Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/02

W16-4472-02

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
HIGHER TIER

P.M. TUESDAY, 12 January 2016

1 hour

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

4472
020001

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **4** and **9***(a)*.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

Examiner only

Answer **all** *questions.*

1. *(a)* Complete the following table of information about atoms of some elements. [5]

Symbol	Number of protons	Number of neutrons	Number of electrons
$^{19}_{9}F$	9	10	9
$^{35}_{17}Cl$	.....	18	.....
$^{16}_{8}O$	8	.....	8
.....	8	10	.....

(b) **From the table** give the names of the two **different** elements found in the same period in the Periodic Table. [1]

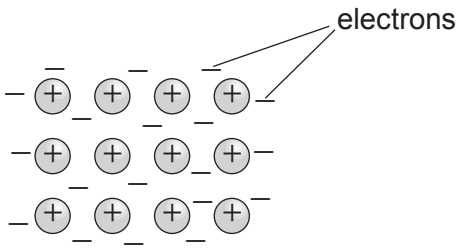
..... and .....

(c) Using **×** to represent an electron, draw the electronic structure of fluorine. [1]

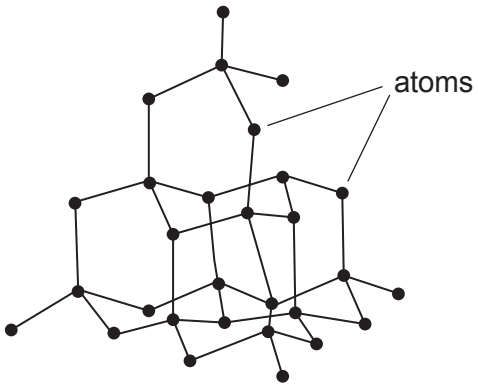
7

Examiner only

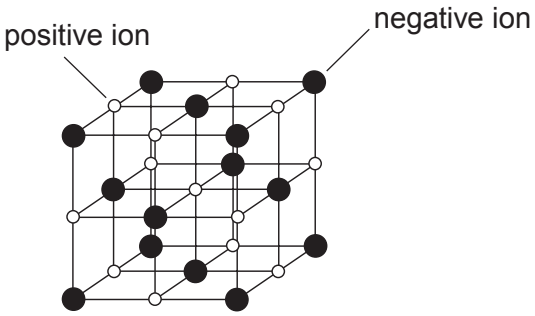
2. The following diagrams show the structures of some substances.



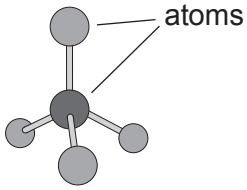
A



B



C



D

(a) Name the types of giant structure shown in **A** and **C**. [2]

A .....

C .....

(b) (i) State which substance, **A**, **B**, **C** or **D**, conducts electricity when solid. Give a reason for your answer. [2]

Letter .....

Reason .....

.....

(ii) State which substance, **A**, **B**, **C** or **D**, is a compound with a high melting point. Give a reason for your answer. [2]

Letter .....

Reason .....

.....

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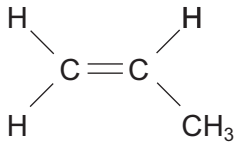
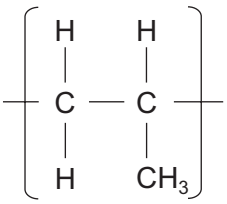
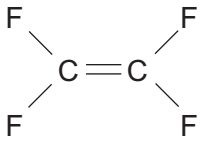
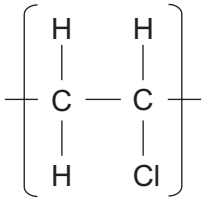
Turn over.

Examiner only

3. *(a)* The table below shows some information about monomers and the polymers that can be made from them. [3]

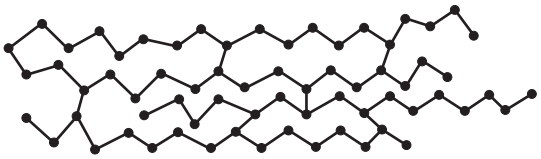
Complete the table.

Name of monomer	Structural formula of monomer	Name of polymer	Repeating unit for the polymer
propene		.....	
tetrafluoroethene		polytetrafluoroethene PTFE	.....
vinylchloride	.....	polyvinylchloride PVC	

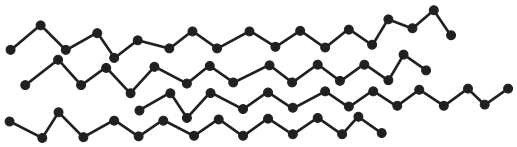
Examiner only

(b) 'PEX' is a form of polythene used to make domestic hot water pipes.

The structures below show the polymer structures of PEX and polythene.



PEX



polythene

Explain, in terms of structure, why PEX is better for making domestic hot water pipes than polythene. [2]

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5

Turn over.

Examiner only

4. The diagram below shows the main stages in the treatment of public water supplies.

Describe what happens in each stage of the process. [6 QWC]

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6

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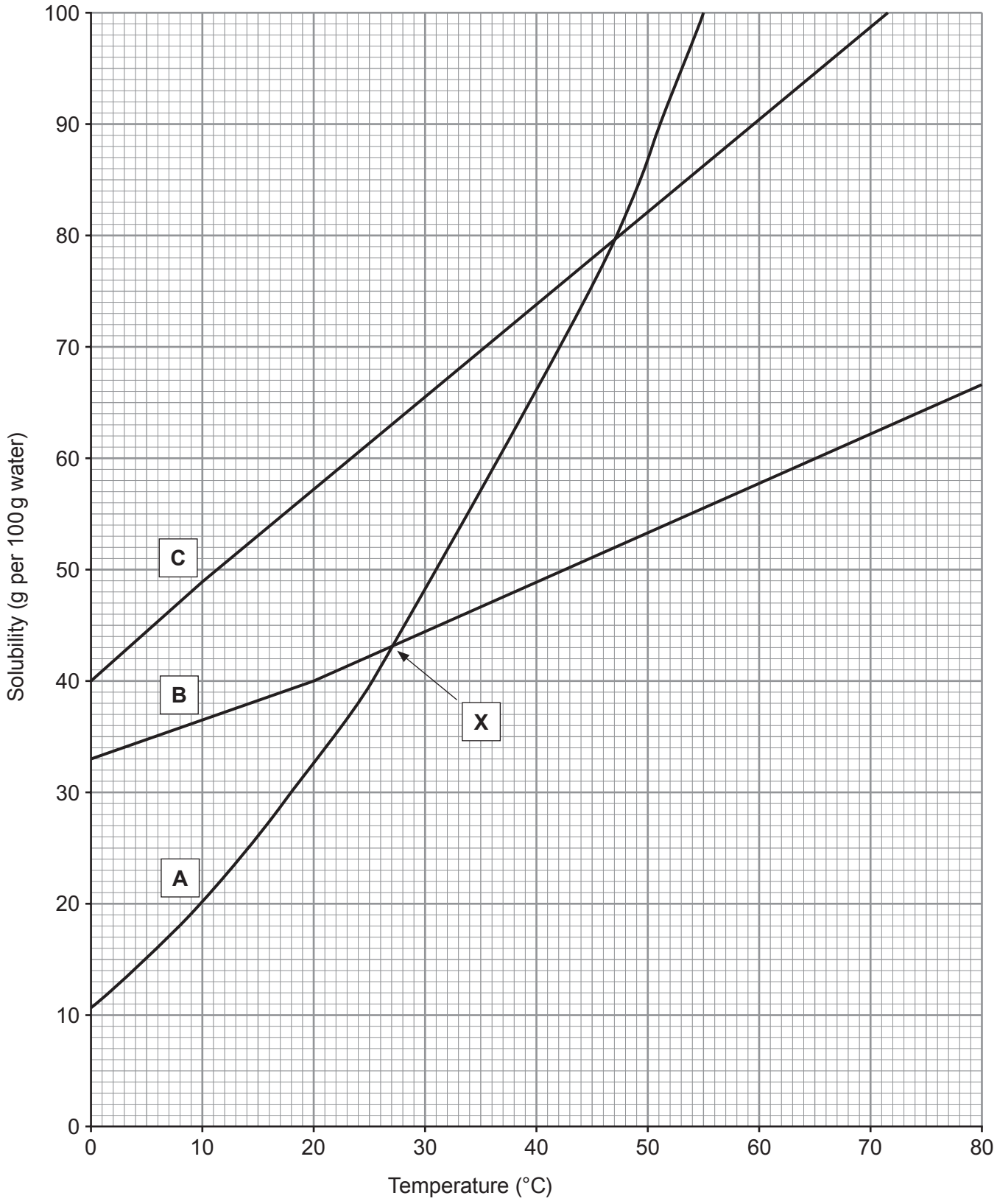
5. *(a)* The graph below shows how the solubility of three substances, **A**, **B** and **C**, in water varies with temperature.



Examiner only

(i) State, giving values, the information that can be obtained from the point labelled **X** on the graph. [2]

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(ii) Using the graph, calculate the mass of solid **C** that forms when a saturated solution in 100 g of water at 50 °C cools to 10 °C. Give the unit. [2]

Mass = ...

Unit .....

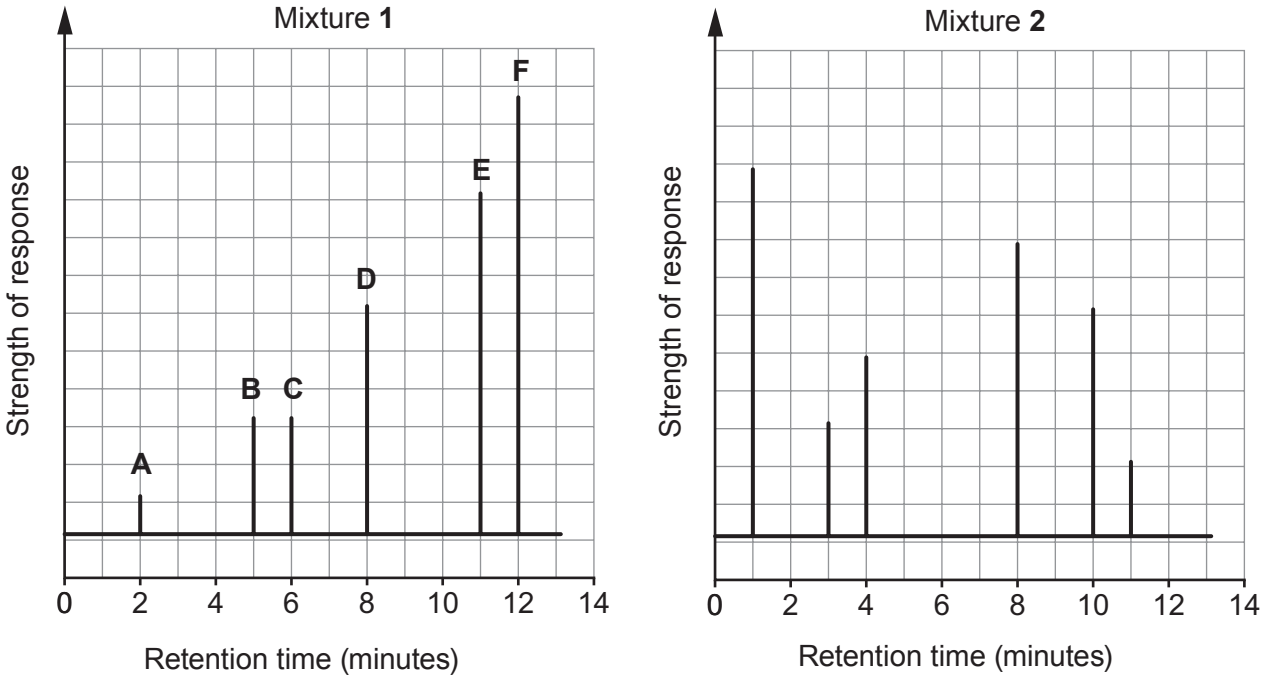
Turn over.

Examiner only

(b) Chromatography is an important technique because it allows chemists to separate substances. Gas chromatography can be used to show:

- the number of compounds in a mixture - represented by the number of peaks
- how much of each compound is present - represented by the height of the peak
- the identity of each compound present - indicated by the position of the peak (retention time)

The diagrams below show the gas chromatograms of mixtures **1** and **2**, each containing several compounds. The compounds in mixture **1** are known and are labelled **A**-**F**.



Use the chromatograms to describe what the mixtures have in common. [2]

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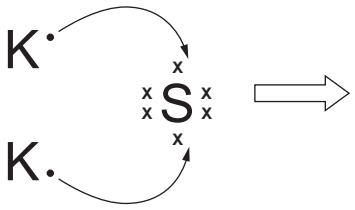
6

Examiner only

6. *(a)* Potassium reacts with sulfur to form potassium sulfide.

(i) Complete the dot and cross diagram below by drawing the electronic structures of the ions formed. Include the charge on each ion. [2]



(ii) Explain why potassium atoms and sulfur atoms behave in this way during the reaction. [2]

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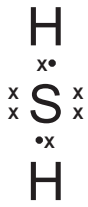
(b) The bonding in a hydrogen sulfide molecule is shown in the dot and cross diagram below.



Explain, in terms of electronic structure, the covalent bonding in the molecule. [2]

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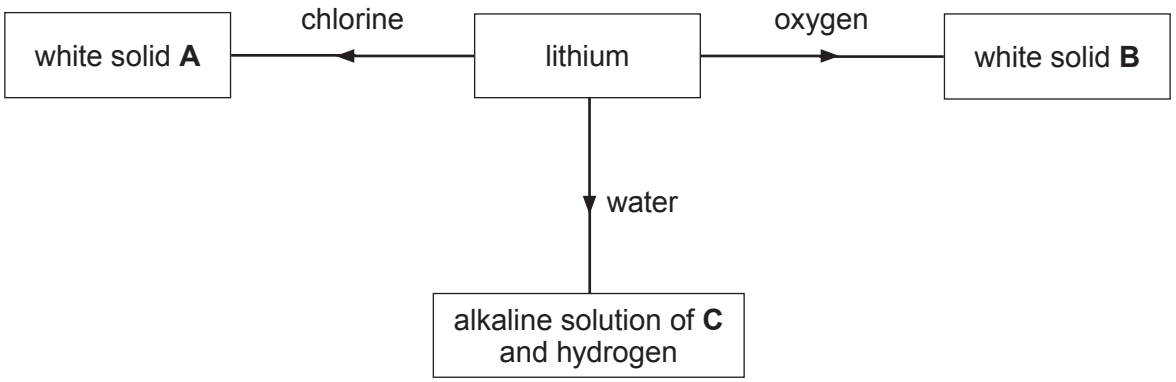
6

Turn over.

Examiner only

7. *(a)* The flow diagram below shows some reactions of lithium.



Give the chemical names for substances **A**, **B** and **C**. [3]

A .....

B .....

C .....

(b) Cold iron wool burns rapidly in fluorine forming iron(III) fluoride.

Complete and balance the equation for this reaction. [2]

$\square$ Fe + $\square$ F_2 ⟶ $\square$ .....

(c) Silver nitrate solution can be used to detect the presence of aqueous chloride ions.

The symbol equation below represents the reaction occurring between silver nitrate solution and calcium chloride solution.

$$2AgNO_3(aq) + CaCl_2(aq) \longrightarrow Ca(NO_3)_2(aq) + 2AgCl(s)$$

Write the **ionic** equation for the reaction. Include the state symbols. [2]

..... + ... ⟶ .....

Examiner only

(d) **X**, **Y** and **Z** represent the halogens bromine, chlorine and iodine, but not necessarily in that order.

Each halogen was added separately to solutions of sodium chloride, sodium iodide and sodium bromide.

The table below shows the results obtained from the series of experiments.

Halogen	Solution of sodium halide		
	chloride	iodide	bromide
X	no reaction	solution turns brown	solution turns orange
Y	no reaction	no reaction	no reaction
Z	no reaction	solution turns brown	no reaction

Use the information in the table to give the letter **X**, **Y** or **Z** which represents bromine. Explain your choice of letter. [3]

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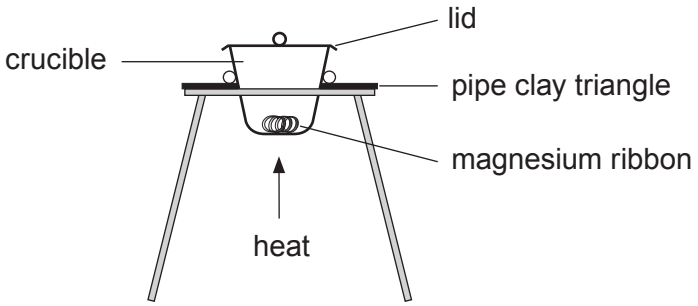
10

Examiner only

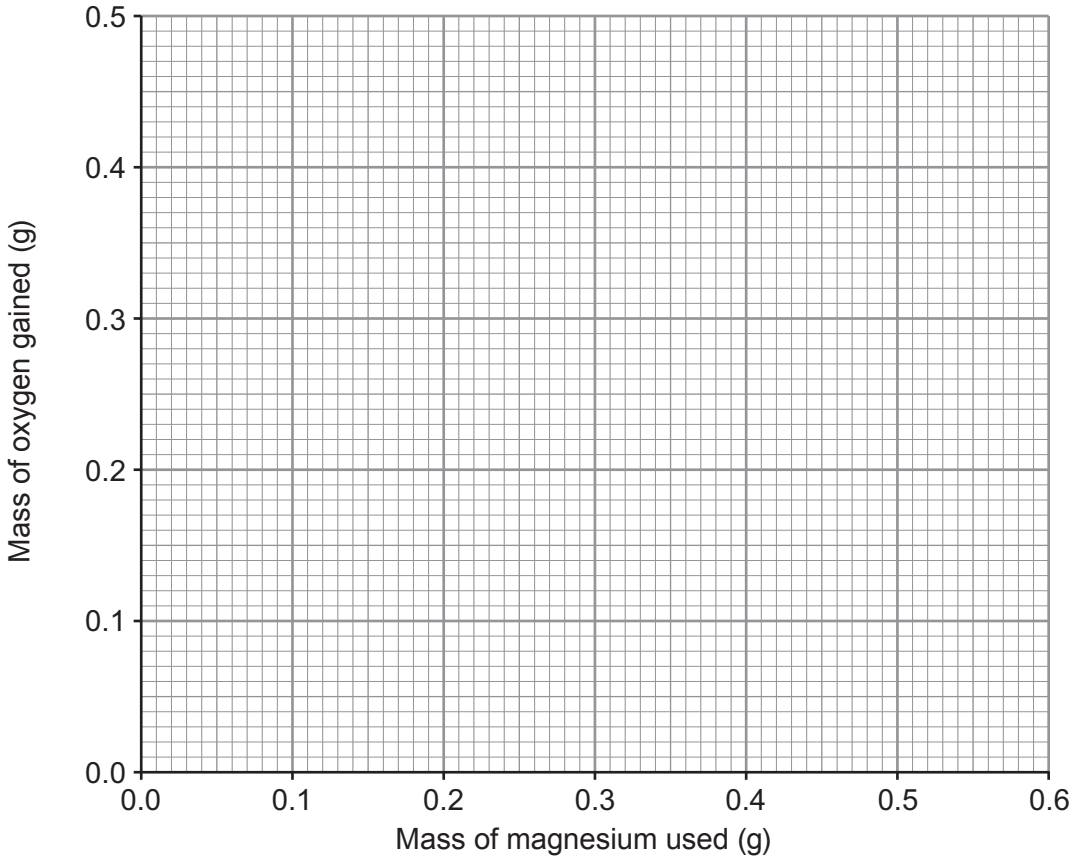
8. Four pupils were trying to show experimentally that the chemical formula of magnesium oxide is MgO. Each pupil was given a different known mass of magnesium ribbon. The magnesium ribbon was completely burned using the apparatus below. The mass of magnesium oxide formed was recorded and the mass of oxygen gained during each reaction was calculated.



The pupils' results are shown below.

Pupil	Mass of magnesium used (g)	Mass of magnesium oxide (g)	Mass of oxygen gained (g)
1	0.15	0.25	0.10
2	0.25	0.45	0.20
3	0.35	0.55	0.20
4	0.45	0.75	0.30

(a) On the grid plot the mass of magnesium used by each pupil against the mass of oxygen gained. Draw a suitable line starting at the origin (0,0). [3]



Examiner only

(b) (i) Use your graph to predict the mass of oxygen needed to completely burn 0.6 g of magnesium. [1]

Mass of oxygen = ... g

(ii) Using the masses of magnesium and oxygen from part (i), show that the simplest formula of magnesium oxide is MgO. [2]

A_r(O) = 16 A_r(Mg) = 24

(c) Suggest why a calculation based on the line of best fit is likely to give a better answer for the formula than using the results from one single experiment. [1]

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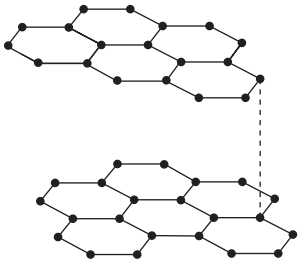
.....

7

Turn over.

Examiner only

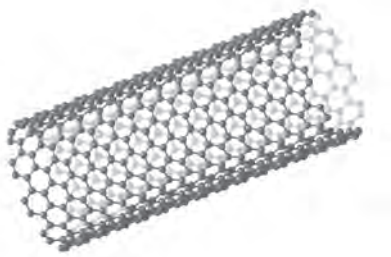
9. *(a)* The diagram below shows the structure of graphite, a form of carbon.



Explain how the structure of graphite is related to its properties and uses. [6 QWC]

Examiner only

(b) Carbon nanotubes are another form of carbon.



Give **one** property which carbon nanotubes and graphite have in common. [1]

.....

7

END OF PAPER

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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+}		

Turn over.

PERIODIC TABLE OF ELEMENTS

1	2											3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: