



Rewarding Learning

General Certificate of Secondary Education
2019

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C2

Higher Tier

MV18

[GDW52]

WEDNESDAY 12 JUNE 2019, MORNING

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.

Do not write on blank pages.

Complete in black ink only. Answer **all eight** questions.

Information for Candidates

The total mark for this paper is 80.

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 **7(a)(ii)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 This question is about gas chemistry.

(a) The atmosphere is a mixture of gases. Two of these gases are nitrogen and oxygen.

(i) Approximately what percentage of the air is **not** nitrogen or oxygen? [1 mark]

(ii) Which element is the third most abundant gas in the atmosphere? [1 mark]

(b) Nitrogen is a very unreactive gas, but under extreme conditions it will react with hydrogen to form ammonia.

(i) What makes nitrogen such an unreactive element? [1 mark]

(ii) Describe the test for ammonia gas. [3 marks]

- (c) (i) Oxygen gas can be prepared by the catalytic decomposition of hydrogen peroxide (H_2O_2). Complete the balanced symbol equation for this reaction. [2 marks]



- (ii) When sulfur burns in oxygen, what colour is the flame? [1 mark]

Circle the correct answer.

white

orange

blue

yellow

red

- (iii) When sulfur burns in oxygen, is the oxide formed acidic, basic or neutral? [1 mark]
-

- (iv) When iron burns in oxygen, is the oxide formed acidic, basic or neutral? [1 mark]
-

2 This question is about metals and the reactivity series.

(a) A chemical reaction happens when small pieces of calcium are added to a beaker of water.

State **four** observations you would make for this reaction. [4 marks]

1. _____
2. _____
3. _____
4. _____

(b) Write a balanced symbol equation for the displacement reaction which occurs between magnesium and zinc(II) sulfate. [2 marks]

(c) A student wanted to find out the order of reactivity of four metals labelled A, B, C and D.

He carried out a series of displacement reactions and found out that:

- metal C displaced metal B but not metal D.
- metal B displaced metal A.

Which of the following correctly shows the order of reactivity of the four metals starting with the most reactive? [1 mark]

Circle the correct answer.

ABCD

DCBA

CBDA

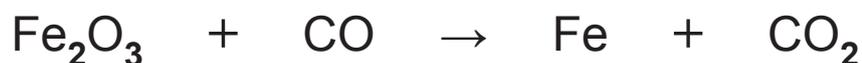
BADC

3 This part of the question is about the extraction of iron from its ore haematite.

(a) Given below are five equations for reactions which occur during the extraction of iron from its ore.



(i) Balance equation **3**. [1 mark]



(ii) Explain why equation **2** can be described as a redox reaction. [3 marks]

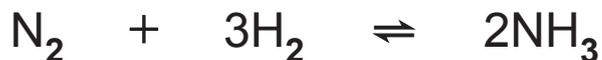
(iii) Equations 4 and 5 occur so that acidic impurities can be removed. What is the name of the main acidic impurity? [1 mark]

(iv) What is the chemical or common name for CaSiO_3 and how is it removed from the blast furnace? [2 marks]

Name: _____

Method of removal: _____

(b) The reaction between hydrogen gas and nitrogen gas to produce ammonia gas is described as a reversible reaction.



Give two reaction conditions which could be changed to alter the direction of this reaction. [2 marks]

1. _____

2. _____

(c) When sulfur dioxide and oxygen react to produce sulfur trioxide, the reaction can reach a dynamic equilibrium.



Explain what is meant by a **dynamic equilibrium**.

[2 marks]

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(Questions continue overleaf)

4 (a) Name three things that all homologous series of organic molecules have in common: [3 marks]

1. _____

2. _____

3. _____

(b) The toxic gas carbon monoxide is formed during incomplete combustion of fuels.

What effect does carbon monoxide have on blood which causes it to be toxic to humans? [2 marks]

(c) (i) Describe what is observed when carbon dioxide is bubbled through a solution of calcium hydroxide (limewater) until carbon dioxide is in excess. [2 marks]

(ii) Name a calcium compound which is formed when carbon dioxide is bubbled through a solution of calcium hydroxide (limewater). [1 mark]

Circle the correct answer.

**calcium
oxide**

**calcium
hydride**

**calcium
chloride**

**calcium
carbonate**

(d) Combustion of fuels containing sulfur leads to the formation of acid rain. Give three different effects of acid rain. [3 marks]

1. _____
2. _____
3. _____

5 This question is about alkenes, alcohols and polymers.

(a) Complete the table below by filling in the blank spaces.
[4 marks]

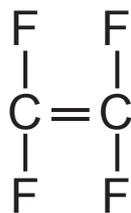
Name	Molecular formula	Structural formula	Physical state at room temperature
but-1-ene		$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{C} & =\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & & \text{H} & \text{H} \end{array} $	
propan-1-ol			liquid

(b) (i) What is the molecular formula of the product from the reaction between ethene and hydrogen?
[1 mark]

(ii) What product is formed when ethene reacts with steam? [1 mark]

(iii) What type of reaction occurs when ethene reacts with hydrogen or with steam? [1 mark]

(c) The structure of the monomer tetrafluoroethene is given below:

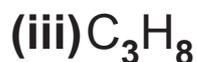


Draw the structure of the polymer polytetrafluoroethene (also known as PTFE). [2 marks]

6 (a) Give the empirical formula for each of the following compounds: [1 mark for each]







(b) A sample of hydrated magnesium sulfate, $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$, was heated to constant mass. Only 48.8% of the original mass remained.

(relative atomic masses: H = 1, O = 16, Mg = 24, S = 32)

(i) Calculate the relative formula mass (M_r) of MgSO_4 .
[1 mark]

(ii) Use your answer to (b)(i) and the information given in the question to calculate the relative formula mass (M_r) of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$. [2 marks]

(iii) Using your answers to (b)(i) and (b)(ii), calculate the value of x . [2 marks]

7 (a) Electrolysis is used in the industrial extraction of aluminium from alumina using graphite electrodes.

(i) Name the ore which is purified to make alumina.
[1 mark]

(ii) Describe the industrial extraction of aluminium.

Your answer should include descriptions and explanations, as appropriate, of:

- what is added to the alumina and why
 - the reaction that happens at the **cathode**
 - how the aluminium is removed
 - why the anode needs to be replaced periodically
- [6 marks]

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

What is added to the alumina and why:

The reaction that happens at the cathode:

How the aluminium is removed:

Why the anode needs to be replaced periodically:

(iii) Write a half equation for the reaction that happens at the anode during the industrial extraction of aluminium. [3 marks]

(iv) Explain why it is better to recycle aluminium rather than extracting it from its ore. [3 marks]

(b) Electrolysis can be used to decompose molten salts such as sodium bromide.

Complete the table to show the products formed, at the cathode and anode, when molten sodium bromide is decomposed using electrolysis. [2 marks]

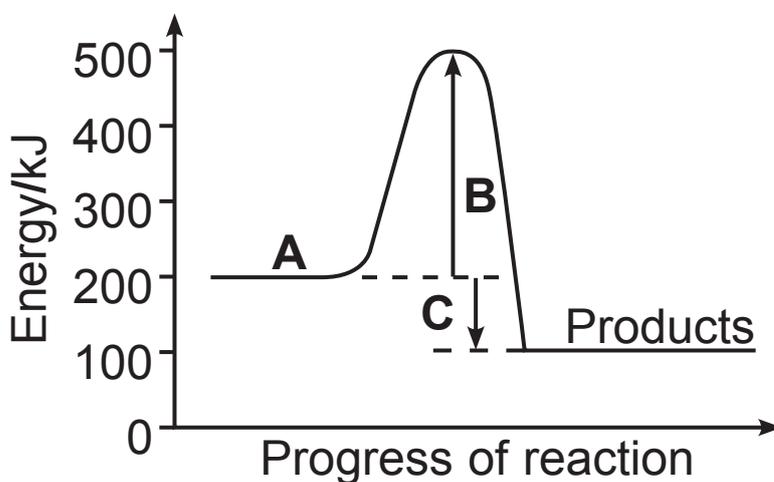
Electrode	Product formed
cathode	
anode	

Blank Page
(Questions continue overleaf)

8 This question is about energy changes during chemical reactions.

(a) Chemical reactions have an activation energy. What is meant by the term **activation energy**? [2 marks]

(b) A reaction profile diagram is shown below:



(i) What do the labels **A**, **B** and **C** represent? [3 marks]

A = _____

B = _____

C = _____

(ii) Does the reaction profile diagram represent an exothermic reaction, an endothermic reaction or both? [1 mark]

(iii) From the energies given on the y axis, calculate the energy change for the reaction. [1 mark]

Circle the correct answer.

+500 kJ

+300 kJ

+100 kJ

-100 kJ

-400 kJ

-500 kJ

(iv) If a catalyst was added, which of the three energies listed below would get smaller? [1 mark]

Circle the correct answer or answers.

activation energy

energy of reactants

energy of products

This is the end of the question paper

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

Total Marks	
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Examiner Number

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Data Leaflet

Including the Periodic Table of the Elements

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

New
Specification

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
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
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

gcse examinations chemistry

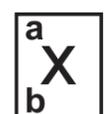
THE PERIODIC TABLE OF ELEMENTS

Group

																		0
																		4
																		He Helium
1	2											3	4	5	6	7		
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	98 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	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112							

* 58 – 71 Lanthanum series

† 90 – 103 Actinium series



a = relative atomic mass (approx)

x = atomic symbol

b = atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 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