



Rewarding Learning

General Certificate of Secondary Education
2022

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C2



Foundation Tier

[GDW51]

GDW51

MONDAY 20 JUNE, MORNING

TIME

1 hour 15 minutes.

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 outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question 7.

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



- 1 (a) This part of the question is about the reactions and reactivity of four metals: magnesium, copper, potassium and zinc.

- (i) Listed below are four metals and five observations from reactions of metals with air. Some of the metals need to be heated.

Draw a line from each metal to the correct observation from its reaction with air.

metal	observation from reaction with air
magnesium	yellow solid formed, turns white on cooling
copper	lilac flame, white solid formed
potassium	bright white light, white solid formed
zinc	orange flame, no solid remains
	blue-green flame, black coating on the metal

[4]



- (ii) List the four metals, magnesium, copper, potassium and zinc in order of reactivity, most reactive first.

most reactive



least reactive

[1]

- (iii) Complete the word equation below for the reaction of magnesium with steam.

magnesium + steam →

+

[1]

- (iv) Which of the four metals, magnesium, copper, potassium or zinc does **not** react with steam?

[1]

- (b) When grey magnesium powder is added to blue copper(II) sulfate solution a displacement reaction occurs.

In the table below, tick (✓) the **two** correct observations you would see during this reaction.

observation	tick (✓) if correct
a green gas is given off	
the blue solution turns colourless	
a red-brown solid is formed	
no solid remains at the end	

[2]

[Turn over



2 This question is about rusting.

(a) Choose words from the list below to complete the sentence which follows:

acid	air	hydrogen
alkali	water	nitrogen

In order for iron to rust, there must be _____
and _____ present. [2]

(b) Oiling, painting, plastic coating and metal coating are barrier methods used to prevent rusting.

(i) Explain what is meant by a **barrier method** by completing the sentence below:

Oiling, painting, plastic coating and metal coating are described as barrier methods to prevent rusting because they _____

_____ [1]

(ii) Suggest two methods used to prevent the handlebars of a bicycle from rusting.

1. _____
2. _____ [2]

(c) Give the full chemical name for rust.

_____ [2]





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3 (a) This part of the question is about the composition of gases in the atmosphere.

(i) Some gases are given in the list below.

argon

carbon dioxide

hydrogen

nitrogen

oxygen

water vapour

Which gas makes up more of the atmosphere than any other gas?

Which gas in the atmosphere is present in varying proportions?

_____ [2]

(ii) What is the percentage composition of oxygen in the atmosphere?
Circle the correct answer.

1%

11%

21%

31%

41%

[1]

(b) From the list below, circle **two** physical properties of nitrogen.

tasteless

odourless

high boiling point

green

pungent smell

[2]



(c) Listed below are four uses of gases and the names of five gases.

Draw a line from each use to the correct gas.

use

gas

fire extinguishers

hydrogen

welding

nitrogen

weather balloons

carbon dioxide

food packaging

chlorine

oxygen

[4]

(d) Give **three** observations when sulfur burns in oxygen.

1. _____

2. _____

3. _____ [3]

[Turn over



- 4 (a) Complete the sentences below about electrolysis by circling the correct word from each box.

Electrolysis is the decomposition of a liquid electrolyte using a direct current

of electricity. The positive electrode is called the

anode.
cathode.
anion.

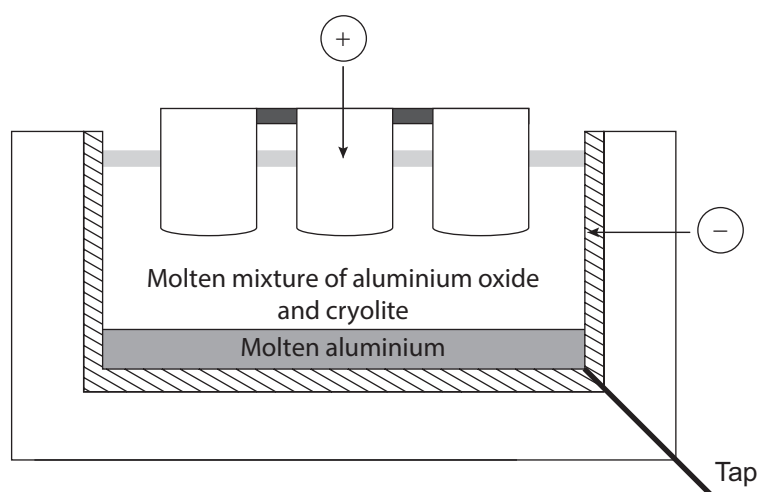
Electrodes that do not take part in a reaction are called

positive
inert
negative

electrodes.

[2]

- (b) The diagram below shows how the electrolysis of aluminium oxide (alumina) is carried out industrially.



- (i) Give **one** reason why aluminium oxide (alumina) is dissolved in molten cryolite.

_____ [1]

- (ii) Give **one** reason why carbon is the material used to make the electrodes.

_____ [1]



(iii) How is the aluminium removed from the mixture when it is formed?

_____ [1]

(iv) The positive carbon electrodes need to be replaced regularly. Complete the sentence below to explain why this is necessary.

The _____ gas formed at the positive carbon electrode
reacts with the electrode to produce _____. [2]

(v) Give **one** reason why it is better to recycle aluminium rather than extracting it from its ore.

_____ [1]

[Turn over]



- 5 (a) Complete the passage below about a homologous series by circling the correct word in each box.

Organic compounds in a homologous series have the same general formula but

they differ by a

CH
CH₂
CH₃

 unit. They have similar

physical
metallic
chemical

 properties

and show a graduation in

physical
metallic
chemical

 properties.

[3]

- (b) Complete the table below by filling in the blank spaces.

name	molecular formula	structural formula	physical state at room temperature
ethane		$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	
	C ₃ H ₈		gas

[4]

- (c) Complete the sentence below by filling in the missing word.

The hydrocarbons in crude oil are separated into fractions by fractional _____.

[1]



(d) Each fraction obtained from crude oil is used for different purposes.

(i) Circle the fraction that is used as a fuel for cars and trains.

naphtha

kerosene

diesel

bitumen

refinery gas

[1]

(ii) Circle the fraction that is used to manufacture chemicals and plastics.

naphtha

kerosene

diesel

bitumen

refinery gas

[1]

(e) (i) When a hydrocarbon undergoes complete combustion it forms carbon dioxide and one other compound. Name the other compound produced.

[1]

(ii) Two of the statements below are about the test for carbon dioxide. Identify the correct statements by putting a tick (✓) in the **two** correct boxes.

A lighted splint is used

☐

Limewater is used

☐

Anhydrous copper(II) sulfate is used

☐

There is a colour change from colourless to milky white

☐

There is a colour change from white to blue

☐

There is a squeaky pop

☐

[2]

[Turn over



6 This question is about energy changes and reversible reactions.

(a) A student carried out two investigations to determine whether there was an exothermic, an endothermic, or no energy change taking place.

(i) In the first investigation the temperature decreased from 21°C to 17°C .
What type of energy change, if any, was taking place?

_____ [1]

The second investigation involved neutralising dilute hydrochloric acid with sodium hydroxide solution in a boiling tube. During the reaction the boiling tube felt warm.

(ii) Complete the student's conclusions below by filling in the missing words.

Neutralisation is an example of an _____ energy change.

This means that during a neutralisation reaction heat energy is

_____. [2]

(b) Hydrogen (H_2) reacts with iodine (I_2) to form hydrogen iodide in a reversible reaction.

(i) Write a balanced symbol equation for this **reversible** reaction.

_____ [3]

(ii) What is meant by the term **reversible reaction**?

_____ [1]





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20GDW5113

7 The combustion of fuels can lead to:

- the greenhouse effect (global warming)
- acid rain
- carbon monoxide release

For each of these, describe the harm they can cause to the environment and people's health.

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

Harm caused by the greenhouse effect (global warming).

Harm caused by acid rain.

Harm caused by carbon monoxide release.

[6]





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20GDW5115

- 8 (a) Fill in the missing words in the passage below to complete the sentences.

An example of a compound that contains water of crystallisation is

hydrated copper(II) sulfate. When heated it loses the water of

crystallisation and changes colour from _____ to

_____, forming _____ copper(II) sulfate. [3]

- (b) Calculate the relative formula mass (M_r) of each of the following solid compounds that contain water of crystallisation.
(relative atomic masses H = 1, O = 16, Mg = 24, S = 32, Cl = 35.5, Mn = 55)



_____ [1]



_____ [1]



(c) When solid calcium carbonate is strongly heated it thermally decomposes to give a solid and carbon dioxide gas.

(i) Name a suitable piece of apparatus that the calcium carbonate could be placed in for heating.

_____ [1]

(ii) How will you know when the thermal decomposition is complete?

_____ [1]

(iii) Name the solid formed when calcium carbonate thermally decomposes.

_____ [1]

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Question Number	Marks
1	
2	
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7	
8	

Total Marks	
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Examiner Number

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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-}

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

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

Group

1	H	Hydrogen	1
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† 90 – 103 Actinium series

A square with side length a is shown. A smaller square with side length b is located in the bottom-left corner. The area of the larger square that is not covered by the smaller square is shaded gray.

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