Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education

Centre Number

Candidate Number

Chemistry

Assessment Unit AS 1
assessing
Basic Concepts in Physical and Inorganic Chemistry

[SCH12]

SCH12

Assessment

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

Controlled Conditions	
Other	

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Answer **all fifteen** questions.
Answer **all ten** questions in **Section A**. Record your answers by marking the appropriate letter on the answer sheet provided. Use only the spaces numbered 1 to 10. Keep in sequence when answering.
Answer **all five** questions in **Section B**. **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.**

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Quality of written communication will be assessed in Question **15(d)**.
In Section A all questions carry equal marks, i.e. **one** mark for each question.
In Section B the figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, containing a Periodic Table of the Elements, is included for your use.

Section A

For each of the following questions only one of the lettered responses (A–D) is correct.

Select the correct response in each case and mark its code letter by connecting the dots as illustrated on the answer sheet.

1 Which one of the following elements is the strongest reducing agent?

A Calcium

B Fluorine

C Iodine

D Potassium

2 Electronegativity is the

A ability of an atom to attract electrons from another atom.

B attraction of an atom for a bonding pair of electrons.

C attraction between the nucleus and the electrons of an atom.

D energy required for a gaseous atom to gain an electron.

3 Addition of excess barium chloride solution to 1.60 g of a metal sulfate, dissolved in water, gave a precipitate of 2.33 g of barium sulfate. The metal sulfate was

A $CaSO_4$

B $CuSO_4$

C $MgSO_4$

D Na_2SO_4

4 Which gas contains the least number of electrons per mole?

A Carbon dioxide

B Nitrogen

C Sulfur dioxide

D Water vapour

5 8 g of a hydrocarbon contains 6 g of carbon. What is the formula of the hydrocarbon?

A CH_4

B C_2H_2

C C_2H_4

D C_6H_8

6 A mixture of sodium sulfate and copper(II) sulfate contains 3 moles of sulfate ions and 1 mole of copper(II) ions. The number of moles of sodium ions present is

A 1

B 2

C 3

D 4

7 Naturally occurring hydrogen contains hydrogen, $^{1}_{1}H$ and deuterium, $^{2}_{1}D$.
The following ions are produced in a mass spectrometer:

H^+ D^+ HD^+ H_2^+ D_2^+

Which pair of ions has the same mass?

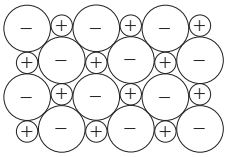
A H^+ and D^+

B H_2^+ and D_2^+

C H_2^+ and D^+

D H_2^+ and HD^+

8 The diagram below represents an ionic substance.



The substance is

A LiI

B $MgCl_2$

C MgO

D RbF

9 How many carbon atoms are present in 0.02 mg of graphite?

A 1×10^{18}

B 2×10^{18}

C 1×10^{21}

D 1×10^{22}

10 Which one of the following has the greatest mass?

A 1 mol of CH_3COCH_3

B 1 mol of CO_2

C 1 mol of $MgCO_3$

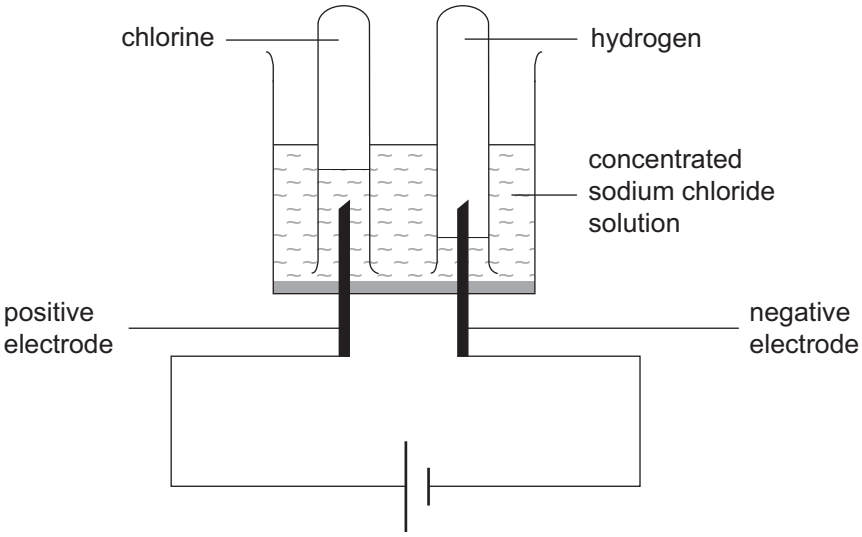
D 1 mol of $Mg(OH)_2$

[Turn over

Section B

Answer **all five** questions in this section

11 The electrolysis of a concentrated solution of sodium chloride can be carried out using the apparatus below.



(a) How would you alter the external circuit to show that electricity is flowing?

_____

_____ [1]

(b) At the positive electrode chloride ions lose electrons to form chlorine gas.

(i) Write an equation, including state symbols, for the reaction taking place.

_____ [2]

(ii) Describe the appearance of chlorine gas.

_____ [1]

(iii) Describe how you could show that chlorine is present in the test tube.

_____

_____ [2]

(c) At the negative electrode hydrogen ions gain electrons to form hydrogen gas.

(i) Write an equation, including state symbols, for the reaction taking place.

_____ [2]

(ii) Describe the appearance of hydrogen gas.

_____ [1]

(iii) Describe how you could show that hydrogen is present in the test tube.

_____

_____ [1]

(d) In the apparatus shown opposite, the electrodes are platinum. Suggest an alternative material that could be used in place of platinum.

_____ [1]

[Turn over

(e) The solution around the negative electrode becomes alkaline as the electrolysis proceeds.

Explain how you would show that the solution becomes alkaline.

_____

_____ [2]

(f) Chlorine reacts with cold dilute sodium hydroxide solution and hot concentrated sodium hydroxide solution. Write equations for each of these reactions.

cold dilute

_____

hot concentrated

_____ [4]

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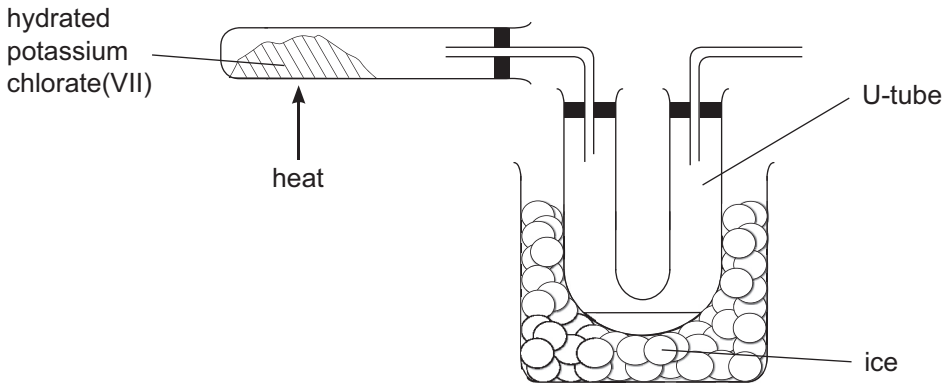
(Questions continue overleaf)

12 A sample of hydrated potassium chlorate(VII), $KClO_4 \cdot xH_2O$, was gently heated using the apparatus shown below. A colourless liquid was collected in the U-tube.



The white crystals of the hydrated potassium chlorate(VII) changed into a white powder. The colourless liquid collected is water.

(a) (i) Define the term **hydrated**.

_____

_____ [1]

(ii) Why is ice used in the beaker?

_____ [1]

(iii) Describe how you would determine the mass of the water collected.

_____

_____ [2]

(iv) Draw a diagram to show a hydrogen bond between two molecules of water. Include all partial charges and lone pairs.

[3]

(b) Explain why the white crystals turn to a white powder.

[1]

(c) 3.85 g of hydrated potassium chlorate(VII) produced 0.44 g of water. Use these masses to deduce the formula of the hydrated potassium chlorate(VII).

[4]

[Turn over

(d) When anhydrous potassium chlorate(VII) is strongly heated it produces potassium chloride and oxygen.

(i) Write the equation for the decomposition of anhydrous potassium chlorate(VII) to produce potassium chloride and oxygen.

_____ [1]

(ii) Describe how you could test for the ions present in potassium chloride.

_____

_____

_____

_____

_____

_____ [5]

(iii) Describe the test for oxygen gas.

_____

_____ [1]

(iv) Draw a labelled diagram to show how you would heat anhydrous potassium chlorate(VII) and collect and measure the volume of oxygen produced at room temperature and pressure.

[3]

[Turn over

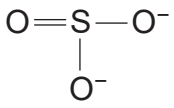
13 The sulfite, sulfate and thiosulfate ions have the following formulae.

Sulfite SO_3^{2-}

Sulfate SO_4^{2-}

Thiosulfate $S_2O_3^{2-}$

(a) The bonding in the sulfite ion can be represented by:



Draw and name the shape of this ion.

Name of shape _____ [2]

(b) Complete the table below.

ion	oxidation state of sulfur	formula of barium salt
SO_3^{2-}		
SO_4^{2-}		
$S_2O_3^{2-}$		

[3]

(c) You are provided with a mixture of solid sodium nitrate and solid sodium sulfate. Describe how you would remove sulfate ions, using precipitation, from the mixture.

[4]

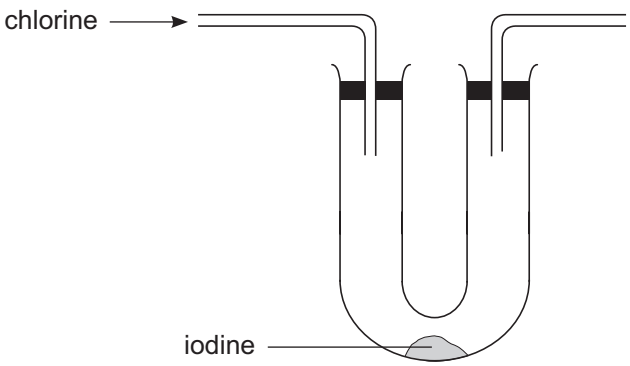
[Turn over

14 Iodine reacts with chlorine at room temperature to produce iodine monochloride which then reacts further with chlorine to produce iodine trichloride.

$$I_2 + Cl_2 \rightarrow 2ICl$$

$$ICl + Cl_2 \rightarrow ICl_3$$

The reaction may be carried out by passing chlorine over iodine crystals in a U-tube at room temperature.



Iodine monochloride forms black crystals that melt at 14 °C and iodine trichloride forms yellow crystals that melt at 101 °C.

(a) Explain why the reaction is carried out in a fume cupboard.

_____

_____ [1]

(b) Suggest why iodine trichloride is obtained as a liquid during the experiment.

_____

_____ [1]

(c) Iodine monochloride is a diatomic molecule.

Draw the dot and cross diagram for iodine monochloride using outer electrons only.

[1]

(d) Iodine trichloride is a tetra-atomic molecule.

(i) Draw the dot and cross diagram for iodine trichloride using outer electrons only.

[1]

(ii) Draw the shape of the iodine trichloride molecule and show the polarity of the bonds.

[2]

(iii) Name the shape of the iodine trichloride molecule.

_____ [1]

(iv) State and explain whether iodine trichloride is a polar or non-polar molecule.

_____

_____ [1]

(e) Iodine trichloride reacts with water in a disproportionation reaction according to the following equation.

$$3ICl_3 + 6H_2O \rightarrow 9HCl + HI + 2HIO_3$$

(i) Calculate the oxidation number of iodine in ICl_3, HI and HIO_3.

[2]

(ii) Define a **disproportionation** reaction.

[2]

(iii) Use the oxidation numbers of iodine to explain why this is a disproportionation reaction.

[2]

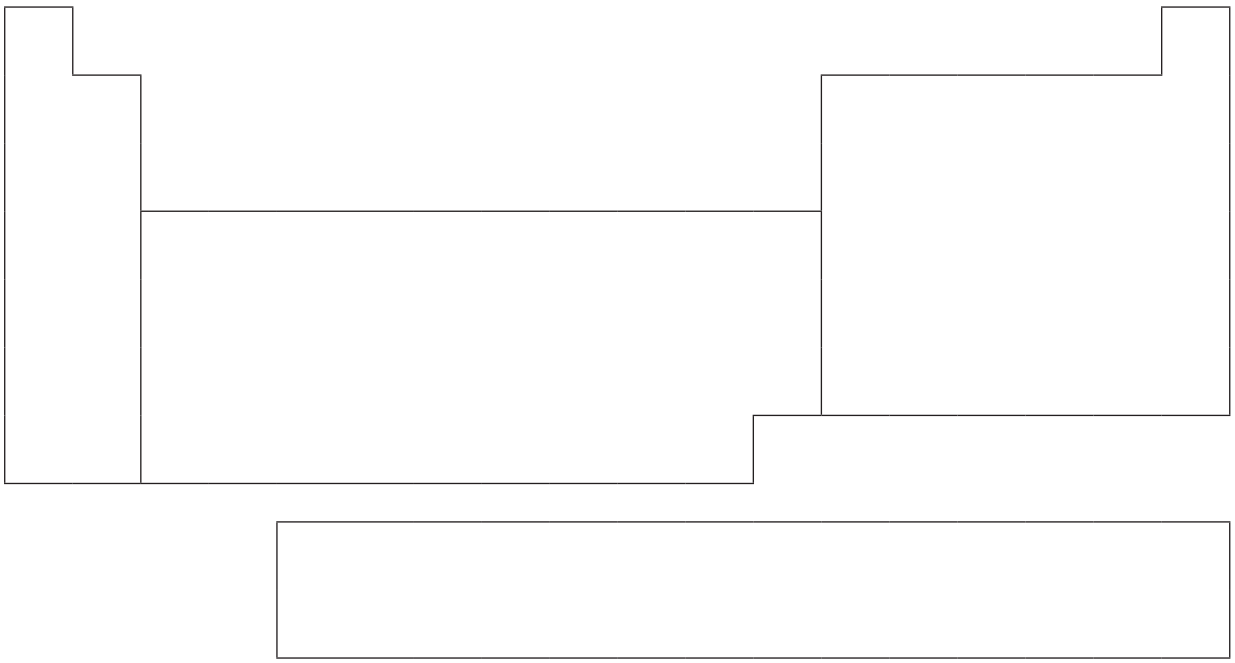
(iv) Calculate the molarity of HIO_3 if 9.34 g of solid iodine trichloride reacts with excess water and the volume is made up to 250 cm^3 in a volumetric flask. Give your answer to 3 significant figures.

[3]

[Turn over

15 The Periodic Table on the data leaflet shows the elements with their relative atomic mass, symbol and atomic number.

(a) A representation of the Periodic Table is shown below. Four areas are outlined.



These areas contain s-block, p-block, d-block and f-block elements. Identify the four blocks by writing s, p, d and f on them. [2]

(b) Define **relative atomic mass**.

_____

_____

_____ [2]

(c) The elements copper and chlorine are in different blocks of the Periodic Table.

(i) Write the electronic configurations of a copper atom and a chlorine atom.

copper _____

chlorine _____ [2]

(ii) Write an equation to represent the second ionisation of chlorine.

_____ [2]

(iii) Explain why the second ionisation energy of chlorine is larger than its first.

_____

_____ [1]

(d) Describe the structure and bonding in lithium, carbon (diamond) and oxygen.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

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