Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

Double Award Science: Chemistry

MV18

Unit C2

Foundation Tier

[GSD51]

WEDNESDAY 15 JUNE 2016, AFTERNOON

Time

1 hour 15 minutes, plus your additional time allowance.

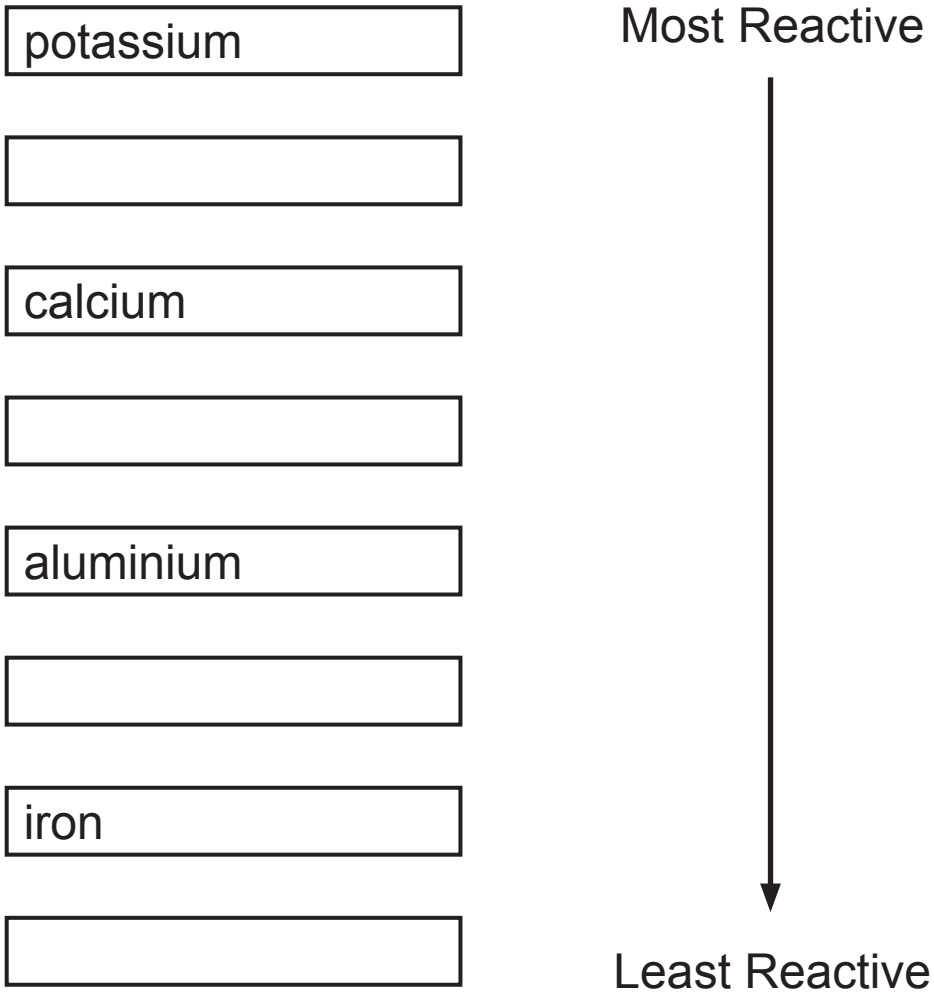
Instructions to Candidates

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 nine** 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 Question **5(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 **(a)** Complete the reactivity series below by placing the metals **zinc, copper, sodium and magnesium** in their correct positions. [4 marks]



(b) Sodium will react with water. In the table below tick (✓) **four** observations that can be made when sodium reacts with water. [4 marks]

Observation	**Tick**
The metal moves about the surface	
The solution changes colour	
The metal sinks to the bottom and rises	
The reaction is vigorous	
A silver ball is formed	
A white solid is formed in the water	
The sodium disappears	

(c) Complete the word equation for the reaction of sodium with water. [2 marks]

sodium + water → +

(d) Lithium reacts with water and is below sodium in the reactivity series. Predict how it will react with water by ticking (✓) the **two** statements below which are correct. [2 marks]

Statement	**Tick**
It will react faster than sodium	
Bubbles of gas will be given off	
It will react more slowly than sodium	
No bubbles of gas will be given off	

2 This question is about oxidation, reduction and the rusting of iron.

(a) Complete the sentence below to explain what is meant by oxidation of a substance. [2 marks]

Oxidation is the gain of _____ or the removal of _____ from a substance.

(b) Different methods can be used to protect iron objects from rusting. Match the objects below to the most suitable rust prevention method. One has been done for you. [3 marks]

Object	Method
Iron gates	Plastic coating
Bicycle chain	Painting
Nuts and bolts	Greasing
Coat hanger	Chrome plating
Bath tap	Oiling

(c) Magnesium can be oxidised by burning in air.

(i) Describe how you would burn magnesium in air. [2 marks]

_____

_____

_____

(ii) Give two safety precautions you should take while doing this experiment. [2 marks]

1. _____

2. _____

(iii) Describe two things you would observe during this experiment. [2 marks]

1. _____

2. _____

(d) When zinc metal is burned in oxygen gas a reaction takes place.

(i) Name the substance formed. [1 mark]

_____

(ii) What is the physical state of the substance formed? [1 mark]

_____

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

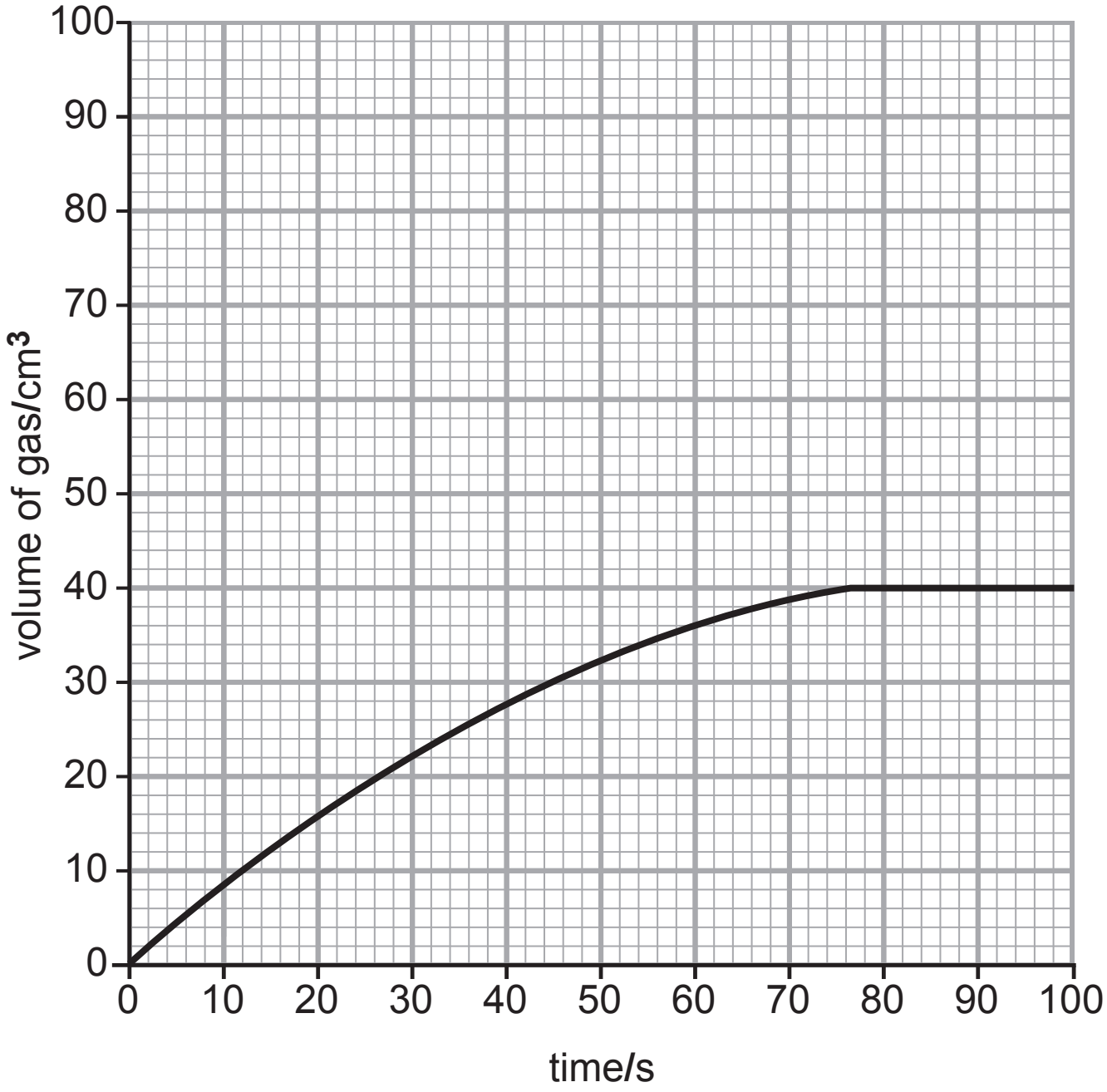
(a) When zinc metal is reacted with acid, the reaction rate can be increased by increasing the concentration of the acid. Give three other things you could do to increase the rate of the reaction. [3 marks]

1. _____

2. _____

3. _____

(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 7 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]

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

(a) (i) What element apart from carbon is needed for combustion to take place? [1 mark]

_____

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

_____

(iii) What other compound is formed on the **incomplete** combustion of carbon? [1 mark]

_____

(iv) Why is combustion not always complete? [1 mark]

_____

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

_____

_____

(b) Carbon dioxide is a gas. Give two other physical properties of carbon dioxide. [2 marks]

1. _____

2. _____

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

carbon dioxide + water →

(d) 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? [2 marks]

_____

_____

_____

5 This question is about sulfur, sulfur dioxide and acid rain.

(a) Give two physical properties of sulfur. [2 marks]

1. _____

2. _____

(b) Sulfur burns in air/oxygen to give the colourless gas, sulfur dioxide.

(i) What colour is the flame when sulfur burns in air? [1 mark]

_____

(ii) Circle the word below which best describes the smell of sulfur dioxide gas. [1 mark]

odourless **pungent** **sweet-smelling** **smoky**

(c) 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.

6 This question is about hard and soft water.

(a) Describe a simple experiment to show that a sample of water is soft water. [2 marks]

_____

_____

_____

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

1. _____

2. _____

3. _____

(c) Water containing two of the substances listed below could be described as hard water.

Circle the **two** substances, from the list below, which would make water hard. [2 marks]

sodium chloride

calcium chloride

copper sulfate

magnesium sulfate

potassium carbonate

lithium carbonate

7 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) The relative formula mass of sulfur dioxide is 64.

(i) 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]

_____ g

8 **(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 bonds are made in a reaction is energy released or is it taken in? [1 mark]

_____

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

(i) Complete the word equation for this reaction.
[2 marks]

Copper carbonate →

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

from _____ to _____

9 **(a)** Crude oil is a source of compounds called alkanes which are hydrocarbons.

What is meant by the term hydrocarbon? [2 marks]

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

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

Name	Molecular Formula	Structural Formula
Ethane		
Ethene		

(d) The alkene ethene undergoes addition polymerisation to form the polymer polythene.
Addition polymers are non-biodegradable and so they cannot be broken down in the environment.
There are two methods of disposal of these polymers – landfill and incineration.
Compare advantages and disadvantages of the two methods of disposal. [4 marks]

Landfill

Advantage: _____

_____

Disadvantage: _____

_____

Incineration

Advantage: _____

_____

Disadvantage: _____

_____

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
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

Rewarding Learning

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