

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3410U10-1



Z22-3410U10-1

FRIDAY, 17 JUNE 2022 – AFTERNOON

**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 **8** 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.	7	
2.	3	
3.	6	
4.	8	
5.	12	
6.	8	
7.	10	
8.	6	
9.	5	
10.	9	
11.	6	
Total	80	

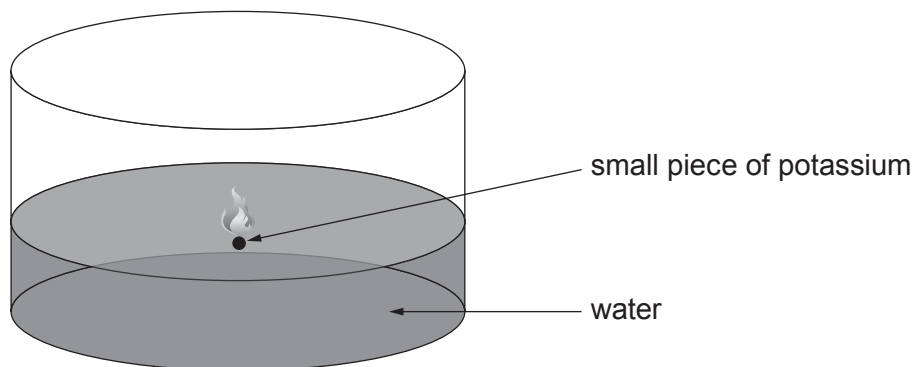
3410U101
01



JUN223410U10101

Answer **all** questions.

1. (a) Potassium reacts with water to produce potassium hydroxide and hydrogen gas.



- (i) Complete the table. Tick (✓) **one** box in **each** of the last two rows.

[2]

Substance	Formula	Element	Compound
potassium	K	✓	
water	H ₂ O		✓
potassium hydroxide	KOH		
hydrogen	H ₂		

- (ii) During the reaction, potassium burns with a **lilac** flame.

Give **two** other observations that you would expect to make.

Choose your answers from the box.

[2]

orange crystals form

fizzing

potassium sinks

potassium floats

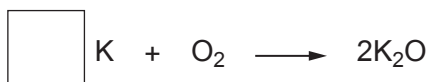
white precipitate forms

Observation 1

Observation 2



- (b) Potassium also reacts with oxygen to produce potassium oxide.



Choose a number from the box to balance the equation for this reaction.

[1]

2

4

6

- (c) Most Group 1 and Group 2 metals can be identified by the colour seen in a flame test.

Draw **one** line from each metal to the colour seen.

One line has been drawn for you.

[2]

Metal

Colour seen

lithium

white

sodium

red

barium

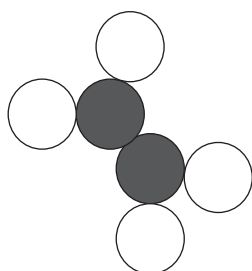
green

blue

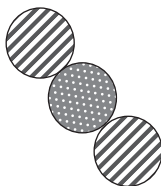
yellow



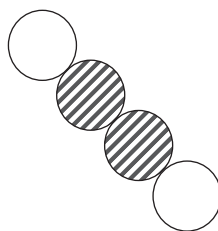
2. (a) The following diagrams represent molecules of some gases.



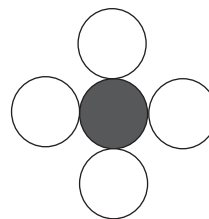
A



B



C



D

Give the **letter** of the diagram which represents each of the following molecules. [2]

sulfur dioxide, SO_2

ethene, C_2H_4

- (b) This chemical equation shows the burning of ethene, C_2H_4 .



Complete the **word** equation for this reaction. [1]

ethene + oxygen $\longrightarrow$ + water



3. Chlorine, bromine and iodine are elements in Group 7 of the Periodic Table.

- (a) State the number of electrons in the outer shell of a chlorine atom. [1]

.....

- (b) Underline the correct formula of chlorine gas. [1]



- (c) A teacher demonstrated the reactivity of Group 7 elements by placing heated iron wool in gas jars containing vapours of the elements.

The class recorded the results shown in the table.

Group 7 element	Observation with heated iron wool
chlorine	glowed very brightly
bromine	
iodine	glowed faintly

- (i) Put a tick (✓) in the box to show the observation when heated iron wool was placed in bromine vapour. [1]

glowed less brightly than iodine

☐

glowed less brightly than chlorine

☐

glowed more brightly than chlorine

☐


- (ii) The compound produced in the reaction between iron wool and bromine contains the ions Fe^{3+} and Br^- .

I. Give the formula of this compound. [1]

.....

II. State the name of this compound. [1]

.....

- (d) Tick (✓) the box next to a common use of iodine. [1]

to disinfect skin before surgery

☐

to make coloured fireworks

☐

to sterilise swimming pools

☐

to fill party balloons

☐

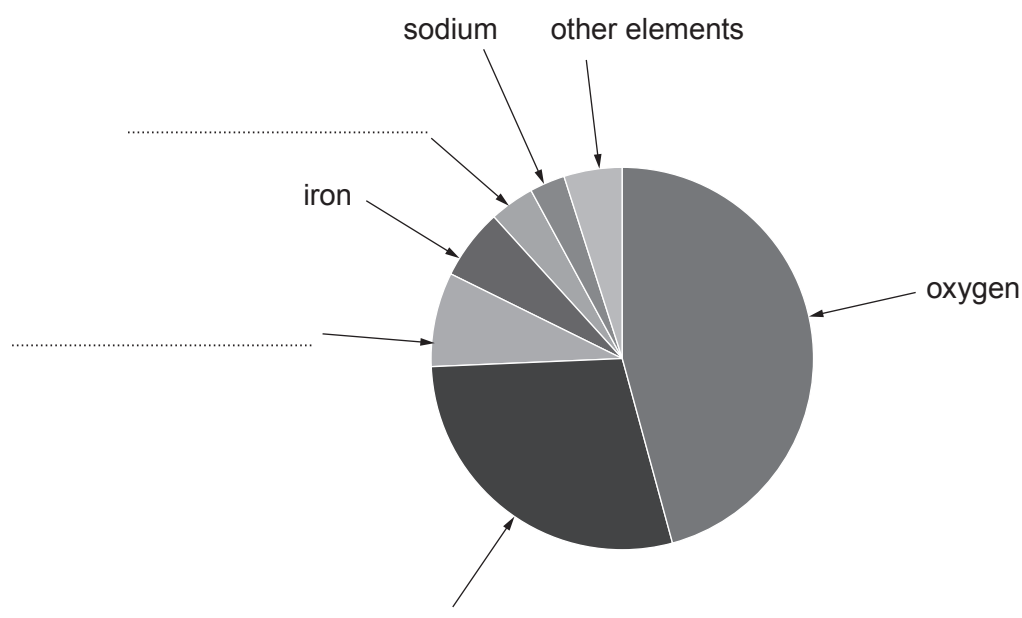
4. (a) The Earth's crust contains more than 80 elements, including many metals. Some of the metals, such as gold, are found 'native' or uncombined, but most are bonded with other elements to form compounds.

The crust can be thicker than 80 kilometres in some spots and less than one kilometre thick in others.

Just six elements make up almost all of the Earth's crust. These are aluminium, calcium, iron, oxygen, silicon and sodium.

Silicon is the second most abundant element. The amount of aluminium is approximately double the amount of calcium.

The chart shows the percentages of elements contained in the crust.



- (i) Use the information given to **label** the remaining sections of the chart. [2]
- (ii) Underline the approximate fraction of elements in the crust which are metals. [1]

$$\frac{1}{2}$$

$$\frac{1}{3}$$

$$\frac{1}{4}$$

$$\frac{3}{4}$$



- (iii) Tick (✓) the statement which best explains why most metals are **not** found native in the crust. [1]

most metals have higher melting points than gold

☐

most metals are magnetic

☐

most metals are more reactive than gold

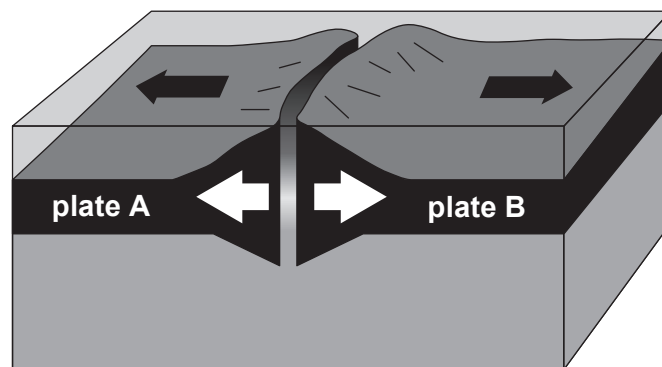
☐

most metals are radioactive

☐

- (b) Tectonic plates are huge sections of the crust that move very slowly above the mantle. The places where plates meet are called plate boundaries.

The diagram shows one type of plate boundary.



- (i) Describe how new rock is formed at this plate boundary. [3]

.....

.....

.....

.....

- (ii) Underline the name of this type of plate boundary. [1]

conservative

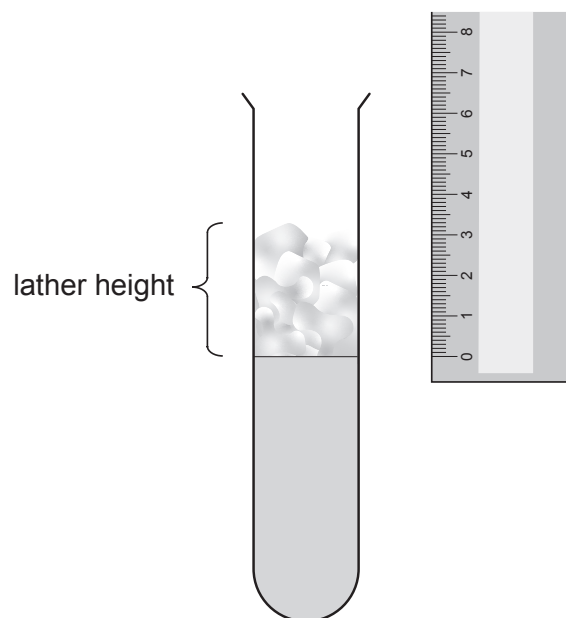
destructive

constructive



5. (a) A class measured the hardness of five different samples of water, **A**, **B**, **C**, **D** and **E**.

They added soap solution to each water sample and measured the height of the lather produced on shaking.



Their results are shown in the table.

Water sample	Lather height (cm)
A	1.5
B	3.0
C	0.5
D	5.0
E	2.0



- (i) Complete the order of hardness of the water samples, from softest to hardest. [1]

softest $\longrightarrow$ hardest

D				C
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- (ii) Calcium is one of two metal ions which cause hardness in water.

Underline the name of the other metal ion which causes hardness in water. [1]

potassium sodium nickel magnesium tin

- (iii) Tick (✓) **all** of the variables which must be controlled in this experiment. [2]

volume of soap solution

☐

type of water

☐

type of soap solution

☐

volume of water

☐

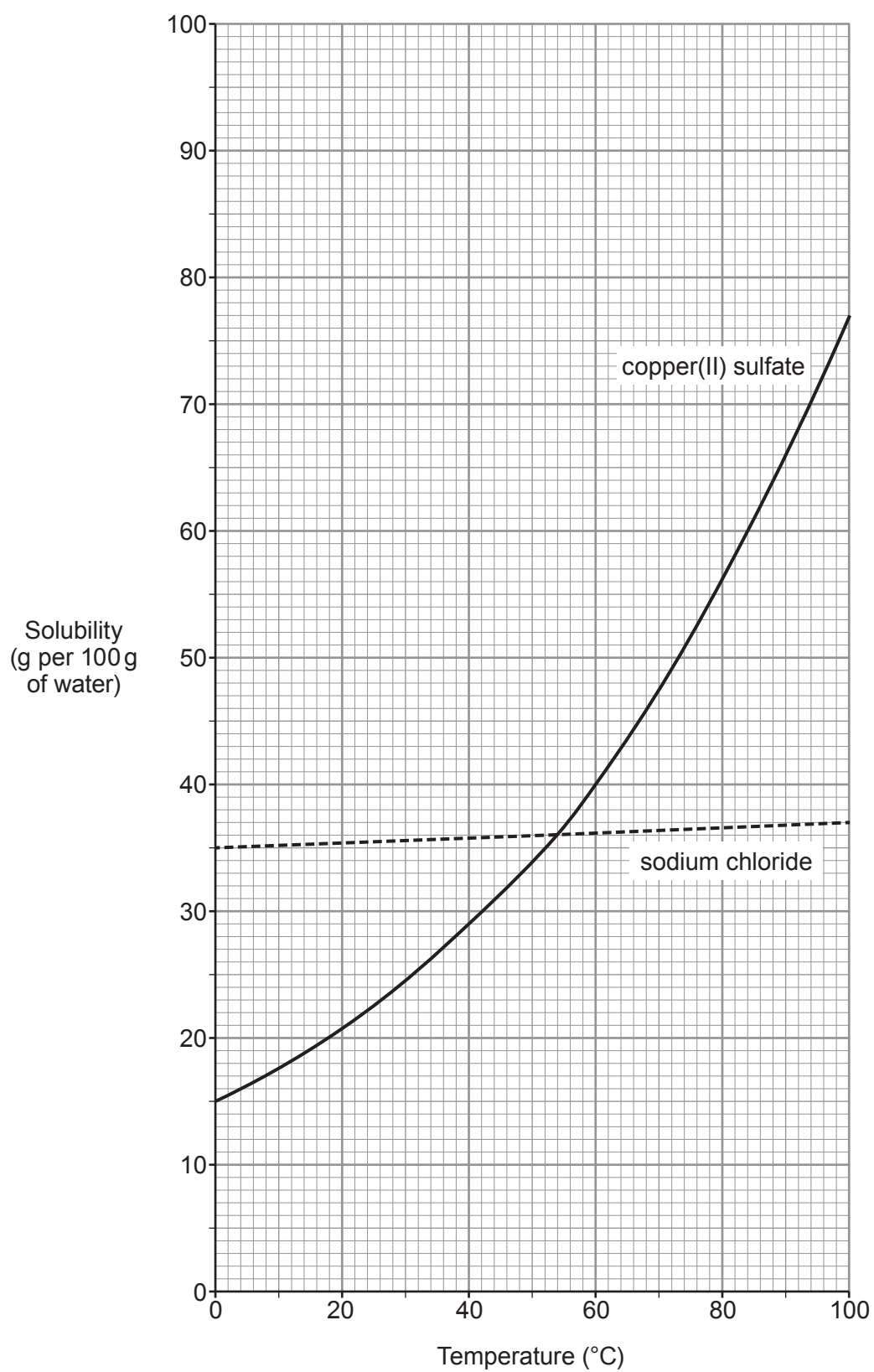
height of lather

☐

width of test tube

☐


- (b) The graph shows the solubilities of sodium chloride and copper(II) sulfate at different temperatures.



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

..... °C

- (ii) Compare the changes in solubility of the two compounds. [2]

.....

.....

.....

- (iii) Calculate the mass of copper(II) sulfate that would dissolve in **1000 g** of water at 40 °C. [2]

Mass = g

- (c) Potassium sulfate, K_2SO_4 , is soluble in water.

- (i) State the number of sulfur atoms in the formula K_2SO_4 . [1]

.....

- (ii) Calculate the relative formula mass (M_r) of K_2SO_4 . [2]

$$A_r(K) = 39 \quad A_r(S) = 32 \quad A_r(O) = 16$$

$M_r =$



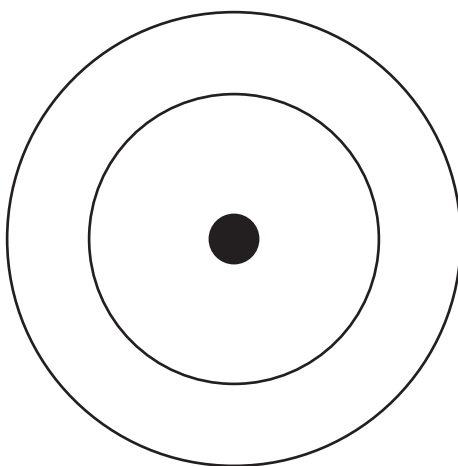
6. (a) An atom of an element has 5 protons, 5 electrons and 6 neutrons.

(i) State the atomic number and the mass number of this atom. [2]

Atomic number

Mass number

(ii) Complete the diagram of the electronic structure of the element. [1]



(iii) Explain why the atom has no overall charge. [2]

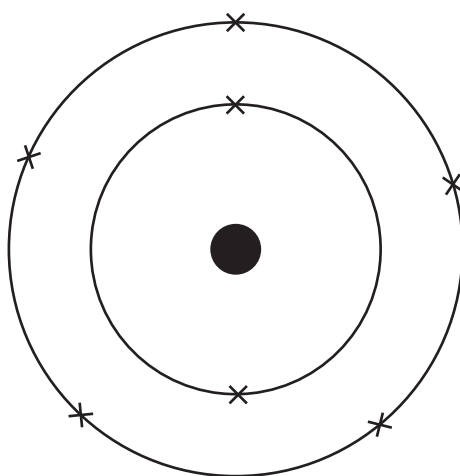
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- (b) The diagram shows the electronic structure of another element.



This element is in Group 5 and Period 2 of the Periodic Table.

- (i) State the name of the element. [1]

.....

- (ii) Use the electronic structure to explain why this element is in Group 5. [1]

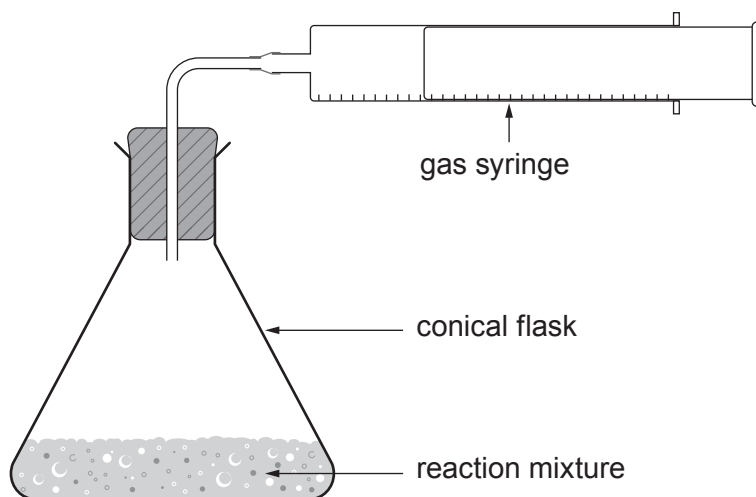
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- (iii) Use the electronic structure to explain why this element is in Period 2. [1]

.....



7. A student decided to investigate the rate of reaction of different concentrations of hydrochloric acid with pieces of chalk, using the equipment shown.



Chalk contains calcium carbonate and the reaction produces carbon dioxide gas.

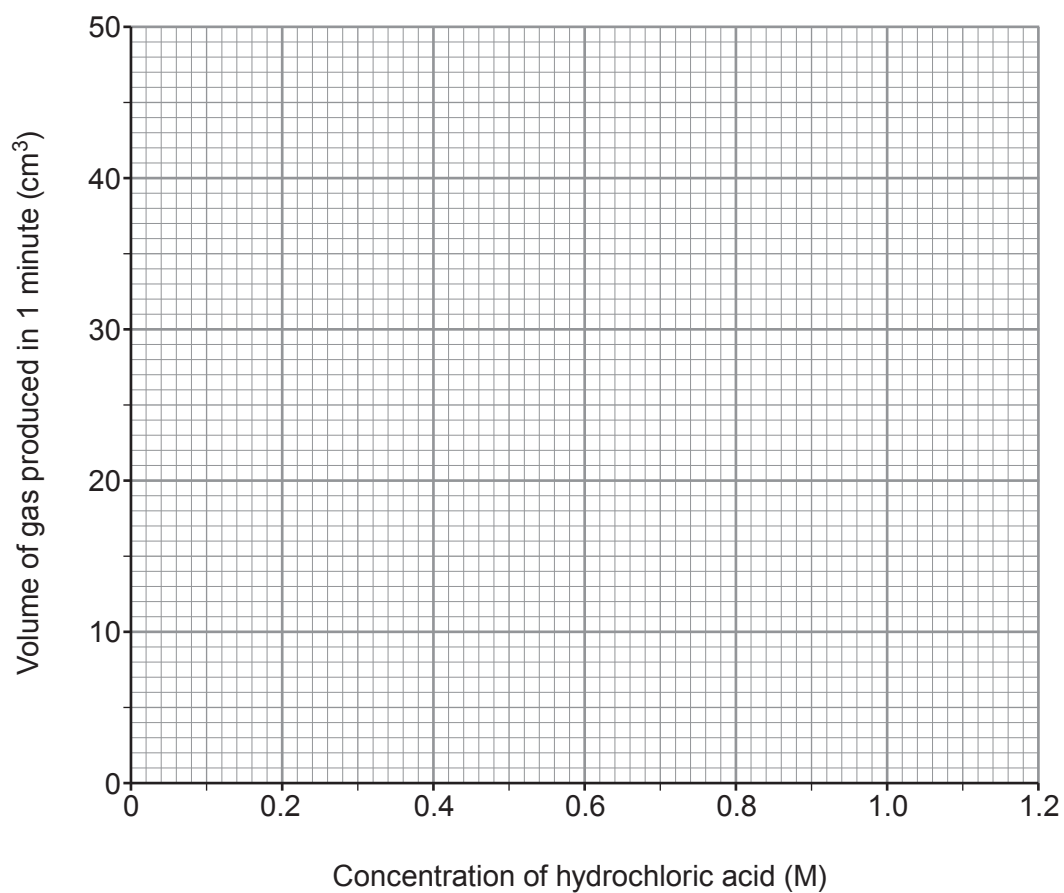
The table shows the student's results.

Concentration of hydrochloric acid (M)	Volume of gas produced in 1 minute (cm ³)
0.2	8
0.4	16
0.6	24
0.8	32
1.0	40
1.2	48



- (a) Plot the results from the table on the grid. Draw a suitable line.

[3]



- (b) Describe how the volume of gas produced in 1 minute changes as the concentration of the acid changes. [2]

.....

.....

.....

- (c) Underline the correct word(s) in each bracket to explain the results. [3]

When the acid concentration is higher, there are

(**more** / less / the same number of) particles in the same volume.

Acid particles (**dissolve** / mix / collide) with the chalk more frequently.

The (**chalk** / acid / gas) is produced at a higher rate.

- (d) Other than changing the concentration of the acid or the mass of the chalk added, state **two** ways in which the rate of this reaction could be increased. [2]

.....

.....

.....



8. Burning fossil fuels leads to global warming.

Explain how global warming arises and describe the problems caused.

[6 QER]

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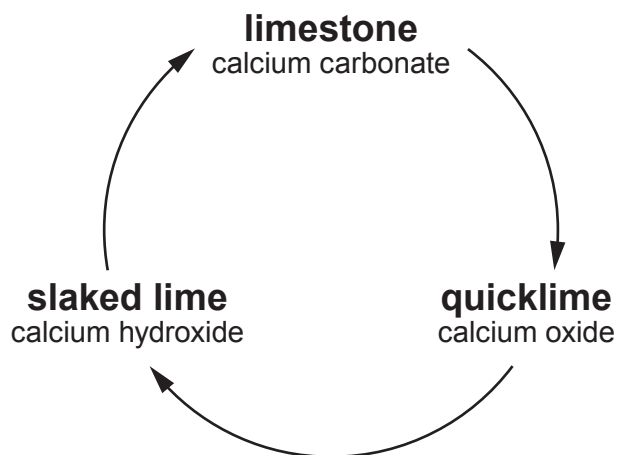
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6



9. Limestone is a rock which consists mostly of calcium carbonate. The diagram shows a cycle of reactions involving limestone.



- (a) (i) When limestone is heated, calcium carbonate is converted to calcium oxide and carbon dioxide.

I. State the name for this type of reaction. [1]

.....

II. Write a balanced symbol equation for the reaction. [2]

..... → +

(ii) State what must be added to calcium oxide to form calcium hydroxide. [1]

.....

(b) Give **one** use of limestone in the construction industry. [1]

.....



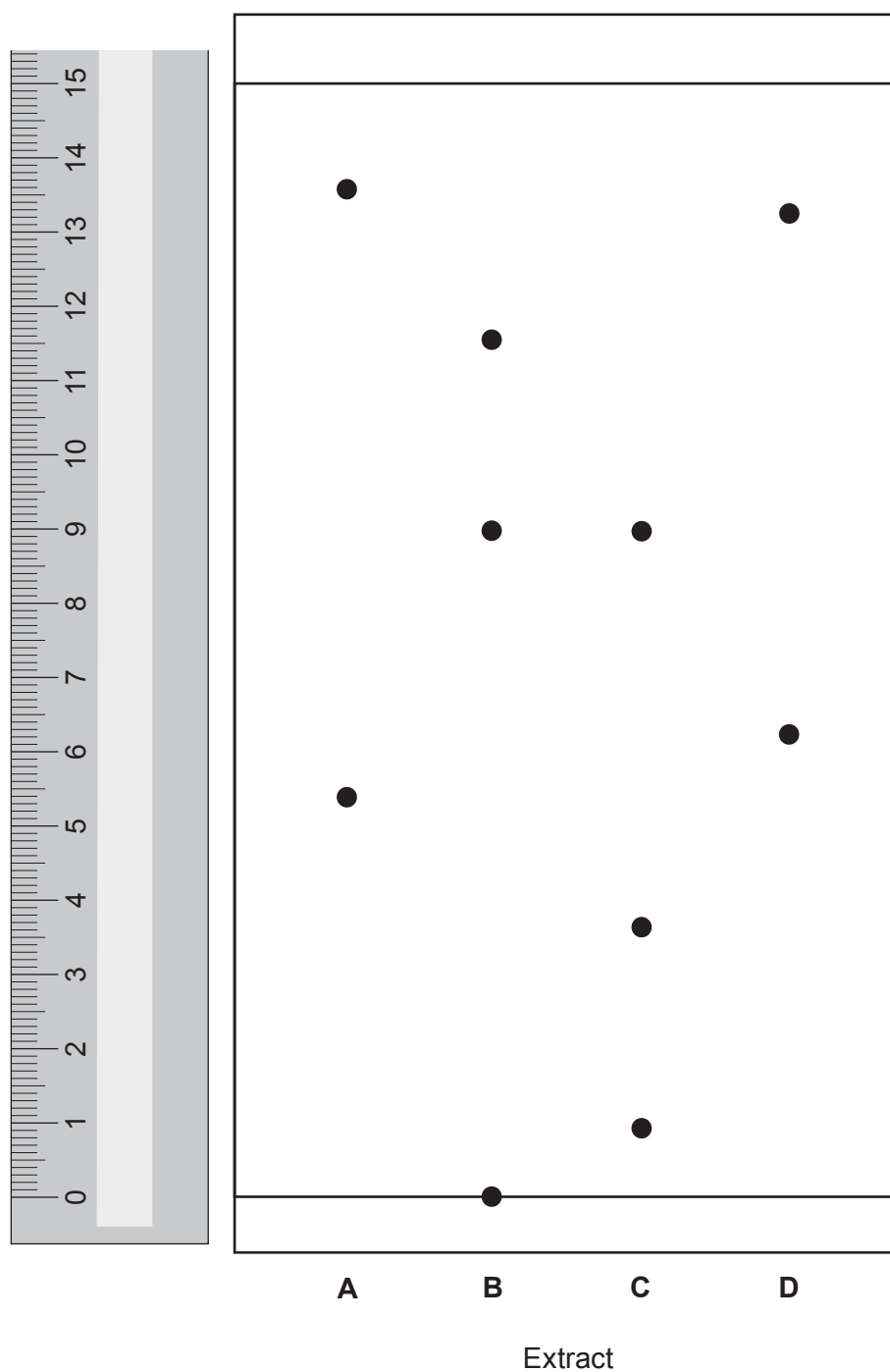
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10. Paper chromatography can be used to identify plant leaf pigments. This process uses a chemical called acetone as the solvent instead of water.

The diagram shows the chromatogram of plant leaf extracts **A**, **B**, **C** and **D** in acetone.



- (a) All of the extracts contain a mixture of pigments with different R_f values.

For which plant leaf extract, **A**, **B**, **C** or **D**, is the **highest** R_f value 0.60?

Give your reasoning.

[3]

Extract

Reasoning

.....

.....

- (b) Explain why the pigments travel different distances on the chromatogram.

[2]

.....

.....

.....

- (c) One of the extracts contains a pigment which is insoluble in acetone.

State the **letter** of this extract. Explain your choice.

[2]

Extract

Explanation

.....

- (d) The chemical formula of the solvent acetone is C_3H_6O . Calculate the percentage by mass of carbon in acetone.

The relative formula mass (M_r) of acetone is 58.

[2]

$$A_r(C) = 12$$

Percentage = %



11. (a) The Earth's early atmosphere contained large amounts of water vapour and carbon dioxide. Explain why the amounts of water vapour and carbon dioxide decreased over geological time. [4]

Water vapour

.....

.....

.....

Carbon dioxide

.....

.....

.....

- (b) State the percentages of nitrogen and oxygen in the present atmosphere. [2]

Nitrogen %

Oxygen %

6

END OF PAPER



[illegible]

[illegible]

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

Group

3

4

5

6

7

0

1	H	1
	Hydrogen	

7	Li	9	Be
	Lithium		Beryllium
	3		4
23	Na	24	Mg
	Sodium		Magnesium
	11		12
39	K	40	Ca
	Potassium		Calcium
	19		20
86	Rb	88	Sr
	Rubidium		Strontium
	37		38
133	Cs	137	Ba
	Caesium		Barium
	55		56
223	Fr	226	Ra
	Francium		Radium
	87		88

45	Sc	48	Ti	51	V	52	Cr	55	Mn	56	Fe	59	Co	59	Ni	63.5	Cu	65	Zn
	Scandium		Titanium		Vanadium		Chromium		Manganese		Iron		Cobalt		Nickel		Copper		Zinc
	21		22		23		24		25		26		27		28		29		30
89	Y	91	Zr	93	Nb	96	Mo	99	Tc	101	Ru	103	Rh	106	Pd	108	Ag	112	Cd
	Yttrium		Zirconium		Niobium		Molybdenum		Technetium		Ruthenium		Rhodium		Palladium		Silver		Cadmium
	39		40		41		42		43		44		45		46		47		48
139	La	179	Hf	181	Ta	184	W	186	Re	190	Os	192	Ir	195	Pt	197	Au	201	Hg
	Lanthanum		Hafnium		Tantalum		Tungsten		Rhenium		Osmium		Iridium		Platinum		Gold		Mercury
	57		72		73		74		75		76		77		78		79		80

11	B	12	C	14	N	16	O	19	F	20	Ne
	Boron		Carbon		Nitrogen		Oxygen		Fluorine		Neon
	5		6		7		8		9		10
27	Al	28	Si	31	P	32	S	35.5	Cl	40	Ar
	Aluminium		Silicon		Phosphorus		Sulfur		Chlorine		Argon
	13		14		15		16		17		18
70	Ga	73	Ge	75	As	79	Se	80	Br	84	Kr
	Gallium		Germanium		Arsenic		Selenium		Bromine		Krypton
	31		32		33		34		35		36
115	In	119	Sn	122	Sb	128	Te	127	I	131	Xe
	Indium		Tin		Antimony		Tellurium		Iodine		Xenon
	49		50		51		52		53		54
204	Tl	207	Pb	209	Bi	210	Po	210	At	222	Rn
	Thallium		Lead		Bismuth		Polonium		Astatine		Radon
	81		82		83		84		85		86

Key

relative atomic mass

A _r	Symbol
	Name
Z	atomic number