

Surname	Centre Number	Candidate Number
First name(s)		0

**GCSE****3430U20-1**

S23-3430U20-1

**FRIDAY, 16 JUNE 2023 – MORNING**

**SCIENCE (Double Award)**  
**Unit 2 – CHEMISTRY 1**  
**FOUNDATION TIER**

1 hour 15 minutes

**ADDITIONAL MATERIALS**

In addition to this examination paper you will need a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

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 **5** 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.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	9	
3.	9	
4.	8	
5.	6	
6.	5	
7.	8	
8.	7	
<b>Total</b>	<b>60</b>	



JUN233430U20101

Answer **all** questions.

1. (a) The table shows four compounds and their formulae.

Compound	Formula
nitrogen dioxide	$\text{NO}_2$
hydrogen bromide	$\text{HBr}$
ethane	$\text{C}_2\text{H}_6$
ammonia	$\text{NH}_3$

Use the information in the table to answer the following questions.

- (i) Give the **name** of the compound that contains the elements hydrogen and bromine. [1]

.....

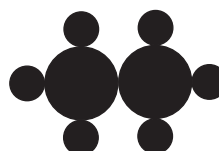
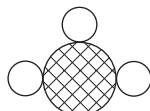
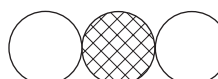
- (ii) Give the **names** of the elements present in ethane. [1]

..... and .....

- (iii) Give the **total** number of atoms found in a molecule of nitrogen dioxide. [1]

.....

- (iv) Tick (✓) the box next to the diagram that represents a molecule of ammonia,  $\text{NH}_3$ . [1]


☐

☐

☐

☐


- (b) Some ants spray a toxic mixture containing formic acid to defend themselves from predators.

Each molecule of formic acid contains two atoms of hydrogen, one atom of carbon and two atoms of oxygen.

Use this information to give the formula of formic acid.

[1]

.....

- (c) The box contains the names of three compounds that are made from positive and negative ions.

**lithium chloride**

**magnesium bromide**

**calcium oxide**

- (i) Give the formulae of the **ions** present in lithium chloride.

[1]

..... and .....

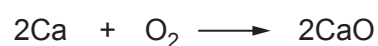
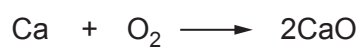
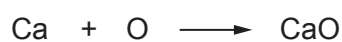
- (ii) Give the formula of magnesium bromide.

[1]

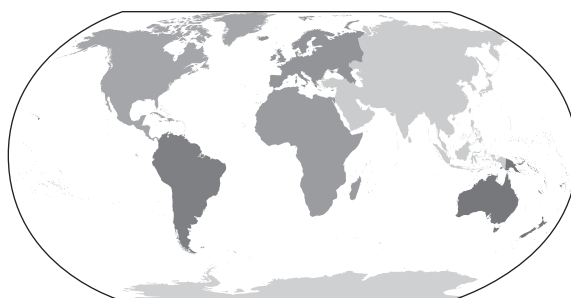
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- (iii) Tick (✓) the box next to the correct equation for the reaction between calcium and oxygen to produce calcium oxide.

[1]


☐

☐

☐


2. The diagram shows how the Earth's continents are arranged today.



In 1912, Alfred Wegener proposed the theory of continental drift.

- (a) (i) Use statements from the table to answer parts I. and II. below.

<b>A</b>	there are similar animals on different continents
<b>B</b>	there are similar fossils on different continents
<b>C</b>	only Europe, Asia and Africa were once joined
<b>D</b>	all of the continents were once joined
<b>E</b>	there is a jigsaw fit of different continents
<b>F</b>	there are similar rocks on different continents
<b>G</b>	none of the continents were joined

- I. Give the **letter** of the statement that describes how Wegener suggested the continents were originally arranged. [1]

.....

- II. Give the **letters of three** pieces of evidence that Wegener used to support his theory. [3]

.....

- (ii) Underline the correct word in the brackets to complete the following sentence. [1]

Wegener could not explain how the continents moved but it is now known that this happens because of ( **conduction** / **convection** / **radiation** ) currents in the Earth's mantle.



- (b) The table shows how the mean temperature of the Earth's atmosphere has increased between 1960 and 2010.

Year	Mean temperature (°C)
1960	13.9
1970	14.0
1980	14.2
1990	14.3
2000	14.4
2010	14.6

- (i) Underline the mean temperature of the Earth's atmosphere in 2020 if this trend continued. [1]

**15.0          14.4          14.8**

- (ii) Name the gas which is mainly responsible for the temperature increase. [1]

.....

- (iii) Give **two** effects of global warming. [2]

.....  
 .....  
 .....



3. The table shows how the solubility of potassium nitrate in water varies with temperature.

Temperature (°C)	Solubility (g per 100g of water)
0	13
10	21
20	32
30	46
40	64
50	86

- (a) Tick (✓) the box that shows approximately how many times more soluble potassium nitrate is at 40 °C than it is at 10 °C. [1]

2 times

☐

3 times

☐

4 times

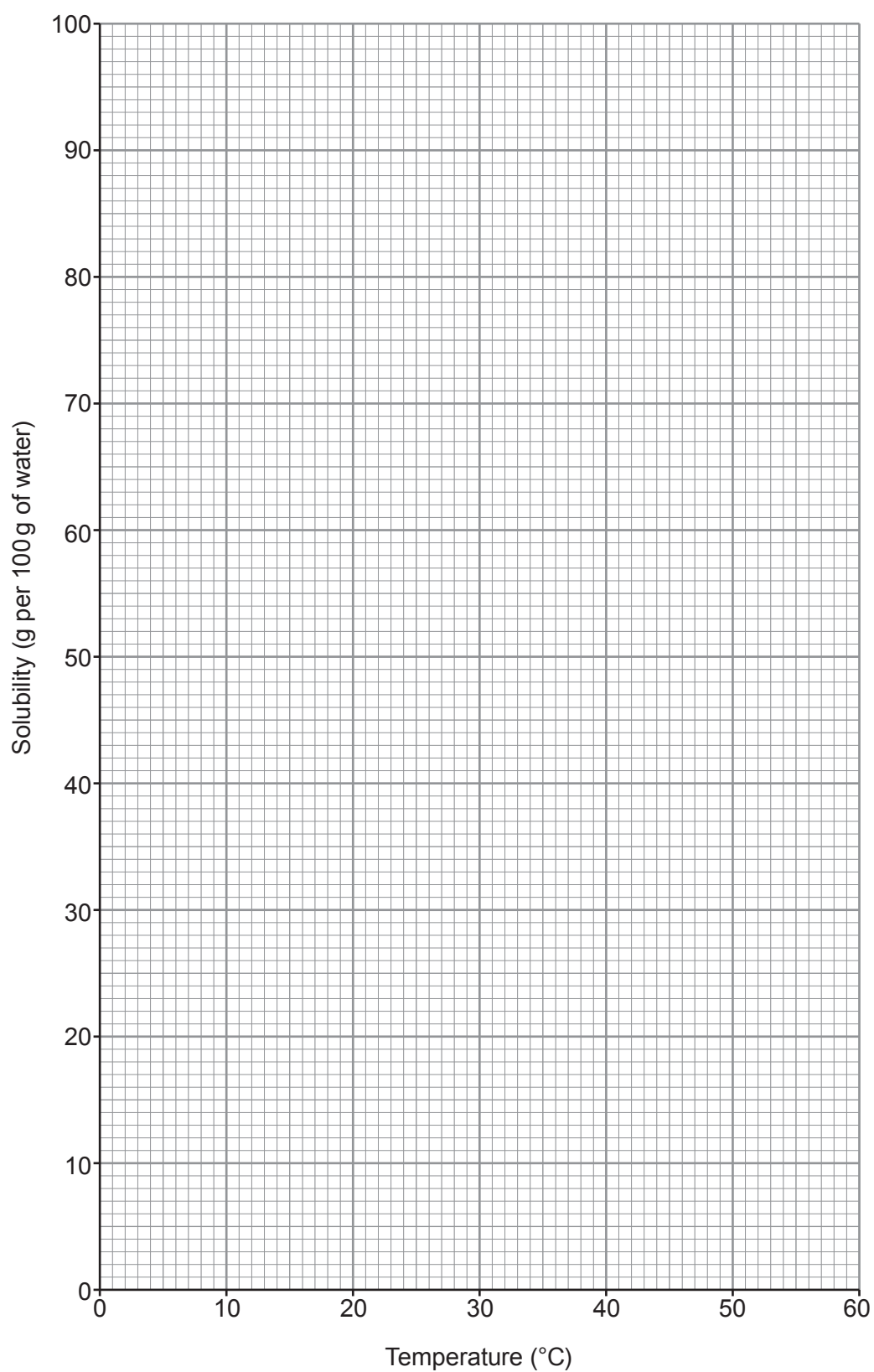
☐

5 times

☐

- (b) (i) Plot the solubility of potassium nitrate against temperature on the grid.  
Draw a suitable line.

[3]



- (ii) I. State the solubility of potassium nitrate at 45 °C. [1]

..... g per 100 g of water

- II. Calculate the mass of solid potassium nitrate that forms when a saturated solution in 100 g of water at 45 °C cools to 25 °C. [1]

Mass = ..... g

- (c) Potassium nitrate decomposes on heating to produce potassium nitrite,  $\text{KNO}_2$ , and oxygen.

- (i) Balance the equation for the reaction. [1]



- (ii) On heating potassium nitrate, a student expected to make 4.35 g of potassium nitrite. However, in an experiment she only made 3.13 g.

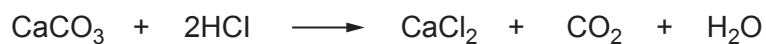
Calculate the percentage yield of potassium nitrite in her experiment. Give your answer to the nearest **whole** number. [2]

Percentage yield = ..... %

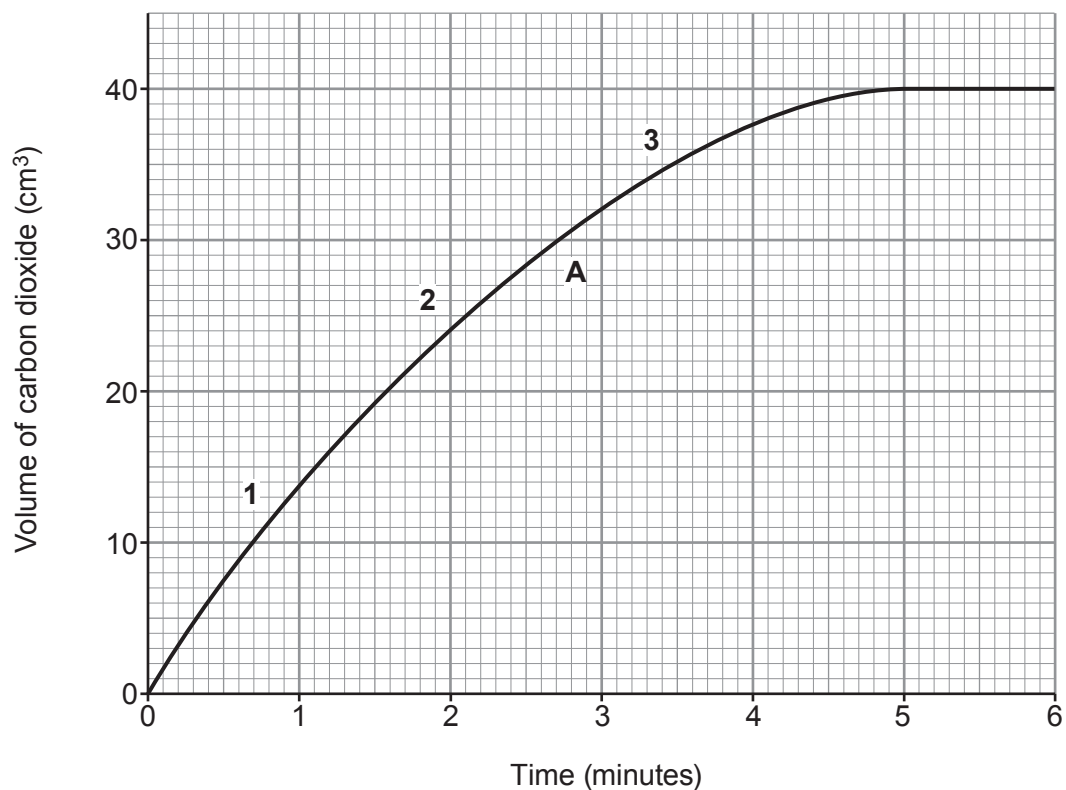




4. Marble chips (calcium carbonate) react with hydrochloric acid to produce carbon dioxide gas as shown in the equation.



Graph **A** shows the volume of carbon dioxide produced over 6 minutes when the reaction was carried out at 30 °C.



- (a) (i) Find the volume of carbon dioxide given off after 2 minutes. [1]

..... cm<sup>3</sup>

- (ii) Find the time taken for the reaction to finish. [1]

..... minutes

- (iii) At which of the following points on graph **A** is the reaction at its fastest? [1]

Tick (✓) the correct box.

1

☐

2

☐

3

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- (iv) After  $\frac{1}{2}$  minute,  $7.5 \text{ cm}^3$  of carbon dioxide has been produced.

Use the equation to calculate the mean rate of reaction over this time in  $\text{cm}^3/\text{s}$ .

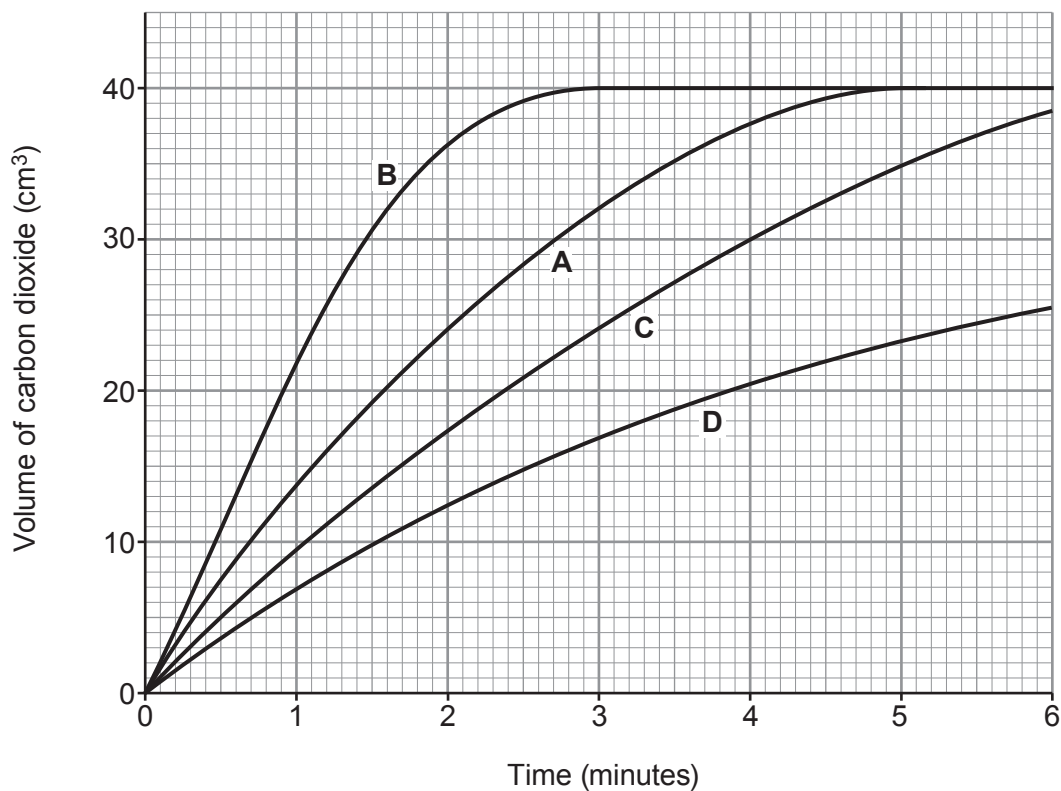
[2]

$$\text{mean rate} = \frac{\text{volume of carbon dioxide produced}}{\text{time (in seconds)}}$$

Mean rate = .....  $\text{cm}^3/\text{s}$



- (b) (i) Graphs **B**, **C** and **D** on the grid below show the results for the experiment carried out at **different** temperatures. Graph **A** for the reaction carried out at 30 °C is also shown.



State which of graphs **B**, **C** and **D** shows the results for the experiment carried out at a temperature of 40 °C. [1]

Graph .....

- (ii) Using your knowledge of particle theory, underline the correct words in the brackets to complete the following sentence. [2]

At a higher temperature, the particles will have

( **more / less / the same amount of** ) energy, so they will move faster and

there will be ( **an equal / a smaller / a greater** ) number of successful

collisions per second.



5. A teacher wanted to demonstrate the reactivity of lithium, sodium and potassium with water.

State what safety precautions the teacher should take and describe the observations you would expect for each metal.

You are **not** expected to include equations in your answer.

[6 QER]

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6. Fluoride ions (mostly from sodium fluoride) are found naturally in the drinking water in some regions of England. The concentration of these fluoride ions is quite low with values being less than  $0.5 \text{ mg/dm}^3$ .

However, water companies in some areas add fluoride ions to drinking water. Areas where this happens include Yorkshire, the North East, the East Midlands and the West Midlands. The mean concentration of fluoride ions added is around  $1 \text{ mg/dm}^3$ .

It is known that a high concentration of fluoride ions in drinking water can be poisonous and can cause a yellowing of teeth – fluorosis. Fluoridation of drinking water is a controversial issue. Some people are opposed to it because it removes the individual's choice to not take fluoride.

The table shows the mean number of decayed, missing and filled teeth (DMFT) in five-year-old children in some areas of England in 2018.

Area	Mean DMFT
South East	0.6
West Midlands	0.7
North West	1.3
London	1.0
South West	0.7
Yorkshire	1.0
North East	1.0
East Midlands	0.9
East England	0.7



- (a) Which **two** of the following statements are correct according to the information given?  
Tick (✓) **two** boxes. [2]

London, Yorkshire and the North West all have a mean DMFT of 1.0

☐

The South East has the lowest mean DMFT

☐

The East Midlands has the highest mean DMFT

☐

East England, the South West and the South East have a mean DMFT of 0.7

☐

The East Midlands has a lower mean DMFT than Yorkshire

☐

London, the North West and the South West all have a mean DMFT of 0.9

☐

- (b) (i) Which of the following statements supports the argument for fluoridation of drinking water? Tick (✓) **one** box. [1]

All areas with fluoridated drinking water have lower mean DMFT than areas which do not fluoridate drinking water

☐

All areas with fluoridated drinking water have the same mean DMFT as non-fluoridated areas

☐

All areas with fluoridated drinking water have lower mean DMFT than the North West

☐

- (ii) Which of the following statements could be used to oppose the argument for fluoridation of drinking water? Tick (✓) **one** box. [1]

It is not possible to decide whether fluoridation of drinking water lowers mean DMFT

☐

All areas with fluoridated drinking water have higher mean DMFT than areas which do not fluoridate drinking water

☐

All areas with fluoridated drinking water have a higher mean DMFT than the South West

☐


- (c) Suggest a possible reason why the South East has a low mean DMFT in five-year-old children even though no fluoride is added to drinking water in this area. [1]

Examiner  
only

5





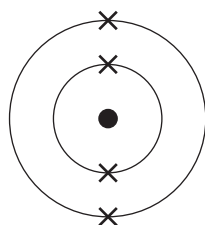
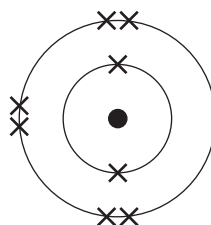
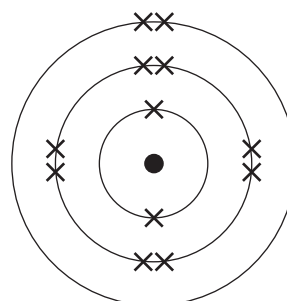
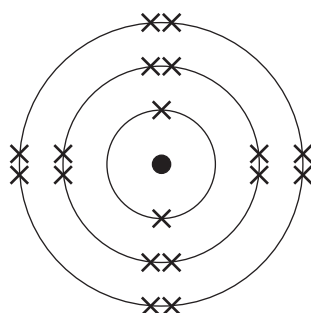
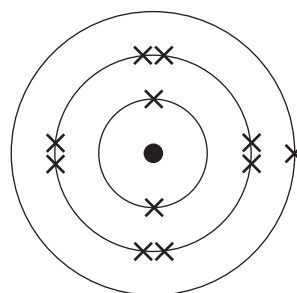
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7. The diagrams below show the electronic structures of five elements, **A**, **B**, **C**, **D** and **E**.

The letters are not the symbols of the elements.

**A****B****C****D****E**

- (a) Give the **letters** of the elements found in Period 2 of the Periodic Table. Give a reason for your choice. [2]

Letters ..... and .....

Reason .....

.....



- (b) Give the **letter** of the element found in Group 0 of the Periodic Table. Give a reason for your choice. [2]

Letter .....

Reason .....

- (c) Explain how the electronic structure of element **E** can be used to determine its atomic number. [2]

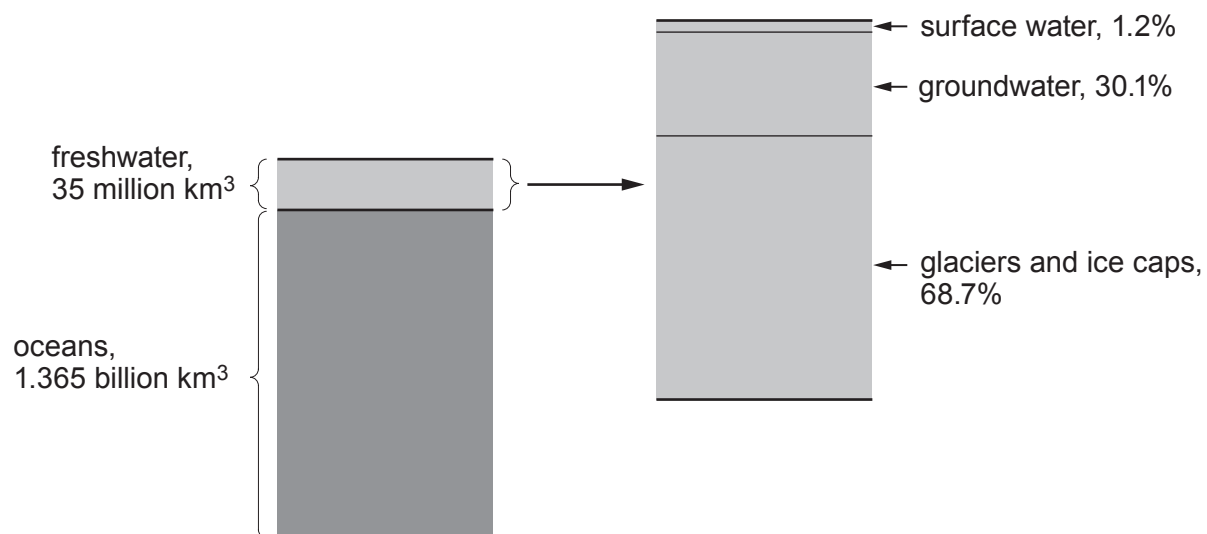
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.....  
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- (d) One of the diagrams represents the element oxygen. Oxygen reacts with potassium to form potassium oxide.

Give the formula for potassium oxide and balance the equation for this reaction. [2]



8. The diagram shows the distribution of water on Earth.



- (a) Use the information in the diagram to calculate the volume of freshwater that is available as surface water. [2]

Volume = ..... million km<sup>3</sup>

- (b) As the Earth's population continues to increase, there is going to be a greater need to get freshwater from seawater. This is known as desalination.

Give a method that could be used to obtain freshwater from seawater. [1]

.....



- (c) Calcium ions,  $\text{Ca}^{2+}$ , cause hardness in groundwater.

Describe an experiment to **compare** the hardness of two groundwater samples. [3]

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- (d) Washing soda is used to soften hard water. This contains sodium carbonate.

Give the formula of sodium carbonate. [1]

.....

**END OF PAPER**

7





### FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
aluminium	$\text{Al}^{3+}$	bromide	$\text{Br}^-$
ammonium	$\text{NH}_4^+$	carbonate	$\text{CO}_3^{2-}$
barium	$\text{Ba}^{2+}$	chloride	$\text{Cl}^-$
calcium	$\text{Ca}^{2+}$	fluoride	$\text{F}^-$
copper(II)	$\text{Cu}^{2+}$	hydroxide	$\text{OH}^-$
hydrogen	$\text{H}^+$	iodide	$\text{I}^-$
iron(II)	$\text{Fe}^{2+}$	nitrate	$\text{NO}_3^-$
iron(III)	$\text{Fe}^{3+}$	oxide	$\text{O}^{2-}$
lithium	$\text{Li}^+$	sulfate	$\text{SO}_4^{2-}$
magnesium	$\text{Mg}^{2+}$		
nickel	$\text{Ni}^{2+}$		
potassium	$\text{K}^+$		
silver	$\text{Ag}^+$		
sodium	$\text{Na}^+$		
zinc	$\text{Zn}^{2+}$		



## Group

## Key

$A_r$	Symbol	Name	Z
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atomic number