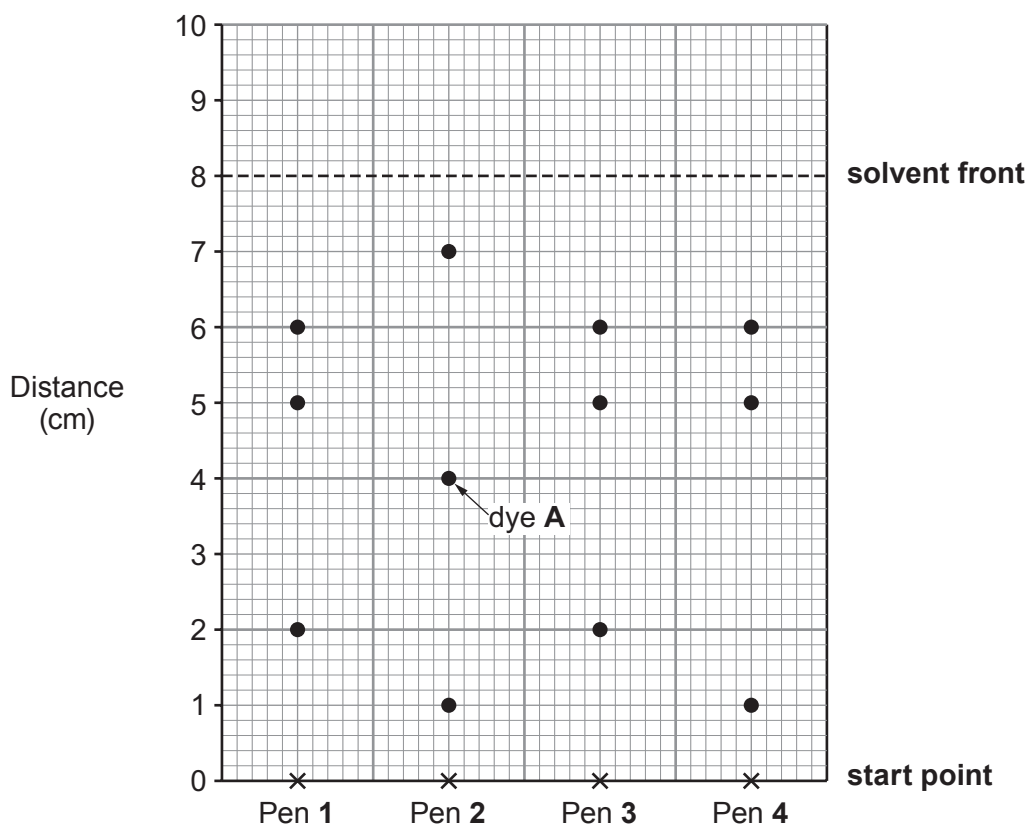
alcohol and water are both liquids

☐

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

.....

- (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]

$R_f =$

- (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

.....

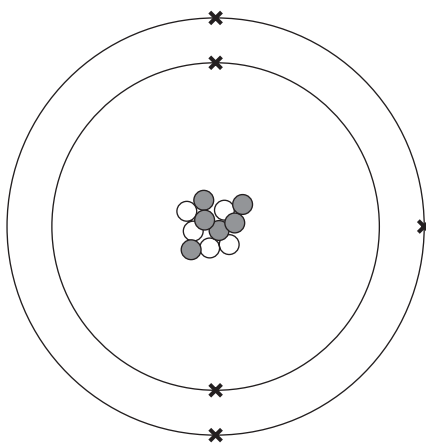
[1]

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



Complete the sentences.

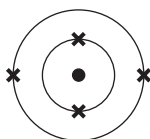
[4]

The nucleus of a boron atom contains five and six

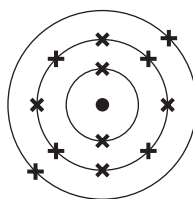
There are five in the shells around the nucleus.

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

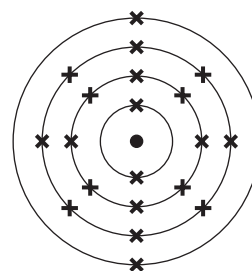
- (b) The diagrams show three different atoms labelled **A**, **B** and **C**. These letters are **not** chemical symbols.



A



B



C

Complete the sentences.

- (i) Atoms **A**, **B** and **C** can be found in Group
- (ii) The atomic number of atom **A** is
- (iii) The electronic structure of atom **C** is (2,).
- (iv) Atom **B** can be found in Period

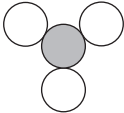
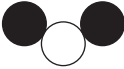
[1]

[1]

[1]

[1]

- (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

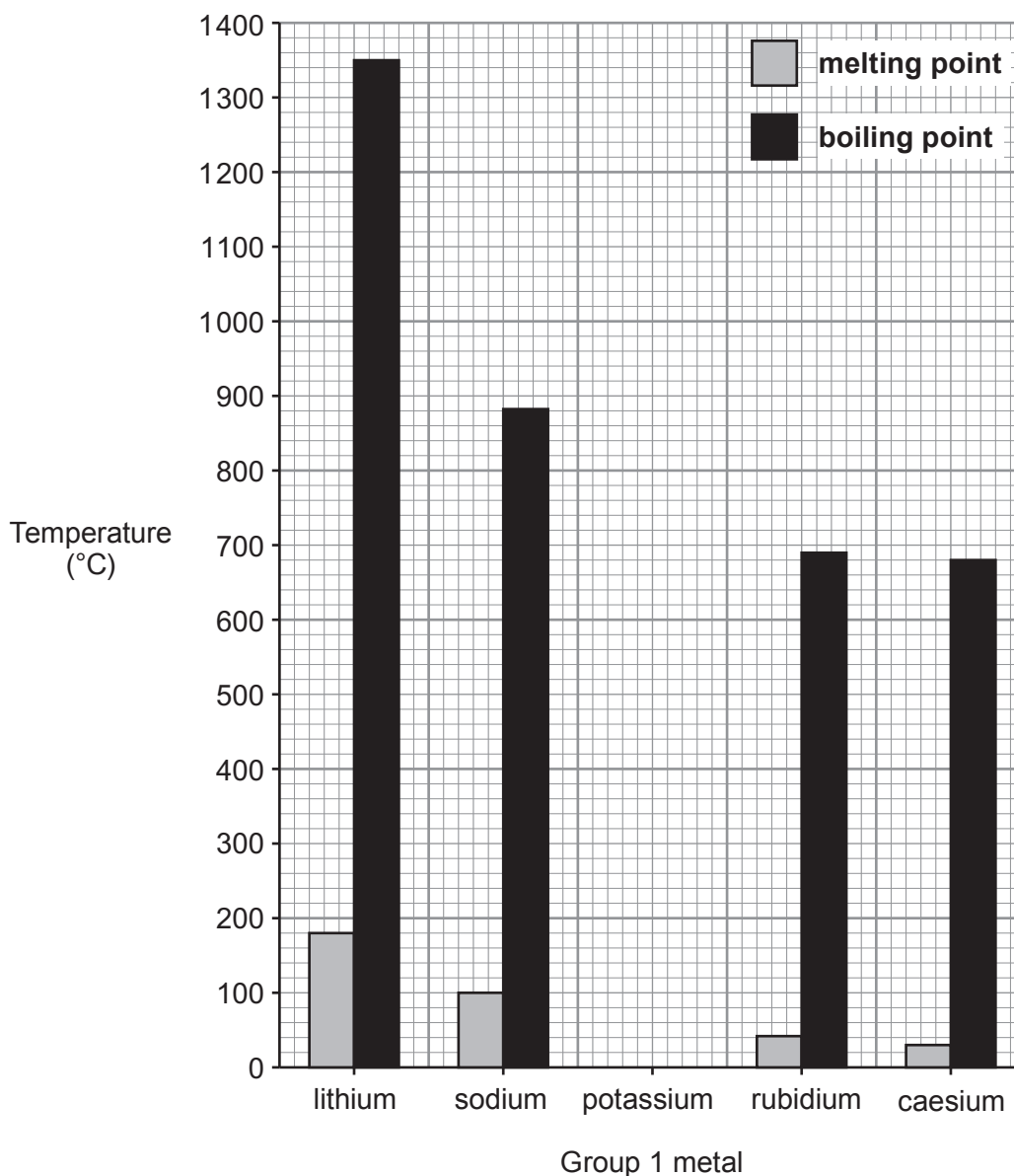
- (ii) **Using the same key** draw a diagram to represent a molecule of carbon dioxide, CO_2 . [1]

- (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]

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



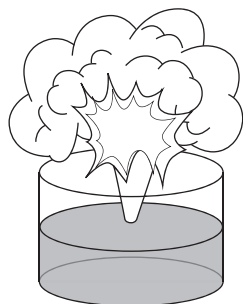
Tick (✓) the box that shows the melting point and boiling point values for potassium which fit the trends shown in the chart. [1]

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

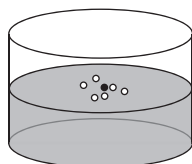
melting point = 60 °C ☐
boiling point = 780 °C

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

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

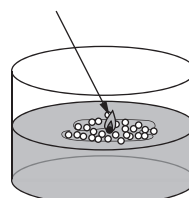
**A**

Violent reaction with
sparks spitting out of
the trough

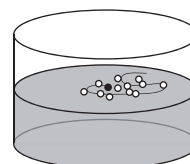
**B**

Gentle fizzing

lilac flame

**C**

Metal ball
melts, moves
around on the
surface and
burns

**D**

Metal ball
fizzes and
moves around
on the surface

- (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]

.....

- (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.

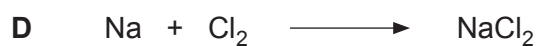
[1]



- (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]

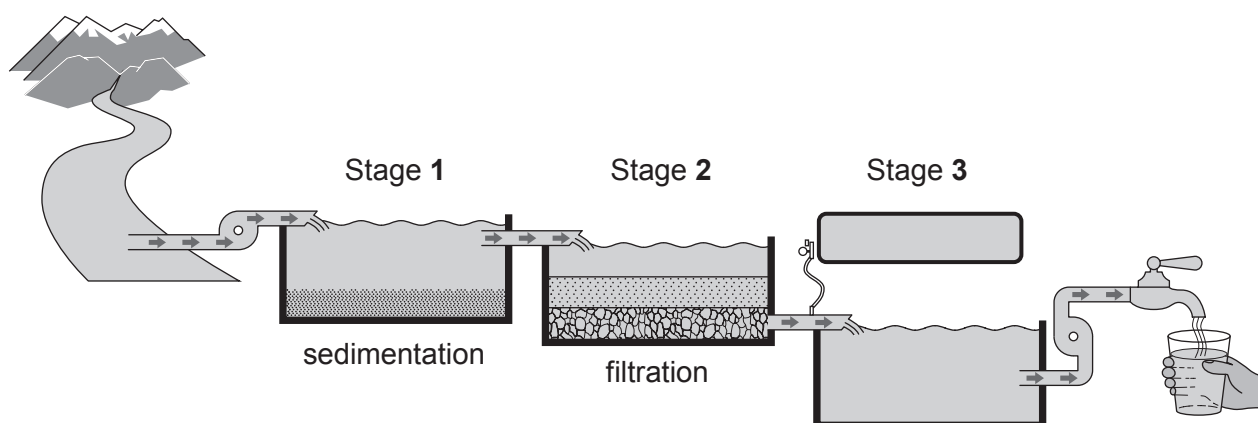


Letter

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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]

.....

.....

.....

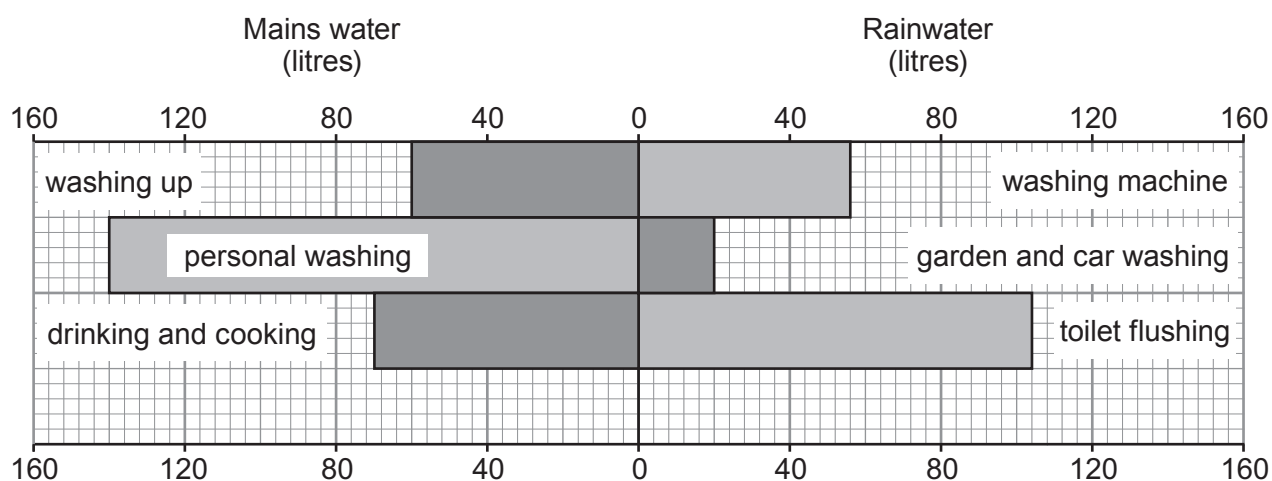
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- (b) A family uses a water butt to collect rainwater in order to reduce their use of mains water.

water butt



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 = %

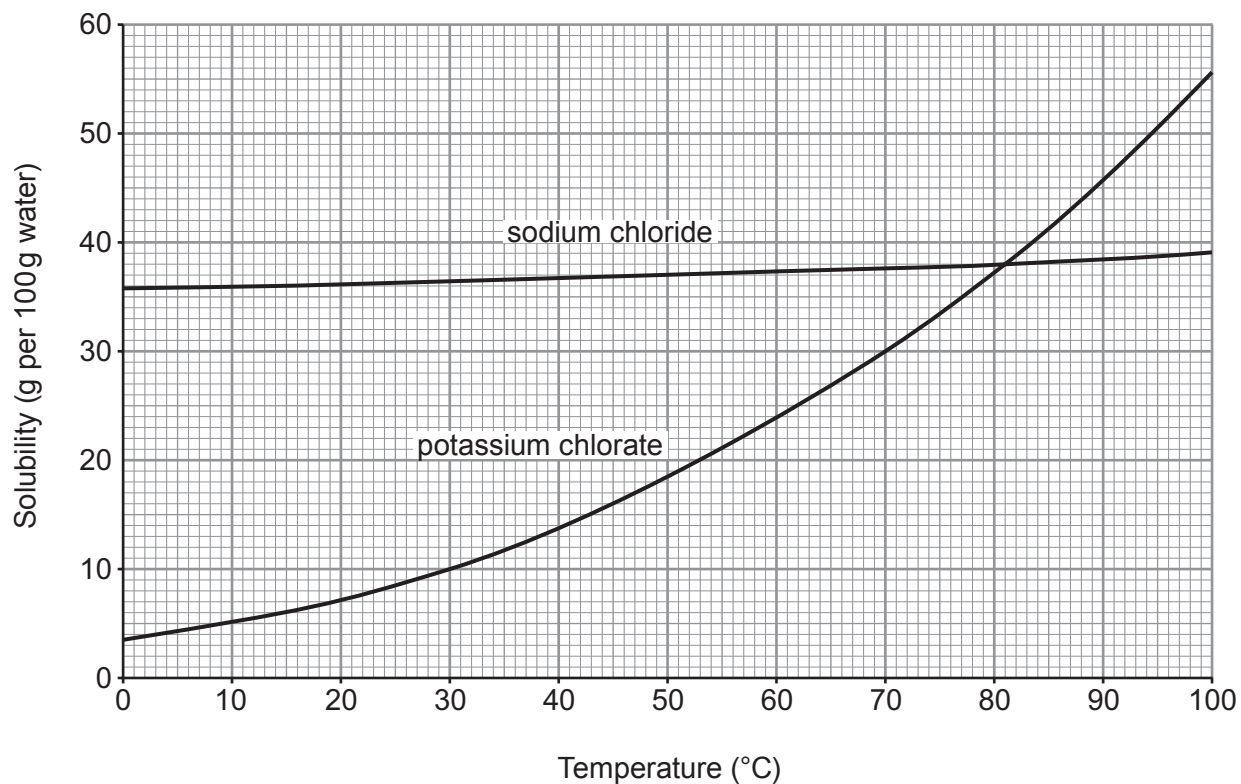
- (ii) Suggest why it is safe to use rainwater for the uses shown on the right hand side of the chart.

[1]

.....

.....

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

- (b) (i) Calculate the relative formula mass (M_r) of potassium chlorate, KClO_3 .

[2]

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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.

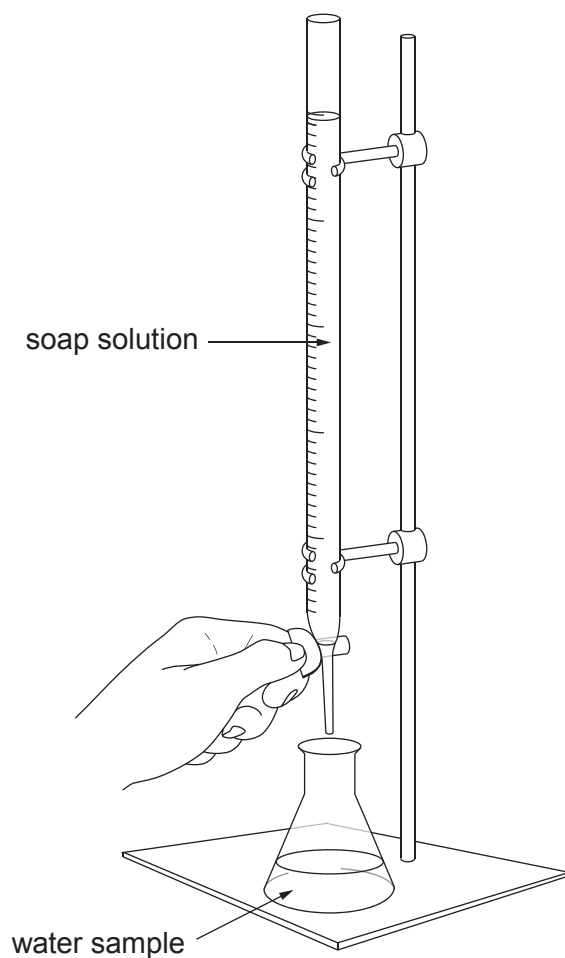
Balance the symbol equation that represents the reaction taking place.

[1]

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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

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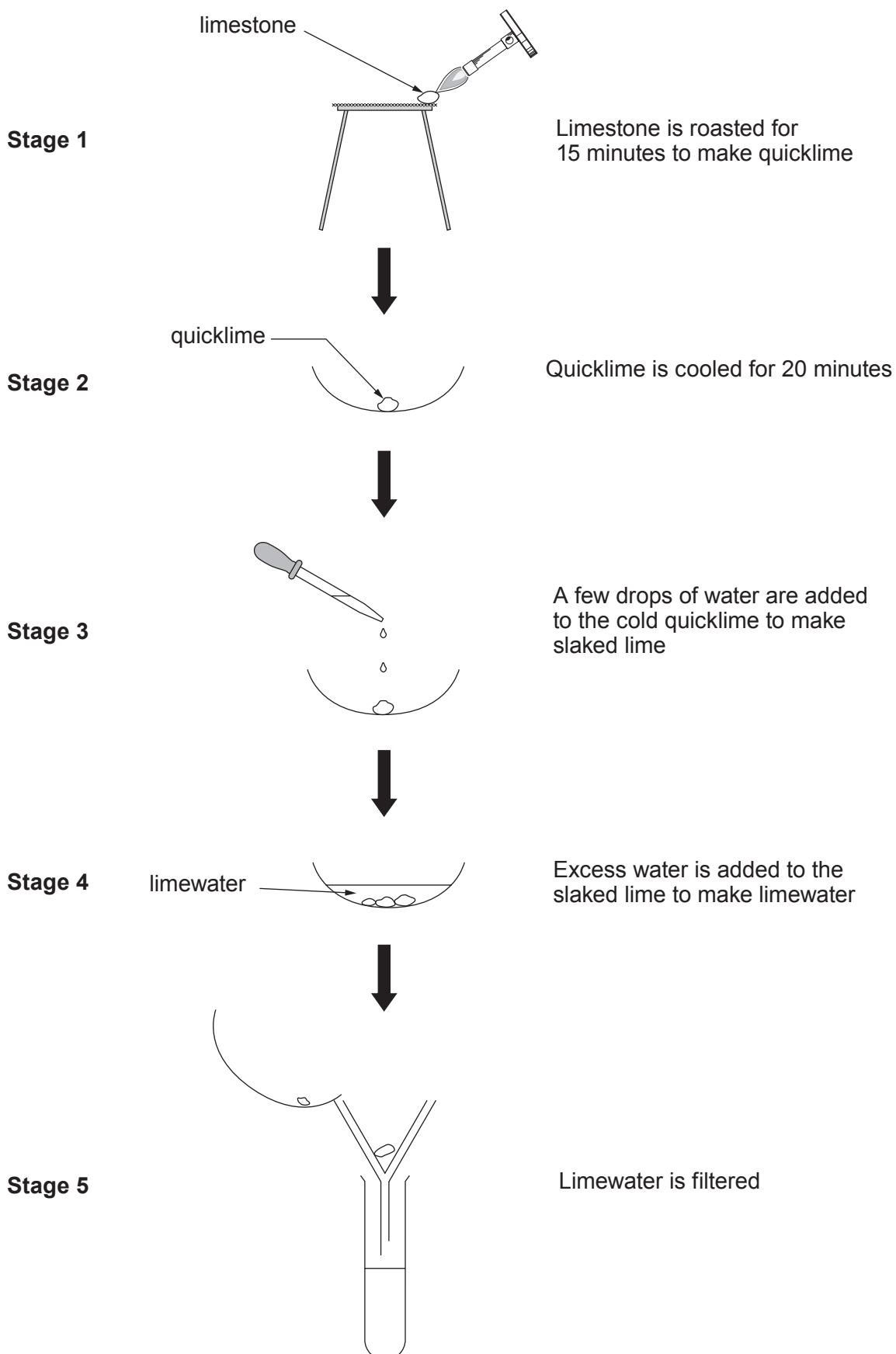
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7. The flow chart shows the stages a student carried out to change calcium carbonate (limestone) into calcium hydroxide solution (limewater).



(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.

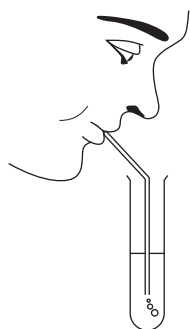
calcium oxide + water $\longrightarrow$ calcium hydroxide

Write a balanced **symbol** equation for this reaction.

[2]

..... + $\longrightarrow$

(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

- (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]

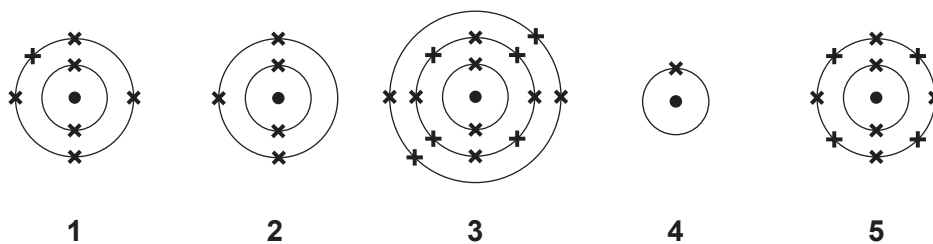
percentage yield = %

10

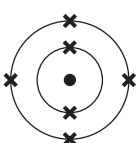
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(b) Diagrams 1-5 show the electronic structure of five elements in the Periodic Table.



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]

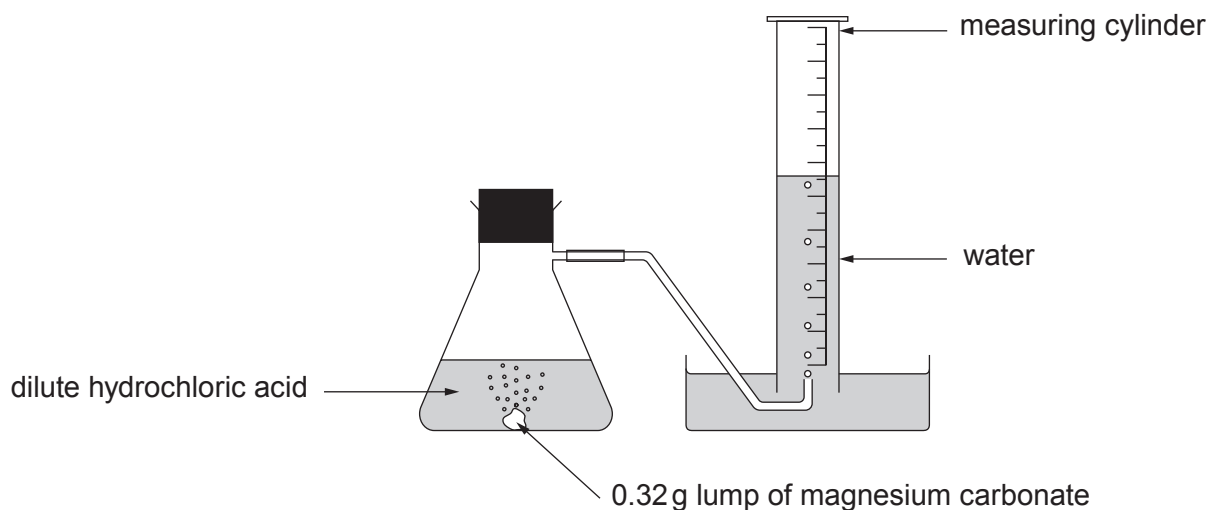
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9. A student carried out an experiment to investigate the speed of the reaction between a **lump** of magnesium carbonate of mass 0.32 g and excess dilute hydrochloric acid at 20 °C.

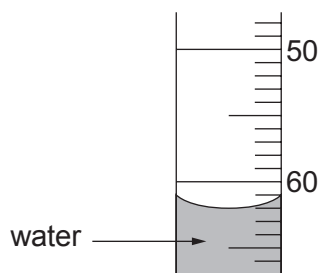
Magnesium carbonate reacts with dilute hydrochloric acid forming carbon dioxide gas. The total volume of carbon dioxide formed was recorded every 5 minutes for 40 minutes.



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

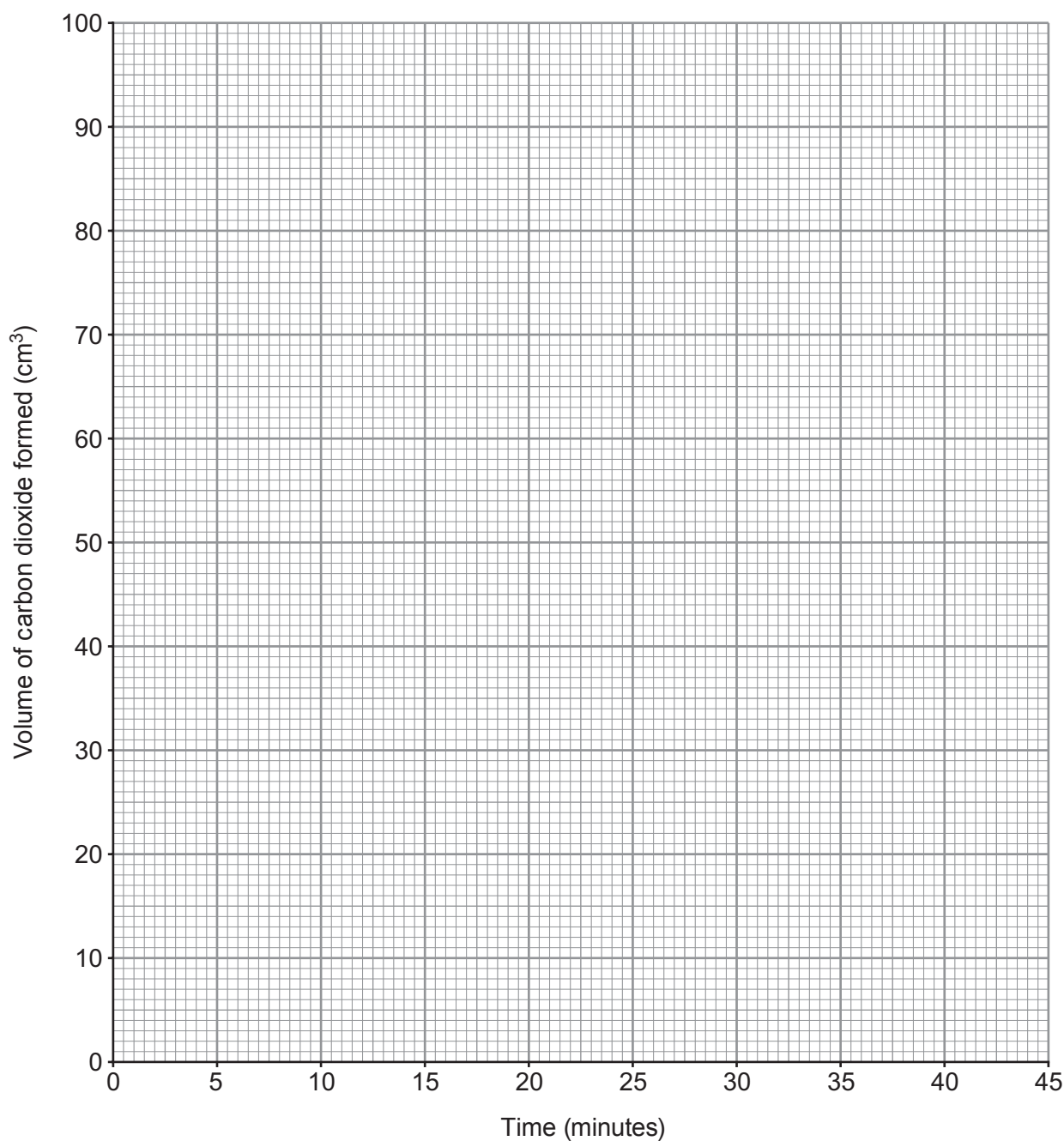
- (a) Use the diagram below to find the volume of carbon dioxide gas formed after 15 minutes. [1]



volume of carbon dioxide = cm³

- (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]

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- (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]

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

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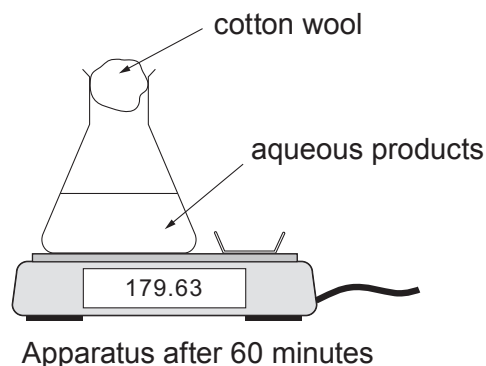
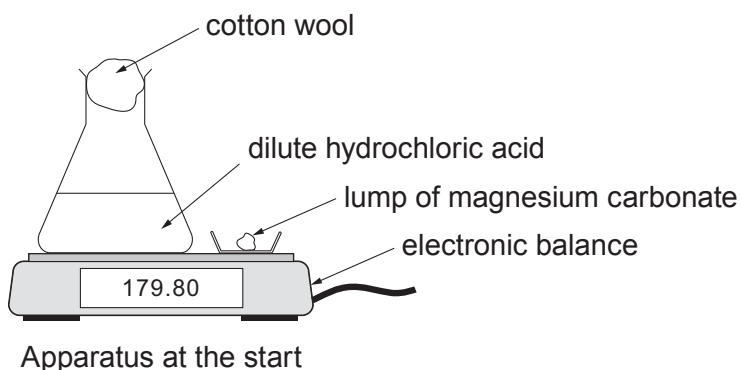
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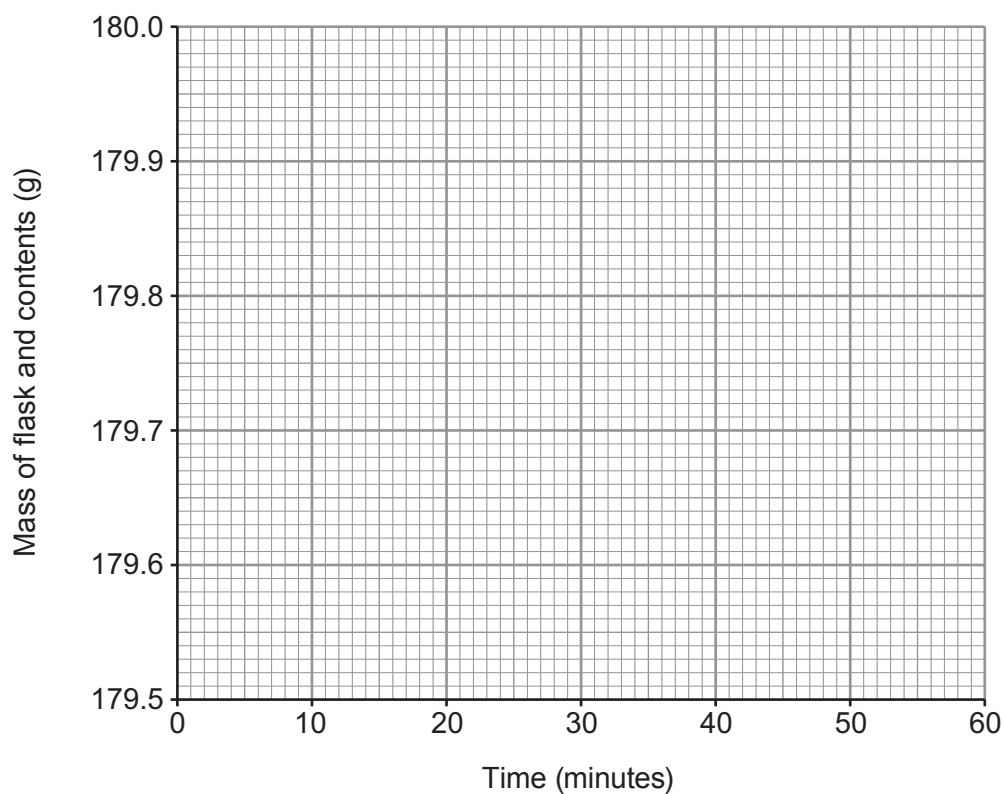
- (e) The student investigated the same reaction using a different apparatus. A lump of magnesium carbonate was added to excess dilute hydrochloric acid at 20 °C.



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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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+}		

THE PERIODIC TABLE

1 2 3 4 5 6 7 0

Group

1 H Hydrogen 1 4 He Helium 2																			
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10		
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18		
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36		
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54		
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86		
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	Key																

Key

A_r	relative atomic mass
Symbol	
Name	
Z	atomic number