Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/02

S16-4472-02

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
HIGHER TIER

A.M. THURSDAY, 19 May 2016

1 hour

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

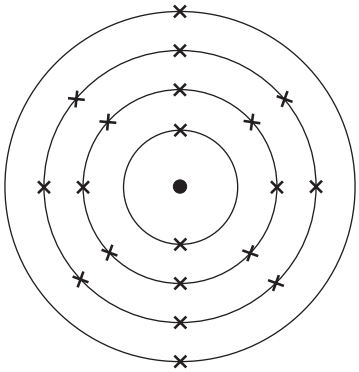
Assessment will take into account the quality of written communication (QWC) used in your answers to questions **3** and **8**.

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.

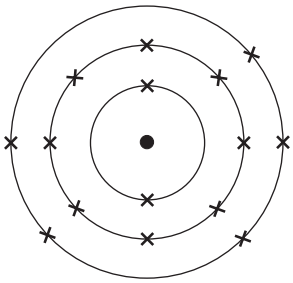
Examiner only

Answer **all** *questions.*

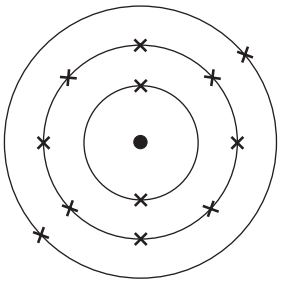
1. The following diagrams show the electronic structures of five different elements, **A**–**E**.



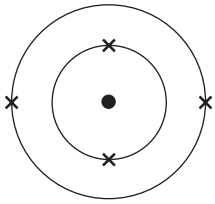
A



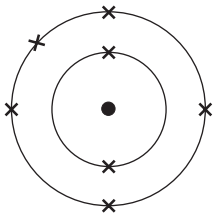
B



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]

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

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(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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6

Examiner only

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

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

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(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]

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(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 = ... %

Examiner only

(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]

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12

Examiner only

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

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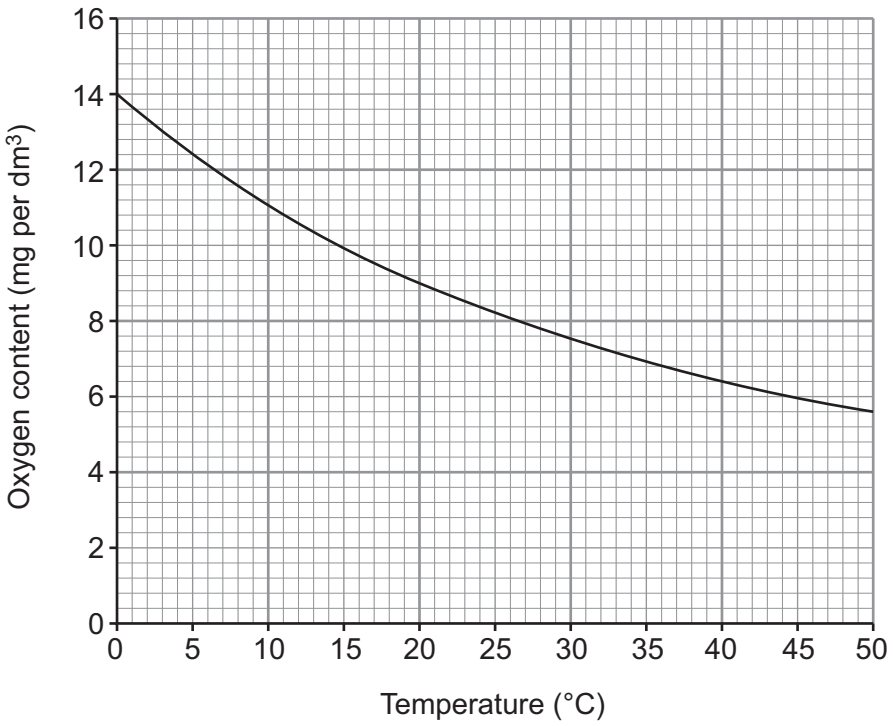
Examiner only

4. The following graph shows the solubility curve for oxygen gas in fresh water.



(a) Use the graph to explain why more fish can be kept in a cold water tank than a warm water tank of the same size. [2]

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(b) Calculate the mass in **grams** of oxygen that dissolves in 100 dm^3 of fresh water at 20 °C. [2]

1 g = 1000 mg

Mass = ... g

Examiner only

(c) Approximately 3.3 g of carbon dioxide gas dissolves in 1 dm^3 of fresh water at 0 °C. Estimate how many times more soluble carbon dioxide is than oxygen at this temperature. Show your working. [2]

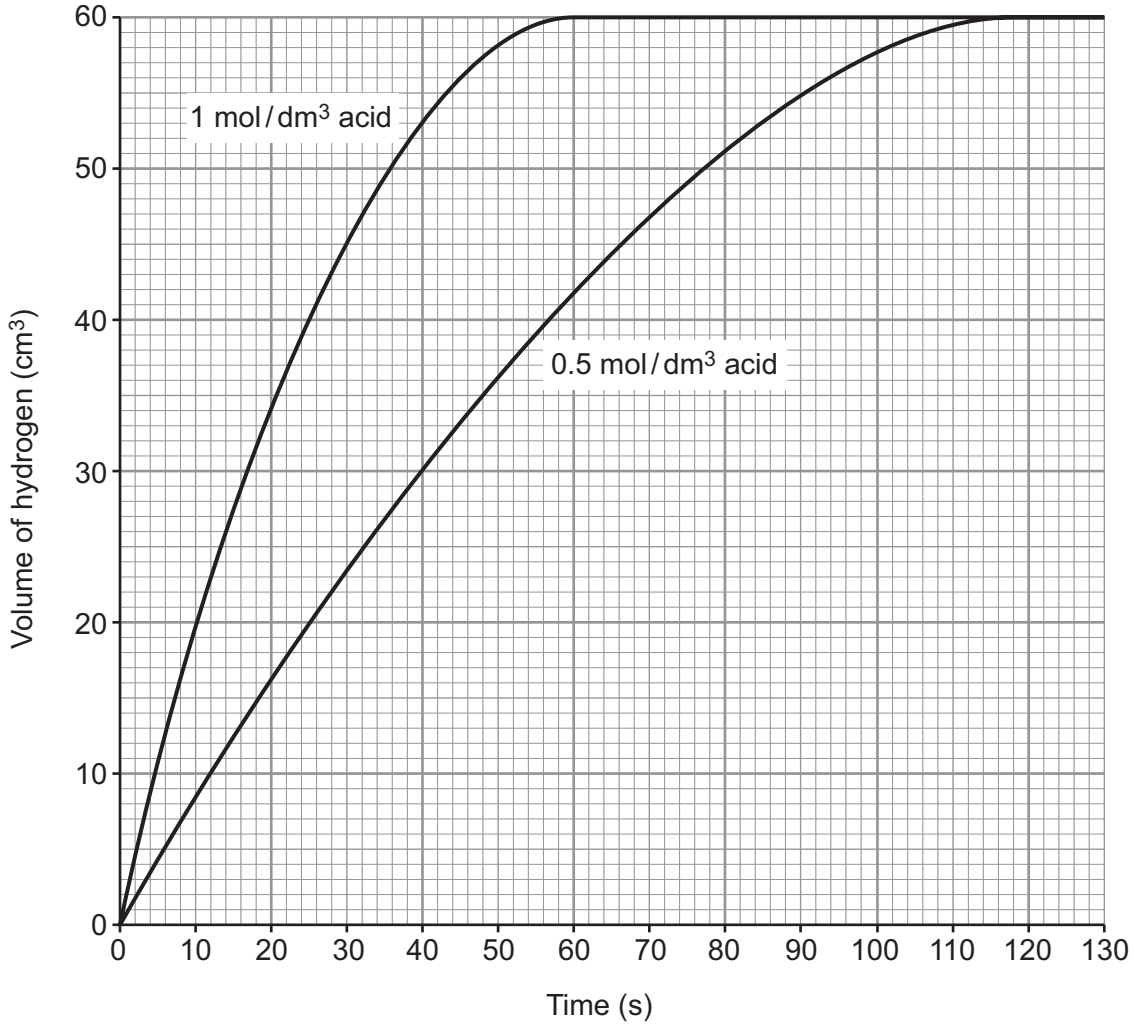
1 g = 1000 mg

Carbon dioxide is approximately ..... times more soluble than oxygen.

6

Examiner only

5. The following graphs show the volume of hydrogen produced over time during the reaction between magnesium and hydrochloric acid of two different concentrations. All other factors were kept constant.



(a) State what conclusion can be drawn from the graph and use your understanding of particle theory to explain that conclusion. [4]

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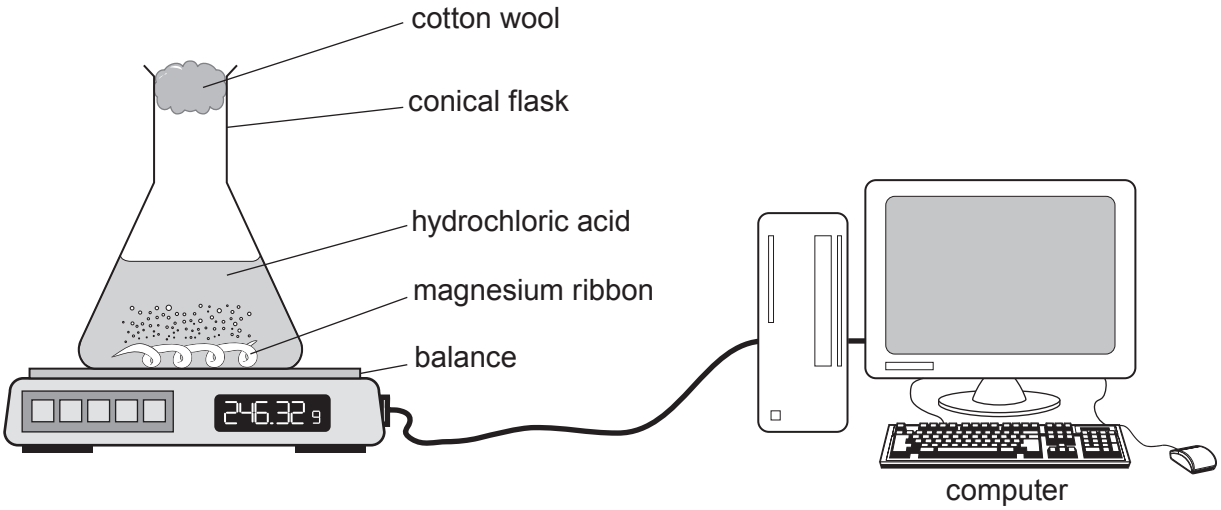
Examiner only

(b) Another method of studying this reaction is to use a balance to record the change in mass over time. The data can be recorded directly on a computer.



(i) State why a two decimal place balance is required for this method to work. [1]

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(ii) Use the relative atomic mass values below to explain why recording the change in mass is better suited to an experiment that releases carbon dioxide, CO_2, than one that releases hydrogen, H_2. [3]

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$

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8

Examiner only

6. *(a)* Alkenes such as ethene are reactive hydrocarbons. They can be recognised by their reaction with bromine, Br_2.

(i) State what you would expect to see when bromine water is added to an alkene. Give the reason this happens. [2]

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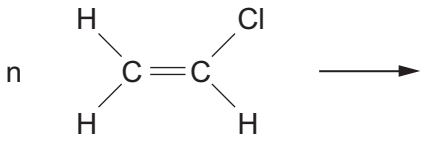
(ii) Complete the equation by giving the structure of the product formed. [1]

(b) Monomers can undergo polymerisation to form polymers. One example is PVC.

(i) Complete the equation for the formation of PVC. [1]



(ii) PVC is a thermoplastic. Describe the effect of heat on thermoplastics and explain in terms of their **structure** why they behave in this way. [3]

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7

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7. *(a)* An experiment was carried out to determine the trend in reactivity of the halogens. The following table shows the results obtained when solutions of halogens were added to different halide solutions.

		Halide solution		
		potassium chloride	potassium bromide	potassium iodide
Halogen added	bromine	no reaction	no reaction	turns brown
	chlorine	no reaction	turns yellow orange	turns brown
	iodine	no reaction	no reaction	no reaction

(i) Use the results in the table to give the order of reactivity of the halogens. Explain your answer. [3]

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(ii) Write the balanced **symbol** equation for the reaction that takes place between chlorine and potassium iodide. [3]

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Examiner only

(b) When silver nitrate solution is added to a solution of potassium bromide, a creamy precipitate of silver bromide is formed. The following reaction takes place.

$$AgNO_3(aq) + KBr(aq) \longrightarrow AgBr(s) + KNO_3(aq)$$

Calculate the mass of silver nitrate needed to form 47 g of silver bromide. [3]

$A_r(Ag) = 108$ $A_r(N) = 14$ $A_r(O) = 16$ $A_r(Br) = 80$

Mass of silver nitrate = ... g

9

Examiner only

8. Using water and carbon dioxide as examples, explain what is meant by covalent bonding and why some molecules contain double bonds. You may use diagrams as part of your answer. [6 QWC]

6

END OF PAPER

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											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: