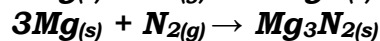


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**CHEMISTRY PAPER 1**  
**FORM FOUR**  
**MID-TERM EXAM**  
**TERM 2 - 2024**

**MARKING SCHEME:**

1. (a) Excess magnesium ribbon was burnt in air to form a white solid mixture. Write two equations to show the formation of the white solid mixture. (2mks)



- (b) When water was added to the white solid mixture effervescence took place and a colourless gas with characteristic chocking pungent smell produced.

i) Identify the gas. (1mk)  
**Ammonia**

ii) State one use of the gas identified in (b) (i) above. (1mk)

- **Removal of greasy stains in laundry.**
- **Softening water.**
- **As a refrigerant.**
- **Manufacture of nitrogenous fertilizer.**

Any one  $1 \times 1 = 1\text{mk}$

2. State two laboratory rules that should be followed to avoid contamination and wastage of chemicals. (2mks)

- **Label all containers carrying chemicals.**
- **Always use a clean spatula to scoop chemicals from containers.**
- **Turn off water and gas taps when not in use.**

Any two  $1 \times 2 = 2\text{mks}$

3. (a) 200g of radioactive isotope A reduce to 25g in 75 minutes. Determine the half-life of A. (2mks)

$$200\text{g} \xrightarrow{\frac{1}{2}} 100\text{g} \xrightarrow{\frac{1}{2}} 50\text{g} \xrightarrow{\frac{1}{2}} 25\text{g}$$

$$\text{No. of half-life} = 3, \text{ hence } \frac{75}{3} = 25 \text{ minutes}$$

(b) Define half-life. (1mk)

**It is the time taken for a radioactive substance to decay by half of its original mass.**

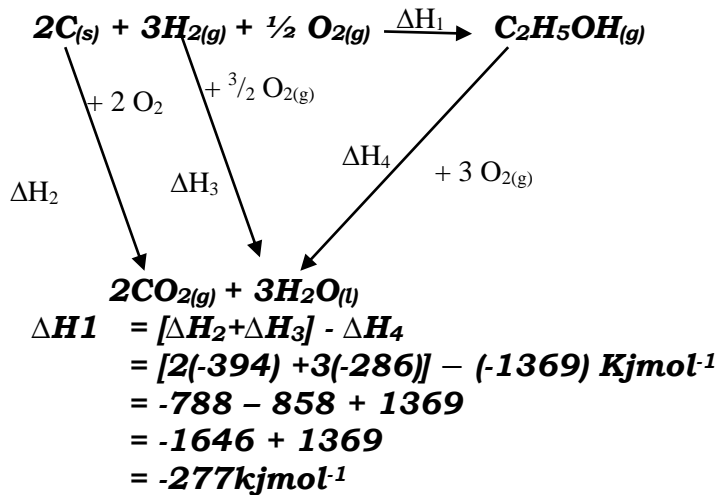
4. Calculate the enthalpy of formation of ethanol given the enthalpies of;

Combustion of ethanol =  $-1369 \text{ KJmol}^{-1}$

Combustion of carbon =  $-394 \text{ KJmol}^{-1}$

Combustion of hydrogen =  $-286 \text{ KJmol}^{-1}$

(3mks)



5. A substance containing only carbon and hydrogen has 80% by mass of carbon. It is also given that 1dm<sup>3</sup> of the compound has a mass of 1.35g. Determine the molecular formula of the compound. (C=12, H=1, MG V at s.t.p=22.4dm<sup>3</sup>) (3mks)

Element	C	H
% by mass	80	20
RAM	12	1
	$\frac{80}{12}$	$\frac{20}{1}$
Moles	6.6667	20
M.R	$\frac{6.6667}{6.6667}$	$\frac{20}{6.6667}$
	1	3

E.F. = CH<sub>3</sub>  
 (CH<sub>3</sub>)<sub>n</sub> = Molecular formula mass

1dm<sup>3</sup>, CH<sub>3</sub> = 1.35g

22.dm3 = \_\_\_ ?

$$\begin{aligned}
 &= \frac{(22.4 \times 1.35)g}{1} \\
 &= 30.24
 \end{aligned}$$

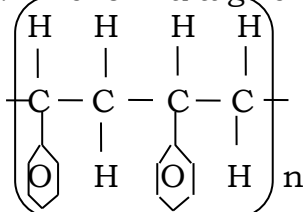
$$\therefore (\text{CH}_3)_n = 30.2$$

$$\frac{15n}{15} = \frac{30}{15}$$

$$n = 2$$

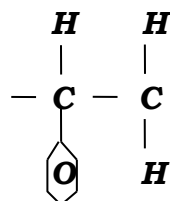
$$\begin{aligned}
 \text{M. F} &= (\text{CH}_3)_2 \\
 &= \text{C}_2\text{H}_6
 \end{aligned}$$

6. The formula given below represents part of polymer.



- a) Name the polymer  
**Polyphenylethene**

b) Draw the structure of the monomer used to manufacture the polymer. (1mk)



c) Name the process that take place when:

i) Natural fats or oils are hydrolysed using alkalis. (1mk)

**Saponification.**

ii) Sulphur is added to natural rubber and heated to form cross links. (1mk)

(1mk)

**Vulcanisation**

7. (a) State Charle's law. (1mk)

**The volume of a fixed mass of a gas is directly proportional to its absolute temperature provided pressure is kept constant.**

(b) The capacity of a balloon to hold a gas at 5°C is 1dm<sup>3</sup> before it bursts due to expansion. Show very clearly whether it will or will not burst at 25°C. (Pressure remains constant.) (2mks)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_1 T_2 = V_2 T_1$$

$$V_2 = \frac{V_1 T_2}{T_1}$$

**Temp in K**

$$T_2 \text{ } 25^\circ\text{C} = (273+25) = 298\text{K}$$

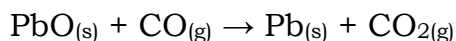
$$T_1 \text{ } 5^\circ\text{C} = (273 + 5) = 278 \text{ K}$$

$$V_2 = \frac{1\text{dm}^3 \times 298\text{K}}{278\text{K}}$$

$$= 1.07194\text{dm}^3$$

**∴ It will burst.**

8. Dry carbon (II) oxide gas reacts with heated lead (II) oxide as shown in the equation below:



a) Name the process undergone by lead (II) oxide. (1mk)

**Reduction.**

b) Give a reason for your answer in (a) above. (1mk)

**Lead (II) oxide oxidizes carbon (II) oxide to carbon (IV) oxide and is itself reduced to lead metal.**

- c) Name another gas that can be used in place of carbon (II) oxide in the above reaction. (1mk)
- **Hydrogen.**
  - **Ammonia**
- Any 1 x 1 = 1mk

9. The structure below represents a type of a cleansing agent.



- a) Identify the cleansing agent. (1mk)
- Soapless detergent.**

- b) Describe how the cleansing agent removes grease from a piece of cloth. (3mks)

**A molecule of the detergent has a polar head and a non-polar tail. The polar head is hydrophilic (water-loving) therefore it gets attracted to water molecules while the non-polar tail is hydrophobic (water hating). The polar head dissolves in water while the non polar tail dissolves in grease. This results in the lowering of the surface tension of water or the emulsification of grease.**

10. The table below shows the number of valence electrons of elements P, Q and R.

Element	P	Q	R
Number of valence electrons	3	5	2

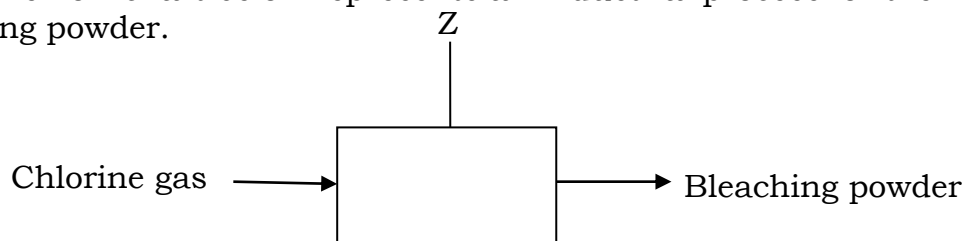
- a) Explain why P and R would not be expected to form a compound. (1mk)
- Both P and R react by losing electrons as they are metals.**

- b) Write an equation to show the effect of heat on the carbonate of R. (1mk)



- c) What is the formula for the most stable ion of Q. (1mk)
- $Q^{3-}$**

11. The flow chart below represents an industrial process for the manufacture of bleaching powder.



- i) Name substance Z. (1mk)
- Concentrated calcium hydroxide.**

- ii) Write a formula of bleaching powder. (1mk)
- $Ca(OCl)_2$**

- iii) Explain why a lot of soap is used during washing with water containing bleaching powder. (1mk)

**The presence of  $\text{Ca}^{2+}$  ions in bleaching powder,  $\text{Ca}(\text{OCl})_2$  wastes soap.**

12. Give one test by which you could differentiate between solution of lead (II) nitrate and zinc nitrate. (2mks)

**To the two solutions in separate test tubes, add an aqueous solution of a soluble sulphate or chloride such as sodium lead(II) nitrate would form a white precipitate since lead (II) sulphate or lead (II) chloride formed is insoluble while zinc nitrate forms a soluble sulphate or chloride.**

13. Given the element  ${}_{12}^{24}\text{R}$

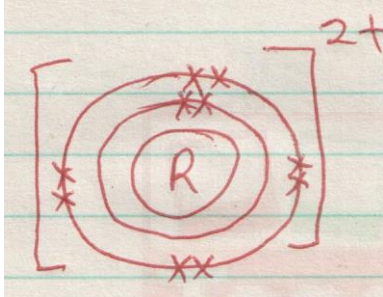
- a) To which chemical family does R belong? (1mk)

**Alkaline earth metals.**

- b) Write the electron arrangement of the atom. (1mk)

**2.8.2**

- c) Draw the structure of its ion. (1mk)



14. An element consist of two isotopes with atomic masses 59 and 61 in the ratio of 3:2 respectively. Calculate its relative atomic mass. (2mks)

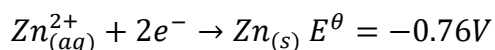
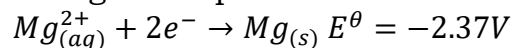
$$\text{R.A.M} = \frac{(59 \times 3) + (61 \times 2)}{5}$$

$$= \frac{177 + 122}{5}$$

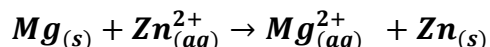
$$= \frac{299}{5}$$

$$= \mathbf{59.8}$$

15. You are given the following half-equations:



- a) Obtain an equation of the cell reaction. (1mk)



- b) Calculate the e.m.f of the cell. (1mk)

$$E_{\text{Cell}}^\theta = E_{(\text{reduction})} - E_{\text{oxidation}}$$

- c) Give the oxidizing species. (1mk)



- d) State one function of the salt bridge in electrochemical cells. (1mk)
- **Complete the circuit by making contact between the two solutions.**
  - **Maintain balance of charges in electrolytes by providing ions to replace those ions that are used up or those that are formed.**
- Any 1 x 1 = 1mk

16. (a) When extinguishing fire caused by burning kerosene, carbon (IV) oxide is preferred to water. Explain. (2mks)
- Carbon (IV) oxide neither burns nor supports combustion and since it is denser than air it covers the fire and acts as a 'blanket' over it cutting off the oxygen supply which supports combustion where as water is denser than kerosene which floats on it and continues to burn.**

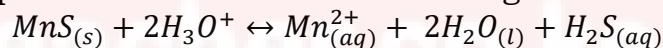
- (b) Write the formula of the oxide of carbon which is 'silent killer' (1mk)

17. (a) Complete the table below. (3mks)

Metal	Aluminium	Lead	Sodium
Chief ore	Bauxite	Galena	<b>Rock salt</b>
Chemical name	<b>Hydrated aluminium oxide</b>	<b>Lead (II) sulphide</b>	Sodium chloride
Method of extraction	<b>Electrolysis</b>	<b>Reduction</b>	<b>Electrolysis</b>

- (b) State two uses of aluminium metal. (2mks)

18. Manganese sulphide reacts with acids according to the following equation.



- a) State, giving a reason what would happen to the equilibrium if:

- i) Water is added to the equilibrium mixture. (1 ½ mk)
- The equilibrium will shift to the left because an increase in water molecules would favour the formation of the reactants.**
- ii) Hydrogen chloride is bubbled into the equilibrium mixture. (1 ½ mk)
- The equilibrium would shift to the right because addition of hydrogen chloride would increase the concentration of hydrogen ions favouring the formation of the products.**

19. Using dots (.) and crosses (x) to represent outermost electrons, draw diagrams showing bonding in:

- a) Aluminium oxide. (1 ½ mk)

- b) Hydroxonium ion. (1 ½ mk)

20. The diagram below represents a set up used for the large scale manufacture of hydrochloric acid.

- a) Name substance x. (1mk)  
**Hydrogen.**
- b) What is the purpose of the glass beads? (1mk)  
**To increase the surface area where the hydrogen chloride gas dissolve in water**
- c) Give one use of hydrochloric acid. (1mk)
- d) A volume of 20 litres of hydrogen chloride (HCl) was completely decomposed to its constituent elements (hydrogen and chlorine) what are the volumes of the constituent elements? (2mks)



**2vols    1 vol    1 vol**

**2 volumes of HCl produces 1 volume of hydrogen and 1 volume of chloride.**

**∴ 20 litres of HCl produces  $(\frac{20 \times 1}{2})$  litres of  $\text{H}_2 = 10\text{L H}_2$**

**and  $(\frac{20 \times 1}{2})$  litres of  $\text{Cl}_2 = 10\text{L Cl}_2$**

**∴ Volume of the constituent elements is  $10\text{L H}_2 + 10\text{L Cl}_2$**

21. Study the diagram below and answer the questions that follow.

- a) On the diagram label the anode and cathode. (2mks)
- b) Write the equation at the anode. (1mk)  
 **$2\text{Cl}_{(l)} \rightarrow \text{Cl}_{2(g)} + 2e^-$**
- c) State a reason why heating must be done in the set up. (1mk)  
**Magnesium chloride is an ionic compound which is its solid state, the ions are held in the structure therefore heat must be supplied to melt the compound for the ions to be mobile.**

22. An element E has relative atomic mass 88. When a current of 0.5 amperes was passed through a solution of a chloride of E for 32 minutes and 10 seconds, 0.44g of E were deposited at the cathode. What is the charge on the ion of E? (1 Faraday = 96500C) (3mks)

$$Q = It$$

$$= 0.5 \times [(32 \times 60) + 10]$$

$$0.5 \times 1930$$

$$= 960\text{C}$$

$$960\text{C} = 0.44\text{g}$$

$$\begin{aligned}
 ? x &= 88g \\
 &= \left( \frac{960 \times 88}{0.44} \right) \\
 K &= 192000C
 \end{aligned}$$

$$\begin{aligned}
 1F &= 96500C \\
 ? &= 192000C \\
 &= \left( \frac{192000 \times 1}{96500} \right) \\
 &= 1.989 \\
 &\cong 2F \\
 &\text{hence charge } +2
 \end{aligned}$$

23. State two applications of chromatography. (2mks)
- ***In sports to identify banned substances.***
  - ***To test purity of drugs in pharmacy.***
  - ***To identify contaminants in foods and drinks.***
  - ***To identify harmful substances in cosmetics.***
- Any two 2 x 1 (2mks)*
24. In an experiment, two 3cm long magnesium ribbons are separately placed in 3cm<sup>3</sup> of 2M HCl and 3 cm<sup>3</sup> of 2M ethanoic acid respectively. State and explain what is observed. (3mks)
- Rapid effervescence occurs and a colourless gas is evolved in reaction between HCl and Mg while moderate effervescence occurs a colourless gas produced in the reaction between magnesium and ethanoic acid.***
- HCl is a strong acid, therefore it ionizes completely in aqueous solution while ethanoic acid is a weak acid, therefore does not ionize completely.***
25. Explain a test for hydrogen gas. (1mk)
- When a burning splint is placed in a gas jar containing hydrogen it is extinguished immediately with a 'pop' sound.***
- Hydrogen extinguishes a burning splint with a 'pop' sound.***
26. Name one apparatus that can be used to measure approximately 80cm<sup>3</sup> of dilute hydrochloric acid. (1mk)
- ***100cm<sup>3</sup> measuring cylinder.***
  - ***Graduated 100cm<sup>3</sup> beaker.***
- Any one 1 x 1*
27. Explain why dilute nitric (V) acid is not used in hydrogen gas preparation. (1mk)
- Nitric (V) acid is a powerful oxidizing agent and therefore would oxidize any hydrogen gas produced immediately into water.***
28. State and explain what you would observe if concentrated Sulphuric (VI) acid is added to cane sugar. (2mks)
- The white solid turns black and rises in the container as a colourless gas is produced. Concentrated sulphuric (VI) acid is a dehydrating agent and hence dehydrates sugar forming carbon.***



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