Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Science: Single Award

Unit 2 (Chemistry)

Higher Tier

[GSS22]

GSS22

THURSDAY 17 MAY 2018, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

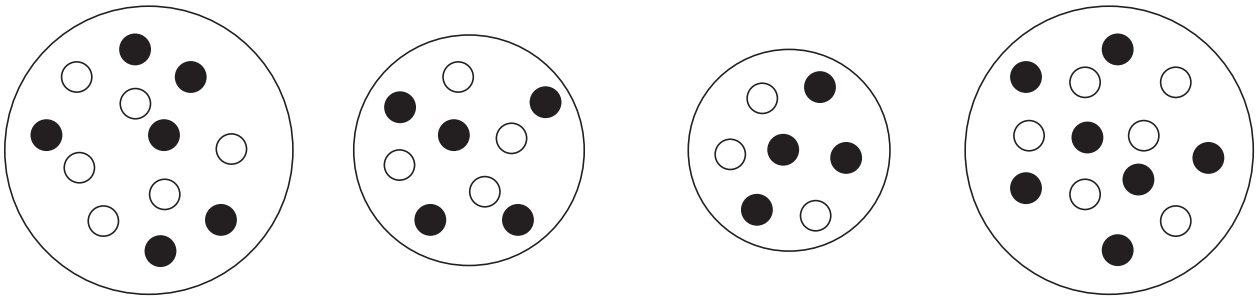
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **3** and **11**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

11669

1 **(a)** The diagrams below show the nuclei (protons and neutrons) of four atoms **A**, **B**, **C** and **D**.



A **B** **C** **D**

Key: ○ Proton
● Neutron

Source: Principal Examiner

(i) Which atom (**A**, **B**, **C** or **D**) has an atomic number of four?

_____ [1]

(ii) Name the element represented by **C**.

You may find your Data Leaflet helpful.

_____ [1]

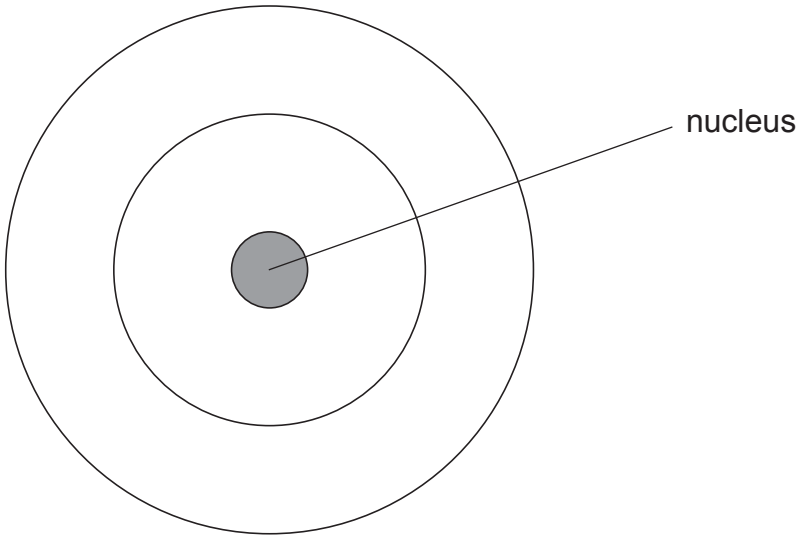
(iii) Which two nuclei (**A**, **B**, **C**, **D**) are from the same element?

_____ and _____ [1]

(b) (i) How many electrons will an atom of element **B** have?

_____ [1]

(ii) On the diagram below show how the electrons in element **B** are arranged.



[1]

(iii) What is the Group number and Period number of element **B**?

Group _____ Period _____ [2]

[Turn over

2 **(a)** Elements and compounds can be represented by chemical symbols and formulae but they must be written correctly.

You may find your Data Leaflet helpful.

(i) What is the correct formula for sodium chloride?

Circle the correct answer.

Na_2Cl_2 : **Na_2Cl** : **$NaCl_2$** : **NaCl**

[1]

(ii) What is the correct formula for magnesium chloride?

Circle the correct answer.

$mgcl_2$: **$MgCl_2$** : **$MGCL_2$** : **$mGcL_2$**

[1]

(b) A compound has the formula $CaSO_4$.

(i) How many elements are present in $CaSO_4$?

_____ [1]

(ii) How many atoms are represented by the formula $CaSO_4$?

_____ [1]

(iii) Name the compound with the formula $CaSO_4$.

_____ [1]

3 Indigestion can cause severe stomach pain.
Many indigestion tablets contain sodium hydrogencarbonate.

Explain how indigestion tablets work.

Your answer should include:

- the cause of stomach indigestion
- how these tablets remove indigestion
- the names of the chemicals produced during this reaction.

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

[6]

[Turn over

4 The table below gives the colour of five indicators at different pH values.

Indicator \ pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
cresol red	R	O	Y	Y	Y	Y	Y	V	V	V	V	V	V	V
universal	R	R	O	O	Y	Y	G	B	B	I	I	I	V	V
thymol blue	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B
phenolphthalein	C	C	C	C	C	C	C	P	P	P	P	P	P	P
blue litmus	R	R	R	R	R	R	B	B	B	B	B	B	B	B

Key:
R = red; O = orange; Y = yellow; C = colourless; P = pink;
G = green; B = blue; I = indigo; V = violet

(a) Use the information from the table above to answer the following questions.

(i) What colour is thymol blue indicator in a neutral solution?

_____ [1]

(ii) Name the indicator which gives the largest range of colour.

_____ [1]

(iii) Name the indicator which can **not** distinguish between pH 1 and pH 8.

_____ [1]

(b) Suggest **two** reasons why phenolphthalein indicator is of limited use when testing solutions with different pH values.

_____

_____

_____ [2]

(c) Complete the word equation below for the reaction of an acid with an alkali.

sulfuric acid + [ ] → sodium sulfate + [ ]

[2]

5 Carbon fibre reinforced plastic is a composite material which can be used in the manufacture of aeroplane parts.

© AlexeyPetrov / iStock / Thinkstock

(a) What is meant by the term **composite material**?

_____

_____

_____ [2]

(b) Carbon fibre reinforced plastic has replaced metal in some parts of aeroplanes.

(i) Suggest **one** property of carbon fibre reinforced plastic that makes it more suitable for use in aeroplane parts. Explain your answer.

_____

_____

_____ [2]

(ii) Give **one** disadvantage of using composite materials.

_____ [1]

(c) Traditionally, fishing rods were made from wood but in some modern fishing rods a carbon fibre composite material is used.

(i) Suggest **one** property that a carbon fibre composite material should have to be useful in a fishing rod.

_____ [1]

(ii) Suggest **one** reason why carbon fibre fishing rods were not used one hundred years ago.

_____

_____ [1]

[Turn over

6 Water can be described as hard or soft. For example, Belfast is described as a soft water region.

(a) Describe an experiment that would show that a sample of water from Belfast was soft.

_____

_____

_____ [2]

(b) A one litre bottle of water had the following information on the label:

Typical composition (mg/l)	
Calcium	40.0
Magnesium	35.5
Sodium	24.7
Potassium	2.0
Hydrogencarbonate	254.0
Chloride	24.3
Sulfate	32.5
Nitrate	2.8

(i) How many metal ions are present in this water?

_____ [1]

(ii) There are two metal ions that cause hardness in water.
Calculate the total mass of hard water ions present in a **two** litre bottle of this water.

(Show your working out.)

_____ mg [2]

(c) Hard water forms undesirable deposits of 'fur' in kettles and hot water pipes.
Complete the balanced symbol equation below for this reaction.

$Ca(HCO_3)_2 \longrightarrow$ _____ + _____ + _____

[2]

[Turn over

7 The table below shows information about some metals.

Metal	Density/ g/cm^3	Relative strength	Relative electrical conductivity	Cost per tonne/ £
copper	8.9	0.6	5.7	3100
aluminium	2.7	0.3	3.8	950
silver	10.5	0.4	6.1	250 000
iron	7.9	1.0	1.0	130

Aluminium is used in overhead cables in the National Grid. This carries electricity throughout the country.

© John-Kelly / iStock / Thinkstock

(a) Silver is the best conductor of electricity shown in the table.
Explain fully why overhead cables in the National Grid are not made of this material.

[3]

(b) Based on the properties of copper in the table opposite, suggest **one** use for it in the home.
Explain why it is the most suitable metal for this use.

_____

_____

_____ [2]

[Turn over

8 **(a)** In September 2017 an earthquake struck southern Mexico, 123 km from Mexico City. It killed 230 people across the region, and rescue crews continued for days to search for survivors. At least 21 children and four adults died in the collapse of a private school. A lot of buildings completely collapsed in Mexico City, with thousands more left damaged and unstable.

The table below shows how the Richter scale is used to compare the size of earthquakes.

Richter magnitude	Earthquake effects
0.0 – 1.9	not felt by people
2.0 – 2.9	slight movement felt by people
3.0 – 3.9	ceiling lights swing
4.0 – 4.9	walls crack
5.0 – 5.9	furniture moves
6.0 – 6.9	some buildings may collapse
7.0 – 7.9	many buildings collapse
Above 8.0	total destruction of buildings, bridges and roads

(i) Suggest a Richter scale value for the earthquake in Mexico.

_____ [1]

(ii) Explain why Mexico is more likely to experience earthquakes than Northern Ireland.

_____

_____ [1]

(iii) Why might governments ignore scientists' predictions that an earthquake is about to happen?

_____

_____ [1]

(b) In the twentieth century scientists had different ideas about the causes of earthquakes. In 1915 Alfred Wegener proposed the theory of continental drift.

(i) Describe Wegener's theory of continental drift.

_____

_____

_____ [2]

(ii) Give **one** piece of evidence that supports Wegener's theory.

_____

_____ [1]

9 Given below is information about the reactions of some metals. The observations were made during a science lesson.

Metal	Reaction when heated in air	Reaction with cold water	Reaction with steam
Potassium	violent reaction, burns with a lilac flame	floats on the water surface, burning with a lilac flame	extremely violent reaction, burns with a lilac flame
Zinc	burns slowly to form a white powder	no reaction	burns slowly giving off a gas
Copper	reacts very slowly	no reaction	no reaction
Magnesium	burns with a bright white light	very slow reaction	extremely violent reaction, glows white
X	reacts slowly	no reaction	reacts very slowly

(a) Use this information to put the metals, including X, in order of reactivity. One has been done for you.

most reactive

_____

_____

Zinc

_____

_____

least reactive _____ [2]

(b) Suggest the name of a metal that could be metal 'X' .

_____ [1]

(c) Explain why potassium must be stored in oil.

_____ [1]

(d) When these metals react with air they undergo an oxidation reaction.
What is meant by the term **oxidation**?

_____

_____ [1]

10 **(a)** Hydrocarbons can be used as fuels because they burn in air.

(i) Complete the balanced symbol equation for the combustion of propane (C_3H_8).

$C_3H_8 \quad + \quad O_2 \quad \rightarrow \qquad\qquad\qquad + \qquad\qquad$

[2]

(ii) Draw the structural formula for propane in the box below.

[1]

(iii) Butane is another hydrocarbon fuel. Give the chemical formula for butane.

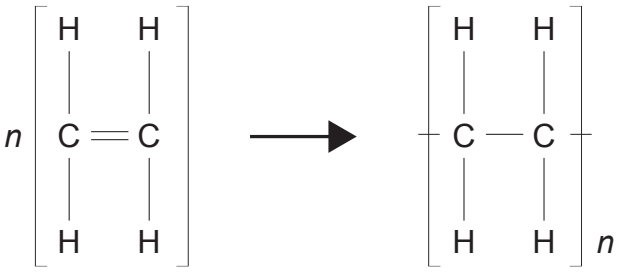
_____ [1]

(b) Alkenes are hydrocarbons that can be used to make polymers.

(i) Name the type of reaction that is used to make polymers.

_____ [1]

The balanced symbol equation for the formation of the polymer polythene is shown below.



ethene polythene

(ii) In terms of bonds, describe how polythene is made from ethene.

_____

_____

_____ [3]

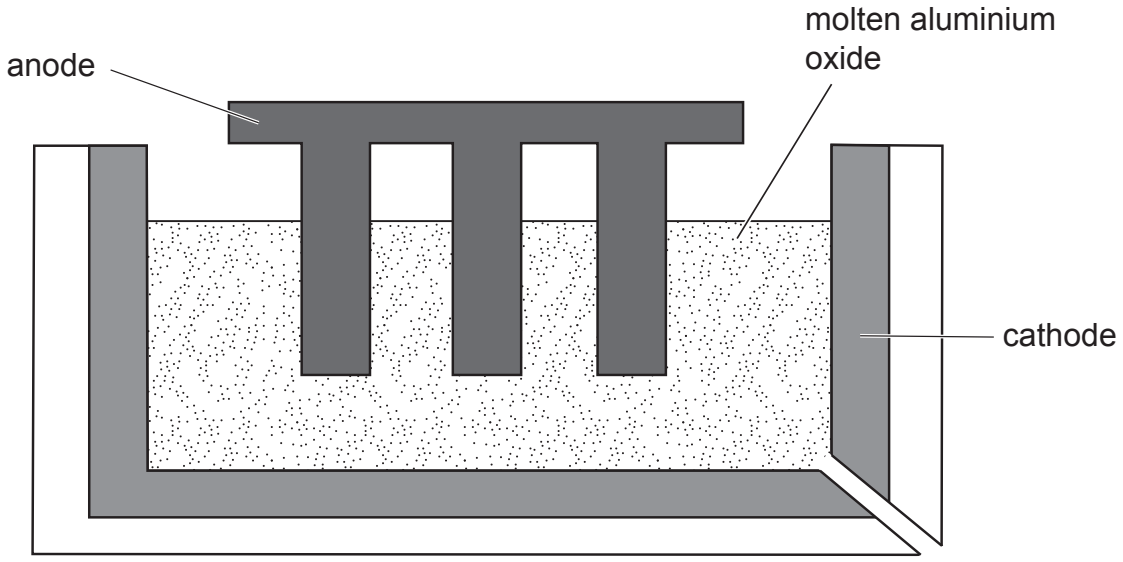
[Turn over

11 Sodium reacts with chlorine to form a compound.
Explain fully, in terms of the atoms and ions involved, how the electronic arrangement changes when sodium and chlorine form a compound. Your answer should include the name of the compound formed.

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

[6]

12 Aluminium is extracted from aluminium oxide using electrolysis, as shown below.



(a) Describe what is meant by the term **electrolysis**.

_____

_____

_____ [2]

(b) Name a suitable material for the anode and explain why it is used.

_____

_____ [2]

(c) Aluminium is produced at the cathode.

Complete the ionic equation for this reaction.

_____ + _____ → Al [2]

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For Examiner's use only	
Question Number	Marks
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Examiner Number