Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education

Double Award Science: Chemistry

Unit C1

Higher Tier

[GDW22]

GDW22

Assessment

Assessment Level of Control:
Tick the relevant box (✓)

Controlled Conditions	
Other	

TIME

1 hour.

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 nine** 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 **3**.
A Data Leaflet, which includes a Periodic Table of the elements is provided.

12787

1 **(a)** The table gives information about four mixtures each of which needs to be separated.

Description of mixture	Substance to be collected	Method of separation to be used
a solution of sodium chloride in water	water	
a mixture of red, green and yellow dyes	red dye	
copper sulfate solution and solid copper oxide	copper oxide	
ethanol and water	ethanol	

Complete the table by choosing, from the list below, the best separation method to obtain a pure sample of the **substance to be collected** from each mixture.
Each separation method may be used once, more than once or not at all.

filtration **simple distillation** **crystallisation**

fractional distillation **paper chromatography**

[4]

(b) Describe, stating clearly the apparatus you would need to use, how you would obtain a pure sample of copper sulfate crystals from a solution of copper sulfate in water.

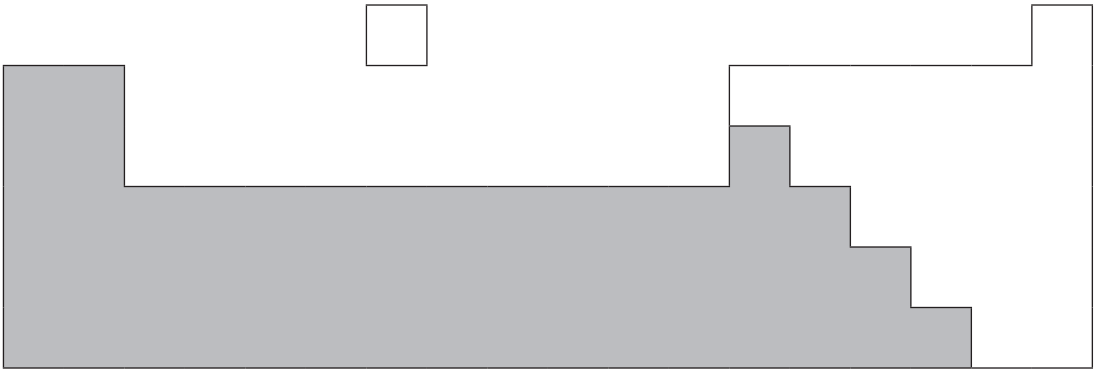
[3]

(c) What flame colour would be observed if a flame test was carried out on a sodium compound?

[1]

[Turn over

2 The diagram below shows an outline of part of the modern Periodic Table.



(a) The elements in the shaded area in the diagram have similar physical properties.
Give **two** physical properties of the elements in this area.

1. _____

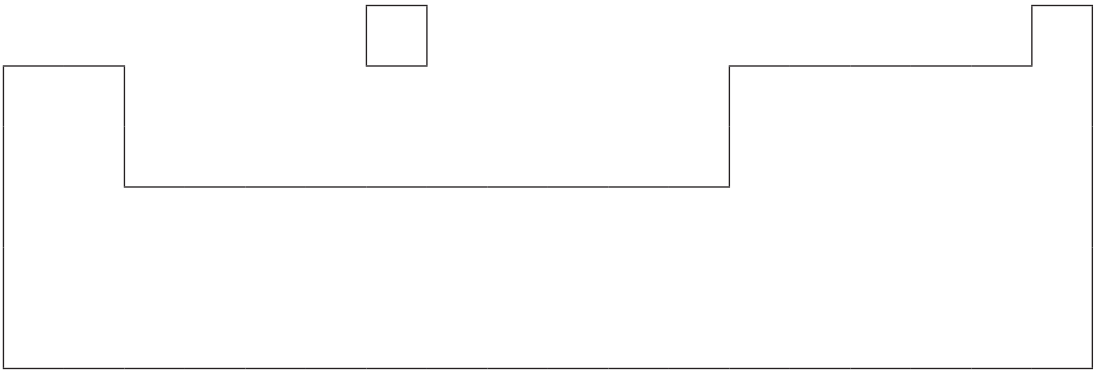
2. _____ [2]

(b) In the outline below shade in:

- the area where you would find the Group called the halogens – label this Group H

and

- the area where you would find the Group called the alkaline earth metals – label this Group AE.



[2]

(c) Graphene is an allotrope of carbon.

(i) Describe the structure of graphene.

_____

_____

_____ [2]

(ii) Complete the sentence below to show your understanding of the term **allotropes**.

Allotropes are different forms of the same element _____

_____ [1]

[Turn over

3 This question is about the chemistry of the alkali metals sodium and potassium.

Describe:

- how sodium and potassium are stored and what is observed if a piece of sodium is placed on some filter paper and then cut with a knife or spatula
- what is observed if a small piece of sodium is dropped into a large beaker or trough containing water (give four or more observations if you can)
- at least two ways in which the reaction of potassium with water is different to that of sodium with water.

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

How sodium and potassium are stored and what is observed if a piece of sodium is placed on some filter paper and then cut with a knife or spatula:

What is observed if a small piece of sodium is dropped into a large beaker or trough containing water (giving four or more observations if you can):

At least two ways in which the reaction of potassium with water is different to that of sodium with water:

_____

_____

_____

_____ [6]

[Turn over

4 This question is about the element Zr of the Periodic Table and its atomic structure.

(a) The element Zr has an atomic number of 40 and a mass number of 91. It forms a Zr^{4+} ion.

(i) What is the name of the element whose symbol is Zr?

_____ [1]

(ii) Complete the table below to show the numbers of protons, neutrons and electrons in a Zr atom and in a Zr^{4+} ion.

Formula	Number of protons	Number of neutrons	Number of electrons
Zr			
Zr^{4+}			

[3]

(b) The element **Zr** has five isotopes.
What is meant by the term **isotopes**?

_____

_____ [2]

The table below gives the mass number and relative abundance of each of the isotopes of Zr. Their mass numbers range from 90 to 96.

(c) Use this information to calculate the relative atomic mass of Zr to **2 decimal places**.

Mass number	Relative abundance
90	51.5%
91	11.2%
92	17.1%
94	17.4%
96	2.8%

You should show your working out here:

_____ [3]

[Turn over

5 **(a)** Complete the **definition** of a **salt** by adding the **three** missing words.

A salt is a compound which is formed when some or all of

the _____ ions of an _____

are replaced by _____ ions or ammonium ions. [3]

(b) The symbol equation below shows a reaction forming a salt.

$$Mg(OH)_2 + 2HNO_3 \longrightarrow Mg(NO_3)_2 + 2H_2O$$

(i) Rewrite this symbol equation as a word equation.

_____ [2]

(ii) What colour would you expect the salt to be in the dry solid state?

_____ [1]

(iii) Write an ionic equation, including state symbols, to show a neutralisation reaction.

_____ [3]

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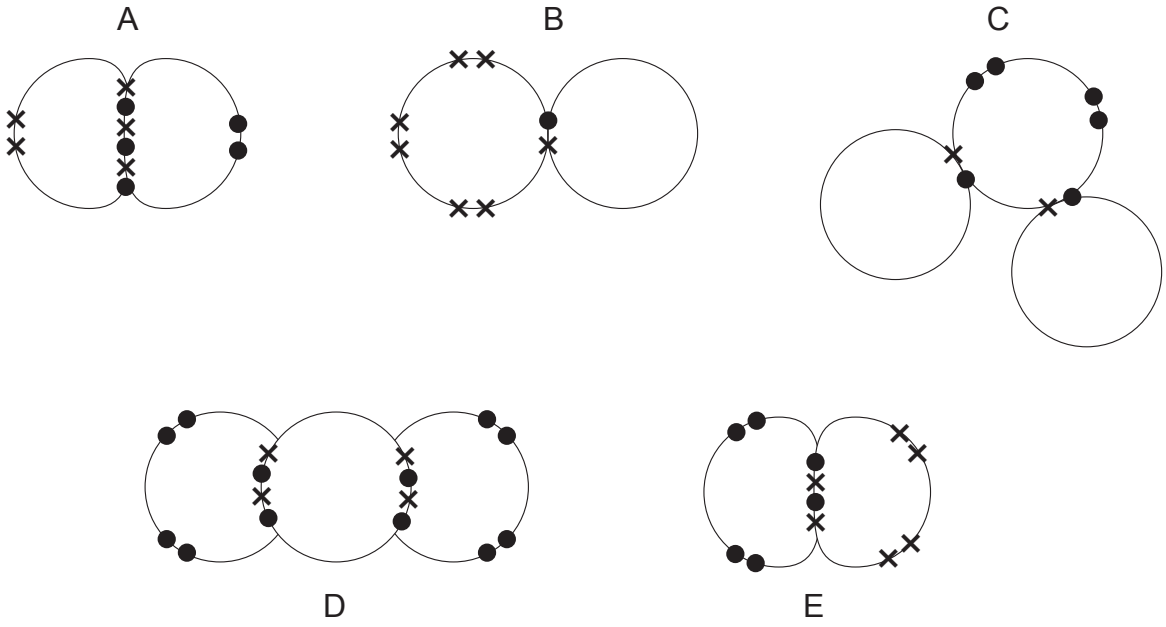
(Questions continue overleaf)

[Turn over

6 **(a)** Five bonding diagrams A, B, C, D and E are shown below. Only the outer electrons are shown.



(i) Complete the table below to describe the arrangements of the electrons for each diagram and name molecules which could be represented by diagrams A, C and E.

Diagram	Number of shared pairs of electrons	Number of lone pairs of electrons	Name of molecule
A	3	2	
B			hydrogen chloride
C	2	2	
D			carbon dioxide
E	2	4	

[3]

(ii) Which **three** of these bonding structures are described as having multiple bonds?

_____ [1]

(b) In the space below draw a dot and cross diagram to show the bonding in ammonia (NH_3).
Only outer electrons are needed.

[2]

[Turn over

7 The chemical formula for ammonium sulfate is $(NH_4)_2SO_4$

(a) Complete the table below.

Number of nitrogen atoms in formula	Number of hydrogen atoms in formula	Number of sulfur atoms in formula	Number of oxygen atoms in formula

[1]

(b) (i) Calculate the mass of one mole of both of the following compounds:
(relative atomic masses: H = 1; N = 14; O = 16; S = 32)

ammonium hydroxide NH_4OH

_____ g

ammonium sulfate $(NH_4)_2SO_4$

_____ g [2]

The balanced symbol equation for the reaction to produce ammonium sulfate from ammonium hydroxide, is given below.

$$2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O$$

(ii) Calculate the theoretical yield of ammonium sulfate, in grams, if 0.1 moles of ammonium hydroxide is reacted with excess dilute sulfuric acid.

_____ g [1]

(iii) In an experiment, using 0.1 moles of ammonium hydroxide with excess dilute sulfuric acid the actual yield was 5.35 g. Calculate the percentage yield to 2 decimal places.

_____ [2]

(c) Ammonium hydroxide NH_4OH is a weak alkali.
Explain in terms of ions what is meant by a **weak alkali**.

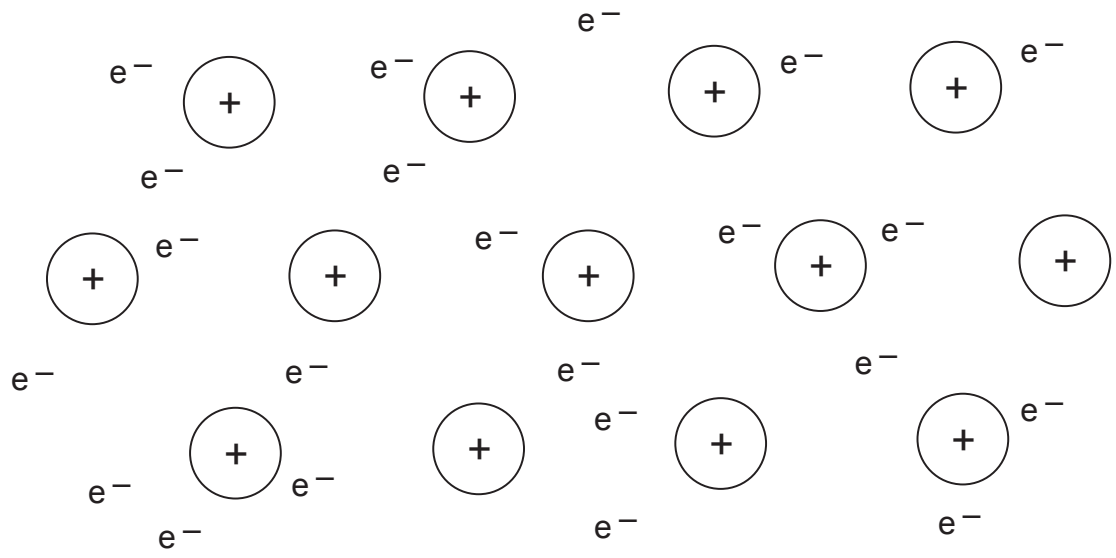
_____

_____

_____ [2]

[Turn over

8 The diagram below represents metallic bonding but is unlabelled.



(a) Explain what this diagram shows.

_____

_____

_____

_____

_____ [3]

(b) Use the diagram to help you explain:

why metals are good conductors of electricity;

_____

_____

_____

why metals are ductile.

_____

_____

_____ [4]

[Turn over

9 The table shows reactions of the first four members of the halogens with solutions of halides.
The elements are labelled here as P, Q, R and S and are **not** in order of their atomic numbers.

Halogen	With sodium chloride solution	With sodium bromide solution	With sodium iodide solution
P	no reaction	reaction	reaction
Q	reaction	reaction	reaction
R	no reaction	no reaction	no reaction
S	no reaction	no reaction	reaction

(a) Use the information in the table to identify halogens P, Q, R and S.

P _____ Q _____

R _____ S _____ [2]

(b) (i) Write a balanced symbol equation for the reaction between sodium iodide and chlorine.

_____ [3]

(ii) This equation can be written as an ionic equation to show only the displacement of the halogen. Complete and balance this ionic equation.

I^- + Cl_2 $\longrightarrow$ [2]

(c) Predict the physical state of the halogen astatine at room temperature. Balance the equation below and name the **product**.

Physical state of astatine at room temperature: _____

Balance: As_2 + Na $\longrightarrow$ NaAs

Name of the product: _____

[3]

THIS IS THE END OF THE QUESTION PAPER

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

Examiner Number