CHEMISTRY
FORM 4
OPENER TERM 3 2025
MARKING SCHEME

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INSTRUCTIONS: ***Answer all the Questions*** **TIME: 1 HR 15 MIN**

1. Element Y has atomic number 17 while X has 12.

(i) **Write** electronic arrangement of X and Y. (1mk)

X 2.8.2 ✓½

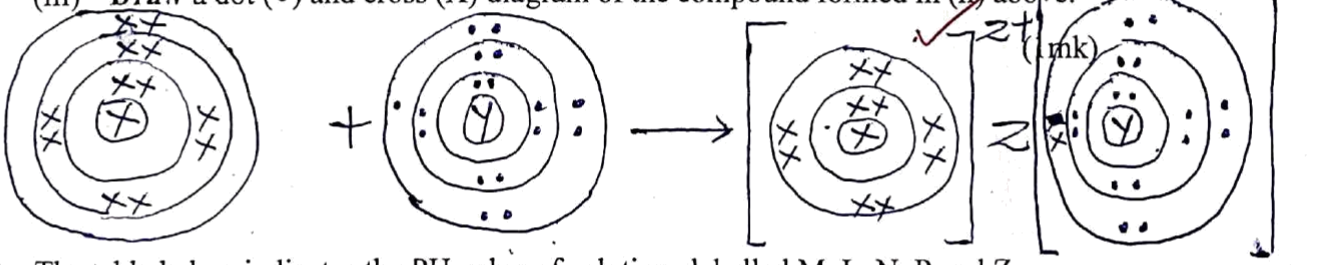
Y 2.8.7 ✓½

(ii) **Name** the type of bond and structure formed when X and Y reacts. (2mks)

Bond: ionic bond

Structure: Giant ionic structure

(iii) **Draw** a dot (•) and cross (X) diagram of the compound formed in (ii) above. (1mk)



2. The table below indicates the PH value of solutions labelled M, L, N, P and Z.

PH	4	14	1	10	7
solution	M	L	N	P	Z

(i) **Which** solution has the highest concentration of hydrogen ions? (1mk)

M ✓½ because it is a strong acids hence it ionises completely to form hydrogen ions. ✓½

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(ii) ... solution can be used as an anti-acid? ... reason for your answer. (2mks)

P. because they effectively neutralize stomach acid without causing drastic shift in PH

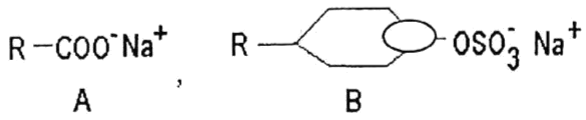
3. In which homologous series do the following compounds belong? (2 marks)

(i) $CH_3\ CH\ CH_2$ Alkenes

(ii) $CH_3\ CH_2\ CH_2\ OH$

Alkanols

4. The structures shown below represent two cleansing agent A and B.



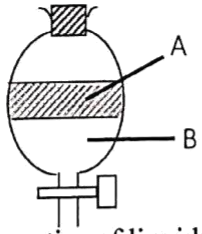
(a) Name the type of cleansing agent A. (1mk)

Soap detergent

(b) Which of the two cleansing agents is more suitable for washing in water containing calcium chloride? Give a reason. (1 marks)

B. because the soap lather easily with hardwater.

5. The apparatus below were used to separate a mixture of liquid A and B.



State *two* properties of liquids that make it possible to separate using such apparatus. (1 mark)

1. The liquid must be miscible
2. The density of the liquids.

6.a) What property of concentrated sulphuric(VI) acid is illustrated by its action on:

(i) Sugar (½ mk)

Dehydrating property

(ii) Copper metal (½ mk)

Oxidising property

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b) Write the equation for the reaction of concentrated sulphuric acid with copper metal.

$Cu_{(s)} + H_2SO_{4(aq)} \longrightarrow CuSO_{4(aq)} + H_{2(g)}$ (1mk)

7. Ammonia is manufactured in the Haber process according to the equation:-

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta H = -92.0 KJ/mol$

(a) How would the following affect the yield of ammonia.

(i) High pressure. (1mk)
It will favour forward reaction since has less molecules.

(ii) High temperature. (1mk)
The equilibrium will shift to the left because the reaction is exothermic (backward reaction favoured)

(b) **Name** the catalyst used. (1mk)
Iron catalyst

8. X grams of anhydrous sodium carbonate was dissolved in water to make a $250cm^3$ solution. $25cm^3$ of the solution neutralized $20cm^3$ of 0.25M nitric acid. **Determine** the value of X. (3mks)

$Na_2CO_{3(s)} + 2HNO_{3(aq)} \longrightarrow NaNO_{3(aq)} + CO_{2(g)} + H_2O_{(l)}$

Moles of HNO_3 in 0.25M $\rightarrow 1000cm^3$
$20cm^3$

$= \frac{0.25M \times 20cm^3}{1000cm^3} = 0.005$ moles

Moles of $Na_2CO_3 = \frac{0.005}{2} = 0.0025$ moles

$\frac{0.0025 \times 250cm^3}{25} = 0.025$ moles

RFM of $Na_2CO_3 = 106 g/mol$

$0.025 \text{ moles} \times 106 g/mol = 2.65$ grams

9. Study the table below and answer the questions that follow.

Bond type	Bond energy $KJmol^{-1}$
C – C	346
C = C	610
C – H	413
C – Br	280
Br – Br	193

a. **Calculate** the heat change for the reaction; (3mks)

$C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$

Bond breaking energy

$(413 \times 4) + 610 + 193 = +2455$

Bond formation energy

$(413 \times 4) + 346 + (280 \times 2) = -2558 KJ/mol$

Heat of reaction $= +2455 - 2558 = -103 KJ/mol$

b. **Name** the type of reaction that occurred in (a) above. (1mk)
Exothermic reaction

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10. The Solvay process is used to manufacture Sodium Carbonate.

c. **Name two** raw materials for the process. (1mk)

1. Coke ½
2. Limestone ($CaCO_3$) ½
3. Brine (NaCl)
4. Ammonia

Any two 1MK

d. **How** is Sodium Carbonate obtained from Sodium Hydrogen Carbonate?

- Through thermal decomposition (1mk) of $NaHCO_3$

$$2NaHCO_3 \xrightarrow{heat} Na_2CO_3 + CO_2 + H_2O$$

e. **Name two** main substances that are recycled. (1mk)

1. Ammonia ½
2. Carbon (IV) oxide ½
3. Water

Any two 1MK

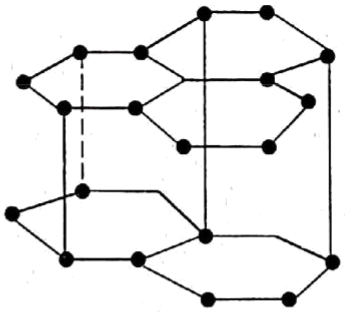
11. Starting with copper turning, **describe** how a solid sample of Copper (II) Carbonate can be prepared. (3mks)

Heat copper turning to form copper(II) oxide. Add nitric (V) acid to copper(II) oxide and stir to form a solution. Add sodium carbonate solution to a solution of copper(II) nitrate. Filter the solution to obtain copper(II) carbonate as the residue and $NaNO_3$ as the filtrate

12. The following diagrams shows the structure of two allotropes of carbon. Study them and answer the questions that follow.

A

B



(a) Name the allotropes. (1 mark)

A Diamond ½

B Graphite ½

(b) Give **one** use of A. (½ mark)

1. used in making jewel
2. used in making drill bit

Any one 1MK

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(c) ...ich allotrope conducts electricity? Explain. (1½ mks)

Boron because it uses three valency electron in bonding hence one electron is left which is delocalised

13. Explain what happens when blue litmus paper is dipped in methylbenzene in which hydrogen chloride is bubbled. (2mks)

There will be no change since hydrogen chloride does not ionize in methylbenzene

. (a) State Graham's gas law of diffusion. (1mk)

It state the rate of diffusion of any gas is inversely proportional to the square root it density when pressure and temperature are kept constant

(b) Two containers, one with Nitrogen (IV) oxide and other with bromine simultaneously develop leaks, after 30 seconds, the smell of Nitrogen (VI) oxide is detected. How much longer will it take before bromine is detected. (N = 14, O = 16, Br = 80) (2mks)

$\frac{r_{NO_2}}{r_{Br_2}} = \sqrt{\frac{MM_{NO_2}}{MM_{Br_2}}}$ ½

$MM_{NO_2} = 46$

$MM_{Br_2} = 80 \times 2 = 160$

$\frac{30}{r_{Br_2}} = \sqrt{\frac{46}{160}}$

½ $\frac{30}{r_{Br_2}} = 0.5362$ ½

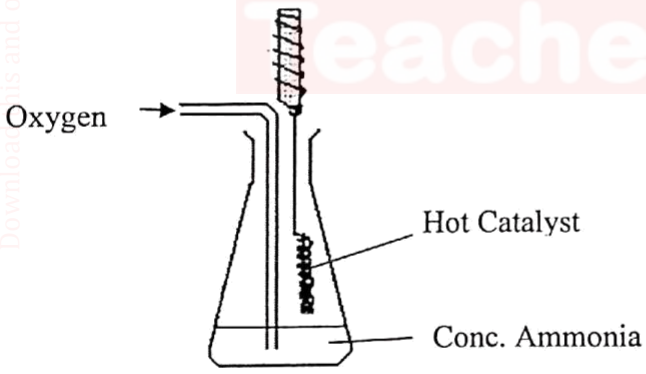
$30 = 0.5362\, r_{Br_2}$

$\frac{0.5362}{0.5362} \quad \frac{0.5362}{0.5362}$

$r_{Br_2} = 55.955$ cc

25.955 sec later ½

14. Study the diagram below and answer the questions given below.



(a) The reaction between ammonia and oxygen in the presence of the catalyst continues without further heating. Explain. (1mk)

Because the reaction is exothermic hence the heat produced maintains glowing.

(b) Name catalyst X. (1mk)

Platinum | Copper

(c) Write an equation for the reaction which takes place in the flask. (1mk)

$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$

$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$

Any one 1MK

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15. The table below shows the tests carried out a sample of water and the results obtained.

Sample	Tests	Observation
A	Addition of sodium hydroxide solution dropwise until in excess	White precipitate which dissolves in excess to form colourless solution
B	Addition of excess aqueous ammonia	White precipitate
C	Addition of dilute nitric (V) acid followed by barium chloride	White precipitate

a) Identify the anion present in the water. (1mk)

SO_4^{2-} ✓ 1MK

b) Write the ionic equation for the reaction in C. (1mk)

$Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \longrightarrow BaSO_{4(s)}$ ✓ 1MK

c) Write the formula for the complex ion in A. (1mk)

$[Al(OH)_4]^-$ ✓ $[Zn(OH)_4]^{2-}$ ✓ $[Pb(OH)_4]^{2-}$ ✓ Any one 1MK

16. One of the four types of oxides is amphoteric oxide.

(a) What is an amphoteric oxide? (1mk)

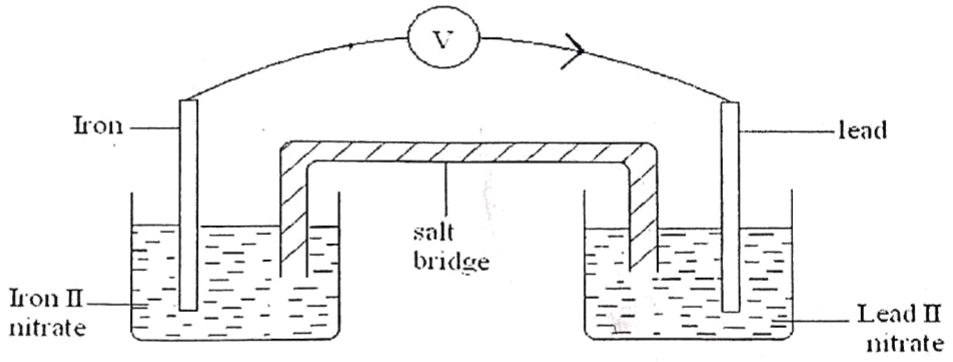
Is an oxide which react with both acid and bases ✓ 1MK

(b) Write the formulae of any two amphoteric oxides. (1mk)

1. Al_2O_3 ✓
2. ZnO ✓
3. PbO ✓

Any two 1MK

17. Two half cells were connected as shown to form a voltaic cell. The reduction potentials are given.



$Pb^{2+}_{(aq)} + 2e \longrightarrow Pb_{(s)}$ $\quad E^{\Theta} = -0.13V$

$Fe^{2+}_{(aq)} + 2e \longrightarrow Fe_{(s)}$ $\quad E^{\Theta} = -0.44V$

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a) **Calculate** the e.m.f of the cell.

$E^{\theta} = E^{\theta}_{R.H.S} - E^{\theta}_{L.H.S}$ ½

$= -0.13V - (-0.44V)$ ½ $= -0.13V + 0.44V$ (1mk)

$= +0.31V$ ½

b) **Sodium chloride is used as the salt bridge. State the** two functions of the salt bridge. (2mks)

1. Complete the circuit by making contact between the two solutions ✓1
2. Maintain balance of charges in electrolytes ✓1

b) **Show** the direction of the electron flow in the external circuit. (1mk)

✓ 1MK in the diagram

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