Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3410UA0-1

S19-3410UA0-1

WEDNESDAY, 12 JUNE 2019 – MORNING

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

HIGHER TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**7**	
3.	**9**	
4.	**6**	
5.	**7**	
6.	**7**	
7.	**9**	
8.	**12**	
9.	**6**	
10.	**10**	
Total	**80**	

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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.

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 **9** 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)* The following table shows some information about Group 1 elements.

Metal	Melting point (°C)	Boiling point (°C)	Density (g/cm^3)	Reaction with chlorine
lithium	180	1342	0.54	reacts slowly to make a white salt
sodium	97	883	0.97	burns vigorously with a yellow flame to make a white salt
potassium	63	759	0.88	reacts violently to make a white salt
rubidium	39	688	1.53	explosive reaction
caesium	28	671	1.93	explosive reaction

(i) Describe the trend in density going down the group. [1]

....

(ii) Explain the difference in reactivity down the group in terms of electronic structure. [2]

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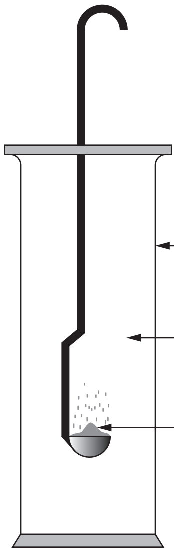
(b) The apparatus below can be used to demonstrate the reaction between sodium and chlorine.



(i) Apart from the use of safety goggles, state **one** safety precaution that needs to be followed when using **each** of these elements. [2]

Element	Safety precaution
sodium	....
chlorine	....

(ii) Complete and balance the symbol equation for the reaction that takes place between sodium and chlorine. [2]

$\square$ Na + Cl_2 ⟶ $\square$ ....

7

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Turn over.

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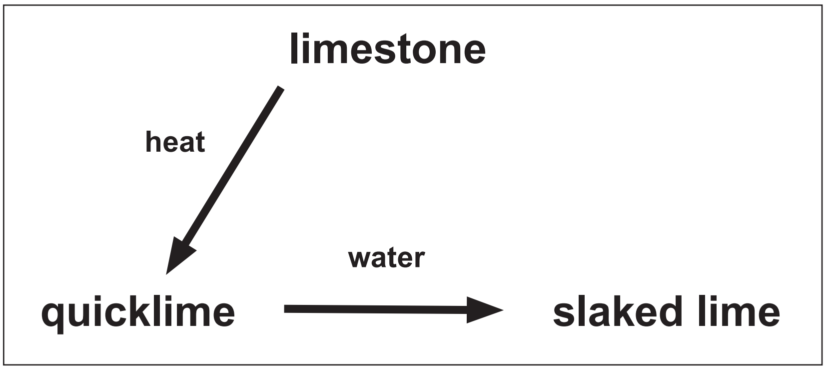
2. The following diagram shows how limestone, $CaCO_3$, can be converted into useful products.



(a) When a piece of limestone is heated strongly its mass decreases.

State the type of reaction taking place. [1]

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(b) (i) Describe what is **seen** when limestone is heated and converted into quicklime. [1]

....

(ii) Write a balanced symbol equation for the reaction taking place. [2]

....

(c) (i) Describe what is observed when quicklime is converted into slaked lime. [1]

....

(ii) Write a balanced symbol equation for the reaction taking place. [2]

....

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3. *(a)* Enzymes are biological catalysts. State what is meant by the term *catalyst*. [2]

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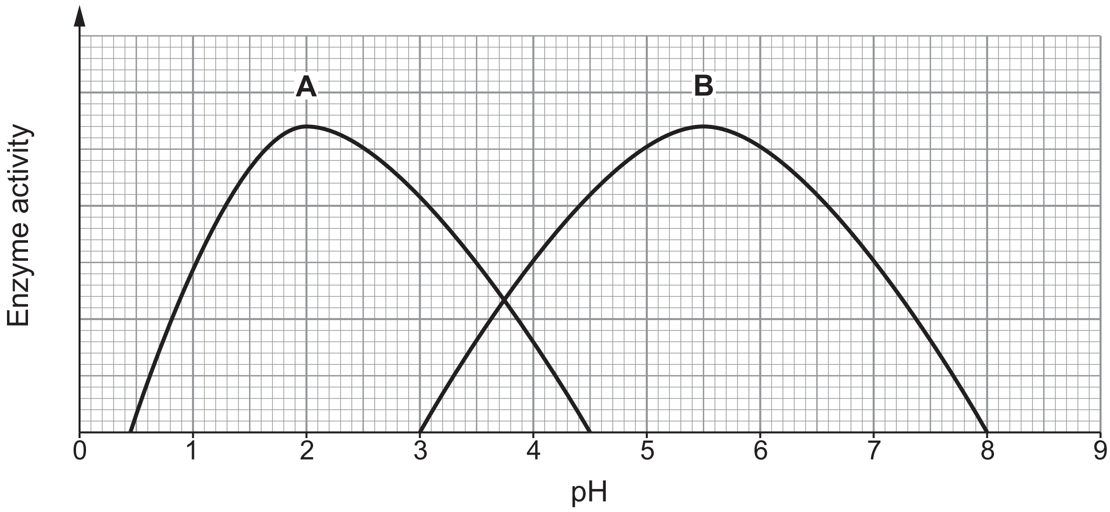
(b) The following graphs show how the activity of two enzymes, **A** and **B**, varies with pH.



(i) Use the graphs to compare the activities of the two enzymes. [2]

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(ii) Enzyme **C** is found in saliva. It works between pH 5 and pH 9 but is best at a neutral pH. **Sketch on the grid above** how the activity varies with pH. [2]

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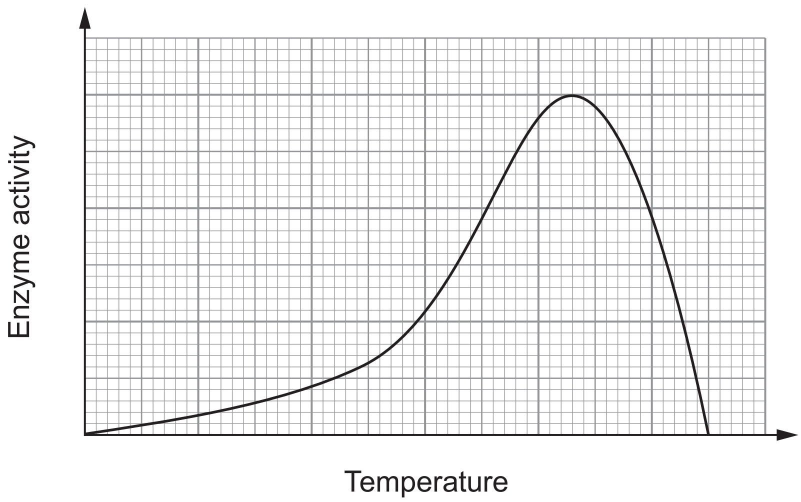
(c) Temperature also affects enzyme activity as shown below.



Use the graph and your knowledge to describe how the activity of a typical enzyme changes as temperature increases. [3]

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4. Alfred Wegener proposed the theory of continental drift.

(a) State the **evidence** that Wegener used to support his theory and explain why other scientists refused to accept it. [3]

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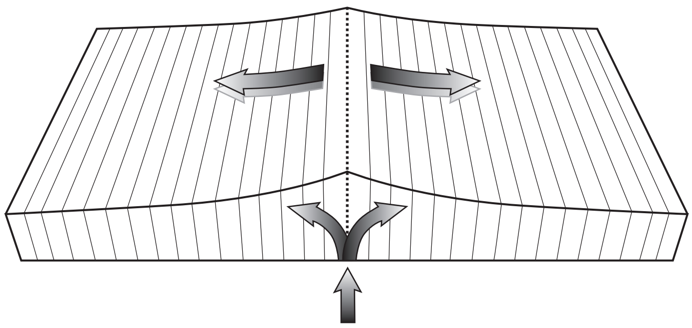
(b) In the 1960s scientists studied the ocean floor at a constructive plate boundary. Their observations are summarised in the following diagram.



(i) Describe what is happening at this boundary. [2]

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....

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(ii) **Label the diagram** clearly to show the **oldest** rock. [1]

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6

5. The following table shows the solubility of potassium permanganate in water at temperatures between 30 °C and 60 °C.

Temperature (°C)	Solubility (g / 100 g of water)
30	9.0
35	10.8
40	12.5
45	14.4
50	16.8
55	19.2
60	22.2

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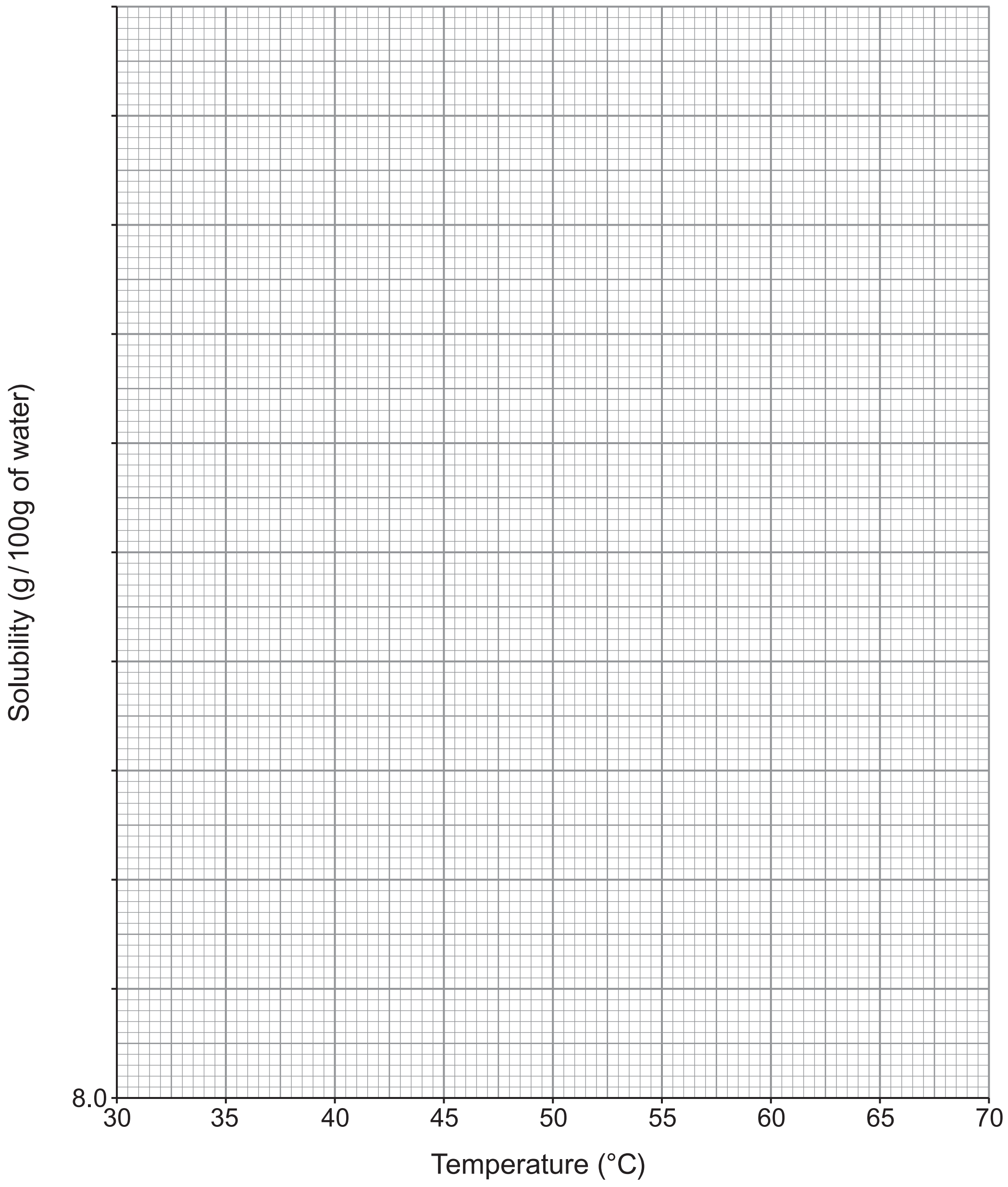
(a) Plot these values on the grid below. Draw a suitable line. [4]



(b) Use the graph to calculate the mass of crystals formed when a saturated solution in 500 g of water is cooled from 65 °C to 30 °C. [3]

Mass of crystals = ... g

7

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 (3410UA0-1) **Turn over.**

6. This question is about the uses of gases present in air.

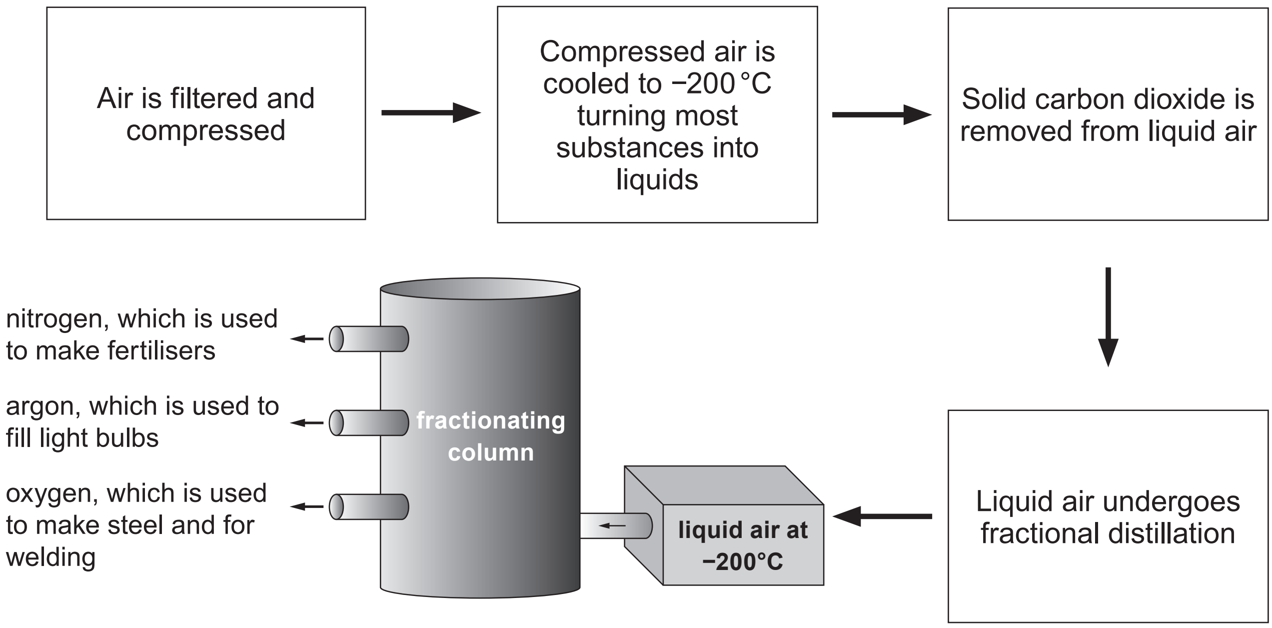
Air is a mixture of different gases. Each gas has different uses. The gases are present in different amounts as shown below.

Gas	Amount present in air	Boiling point (°C)
N_2	78.04%	−195.8
O_2	20.95%	−183.0
CO_2	0.03%	−78.5
Ar	0.93%	−189.2
Ne	18 ppm	−246.0
He	5 ppm	−268.9
Kr	1 ppm	−152.3
Xe	0.08 ppm	−107.1
H_2	0.5 ppm	−257.9
CH_4	2 ppm	−164.0
N_2O	0.5 ppm	−88.5

ppm = parts per million

Separating a complex mixture!

Air is firstly compressed and cooled which turns it into a liquid. Carbon dioxide freezes and is removed as solid dry ice. The rest of the mixture goes on to a fractionating column where it is slowly warmed allowing most of the substances to be separated.



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(a) Tick (✓) the **main** reason why hydrogen is not separated during the fractional distillation of liquid air. [1]

hydrogen is a highly reactive gas ☐

only 0.5 ppm of hydrogen is present ☐

hydrogen does not become liquid on cooling to −200 °C ☐

hydrogen has a higher boiling point than helium ☐

(b) Tick (✓) the reason why carbon dioxide becomes a solid during the first part of the process. [1]

carbon dioxide has a boiling point above −200 °C ☐

carbon dioxide has a melting point above −200 °C ☐

carbon dioxide has a melting point below −200 °C ☐

carbon dioxide has a boiling point below −200 °C ☐

(c) Describe, in terms of boiling points, how nitrogen, argon and oxygen are separated during fractional distillation. [3]

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(d) The noble gases are present in very small quantities in the air. The amount of each gas produced per year is shown in the table.

Noble gas	World production (tonnes per year)
helium	28 000
neon	1 000
argon	700 000
krypton	8
xenon	0.6

Use the data to calculate the number of tonnes of air needed to produce 700 000 tonnes of argon. Give your answer in **standard form**. [2]

Mass of air needed = ... tonnes

7

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7. *(a)* Potassium has three stable isotopes – ^{39}K, ^{40}K and ^{41}K.

(i) Compare the nuclei of each of these isotopes. [1]

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(ii) Use the information to calculate the relative atomic mass, A_r, of potassium.

Record your answer to **three** significant figures. [3]

Isotope	Relative isotopic mass	% in sample
^{39}K	39	93.1
^{40}K	40	0.0122
^{41}K	41	6.88

$$A_r = \frac{(\text{mass} \times \%\ \text{isotope 1}) + (\text{mass} \times \%\ \text{isotope 2}) + (\text{mass} \times \%\ \text{isotope 3})}{100}$$

A_r = ...

Examiner only

(b) Lithium lies above potassium in the Periodic Table.

(i) Give **two** similarities and **two** differences between the reactions of potassium and lithium with water. [2]

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(ii) Write a balanced symbol equation for the reaction between potassium and water. [3]

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9

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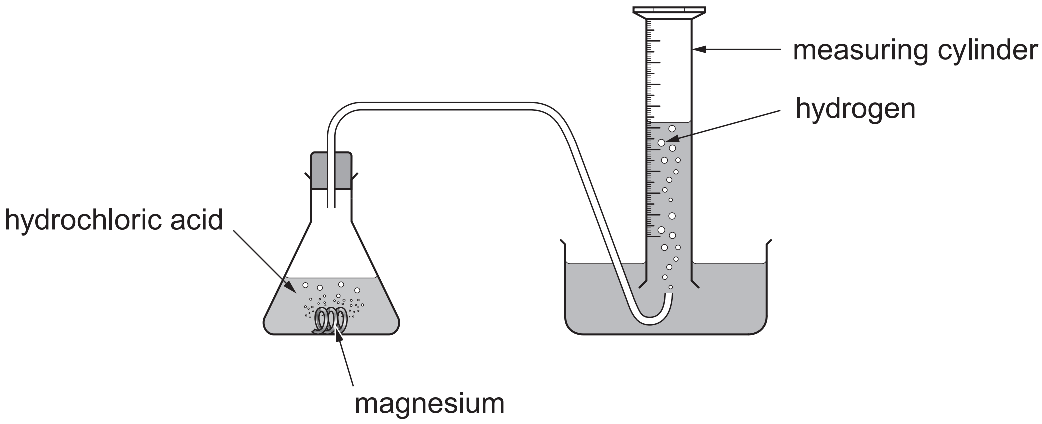
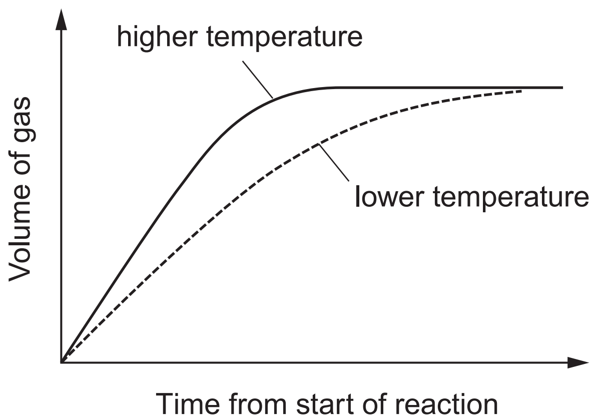
8. The following apparatus can be used to investigate the rate of the reaction between magnesium and excess dilute hydrochloric acid.



The results obtained at two different temperatures are shown below.



(a) Explain the results obtained at different temperatures in terms of particle theory. [3]

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(b) Explain the change in rate over time. [2]

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(c) State **one** way of improving the validity of the results obtained. Explain your answer. [2]

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(d) The equation for the reaction taking place is as follows.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

(i) In the experiment, 0.445 g of magnesium was used.

Calculate the mass of hydrogen that will be produced during the reaction. [3]

A_r(Mg) = 24 A_r(H) = 1

Mass = ... g

(ii) It is known that one mole of gas has a volume of 24 dm^3.

Use the equation below to calculate the volume of hydrogen produced. [2]

$$\text{number of moles} = \frac{\text{volume of gas}}{24}$$

Volume = ... dm^3

12

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9. A student is investigating the relative reactivities of the halogens using the elements and solutions of their halides. She adds each halogen to separate solutions of the other halides.

State and explain the observations made. How can the results be used to determine the relative reactivities of the halogens? Include equations in your answer. [6 QER]

6

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10. *(a)* Global warming is believed to be mainly the result of increasing levels of carbon dioxide in the atmosphere.

(i) State how the balance of carbon dioxide and oxygen is maintained in the atmosphere. Explain why levels of carbon dioxide are increasing and how this leads to global warming. [3]

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(ii) Carbon capture and storage (CCS) is one possible method of reducing global warming.

Describe briefly how CCS is carried out. [2]

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Examiner only

(b) Oxides of nitrogen are released in vehicle exhaust fumes. They can cause smog in busy city centres as well as acid rain.

(i) One oxide of nitrogen contains 30.4 g of nitrogen and 69.6 g of oxygen.

Find the simplest formula of this oxide. You **must** show your working. [3]

$A_r(N) = 14$ $A_r(O) = 16$

Simplest formula ....

(ii) The oxide with this simplest formula is found to have a relative molecular mass of 92. Find its molecular formula. [2]

Molecular formula ....

10

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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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

Group

1	2											3	4	5	6	7	0
						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

A_r — relative atomic mass Symbol Name Z — atomic number