



PROVISIONAL MARKING KEY



CHEMISTRY I

Subject number: M038/I

Section A

1. a. Define the term 'hydrated salt'.

Hydrated salt is referred to any salt that contains water molecules. / It is a moist salt.

(1 mark)

b. Calculate the percentage composition of water of crystallisation in hydrated copper sulphate whose molecule is $\text{CuSO}_4 \cdot 4\text{H}_2\text{O}$. ($A_r \text{ Cu} = 64, \text{S} = 32, \text{O} = 16, \text{H} = 1$)

$$\text{Water, H}_2\text{O} = 2 \times 1 + 1 \times 16$$

$$= 2 + 16 = 18 \quad (1)$$

$$\text{Then } 4 \times 18 = 72 \quad (1)$$

Hydrated copper sulphate, $\text{CuSO}_4 \cdot 4\text{H}_2\text{O}$

$$64 \times 1 + 32 \times 1 + 16 \times 4 + 72 \quad (1)$$

$$= 64 + 32 + 64 + 72$$

$$= 232 \quad (1)$$

$$= 7200 / 232 = 31.034482759\%$$

$$= 31\% \quad (1)$$

c. When 10g of calcium carbonate, CaCO_3 was heated, it decomposed and5.2g of calcium oxide, CaO was obtained using the chemical equation below:

(A_r for Ca = 40, O = 16 and C = 12).

Calculate percentage yield of calcium oxide from the reaction in 1c.

RFM for CaO

$$40 + 16$$

$$56 \quad (1)$$

But 1 mole of Calcium carbonate produces 1 mole of calcium oxide

This means that 0.1 mole produces 0.1 mole which is 5.6g

$$(5.2/5.6)100 \quad (1)$$

$$92.857142857$$

$$= 93\% \quad (1)$$

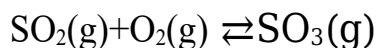
(3 marks)

2. a. Define the term “rate of reaction”.

It is the rate of change in an amount or concentration of a particular reactant or product per unit time.

(1 mark)

- b. Given the reaction between Sulphur dioxide (SO_2) and Oxygen (O_2) below:



What will be the effect on the position of the equilibrium if temperature of the reactants is increased when the system is in the chemical equilibrium state? Explain your answer.

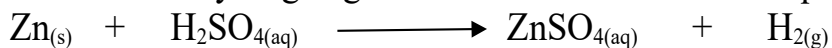
(ii)- The equilibrium shifts to the L^1 (product)



- Reactants gain kinetic energy which makes them move faster¹ hence frequently colliding¹ with other atoms hence reaction is speeded up

(3 marks)

- c. Zinc powder reacts with a dilute sulphuric acid producing zinc sulphate solution and hydrogen gas as shown in the chemical equation below:

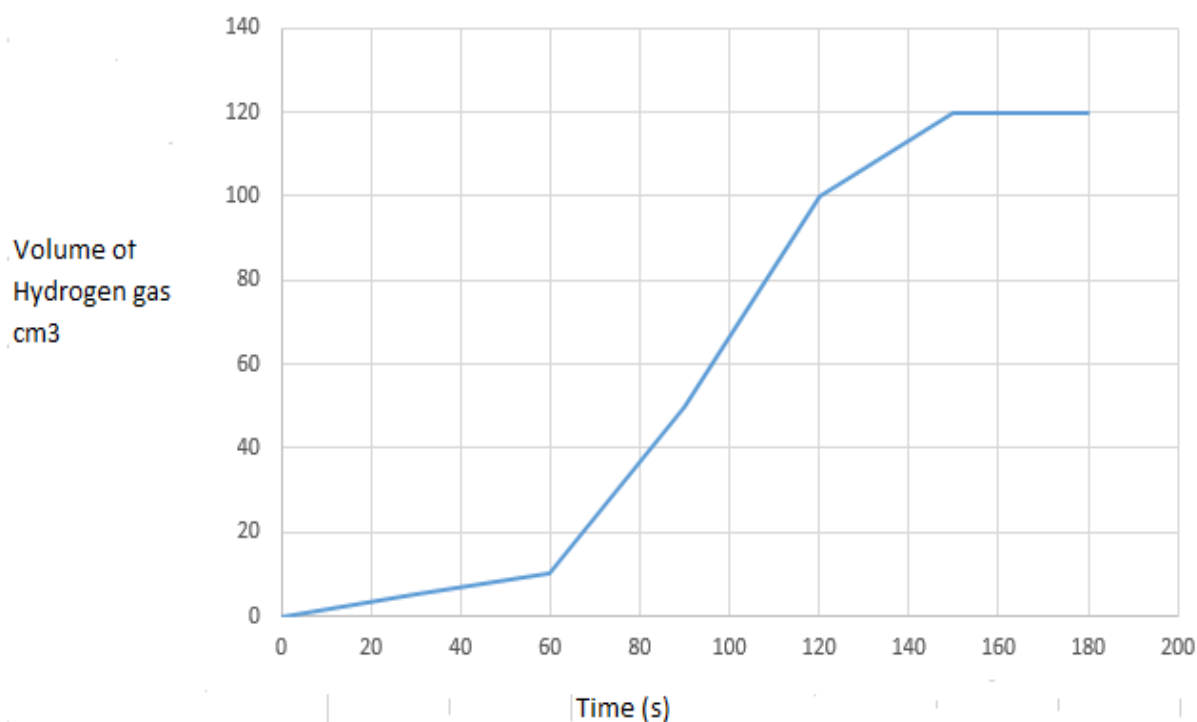


Plot a graph of volume of hydrogen gas produced against time taken using the results in the **Table 1** provided below:

Table 1

Volume of hydrogen gas (cm ³)	0	5	10	50	100	120	120
Time Taken (s)	0	30	60	90	120	150	180

Volume of Hydrogen gas against Time



(1) for labels, (1) for scaling, (2) for coordinates and (1) for line of fitness

3. a. Describe **two** methods that can be used to remove permanent hardness in water.

➤ **Addition of sodium carbonate solution**

Sodium carbonate solution reacts with calcium sulphate and produces sodium sulphate solution and insoluble calcium carbonate and these precipitates settle down and leave the water soft.

➤ **Distillation**



Distillation process removes all the ions in the hard water and the produced water is called distilled water. The water without salts and it is pure water and it is soft water.

➤ Use of ion exchange method

The method involves the sodium complex salt solution as sodium ions replace calcium ions or magnesium ions as sodium is more reactive than either magnesium or calcium. Ion exchange resin has sodium permutit and its this sodium permutit that provides sodium ions for replacing calcium ions or magnesium ions in hard water. Thereafter hard water after being treated with ion exchange resin becomes soft water.

(4 marks)

b. What are greenhouse gases?

Greenhouse gases are air components whose accumulation in the atmosphere cause rise in global temperatures.

(1 mark)

(1 mark)

c. Explain how carbon dioxide and methane contribute to global warming.

Both Carbon dioxide and methane are good at trapping most of heat energy produced during different exothermic reactions taking place all the times and radiant energy, ⁽¹⁾ therefore raising the temperatures and causes global warming.

(1)

(2 marks)

4. Given below are general formulae of homologous series of organic compounds.

M: $C_nH_{2n+1}COOH$

N: C_nH_{2n+2}

P: $C_nH_{2n+1}CHO$

Q: $C_nH_{2n+1}COC_nH_{2n+1}$

R: C_nH_{2n}

a. Which homologous series represent hydrocarbons?

-N: C_nH_{2n+2} -1

-R C_nH_{2n} -1

b. $C_nH_{2n+1}COOH$ when $n = 3$

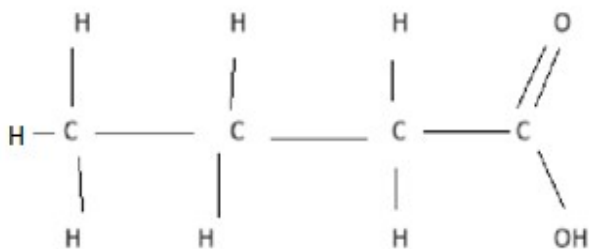
C_3H_7COOH

1

(2 marks)

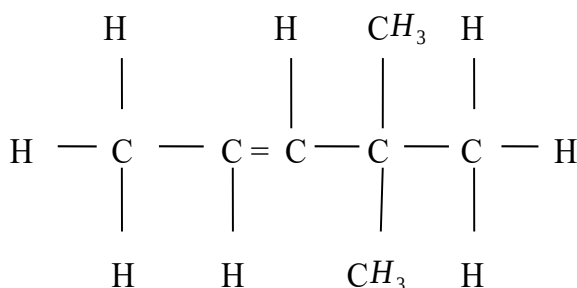


b. Draw a structure of a member of **M** whose *n* is 3, hence name the compound



Butanoic acid (1 for structure/1 for naming)

c. Draw a structure of 4,4 dimethyl pent-2-ene



1- for functional gap

1- for branches

1- for correct structure

5. a. What are allotropes?

These are elements that exist in different forms but in the same physical state of matter

(1 mark)

b. **Figure 2** shows allotropes of carbon.

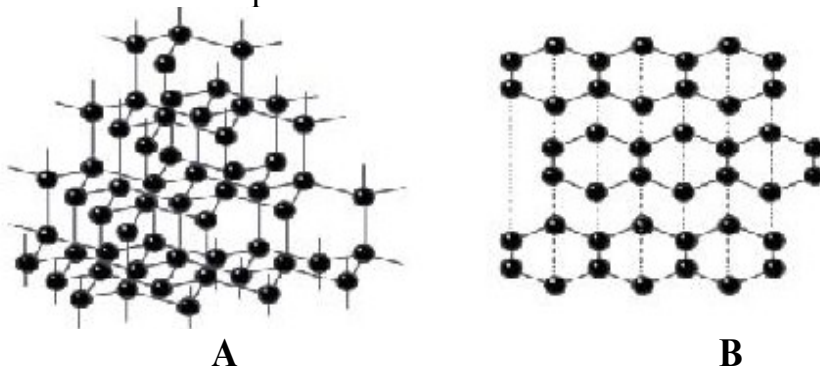


Figure 2

Identify these allotropes.

A is Graphite

(1 mark)

B is Diamond

(1 mark)

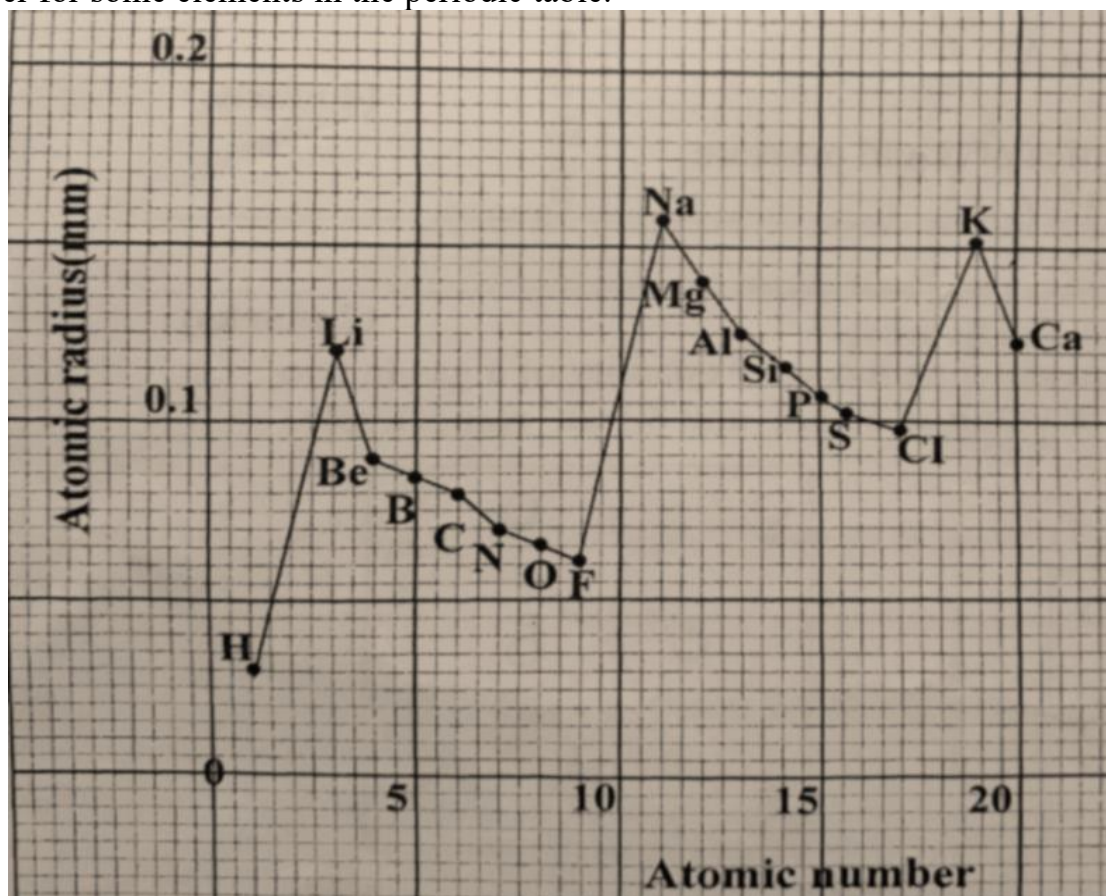
c. Give any **three** differences between oxygen and ozone gases.

- **Oxygen has a density of 16 (H=1) while ozone has a density of 24 (H = 1).**
- **Oxygen is non-poisonous while ozone is a poisonous.**

- Oxygen does not react with potassium iodide solution while ozone reacts with potassium iodide solution produces iodine.
- Oxygen is not attacked by heat while ozone is converted to oxygen by heat.

(3 marks)

6. a. **Figure 1** is a graph of atomic radius across the period against atomic number for some elements in the periodic table.

**Figure 1**

- (i) Which Group II element has the largest atomic radius?

Magnesium, Mg

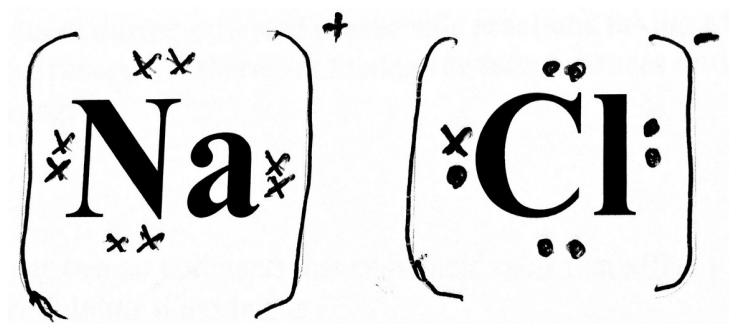
(1 mark)

- (ii) Why is there a sudden increase in atomic radius from Cl to K?

There will be an increase of a fourth shell to cover the three shells that contain electrons. As we move from period to another period, atomic radius increases.

(2 marks)

- b. Draw electron dot and cross diagrams for the reaction between Sodium (Na) and Chlorine (Cl) to form Sodium Chloride (NaCl).



(2 marks)

7. a. (i) Explain the difference between bond breaking and bond formation.

(i) Any reaction needs to *absorb*¹ energy for the bonds to break while for bond to be formed energy is *released*¹

b. **Table 2** below shows bond energy values. Use it to answer the questions that follow.

Table 2

Bond	Energy (KJ)
N $\equiv$ N	410
N - H	391
H - H	435

(i) Determine the enthalpy change when hydrogen (H_2) gas react with Nitrogen (N_2).



Reactants: (3X 435)=1305

$$(1 \times 391) = \frac{410}{1715} + \quad 1$$

Products (6 X 391)=2346

Energy for products-energy for reactants

$$(2346 - 1715) \text{KJ}$$

$$= 631 \text{KJ}$$

1 Correct answer

(5 marks)

(ii) What conclusion can you make from the reaction?

The reaction is endothermic 1

8. a. What is Chemical bond?

It is an attraction between two particles as atoms and ions. (1 mark)

b. Discuss any **two** properties of ionic compounds.

- **They conduct electricity in their aqueous solutions or molten state as ions are free to move and be attracted by electrodes as positive ion are attracted by cathode and negative ions are attracted by anode.**
- **They have high melting points and high boiling points because their intermolecular forces are very strong that they require a lot of heat energy to break the IMFs.**
- **They are soluble in water due to the polarity of water molecule and the partial negative part of water attracts the positive ion in ionic compound and separate it from the negative ion as the negative one is also attracted by the partial positive part of water**
- **They are crystalline solids as the crystals are regularly arranged and be in octahedral shape.**
- **They are insoluble in organic solvents because organic solvents are non-polar.**

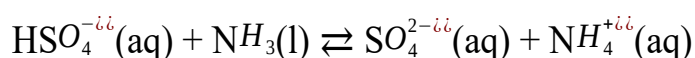
(2 marks
)

c. Explain how covalent bonding is formed.

Covalent bonding is formed by sharing unpaired electrons for the atoms involved in bonding.

(2 marks)

9. a The following is a reaction between HSO_4^- and NH_3 :

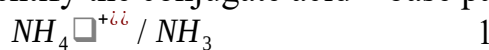


(i) Explain the meaning of the $\rightleftharpoons$



a (i) it means the reaction is reversible/it can be reversed/the products formed can react to produce reactants

(ii) Identify the conjugate acid – base pairs in the above reaction



b. Form 4 students at Zenga Secondary School reacted propane (C_3H_8) and Chlorine (Cl_2).

(i) Mention a chemical waste from the reaction

Hydrogen Chloride (HCl) gas¹

(ii) Explain how the waste above would be disposed

The reaction could be performed/ carried out in a fume chamber¹/since hydrogen chloride gas is poisonous¹.

(2 marks)

10. a (i). Calculate the oxidation number of R in $RMnO_4$ if oxidation number of Mn = +7 and O = -2

a.(i) a.(ii) $RMnO_4$

$$RMnO_4 = 0 \quad 1$$

$$R + Mn + 4O = 0$$

$$R + (7) + 4(-2) = 0 \quad 1$$

$$R + 7 - 8 = 0$$

$$R - 1 = 0$$

$$R = +1 \quad 1$$

d. **Table 3**, shows electrochemical series with voltage series

Table 3



Electrochemical series	E^0 ; Voltage series
$Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg(s)$	-2.36
$Pb^{2+}(aq) + 2e^- \rightleftharpoons Pb(s)$	-0.13

If the cell is represented as follows

$Mg(s)/Mg^{2+}(aq)//Pb^{2+}(aq)/Pb(s)$

Calculate the standard potential electrodes

$$b. E_{cell} = E_{RHS} - E_{LHS}$$

$$= 2.36 - 0.13$$

$$= 2.23$$

(3 marks)

Section B (30 marks)

Answer all questions in the spaces provided

11.a. Define the term “saponification”.

Define the term “saponification”.

(1 mark)

Refers to hydrolysis of esters with concentrated alkali solution to form soap.

(1 mark)

Or

It is the chemical process of soap making from oils or fats in the presence of concentrated alkali solution.

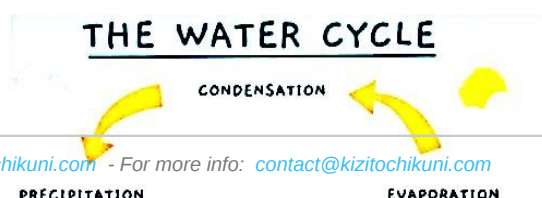
(1 mark)

b. Describe an experiment that could be carried out to prepare soap in the laboratory.

Procedure

- Measure 40ml of castor oil using measuring cylinder and transfer it to a 100ml beaker. (2)
- Add 15ml of 4M sodium hydroxide solution to the content. (1)
- Boil the mixture for 10 – 15 minutes while stirring the mixture. (1)
- Add small amounts of distilled water to replace the lost water molecules in the mixture. (1)
- Add about four spatulaful of sodium chloride and stir it well (1)
- Allow the content to cool (1)
- Filter off the solids / precipitates formed. (1)
- Wash the residues with distilled water. (1)

12. With the aid of a diagram, describe the hydrological cycle



1 mark for water body and sun

1 mark for correct change of state

1 mark for correct direction of arrows

-heat from the sun causes evaporation¹ from sea, oceans, lakes, rivers¹

-transpiration also occurs from leaves¹

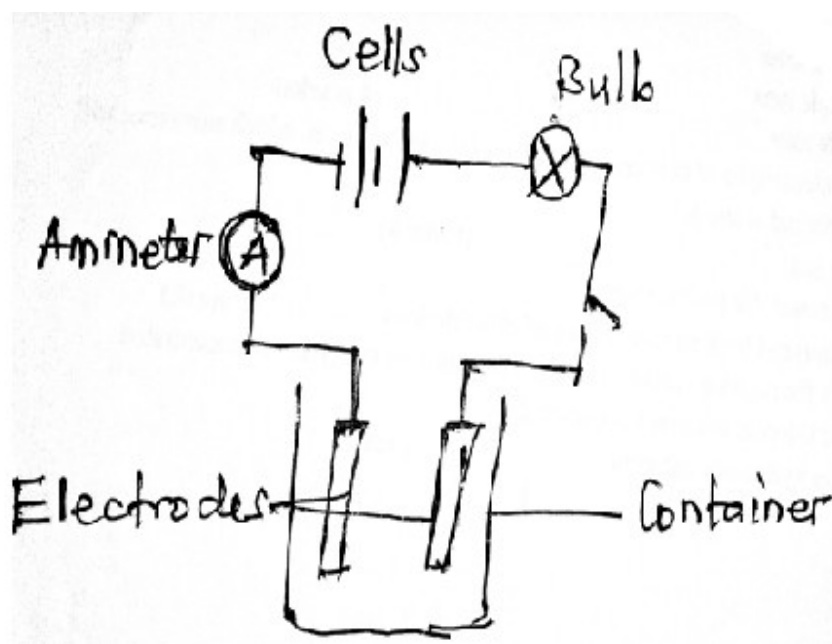
-vapour that escape into the atmosphere are then condensed upon reaching cold air places¹ - condensed vapour form droplets of water¹

-the droplets form clouds which move by air currents forming larger droplets¹

- these large droplets then fall as rains¹

13. With the aid of a well-labelled diagram, describe an experiment that can be done to show that ionic compounds conduct electricity only in aqueous state and not in solid state.





Procedure:

- Arrange⁽¹⁾ the apparatus as shown above.
 - Put⁽¹⁾ 30g Of sodium chloride in the beaker.
 - Put⁽¹⁾ electrodes in the same beaker that contains sodium chloride.
 - Connect⁽¹⁾ the circuit and close the switch.
 - Observe⁽¹⁾ if sodium chloride gives off light or not and record the observation.
 - Dissolve⁽¹⁾ 30g sodium chloride to a 2.0M concentration.
 - Repeat⁽¹⁾ steps b to e with sodium chloride solution.
- Compare⁽¹⁾ the results and draw a conclusion from the results.

END OF MARKING KEY