

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3410U10-1



S25-3410U10-1

FRIDAY, 13 JUNE 2025 – MORNING

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

1 hour 45 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(s) 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 7(a) 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.	6	
2.	8	
3.	7	
4.	14	
5.	10	
6.	5	
7.	10	
8.	5	
9.	6	
10.	9	
Total	80	

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01

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Answer **all** questions.

1. The diagram shows part of the Periodic Table.

	1	2											3	4	5	6	7	0
1																		He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe

- (a) Tick (✓) the box next to the number of the **group** in the Periodic Table that contains the element chlorine, Cl. [1]

5

☐

6

☐

7

☐

- (b) Tick (✓) the box next to the number of the **period** in the Periodic Table that contains the element chlorine, Cl. [1]

1

☐

2

☐

3

☐

(c) Tick (✓) the box next to the colour of chlorine gas.

[1]

green

☐

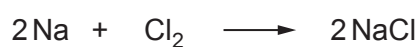
orange

☐

blue

☐

(d) Sodium metal reacts with chlorine gas to form sodium chloride.



(i) Tick (✓) the box next to the word that describes sodium chloride.

[1]

element

☐

compound

☐

mixture

☐

(ii) Sodium ions in sodium chloride can be identified using a **flame test**.

Tick (✓) the box next to the colour of the flame produced by sodium ions in a flame test.

[1]

red

☐

yellow

☐

green

☐

(e) Sodium reacts with bromine to form sodium bromide.

Circle the correct formula of sodium bromide.

[1]

NaBr

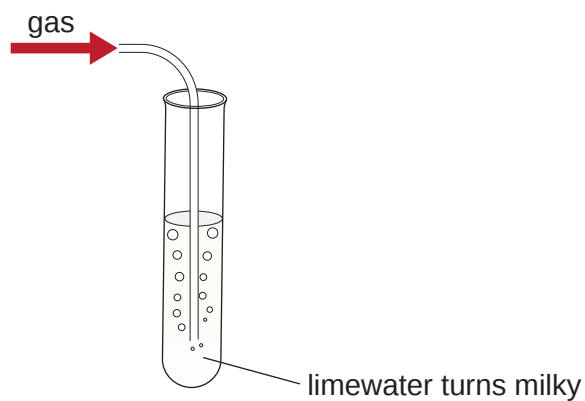
SBr

nabr

NaB



2. (a) Tick (✓) the box next to the name of the gas that is being identified by the test in each diagram. [2]



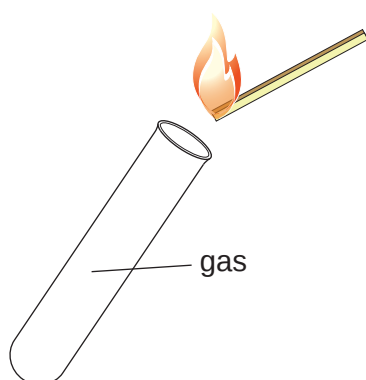
carbon dioxide

☐

oxygen

☐

hydrogen

☐

there is a squeaky pop when a lit splint
is held at the top of the tube

carbon dioxide

☐

oxygen

☐

hydrogen

☐

- (b) The gases in the early atmosphere came from volcanic eruptions.

The table shows the percentages of some gases in the early atmosphere and today's atmosphere.

Name of gas	Percentage of gas (%)	
	Early atmosphere	Today's atmosphere
oxygen	0	21
water vapour	20	0-3
carbon dioxide	35	0.04

- (i) **Use only the information in the table** to complete the sentence. [2]

Over geological time, the amount of in the
atmosphere has increased and the amounts of
and have decreased.

- (ii) Underline the names of **two** processes which **use** oxygen from the atmosphere. [2]

photosynthesis

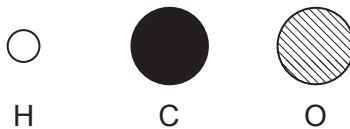
sedimentation

respiration

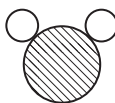
combustion



- (c) The following symbols represent atoms of hydrogen, carbon and oxygen.



A molecule of water, H_2O , can be represented by the following diagram.

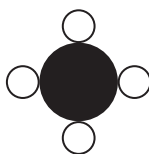


- (i) Use the key to draw a molecule of carbon dioxide, CO_2 .

[1]

- (ii) Write the formula of the following molecule.

[1]



.....



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3. Lithium, sodium, potassium and rubidium are all Group 1 elements.

(a) Tick (✓) the box next to the name given to the Group 1 elements. [1]

halogens

☐

noble gases

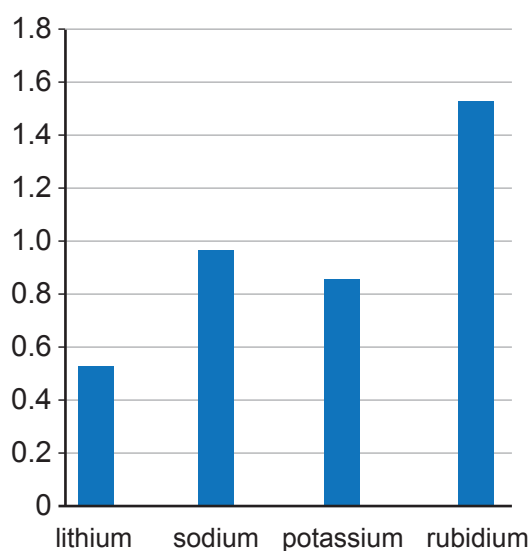
☐

alkali metals

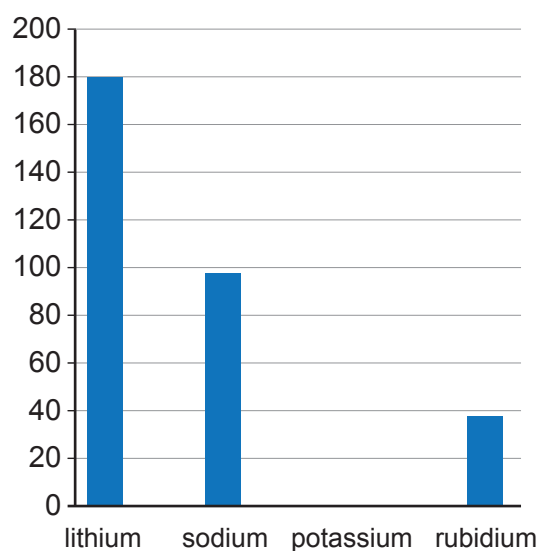
☐

(b) The charts below show the densities and some of the melting points of the Group 1 elements.

Density (g/cm^3)



Melting point ($^{\circ}\text{C}$)



Use only the information in the charts to answer the following questions.

(i) Name the element with the highest density. [1]

.....

(ii) Give the state (solid, liquid or gas) of sodium at 100°C . [1]

.....



(iii) Tick (✓) the box next to the most likely melting point of potassium. [1]

25 °C

☐

64 °C

☐

106 °C

☐

(c) (i) Potassium reacts with oxygen to produce potassium oxide.

Potassium oxide contains the ions K^+ and O^{2-} .

(Circle) the correct formula of potassium oxide. [1]

KO**KO₂****K₂O****K₂O₂**

(ii) Potassium reacts with water to produce potassium hydroxide solution and hydrogen gas.

I. Put a number in the box to balance the equation for this reaction. [1]



II. Tick (✓) the box next to the observation which shows that a gas is formed during this reaction. [1]

potassium floats

☐

potassium melts

☐

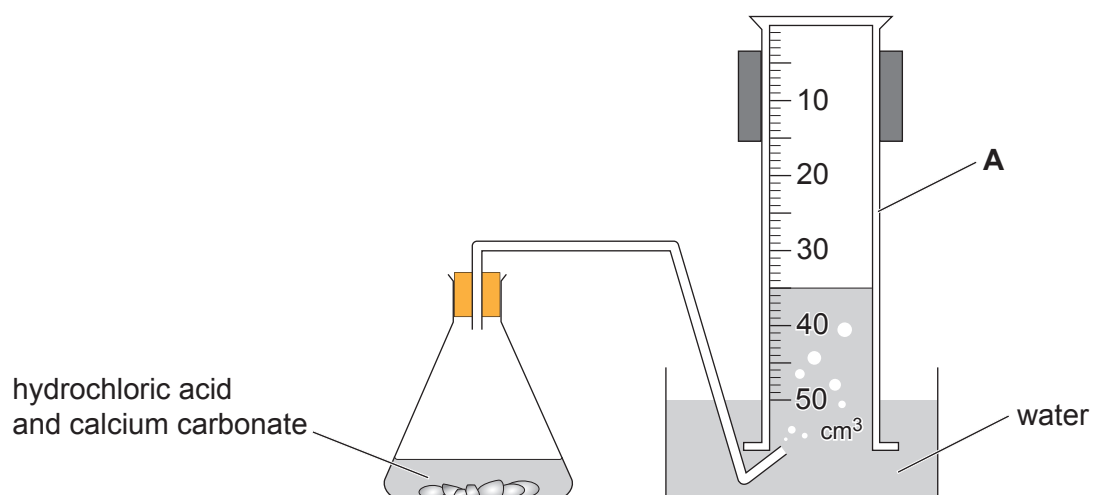
fizzing

☐

potassium disappears

☐

4. (a) Calcium carbonate reacts with hydrochloric acid to produce a gas which can be collected and measured using the apparatus shown.



- (i) measuring cylinder the name of the apparatus labelled **A**.

[1]

test tube

measuring cylinder

beaker

evaporating dish

- (ii) Use the diagram to give the volume of gas collected.

[1]

..... cm^3



- (iii) If the experiment is repeated using a higher concentration of acid, the rate of the reaction increases.

Choose words from the box to complete the sentence to explain why the rate increases.

[2]

energy

particles

collisions

gases

solutions

When the concentration of the acid increases there are more

..... in the same volume and a higher chance of
successful

- (iv) Apart from increasing the concentration of the acid, give another change that will increase the rate of this reaction. [1]

.....

- (b) In a similar experiment, 48 cm³ of gas was collected in 2 minutes.

The mean rate of the reaction can be calculated using the following equation.

$$\text{mean rate} = \frac{\text{volume of gas}}{\text{time}}$$

Use the equation to calculate the mean rate of the reaction in cm³/s. [2]

Mean rate = cm³/s



- (c) Calculate the relative formula mass, M_r , of calcium carbonate, CaCO_3 . [2]

$$A_r(\text{Ca}) = 40$$

$$A_r(\text{C}) = 12$$

$$A_r(\text{O}) = 16$$

$$M_r = \dots\dots\dots$$

- (d) The word equation for the reaction is as follows.



Complete the symbol equation for the reaction by

- giving the formula of calcium chloride
- putting a number in the box to balance the equation

[2]



- (e) Limestone is mainly composed of calcium carbonate. Limestone is quarried on Halkyn mountain in Flintshire.

There are benefits and drawbacks associated with limestone quarrying.

Benefits include the production of an important building material and employment for the local community.

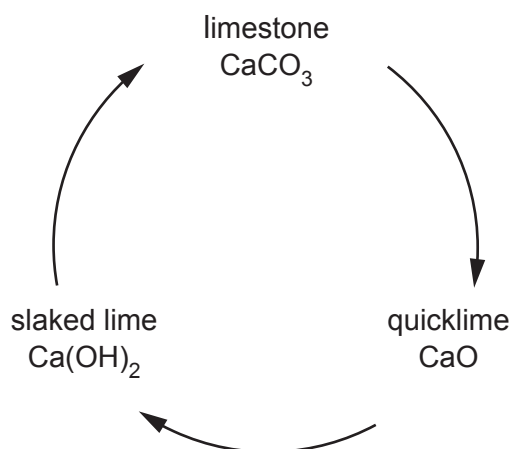
Give **one** drawback of limestone quarrying.

[1]

.....



- (f) The limestone cycle is shown in the diagram.



- (i) Give the chemical name of quicklime, CaO .

[1]

.....

- (ii) Give the name of the substance added to quicklime, CaO , to convert it to slaked lime, Ca(OH)_2 .

[1]

.....



5. The hardness of water can be measured by adding soap solution.

A class investigated the hardness of water from different locations in Wales.

They measured the volume of soap solution needed to create a permanent lather when it was shaken in a flask with samples of water from each location.

The results are shown in the table.

Location	Volume of soap solution needed to create a permanent lather (cm ³)		
	Test 1	Test 2	Mean
Abergavenny	23	27	25
Brecon	15	14	15
Carmarthen	52	55	54
Holyhead	37		35
Wrexham	59	57	58

- (a) (i) Give the **missing result** for Test 2 used to calculate the mean volume for the sample from Holyhead.

[1]

Missing result = cm³

- (ii) State **two** factors that must be controlled in this investigation.

[2]

Factor 1

Factor 2

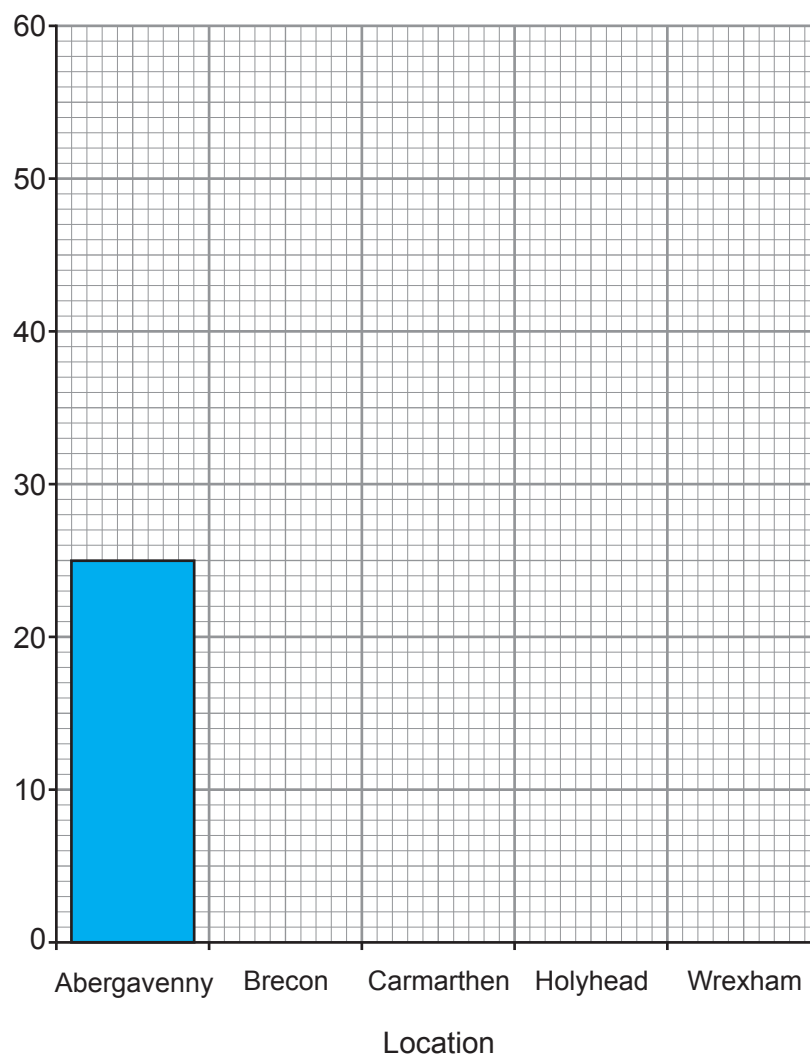


- (iii) Complete the bar chart to show the mean volume of soap solution needed to create a permanent lather for the water from each location.

The first bar has been drawn for you.

[2]

Volume of soap solution (cm³)



- (iv) Give the location with the hardest water. Explain your answer.

[2]

Location

.....

.....



(b) Give the name of an ion which causes hard water.

[1]

.....

(c) Tick (✓) the boxes next to the **two** benefits of hard water.

[2]

makes boilers more efficient

☐

reduces the risk of heart disease

☐

strengthens bones

☐

less detergent is needed to wash dishes

☐

prevents limescale forming

☐

10

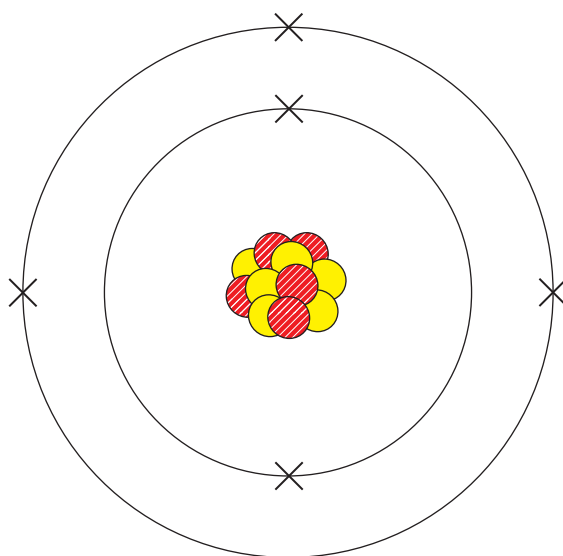


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6. (a) The diagram shows an atom of the element boron.



- (i) Complete the sentence. [1]

The nucleus of the boron atom contains five and
six

- (ii) Give the mass number of the boron atom. [1]

.....

- (iii) Explain why an atom of boron has no overall charge. [2]

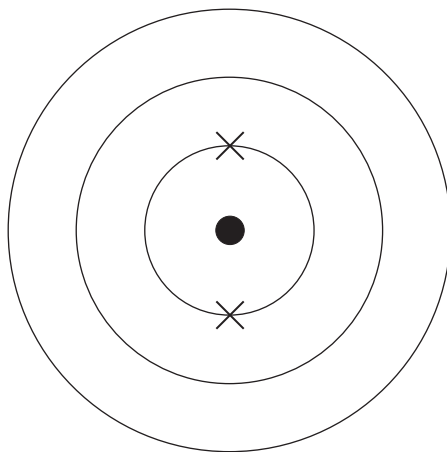
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.....



- (b) An atom of aluminium has 13 electrons.

Complete the diagram to show the electronic structure of an aluminium atom.

[1]



Examiner
only

5



7. (a) The photograph shows the chromatogram produced when the dyes in a purple ink were separated using water as the solvent.



Diagrams **A** and **B** show two possible ways of setting up the apparatus to produce this chromatogram.

Diagram **A**

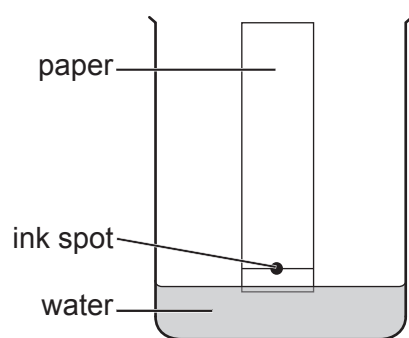
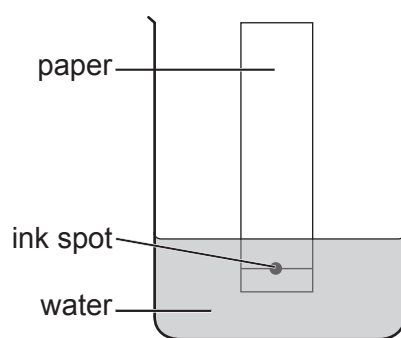


Diagram **B**



Explain why

- chromatography can separate dyes in this way
- the set up in diagram **A** rather than diagram **B** would produce the chromatogram shown

[6 QER]

.....

.....

.....

.....

.....

.....

.....

.....

.....

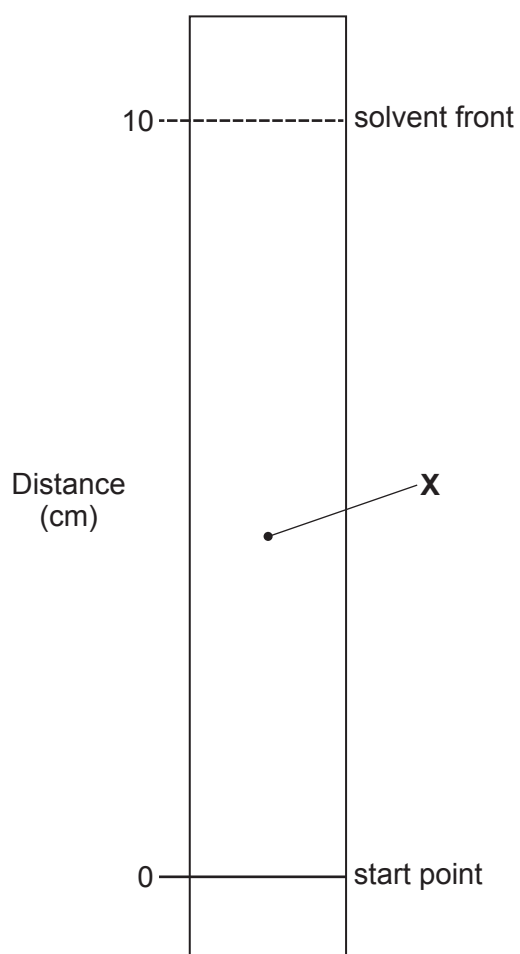
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- (b) The diagram shows a simplified chromatogram produced in another experiment.



The R_f value of a dye can be calculated using the equation

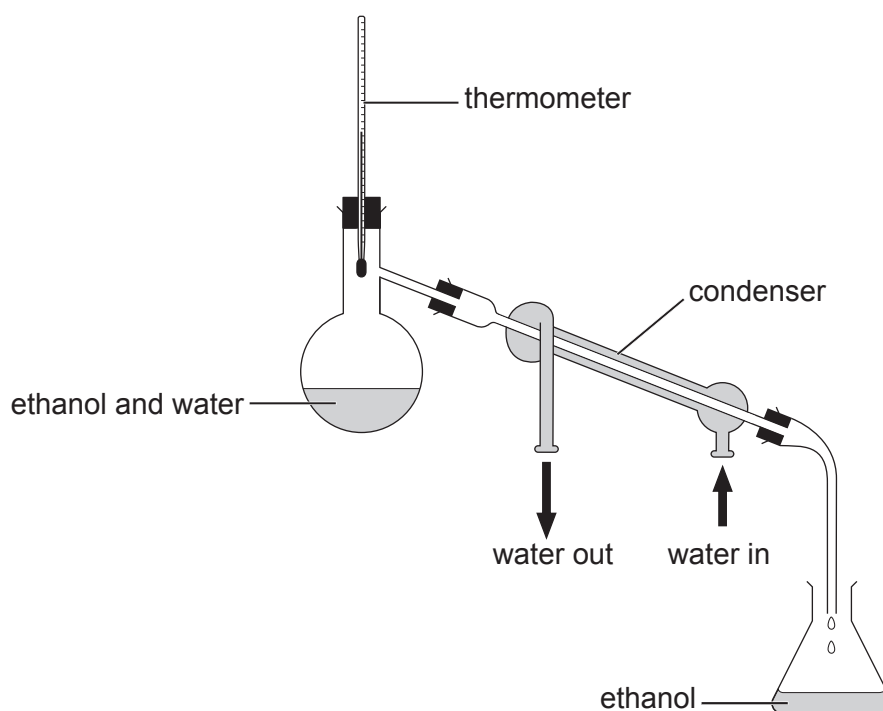
$$R_f = \frac{\text{distance travelled by dye}}{\text{distance travelled by solvent}}$$

Measure the distance travelled by dye **X** and use the equation to calculate its R_f value. [2]

$R_f =$



- (c) The diagram shows the apparatus used to separate a mixture of ethanol and water.



Explain why a mixture of ethanol and water is separated when it is heated in this apparatus.

[2]

.....

.....

.....

.....



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Examiner
only

8. The diagram represents part of the Periodic Table.

The letters shown are **not** the symbols of the elements.

																	F
												C					
												D	E				
A																	
										B							

(a) Use letters from the diagram to answer parts (i) and (ii).

(i) Give the letters of two elements that have atoms with three electrons in their outer shell. [1]

..... and

(ii) Give the letter of the element that has atoms with four electron shells. [1]

(b) Name the element represented by the letter **F**. Give **one** use of this element. [1]

Name

Use

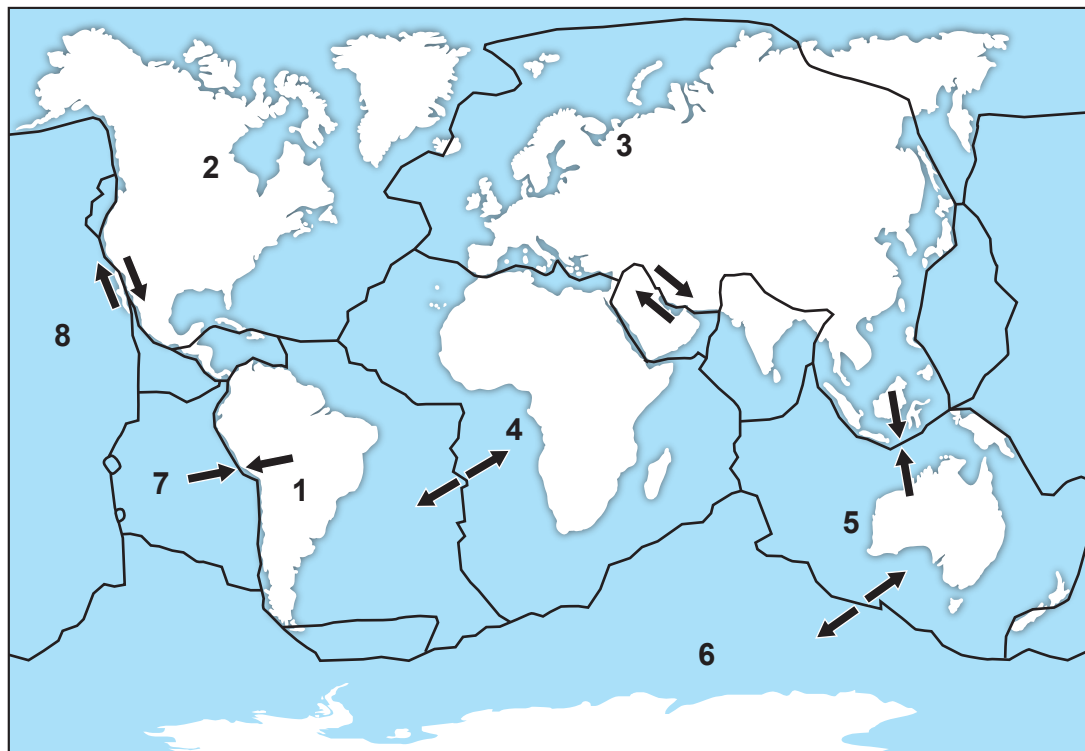
(c) State **two** properties that you would expect element **B** to have. [2]

Property 1

Property 2



9. (a) The diagram shows some of the Earth's tectonic plates and the directions in which they are moving.



- (i) Give the numbers of two plates which share a **constructive** boundary. [1]

..... and

- (ii) Describe what happens at a **destructive** plate boundary. [2]

.....

.....

.....

.....



- (b) Alfred Wegener proposed that the Earth's continents had once all been joined together in a land mass he called Pangaea and that they had moved apart over time.

He called this the 'theory of continental drift'.

200 million years ago



Present



- (i) Give **two** pieces of evidence that Alfred Wegener used to support his theory of continental drift. [2]

Evidence 1

Evidence 2

- (ii) State why Wegener's theory was not initially accepted. [1]

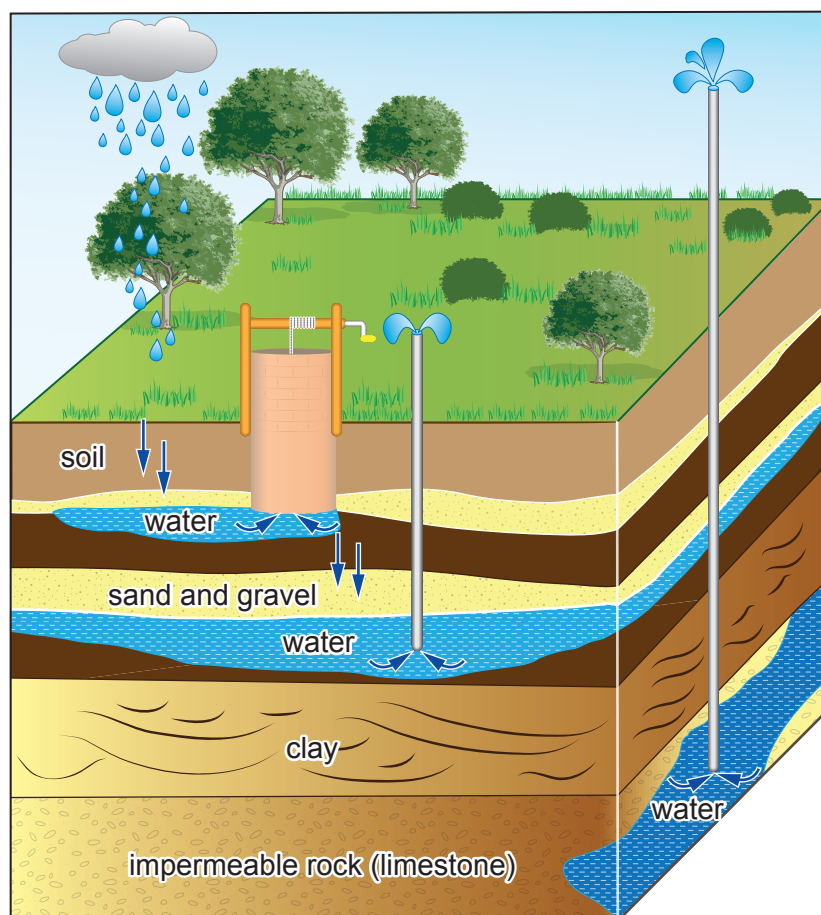
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10. Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through layers of soil, sand and rocks called aquifers.

Groundwater provides 550 megalitres of the total water needed on average per day in Wales, approximately 5% of the total volume used. Some of the negative ions dissolved in groundwater include carbonate, chloride and sulfate ions.

Groundwater can also contain pollutants which can cause harm to humans if consumed. Many of these pollutants are natural, such as bacteria and viruses. However, there are now a number of man-made pollutants present in our water supplies, including fertilisers, pesticides and chemicals from industrial and household landfill waste.



- (a) (i) Tick (✓) the box next to the approximate total volume of water used daily in Wales. [1]

110 megalitres

☐

550 megalitres

☐

11 000 megalitres

☐

- (ii) Suggest why recycling more industrial chemicals could improve the quality of groundwater. [1]

.....

.....

- (iii) Tick (✓) the box next to the solution that could be used to identify one of the negative ions present in groundwater supplies. [1]

sodium hydroxide, NaOH

☐

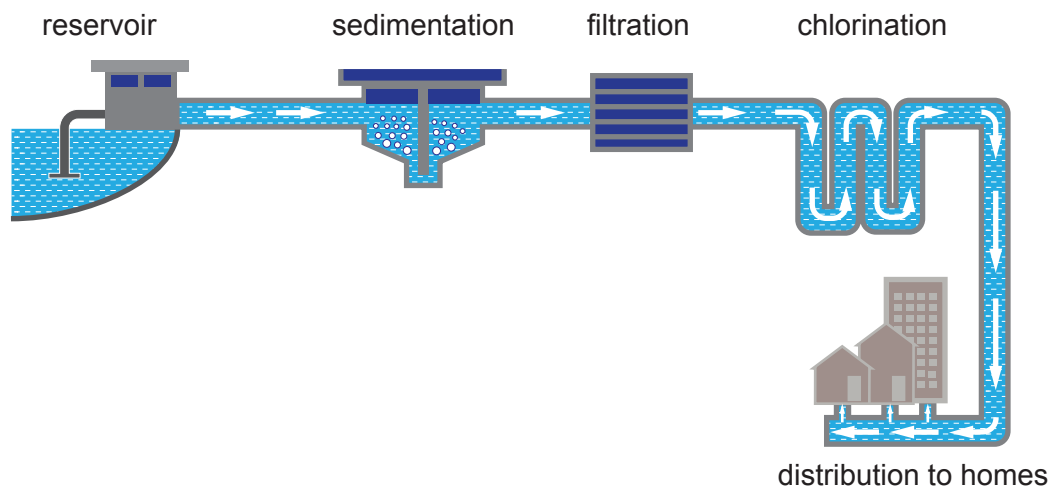
silver nitrate, AgNO₃

☐

potassium nitrate, KNO₃

☐

- (b) The diagram shows the stages of treatment of the public water supply when it leaves reservoirs before being distributed to our homes.



The first stage of treatment of the public water supply is sedimentation.

The purpose of sedimentation is to remove large insoluble particles from the water.

Give the purpose of the filtration and chlorination stages of water treatment. [2]

Filtration

.....

Chlorination

.....

- (c) (i) In some areas, fluoride is added to water supplies.

Give the reason why fluoride is added to water supplies. [1]

.....

- (ii) Give **one** reason why some people disagree with the addition of fluoride to water supplies. [1]

.....

.....



- (iii) Fluoride is added to water in compounds such as sodium fluorosilicate, Na_2SiF_6 .

The relative formula mass (M_r) of Na_2SiF_6 is 188.

Calculate the percentage by mass of sodium in Na_2SiF_6 . [2]

$$A_r(\text{Na}) = 23$$

Percentage = %

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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+}		





36

THE PERIODIC TABLE

1 2

Group

3

4

5

6

7

0

1	H	Hydrogen	1
---	---	----------	---

7	Li	Lithium	3
9	Be	Beryllium	4
23	Na	Sodium	11
24	Mg	Magnesium	12
39	K	Potassium	19
40	Ca	Calcium	20
86	Rb	Rubidium	37
88	Sr	Strontium	38
133	Cs	Caesium	55
223	Fr	Francium	87

11	B	Boron	5
12	C	Carbon	6
14	N	Nitrogen	7
16	O	Oxygen	8
19	F	Fluorine	9
20	Ne	Neon	10
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
70	Ga	Gallium	31
73	Ge	Germanium	32
75	As	Arsenic	33
79	Se	Selenium	34
80	Br	Bromine	35
84	Kr	Krypton	36
115	In	Indium	49
119	Sn	Tin	50
122	Sb	Antimony	51
127	I	Iodine	53
131	Xe	Xenon	54
204	Tl	Thallium	81
207	Pb	Lead	82
209	Bi	Bismuth	83
210	Po	Polonium	84
210	At	Astatine	85
222	Rn	Radon	86

36

59	Co	Cobalt	27
56	Fe	Iron	26
55	Mn	Manganese	25
52	Cr	Chromium	24
51	V	Vanadium	23
48	Ti	Titanium	22
45	Sc	Scandium	21
89	Y	Yttrium	39
91	Zr	Zirconium	40
93	Nb	Niobium	41
96	Mo	Molybdenum	42
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
127	I	Iodine	53
131	Xe	Xenon	54
201	Hg	Mercury	80
197	Au	Gold	79
195	Pt	Platinum	78
192	Ir	Iridium	77
190	Os	Osmium	76
186	Re	Rhenium	75
184	W	Tungsten	74
181	Ta	Tantalum	73
179	Hf	Hafnium	72
139	La	Lanthanum	57
227	Ac	Actinium	89

Key

A_r	relative atomic mass
Symbol	
Name	
Z	atomic number