Rewarding Learning

General Certificate of Secondary Education
2019

Centre Number

Candidate Number

# Double Award Science: Chemistry

Unit C2

Foundation Tier

**MV18**

**[GDW51]**

**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 nine** questions.

## Information for Candidates

The total mark for this paper is 70.
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 **8(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 air is a mixture of gases. One of the gases in air is nitrogen.

**(i)** What percentage of the air is nitrogen? [1 mark]

Circle the correct answer.

**21%** **0.04%** **78%** **1%**

**(ii)** From the list below, circle **two** correct physical properties of nitrogen. [2 marks]

**tasteless**

**colourless**

**high boiling point**

**pungent smell**

**(b)** Listed below are four gases. Draw a line from each gas to its most appropriate use. [4 marks]

| Gas | Use |
| --- | --- |
| nitrogen | clean fuel |
| hydrogen | coolant |
| oxygen | disinfectant |
| carbon dioxide | fizzy drinks |
| | welding |

**2** This question is about metals and the reactivity series.

**(a)** Six of the metals from the reactivity series are listed below:

**aluminium**
**copper**
**iron**
**magnesium**
**potassium**
**zinc**

**(i)** Which **one** of the metals listed above will **not** react with cold water or steam? [1 mark]

_____

**(ii)** Which **one** of the metals listed above will produce a bright white light when it burns in air? [1 mark]

_____

**(iii)** What gas is produced when a metal reacts with steam? [1 mark]

Circle the correct answer.

**carbon dioxide**

**hydrogen**

**oxygen**

**nitrogen**

**(iv)** Put the metals aluminium, copper, iron, magnesium, potassium and zinc in order of their reactivity, **most reactive first**. [2 marks]

_____ most reactive

_____

_____

_____

_____

_____ least reactive

**(v)** Name two of the metals from the list in **part (a)** which are extracted from their ores by chemical reduction. [2 marks]

_____ and _____

**(b)** Complete the word equation for the displacement reaction which occurs between magnesium and zinc sulfate. [1 mark]

magnesium + zinc sulfate ⟶ + 

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

She 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** **(a)** Listed below are five elements that will react with oxygen to form oxides.

**carbon**
**copper**
**iron**
**magnesium**
**sulfur**

**(i)** Which two elements will form acidic oxides? [1 mark]

_____ and _____

**(ii)** Which element will form a white oxide? [1 mark]

_____

**(iii)** Which elements will form oxides which are solid at room temperature? [1 mark]

_____

**(b) (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**

**4** **(a)** A chemical reaction happens when small pieces of calcium are added to a beaker of water. Place a tick **(✓)** beside each of the **three** correct observations for this reaction. [3 marks]

| **Observation** | **Tick (✓)** |
|---|---|
| calcium burns with a lilac flame | |
| calcium sinks and rises | |
| calcium melts into a sphere | |
| a white solid forms | |
| bubbles of gas form | |
| the reaction is very slow | |

**(b)** **(i)** Iron is a very important metal for the building of bridges and other structures. Iron is produced in a blast furnace by reacting iron(III) oxide with carbon monoxide.

Write a word equation for the extraction of iron from iron(III) oxide. [2 marks]

_____

**(ii)** Which **one** of the following physical properties of iron is the most important in its use as a building material for bridges? [1 mark]

Circle the correct answer.

**high melting point**

**strength**

**conductor of electricity**

**shiny**

**5** This question is about the homologous series of alkanes and the fractions in crude oil.

**(a)** In the table below tick (✓) the **three** correct properties of the molecules in the homologous series of alkanes. [3 marks]

| **Property of the homologous series of alkanes** | **Tick (✓)** |
|---|---|
| they show a gradation in their physical properties | |
| they differ by a $CH_3$ group | |
| they are all colourless liquids | |
| they have similar chemical properties | |
| they have the same general formula | |

**(b)** Crude oil can be separated into fractions which have many uses.

Five of these fractions are listed below:

**petrol**

**naphtha**

**kerosene**

**diesel**

**fuel oils**

**(i)** Which two fractions, from the list, are used as fuels for cars? [1 mark]

_____ and _____

**(ii)** Which fraction, from the list, is used to manufacture chemicals and plastics? [1 mark]

_____

**(iii)** Name the fraction, **not** given in the list, which is used to surface roads and roofs. [1 mark]

_____

**(iv)** Which chemical technique is used to separate the fractions in crude oil? [1 mark]

Circle the correct answer.

**filtration**

**fractional distillation**

**simple distillation**

**chromatography**

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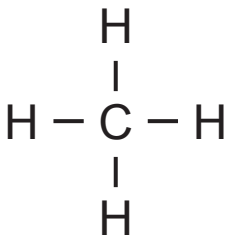
**(Questions continue overleaf)**

**6** This question is about the structure of some organic compounds and combustion reactions.

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

| **Name** | **Molecular formula** | **Structural formula** | **Physical state at room temperature** |
|---|---|---|---|
| methane | |  | |
| | $C_2H_4$ | | gas |

**(b)** Name the two products formed by the complete combustion of methane. [1 mark]

_____ and _____

**(c) (i)** 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]

_____

_____

_____

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

1. _____

2. _____

3. _____

**7** **(a)** The following equation is for a dehydration reaction.

$$CuSO_4.5H_2O \longrightarrow CuSO_4 + 5H_2O$$

**(i)** Give the formula of the substance in the equation above which contains water of crystallisation. [1 mark]

_____

**(ii)** Give the formula of the substance in the equation above which is anhydrous. [1 mark]

_____

**(iii)** Which statement **A**, **B** or **C** describes how this dehydration reaction could be carried out? [1 mark]

**A** Heat a sample of $CuSO_4.5H_2O$ in a boiling tube with damp mineral wool.

**B** Heat a sample of $CuSO_4.5H_2O$ in an evaporating basin until constant mass.

**C** Place a sample of $CuSO_4.5H_2O$ in a beaker and add excess distilled water.

_____

**(b)** Calculate the relative formula mass ($M_r$) of each of the following substances.

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

**(i)** sodium carbonate $Na_2CO_3$ [1 mark]

_____

**(ii)** hydrated sodium carbonate $Na_2CO_3.10H_2O$ [1 mark]

_____

**8** **(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)** 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 | |

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**(Questions continue overleaf)**

**9** **(a)** Some chemical reactions are described as exothermic and some are endothermic.

**(i)** **Three** of the examples below represent exothermic reactions. Identify the **exothermic** reactions by putting ticks (✓) in the correct boxes. [2 marks]

burning wood ☐

photosynthesis ☐

neutralising hydrochloric acid with sodium hydroxide ☐

thermal decomposition of calcium carbonate ☐

reacting magnesium with oxygen ☐

**(ii)** A student held a boiling tube containing some water in his hand. He added a solid to the water, stirred the mixture and then said "This is an endothermic reaction".

How did the student know that the reaction was endothermic? [1 mark]

_____

_____

**(b)** Some chemical reactions are described as reversible.

**(i)** What is meant by the term **reversible reaction**?
[1 mark]

**(ii)** Hydrogen can react with bromine to form hydrogen bromide in a reversible reaction.
Write the balanced symbol equation for this **reversible** reaction. [4 marks]

**This is the end of the question paper**

| 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 |
|---|---|
| Butanoate | $C_3H_7COO^-$ |
| Carbonate | $CO_3^{2-}$ |
| Dichromate | $Cr_2O_7^{2-}$ |
| Ethanoate | $CH_3COO^-$ |
| Hydrogencarbonate | $HCO_3^-$ |
| Hydroxide | $OH^-$ |
| Methanoate | $HCOO^-$ |
| Nitrate | $NO_3^-$ |
| Propanoate | $C_2H_5COO^-$ |
| 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<br>EXCEPT silver and lead chlorides, bromides and iodides |
| Most sulfates EXCEPT lead and barium sulfates<br>Calcium sulfate is slightly soluble |

| Insoluble |
|---|
| Most carbonates<br>EXCEPT sodium, potassium and ammonium carbonates |
| Most hydroxides<br>EXCEPT sodium, potassium and ammonium hydroxides |
| Most oxides<br>EXCEPT sodium, potassium and calcium oxides which react with water |


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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**

## gcse examinations

# chemistry

For first teaching from September 2017

# 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 | 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 | | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

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

a
X
b

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