Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

Double Award Science: Chemistry

MV18

Unit C2

Higher Tier

[GSD52]

WEDNESDAY 15 JUNE 2016, AFTERNOON

Time

1 hour 15 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Complete in blue or black ink only**.**
Answer **all eight** questions.

Information for Candidates

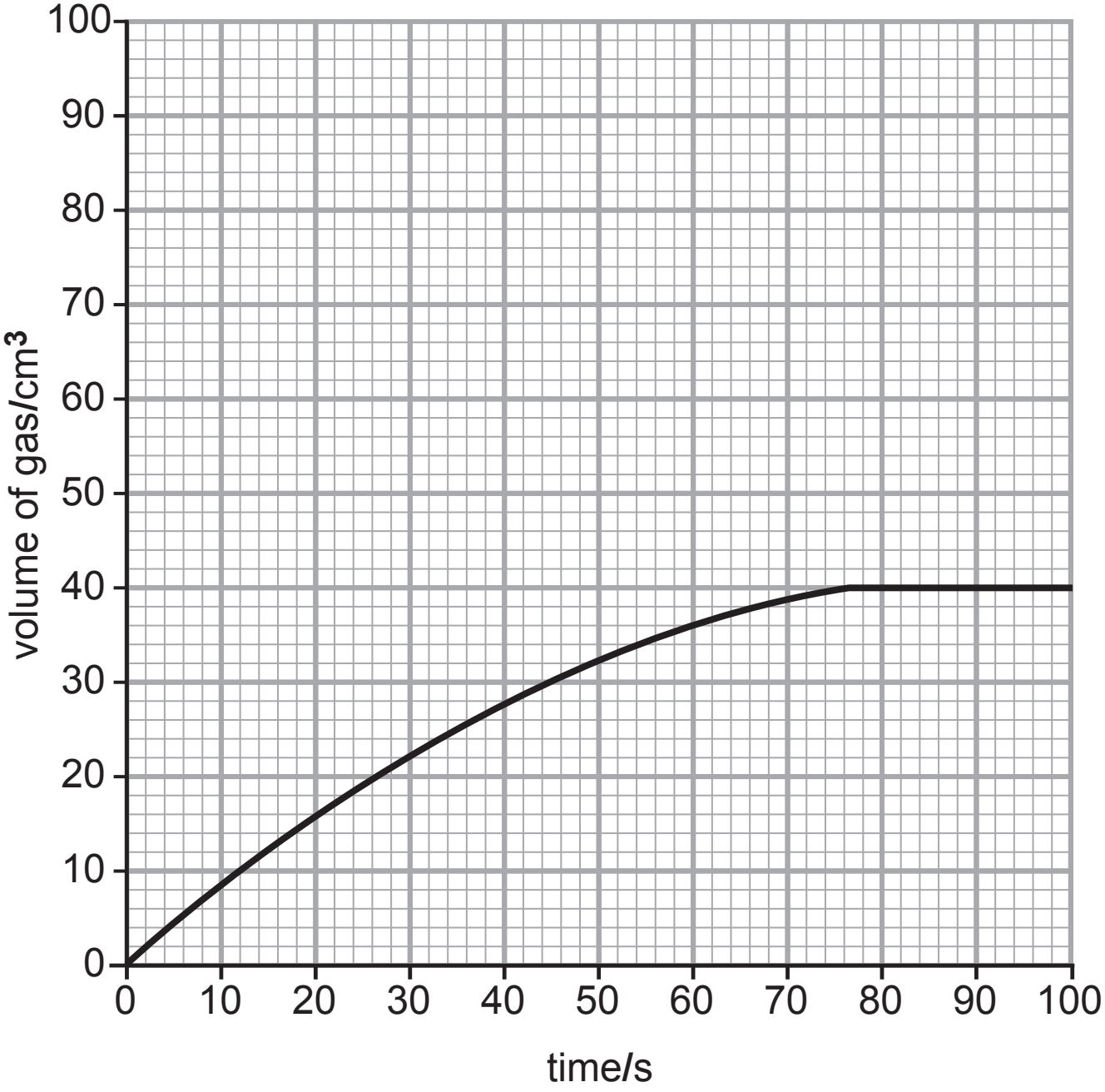
The total mark for this paper is 90.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **3** and **6(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 This question is about the rate of reaction of zinc metal with acid.

(a) In the reaction of zinc granules with hydrochloric acid, a little copper sulfate is sometimes added as a catalyst.

Why is the copper sulfate described as a catalyst and not a reactant? [2 marks]

(b) A group of students investigated how dilute hydrochloric acid reacted with zinc granules. The volume of hydrogen gas given off was measured every 20 seconds and a graph drawn as shown opposite. Excess zinc was used to make sure that all the acid reacted.



(i) How much gas is given off after 40 seconds?
[1 mark]

_____

(ii) After how many seconds did the reaction stop?
[1 mark]

_____

(iii) What happens to the reaction rate as the time increases? [1 mark]

_____

_____

(c) **On the graph** on page 3 draw the curve you would expect to get if the acid concentration was doubled and the zinc granules were still in excess. You should assume that the volume of acid used was the same as in the earlier investigation. [2 marks]

2 This question is about the combustion of carbon and the properties of the products formed.

(a) (i) What compound is formed on the **complete** combustion of carbon? [1 mark]

_____

(ii) Write a balanced symbol equation for the **incomplete** combustion of carbon. [3 marks]

_____

(iii) Explain why the compound formed in the incomplete combustion of carbon is so dangerous. [2 marks]

_____

_____

(b) (i) Complete the symbol equation below to show what happens when carbon dioxide reacts with water. [1 mark]

$CO_2 + H_2O \rightarrow$

(ii) Name the product formed in this reaction. [1 mark]

_____

(c) When carbon dioxide is bubbled through limewater ($Ca(OH)_2$) solution a white precipitate is formed. If more carbon dioxide is bubbled through, the precipitate will disappear.

(i) What is the chemical name of the precipitate? [1 mark]

_____

(ii) Why does the precipitate disappear when excess carbon dioxide is added? [3 marks]

_____

_____

_____

3 Sulfur dioxide reacts with water in the air to form acid rain.

Describe environmental and economic effects of acid rain and outline measures which are used to help prevent acid rain. [6 marks]

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

4 This question is about relative formula masses and using and understanding the term mole.

(a) Calculate the relative formula mass of each of the following substances.

(relative atomic masses:
H = 1, C = 12, O = 16, N = 14, Na = 23, Mg = 24)

(i) ammonia NH_3 [1 mark]

_____

(ii) sodium carbonate Na_2CO_3 [1 mark]

_____

(iii) magnesium hydroxide $Mg(OH)_2$ [1 mark]

_____

(b) What do you understand by the term “a mole of a substance”? [2 marks]

_____

_____

_____

(c) **(i)** The relative formula mass of sulfur dioxide is 64. What is the mass of 0.6 moles of sulfur dioxide? [1 mark]

_____ g

(ii) How many moles are in 320 grams of sulfur dioxide? [1 mark]

_____

(d) Solid silver chloride can be formed by mixing silver nitrate solution with magnesium chloride solution.

$$2AgNO_3 = MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$$

Relative formula masses:
silver nitrate = 170,
magnesium chloride = 95,
silver chloride = 143.5

(i) How many moles of magnesium chloride would be needed to react with 8.5 g of silver nitrate?
[2 marks]

_____ moles

(ii) Use the equation:

$$2AgNO_3 + MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$$

to calculate the mass of silver nitrate needed to produce 14.35 g of silver chloride. [2 marks]

_____ g

5 **(a)** Adding water to anhydrous copper sulfate can be used as a test for water.

(i) Describe the colour change when water is added drop by drop to anhydrous copper sulfate.
[2 marks]

from _____ to _____

(ii) Is this an exothermic or endothermic reaction?
[1 mark]

_____

(b) When copper carbonate is heated it undergoes thermal decomposition.

(i) Write a balanced symbol equation for this reaction.
[2 marks]

_____

(ii) Describe the colour change when copper carbonate is heated. [2 marks]

from _____ to _____

(c) Propane can be used as a fuel. It burns to form carbon dioxide and water.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

Describe in terms of bond breaking and bond making why **this** reaction is exothermic. [5 marks]

6 This question is about hard and soft water.

(a) Give three disadvantages of hard water. [3 marks]

1. _____

2. _____

3. _____

(b) Temporary hardness in water occurs in limestone regions. Explain what happens chemically to produce temporary hardness in water. [3 marks]

_____

_____

_____

_____

_____

(c) Temporary hardness in water can be softened by boiling. All hard water can be softened by ion exchange. Explain how both these methods work by setting out clearly what happens and why the water ends up being soft. [6 marks]

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Boiling:

Ion exchange:

7 **(a)** Explain how fractional distillation separates the compounds found in crude oil. [3 marks]

(b) Complete the table below by giving the molecular and structural formulae of the named compounds. [4 marks]

Name	Molecular Formula	Structural Formula
Ethane		
Ethene		

(c) Ethene and ethane are both gaseous hydrocarbons.

(i) To which homologous series does ethene belong? [1 mark]

_____

(ii) Describe a test to distinguish between the two gases ethane and ethene. [4 marks]

_____

_____

_____

_____

(d) Polychloroethene is a useful plastic made from chloroethene molecules.

(i) Write a balanced symbol equation for the reaction of chloroethene molecules to form polychloroethene. [4 marks]

(ii) Give one use of polychloroethene and explain what property or properties make it suitable for this use. [2 marks]

Use: _____

Property: _____

8 **(a)** In the manufacture of iron, haematite (impure iron(III) oxide), limestone (calcium carbonate), coke (carbon) and hot air are used.

(i) What happens to the limestone in the Blast Furnace? [3 marks]

(ii) Describe the main way in which the reducing agent, carbon monoxide, is produced in the Blast Furnace. [2 marks]

(b) Write a balanced symbol equation for the reduction of iron(III) oxide in the Blast Furnace. [3 marks]

(c) In the manufacture of aluminium the reaction at the cathode can be represented as:

$$Al^{3+} + 3e^- \rightarrow Al$$

Is this type of reaction an oxidation, a reduction, redox or none of these?
Explain your answer. [2 marks]

(d) The Haber process involves the following reaction:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(i) Which substance undergoes reduction in the reaction above? [1 mark]

(ii) What is the meaning of the symbol ⇌ that is used in the reaction above? [1 mark]

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

Contents **Page**

gcse

science

chemistry
double award
single award

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THE PERIODIC TABLE OF ELEMENTS

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	64 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
85 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	178 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	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a / b x
a = relative atomic mass (approx)
x = atomic symbol
b = atomic number