Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/02

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
HIGHER TIER

A.M. TUESDAY, 14 January 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**4**	
3.	**6**	
4.	**6**	
5.	**6**	
6.	**9**	
7.	**7**	
8.	**4**	
9.	**4**	
10.	**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) in your answers to questions **4** and **10**.

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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Examiner only

Answer **all** *questions.*

1. The following table shows information about some atoms, **A–E**.

A–E are not the chemical symbols for the elements.

Atom	**A**	**B**	**C**	**D**	**E**
atomic number	3	6		10	11
mass number		12	14	20	23
number of protons	3	6	6	10	11
number of neutrons	4	6	8	10	
number of electrons	3	6	6	10	11

(a) **Complete** the table. [3]

(b) (i) Give the electronic structure of element **D**. ..... [1]

(ii) Use this information to explain why this element is found in Period 2 and Group 0. [2]

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(c) Choose the letters, **A–E**, of the atoms that represent isotopes and give a reason for your choice. [2]

Letters ..... and .....

Reason .....

.....

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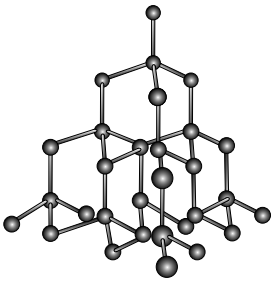
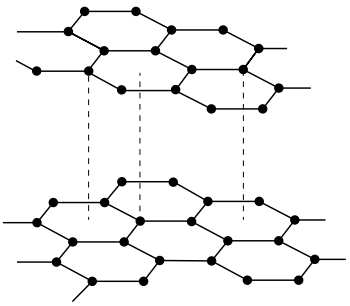
8

Examiner only

2. The following diagrams show the structures of diamond, graphite and carbon nanotubes.



diamond



graphite

carbon nanotube

(a) Two of the structures shown above conduct electricity. Name both and give the reason why they are able to conduct electricity. [2]

Structures ..... and .....

Reason .....

.....

(b) Name the structure above that is used as a lubricant and give a reason why it is suitable for this use. [2]

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4

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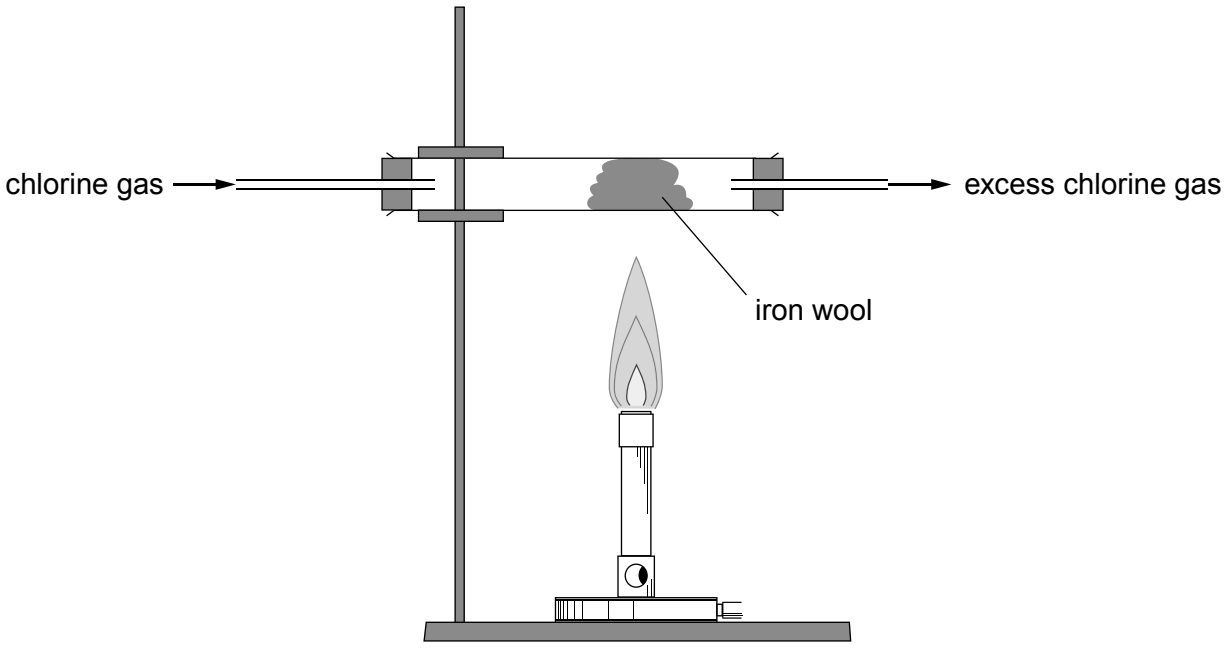
3. The reaction of chlorine with iron can be demonstrated using the following apparatus.



(a) State why the reaction should be carried out in a fume cupboard. [1]

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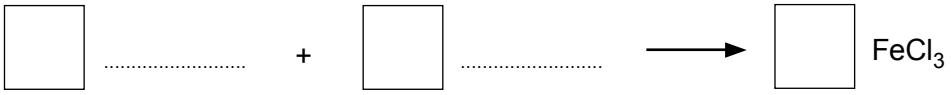
(b) The product of the reaction above is iron(III) chloride, $FeCl_3$. Complete and balance the following symbol equation for the reaction. [2]



(c) Calculate the percentage by mass of chlorine in iron(III) chloride, $FeCl_3$. [3]

A_r (Fe) = 56 A_r (Cl) = 35.5

Percentage by mass of chlorine = ... %

6

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4. Thermochromic pigments, photochromic pigments and shape memory alloys are types of smart material.

Describe your understanding of smart materials. [6 QWC]

Your answer should include:

- what is meant by a smart material;
- some examples of smart materials, their special properties and uses.

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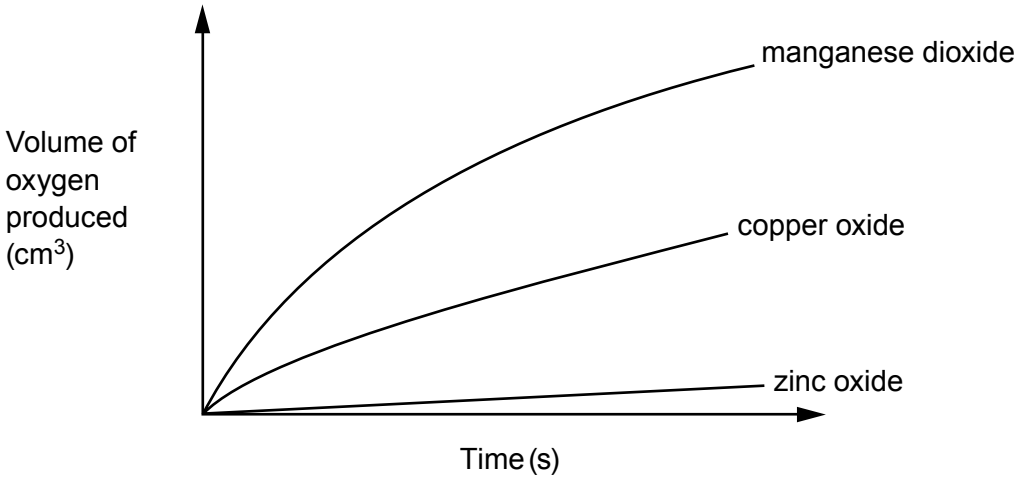
5. Hydrogen peroxide solution, H_2O_2, decomposes to form oxygen and water.

$$2H_2O_2 \longrightarrow O_2 + 2H_2O$$

The reaction is very slow at room temperature but can be speeded up by adding certain metal oxide powders, which act as catalysts.

The rate of reaction can be measured by recording the volume of oxygen produced over time. The following graph shows the volume of oxygen produced using three different metal oxides.



(a) (i) Compare the results for each metal oxide. [2]

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(ii) Give **three** ways of ensuring that the experiment is a fair test. [2]

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(b) Catalysts are used to speed up industrial processes. Explain why this is important. [2]

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6

Examiner only

6. When lithium reacts with chlorine, lithium chloride is formed.

(a) Give the electronic structures of lithium and chlorine. [1]

lithium .....

chlorine .....

(b) Use the electronic structures above to draw diagrams to show the transfer of electrons and the formation of ions that occur as lithium chloride is formed. [3]

(c) Oxygen has an electronic structure of 2,6.

Use this information to draw a diagram to show the bonding in a molecule of oxygen, O_2. [2]

(d) Lithium chloride is a solid at room temperature whereas oxygen is a gas.

Name the type of bonding present in each substance and explain the difference in their states at room temperature. [3]

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9

Examiner only

7. A scientist carried out tests to identify halides **A**, **B** and **C**. The results are shown in the table below.

Substance	Result when carrying out a flame test	Observation when adding silver nitrate solution
A	lilac flame	white precipitate
B	yellow flame	yellow precipitate
C	red flame	cream/off-white precipitate

(a) Use the results to identify substances **A**, **B** and **C**. [3]

A .....

B .....

C .....

(b) Chlorine gas is bubbled through a solution of potassium bromide. The solution turns orange as bromine is formed.

(i) State why this happens. [1]

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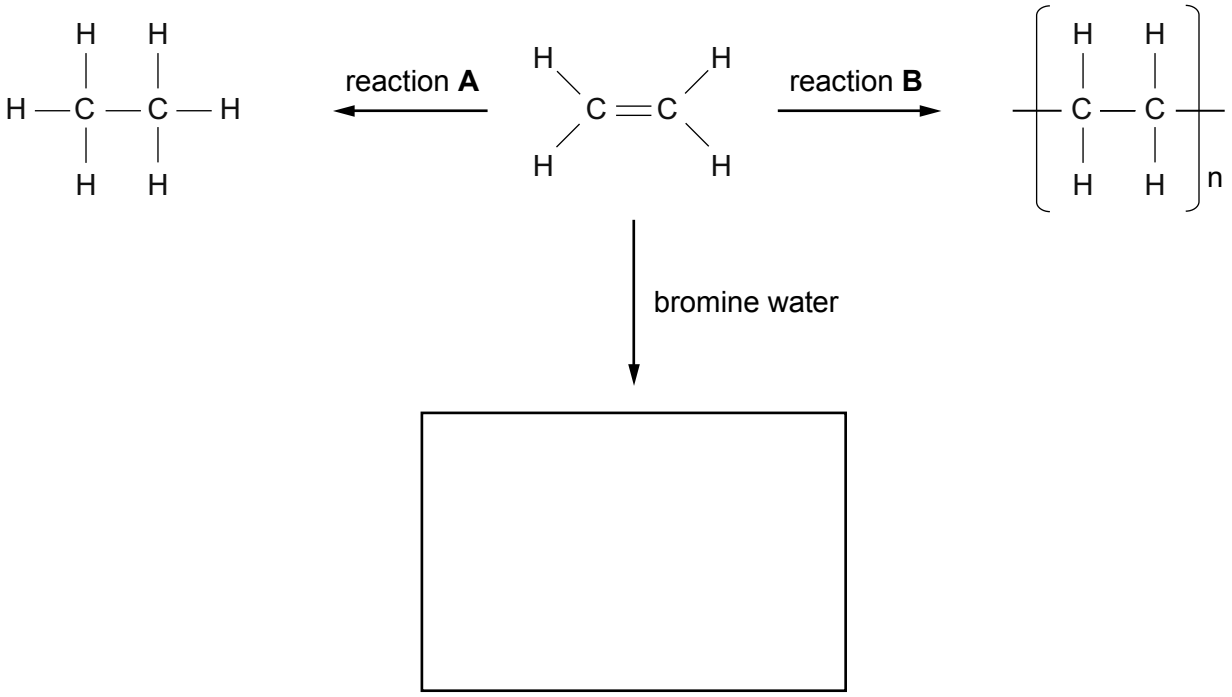
(ii) Write a balanced **symbol** equation for the reaction taking place. [3]

..... + ... ⟶ ..... + ...

7

Examiner only

8. The following diagram shows some reactions of ethene.



(a) (i) Complete the diagram by giving the missing structure. [1]

(ii) Describe what would be **seen** during the reaction between ethene and orange bromine water. [1]

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(b) Give the names of the **types** of the reactions labelled **A** and **B**. [2]

Reaction **A** .....

Reaction **B** .....

4

Examiner only

9. Copper is an important metal in everyday life. It can be produced from its oxide by heating with carbon. The equation for the reaction is shown below.

$$2CuO + C \longrightarrow 2Cu + CO_2$$

(a) Use the equation to calculate the maximum mass of copper that could be produced when using 1.5 tonnes of carbon. [3]

A_r (Cu) = 64 A_r (C) = 12

Maximum mass of copper = ... tonnes

(b) When the reaction was carried out using 1.5 tonnes of carbon, it was found that the yield of copper was only 12 tonnes. Calculate the percentage yield for the reaction. [1]

Percentage yield = ... %

4

Examiner only

10. Describe and compare the methods that can be used to soften hard water. [6 QWC]

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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+}		

PERIODIC TABLE OF ELEMENTS

1	2	Group										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: