

Surname	Centre Number	Candidate Number
First name(s)		0



**GCSE**

3430UB0-1



**FRIDAY, 17 JUNE 2022 – AFTERNOON**

**SCIENCE (Double Award)**

**Unit 2 – CHEMISTRY 1  
HIGHER TIER**

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	9	
2.	6	
3.	6	
4.	10	
5.	6	
6.	6	
7.	8	
8.	9	
<b>Total</b>	<b>60</b>	

### 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.



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Answer **all** questions.

1. (a) (i) State why sodium is stored in oil in the laboratory. [1]

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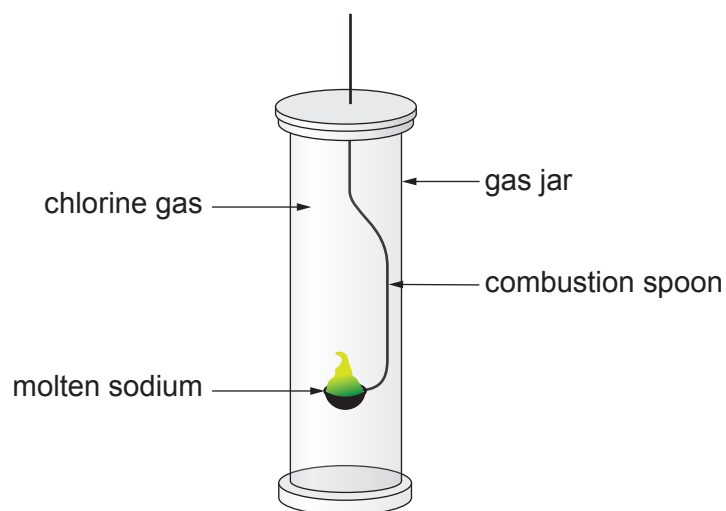
- (ii) Describe the change in appearance when a piece of freshly cut sodium is left for a few minutes. [1]

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- (iii) Give the formula of the compound formed when sodium reacts with oxygen. [1]

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- (b) The diagram shows the reaction of sodium with chlorine.



- (i) State why it is necessary to carry out this reaction in a fume cupboard. [1]

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- (ii) Complete and balance the equation for the reaction of sodium and chlorine. [2]



(c) The table shows some properties of Group 7 elements.

Element	Melting point (°C)	Boiling point (°C)	Reaction with hot iron
fluorine	-220	-188	explosive
chlorine	-101	-34	very fast
bromine	-7	59	quite fast
iodine	114		slow

(i) Put a tick (✓) in the box next to the most likely boiling point for iodine. [1]

-25°C       25°C       100°C       150°C

(ii) Astatine lies below iodine in Group 7. State how you would expect astatine to react with hot iron.

Give a reason for your answer. [2]

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2. (a) In 1915 Alfred Wegener suggested that the Earth's continents were once joined together as one large land mass.



- (i) State **three** pieces of evidence that Alfred Wegener used to support his theory. [3]

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- (ii) Explain why Wegener's theory was not originally accepted by other scientists, but it is today. [2]

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(b) What type of destructive event is likely to happen at a **conservative** plate boundary? [1]

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3. The table shows the electronic structures of atoms of the elements **A–F**.

**A–F are not the chemical symbols for the elements.**

Element	Electronic structure
<b>A</b>	2
<b>B</b>	2,6
<b>C</b>	2,8,1
<b>D</b>	2,8,7
<b>E</b>	2,8
<b>F</b>	2,8,6

(a) Which of elements **A–F** is found in Group 6 and Period 3 of the Periodic Table?

Explain your choice, referring to electronic structure.

[2]

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(b) Which **two** of elements **A–F** are chemically inert?

Explain your choice, referring to electronic structure.

[2]

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(c) Element **D** has two isotopes. Isotope **1** has 18 neutrons and isotope **2** has 20 neutrons.

Complete the table by giving the atomic number and mass number of both isotopes. [2]

Isotope	Atomic number	Mass number
<b>1</b>		
<b>2</b>		

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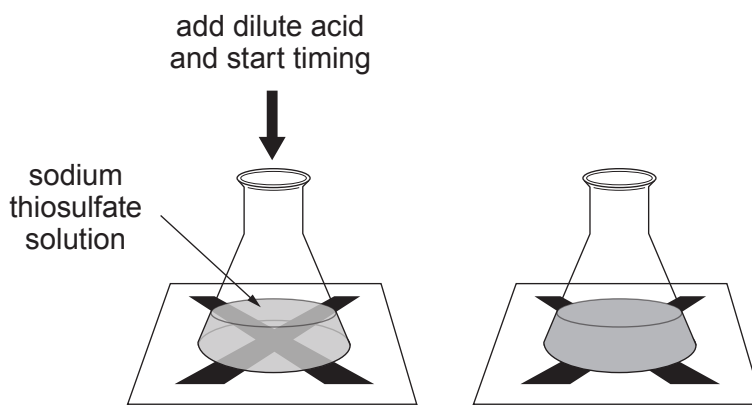
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4. Sodium thiosulfate solution reacts with dilute hydrochloric acid to form a precipitate. The precipitate causes the solution to go cloudy.

The rate of the reaction can be measured by placing a cross beneath the flask and measuring the time taken for the cross to disappear.



Gareth and Sion studied the effect of sodium thiosulfate concentration by carrying out the reaction with thiosulfate of five different concentrations. They tested each concentration three times.

Their results are shown in the table below.

Concentration of sodium thiosulfate (g/dm <sup>3</sup> )	Time 1 (s)	Time 2 (s)	Time 3 (s)	Mean time (s)
0.2	114	113	112	113
0.4	74	70	72	72
0.6	40	38	57	39
0.8	21	23	22	22
1.0	14	16	15	15

- (a) When calculating the mean times, they ignored one of the values recorded.

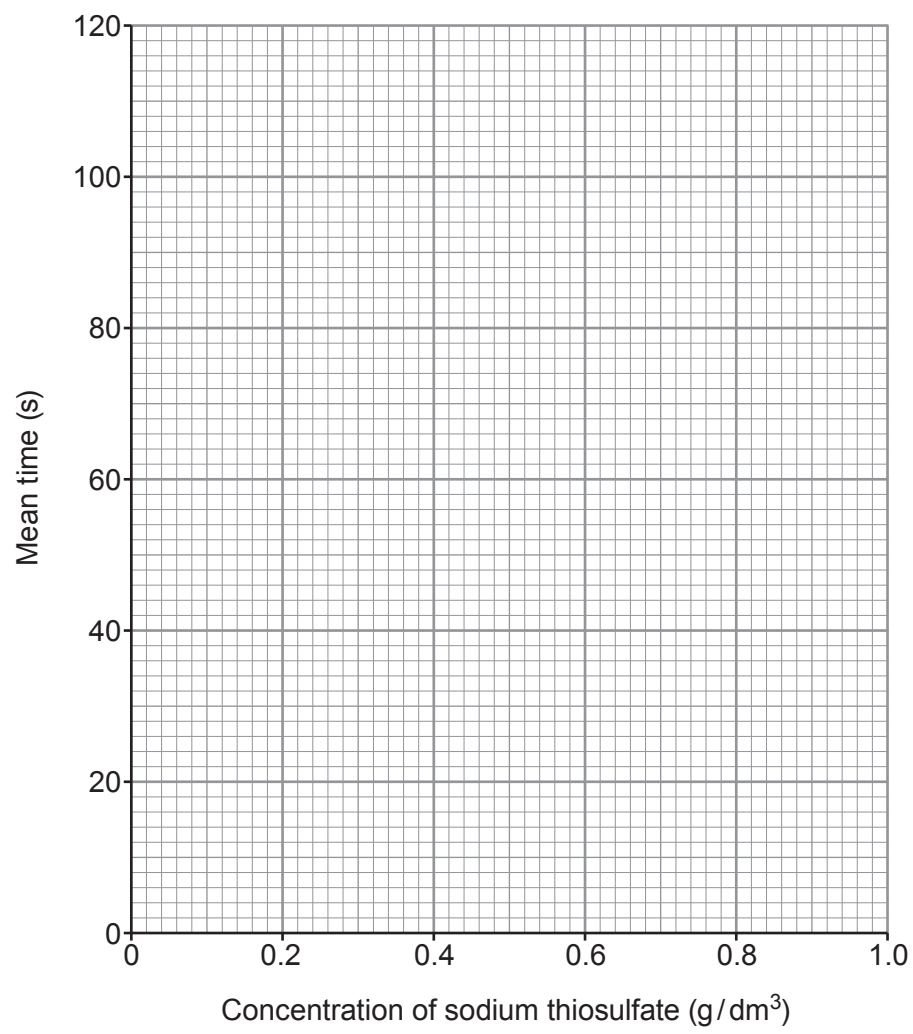
Circle this value in the table.

[1]





(b) Plot the mean time against sodium thiosulfate concentration on the grid below. Draw a suitable line. [3]



(c) Explain the results in terms of particle theory. [3]

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(d) A second group of students carried out the same experiment with sodium thiosulfate solution at a higher temperature.

On the grid above, sketch a line to show the results you would expect them to record. [1]



- (e) The stock solution of sodium thiosulfate used in both experiments was made by dissolving 1.0 g of the solid in 1 dm<sup>3</sup> of water.

Calculate the number of moles of sodium thiosulfate (Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>) in 1.0 g.

Give your answer to **two** significant figures.

[2]

$$A_r(\text{Na}) = 23 \quad A_r(\text{S}) = 32 \quad A_r(\text{O}) = 16$$

Number of moles = ..... mol

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5. Calcium ions ( $\text{Ca}^{2+}$ ) and magnesium ions ( $\text{Mg}^{2+}$ ) both cause hardness in water. Both can be present in temporary hard water and permanent hard water. It is the other ions present which cause hardness to be temporary or permanent.

State the difference between the composition of temporary hard water and permanent hard water. Describe a method to distinguish between them in the laboratory. Explain how this method works. [6 QER]

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6. Levels of oxygen and carbon dioxide in the atmosphere are maintained at approximately constant values.

(a) Identify the natural processes that help maintain the balance of oxygen and carbon dioxide levels in the atmosphere. Describe briefly how this is achieved. [3]

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- (b) The table shows the amount of carbon dioxide produced by the United States of America and India between 1955 and 2015.

Year	Carbon dioxide emissions (million tonnes)	
	USA	India
1955	700	100
1965	800	250
1975	1150	250
1985	1150	450
1995	1150	600
2005	1400	900
2015	1300	1850

Use the information in the table to compare the increase in carbon dioxide emissions in the United States of America and India between 1955 and 2015. [2]

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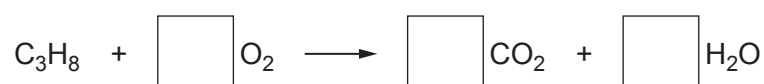
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- (c) The combustion of the fossil fuel propane ( $C_3H_8$ ) produces carbon dioxide and water. Balance the equation for this reaction. [1]



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7. The table shows some properties of elements in Period 3 of the Periodic Table.

Element	Melting point (°C)	Boiling point (°C)	Density (g/cm <sup>3</sup> )	Appearance	Malleability	Conductivity
Na	98	882	1.00	shiny solid	malleable	good
Mg	650	1091	1.75	shiny solid	malleable	good
Al	660	2470	2.70	shiny solid	malleable	good
Si	1410	3265	2.35	shiny solid	brittle	semiconductor
P	44	281	1.80	red solid	brittle	poor
S	113	444	2.05	yellow solid	brittle	poor
Cl	-101	-34	0.003	green gas	n/a	poor

(a) One of the elements is difficult to classify as a metal or non-metal.

Identify this element and give your reasoning.

[2]

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- (b) Tick (✓) **two** boxes which correctly describe the change in density and boiling point for the elements across Period 3. [2]

The density of metals and non-metals increases

The boiling point of metals increases but the boiling point of non-metals shows no trend

The density of metals shows no trend but the density of non-metals decreases

The boiling point of metals and non-metals shows no trend

The density of metals increases but the density of non-metals shows no trend

The boiling point of metals shows no trend but the boiling point of non-metals decreases

The density of metals decreases but the density of non-metals shows no trend

- (c) Argon is the next element in Period 3 after chlorine, Cl.

State why it is not possible to predict a melting point for argon using the information in the table. [1]

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(d) Phosphorus is found in phosphoric acid,  $\text{H}_3\text{PO}_4$ .

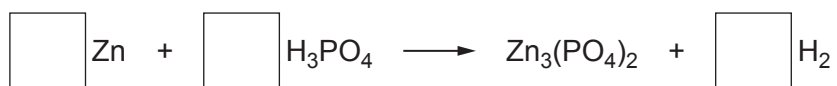
(i) During the production of phosphoric acid, phosphorus is heated to  $60^\circ\text{C}$ .

Give the state of phosphorus at  $60^\circ\text{C}$ . Explain your choice. [2]

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(ii) Phosphoric acid reacts with zinc to produce zinc phosphate and hydrogen.

Balance the equation for this reaction. [1]



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8. The tables show the electronic structures of some Group 1 and Group 2 elements.

Group 1 metal	Electronic structure
sodium	2,8,1
potassium	2,8,8,1

Group 2 metal	Electronic structure
magnesium	2,8,2
calcium	2,8,8,2

(a) (i) Use the information to explain the trend in reactivity down Group 1. [2]

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(ii) Use the information to explain the difference in reactivity of Group 1 and Group 2 elements. [2]

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- (b) Sodium reacts with water to produce sodium hydroxide and hydrogen. The equation for this reaction is shown.



Calculate the mass of sodium needed to produce 11.2g of hydrogen gas. [3]

$$A_r(\text{Na}) = 23 \quad A_r(\text{H}) = 1$$

Mass of sodium = ..... g

- (c) Group 2 metals react in a similar way with water as Group 1 metals.

The word equation for the reaction of calcium and water is shown.



Write the balanced symbol equation for this reaction. [2]

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**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	$\text{Zn}^{2+}$		



# THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

		$\begin{matrix} 1 \\ \text{H} \\ \text{Hydrogen} \\ 1 \end{matrix}$										$\begin{matrix} 4 \\ \text{He} \\ \text{Helium} \\ 2 \end{matrix}$																									
7	Li Lithium 3	9	Be Beryllium 4	11	Na Sodium 11	12	C Carbon 6	13	Al Aluminium 13	14	N Nitrogen 7	15	O Oxygen 8	16	F Fluorine 9	17	Ne Neon 10																				
23	Na Sodium 11	24	Mg Magnesium 12	25	Mn Manganese 25	26	Fe Iron 26	27	Co Cobalt 27	28	Ni Nickel 28	29	Cu Copper 29	30	Zn Zinc 30	31	Ga Gallium 31	32	Ge Germanium 32	33	As Arsenic 33	34	Se Selenium 34	35	Br Bromine 35	36	Kr Krypton 36										
39	K Potassium 19	40	Ca Calcium 20	41	Sc Scandium 21	42	Ti Titanium 22	43	V Vanadium 23	44	Cr Chromium 24	45	Mn Manganese 25	46	Fe Iron 26	47	Co Cobalt 27	48	Ni Nickel 28	49	Cu Copper 29	50	Zn Zinc 30	51	Ga Gallium 31	52	Ge Germanium 32	53	As Arsenic 33	54	Se Selenium 34	55	Br Bromine 35	56	Kr Krypton 36		
86	Rb Rubidium 37	87	Sr Strontium 38	88	Y Yttrium 39	89	Zr Zirconium 40	90	Nb Niobium 41	91	Mo Molybdenum 42	92	Tc Technetium 43	93	Ru Ruthenium 44	94	Rh Rhodium 45	95	Pd Palladium 46	96	Ag Silver 47	97	Cd Cadmium 48	98	In Indium 49	99	Sn Tin 50	100	Sb Antimony 51	101	Te Tellurium 52	102	I Iodine 53	103	Xe Xenon 54		
133	Cs Caesium 55	137	Ba Barium 56	138	La Lanthanum 57	139	Hf Hafnium 72	140	Ta Tantalum 73	141	W Tungsten 74	142	Re Rhenium 75	143	Os Osmium 76	144	Ir Iridium 77	145	Pt Platinum 78	146	Au Gold 79	147	Hg Mercury 80	148	Tl Thallium 81	149	Pb Lead 82	150	Bi Bismuth 83	151	Po Polonium 84	152	At Astatine 85	153	Rn Radon 86		
223	Fr Francium 87	226	Ra Radium 88	227	Ac Actinium 89	228		229		230		231		232		233		234		235		236		237		238		239		240		241		242		243	

### Key

