Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

S16-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. THURSDAY, 19 May 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**8**	
3.	**7**	
4.	**7**	
5.	**4**	
6.	**4**	
7.	**6**	
8.	**12**	
9.	**6**	
Total	**60**	

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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) used in your answer to question **9**.

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.

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Answer **all** *questions.*

1. *(a)* Draw a line from the reactants to the products they form. [2]

Reactants	**Products**
lithium and oxygen	sodium chloride
sodium and chlorine	lithium hydroxide and hydrogen
iron and fluorine	lithium oxide
lithium and water	iron fluoride

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(b) Flame tests can be used to detect the presence of alkali metal ions.

red	**yellow**	**blue**	**lilac**

Choose from the box the colours of the flames produced by the following ions. [2]

Ion	Colour
lithium	
sodium	

(c) Lithium oxide has the formula Li_2O. Calculate the M_r of lithium oxide. [2]

A_r(Li) = 7 A_r(O) = 16

M_r = ...

6

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2. A pupil studied the reaction between calcium carbonate powder and hydrochloric acid.

calcium carbonate + hydrochloric acid ⟶ calcium chloride + carbon dioxide + water

(a) State what would be **seen** during this reaction. [1]

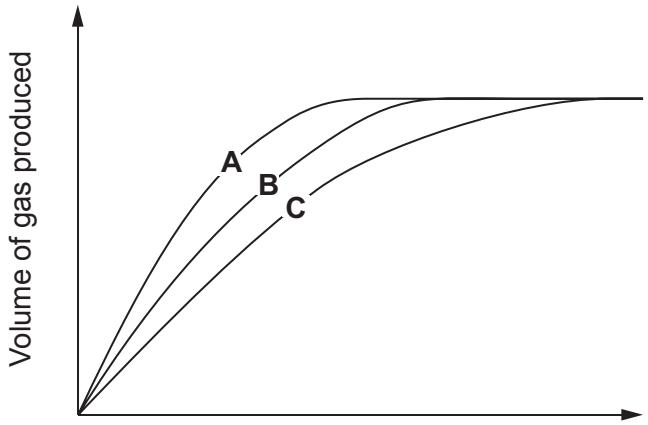
.....

(b) Choose from the box the apparatus that would **not** be suitable for measuring the volume of gas produced. [1]

measuring cylinder	**conical flask**	**gas syringe**	**burette**

.....

(c) The same pupil investigated the reaction at three different temperatures.
The following graphs show the volume of gas produced over time during these three reactions.



(i) State which reaction, **A**–**C**, was carried out at the highest temperature.
Give a reason for your answer. [1]

.....

.....

(ii) Apart from temperature, state **two** factors that could be changed in order to alter the rate of this reaction. [2]

..... and .....

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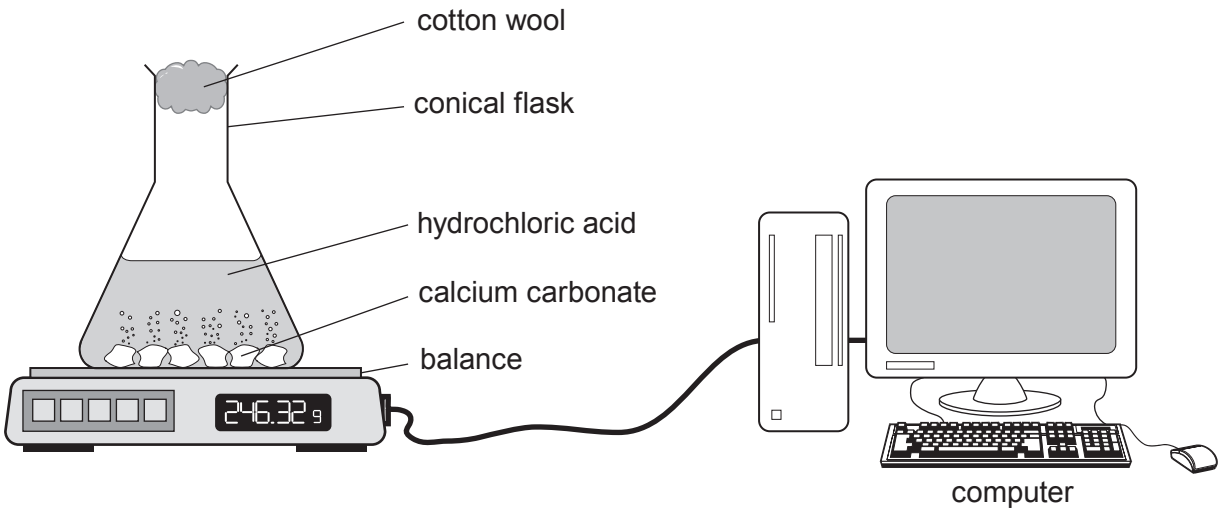
(d) Another pupil suggested that the same reaction could be studied using a balance.



(i) Explain how this method works. [2]

.....

.....

.....

(ii) Give **one** advantage of connecting the balance to a computer. [1]

.....

.....

8

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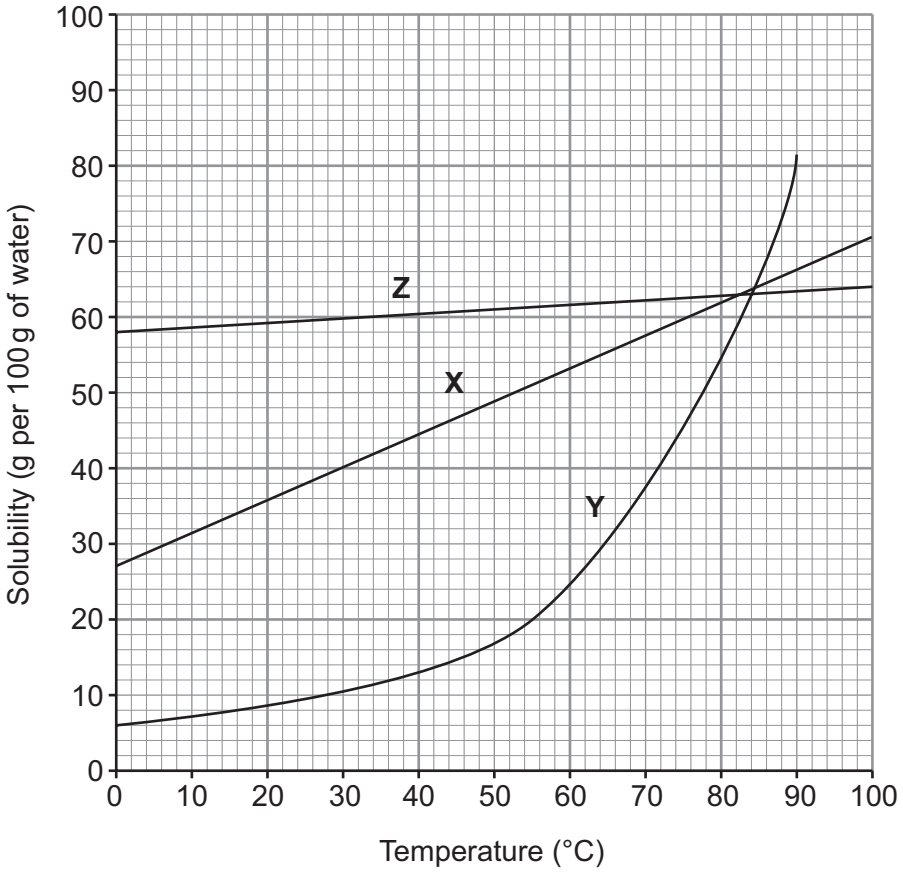
3. The following graphs show the solubility curves for three substances, **X**, **Y** and **Z**.



(a) Give the letter of the substance, **X**, **Y** or **Z**, whose solubility changes most with temperature. [1]

.....

(b) Give **one** similarity and **one** difference between the solubilities of substances **X** and **Z** as the temperature increases. [2]

Similarity .....

Difference .....

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(c) The solubility of another substance, **W**, was recorded at different temperatures.

The results are shown in the table.

Temperature (°C)	0	20	40	60	80	100
Solubility (g per 100 g of water)	15	20	27	36	47	60

(i) Plot a graph of these results on the same grid and draw a suitable line. [3]

(ii) Use the data to calculate the mass of crystals formed if a saturated solution of **W** containing 100 g of water was cooled from 80 °C to 40 °C. [1]

Mass = ... g

7

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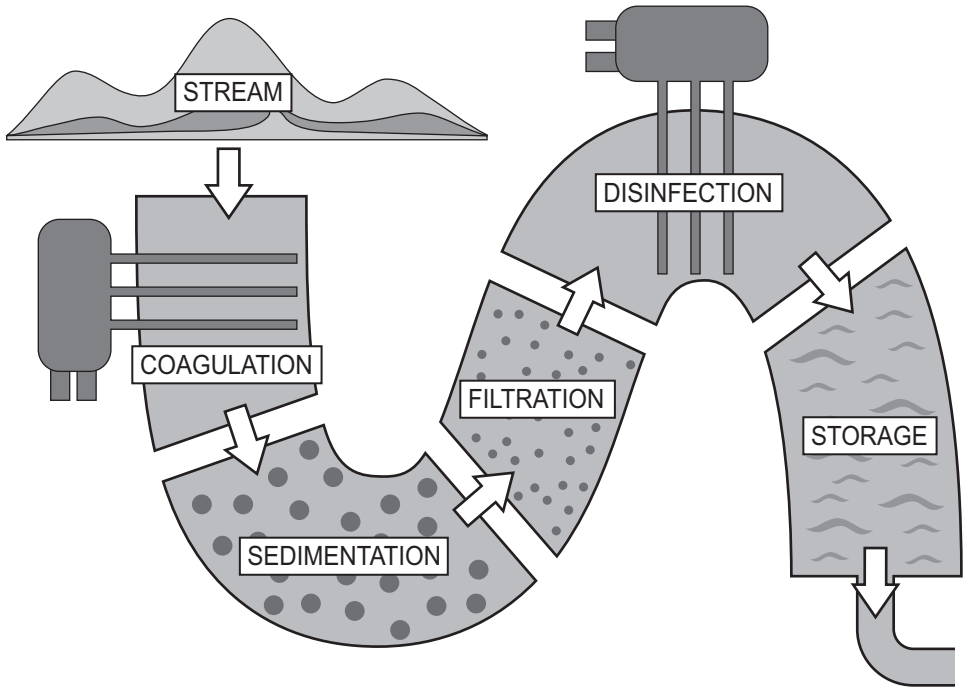
4. The diagram shows the stages involved in the treatment of our mains water supply.



(a) State the purpose of the filtration stage. [2]

.....

.....

(b) Disinfection is the stage that makes the water safe to drink. State how this is done and how it makes the water safe to drink. [2]

.....

.....

(c) State why hosepipe bans are sometimes introduced during the summer. [1]

.....

.....

(d) Desalination removes salt from seawater by distillation to produce drinking water. Explain how this process can be carried out. [2]

.....

.....

.....

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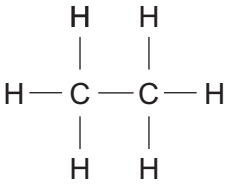
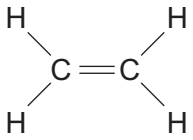
5. *(a)* The following diagrams show the structures of an alkane and an alkene.

Name both compounds. [1]





....

(b) Describe **one** similarity and **one** difference between the structures of alkanes and alkenes. [2]

Similarity

.....

.....

Difference

.....

.....

(c) Butane is an alkane containing four carbon atoms and ten hydrogen atoms.
Draw its structural formula. [1]

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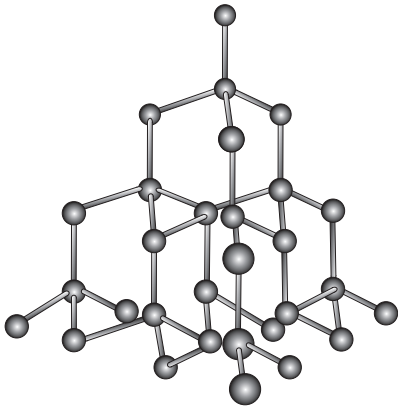
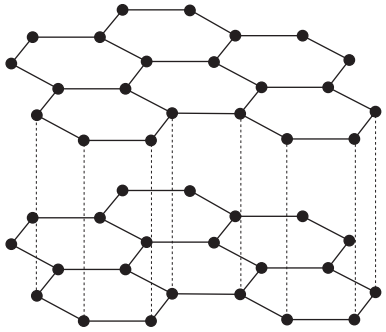
6. The following boxes show some information about the structures of diamond and graphite.

Diamond



Each carbon atom is bonded strongly to four others. All four outer electrons are used in bonding.

Graphite



Each carbon atom is bonded strongly to three others. They form layers that are held together weakly. Three electrons are involved in bonding whilst the other moves freely between the layers.

(a) State why both substances have high melting points. [1]

.....

.....

(b) State which of the above substances will conduct electricity. Give a reason for your answer. [1]

Substance .....

Explanation .....

.....

(c) Graphite is used in pencils. Explain in terms of structure why this is possible. [2]

.....

.....

4

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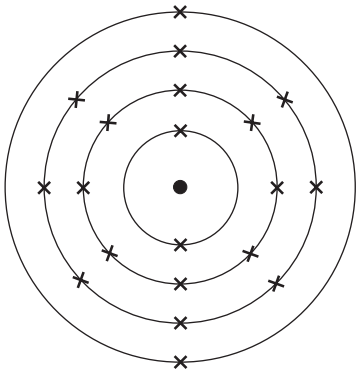
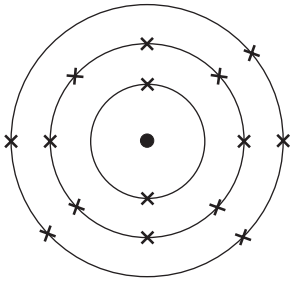
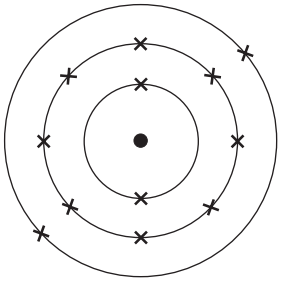
7. The following diagrams show the electronic structures of five different elements, **A**–**E**.



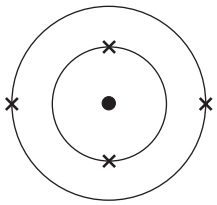
A



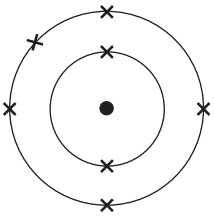
B



C



D



E

(a) State which elements, **A**–**E**, are found in Period 2 of the Periodic Table. Give a reason for your choice. [2]

.....

.....

(b) State which element, **A**–**E**, has an atomic number of 15. Give a reason for your answer. [1]

.....

.....

(c) Aluminium can be represented as $^{27}_{13}\mathbf{Al}$.

State what this tells you about the structure of its atoms. [3]

.....

.....

.....

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8. *(a)* Sodium bromide is formed by reacting sodium with bromine, Br_2.

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

..... + ... ⟶ .....

(b) A scientist has **solid** samples of sodium chloride and sodium iodide but is not sure which is which.

Describe how silver nitrate solution could be used to distinguish between them.

Give the observations expected for both substances. [3]

.....

.....

.....

.....

(c) During a chemical reaction, aluminium combines with chlorine to produce aluminium chloride, $AlCl_3$.

$$2Al + \square\ Cl_2 \longrightarrow \square\ AlCl_3$$

(i) Balance the equation. [1]

(ii) Calculate the percentage of chlorine present in aluminium chloride, $AlCl_3$. [3]

$A_r(Al) = 27$ $A_r(Cl) = 35.5$

Percentage chlorine = ... %

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(d) Electrolysis can be used to extract aluminium from its oxide. The equation for the reaction is as follows.

$$2Al_2O_3 \longrightarrow 4Al + 3O_2$$

204 tonnes of aluminium oxide are expected to produce 108 tonnes of aluminium. However, only 81 tonnes are actually made.

(i) Calculate the percentage yield of this process. [1]

Percentage yield = ...%

(ii) Suggest reasons why the actual amount produced was lower than expected. [2]

.....

.....

.....

12

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9. Describe what is meant by a *smart material*. Use thermochromic and photochromic materials to support your answer, giving everyday uses of each. [6 QWC]

6

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+}		

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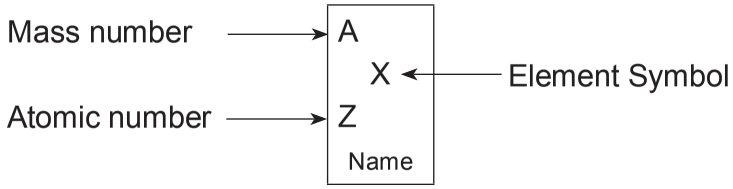
Turn over.

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:



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