Name: MARKING SCHEME Adm No. ..... Index no .....

Candidate's sign ..... Class..... .

Date: .....

233/2
CHEMISTRY
PAPER 2
TIME: 2 HOURS

ALLIANCE HIGH SCHOOL
TRIAL EXAMINATION
SEPTEMBER 2022

INSTRUCTIONS TO CANDIDATES:

- Write your Name, Admission Number, index number in the spaces provided above.
- Sign and write the date of examination in the spaces provided above.
- Answer All the questions in the spaces provided below each question.
- All working MUST be clearly shown where necessary.
- Sign and write the date of examination in the spaces provided above.
- Electronic calculators may be used
- This paper consists of 11 printed pages.
- Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing

For Examiner's Use Only

Question	Maximum score	Candidate's score
1-7	80	

1. Study the electrode potentials for the half cells below and use them to answer the questions that follow. The letters do not represent the actual elements.

	$E\theta$ (volts)
$A^+_{(aq)} + e^- \longrightarrow A_{(s)}$	-2.96
$B^+_{(aq)} + e^- \longrightarrow B_{(s)}$	+0.52
$C^+_{(aq)} - e^- \longrightarrow \frac{1}{2} C_2$	0.00
$D^{2+} + 2e^- \longrightarrow D_{(s)}$	-0.44
$\frac{1}{2} G_{2(g)} + e^- \longrightarrow G^-_{(aq)}$	+1.36

a) Identify the strongest oxidizing agent. Explain. (2 mks)

G_2 ✓ ✓ – The most positive E^θ value ✓ 1

b) Which of the two half cells would produce the highest potential difference when combined. (2 mks)

G^- ✓ and A ✓ / $\frac{1}{2}G_{2(g)} + e^- \rightarrow G^-$ ✓ and $A^+ + e^- \rightarrow A_{(s)}$ ✓ 1

Award for the letters or half cell equations.

c) Explain whether the reaction below can take place. (2 mks)

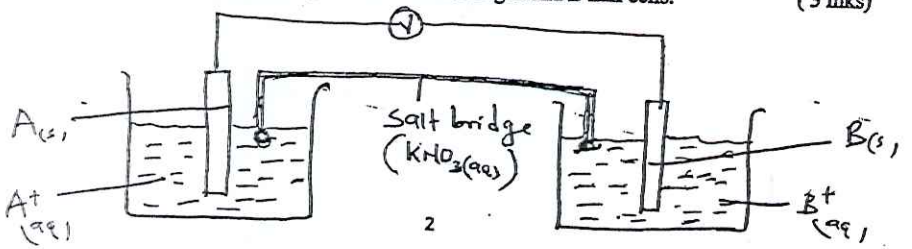
$D_{(s)} + 2A^+_{(aq)} \longrightarrow D^{2+}_{(aq)} + 2A_{(s)}$

$E^\theta = E_R - E_O \quad -2.96 - (-0.44)$ ✓ 1

$= -2.54\,V$ ✓ 1

The reaction will not take place because the calculated E^θ value is negative.

d) Draw a well labelled diagram when combining A and B half cells. (3 mks)



b) Write the equation for the reaction in : (3 mks)

Step I

$CH_3CH_2CH_2OH + CH_3COOH \rightleftharpoons CH_3COOCH_2CH_2CH_3 + H_2O$ ✓1

Step II

$CH_3CH_2CH_2OH \xrightarrow[\text{Temp } 170^oC]{H_2SO_4} CH_3CH_2CH_2OH \xrightarrow[Ht|H_2C_2O_4]{Ht|Kmno_4} CH_3CH_2COOH + H_2O$ ✓1

Step III

$2CH_3CH_2CH_2OH + 2Na \rightarrow 2CH_3CH_2CH_2ONa + H_{2(g)}$ ✓1

c) Name the type of reaction in step I and step II and give the conditions. (4 mks)

I – Esterification ✓1 H_2SO_4 (1) | conc H_2SO_4 | Warming. ✓1

II – Oxidation ✓1 Ht | ~~Acidifying~~ | heat. ✓1

d) A sample of polymer 'Q' is found to have a molecular mass of 4200. Determine the number of monomers in the polymer (C = 12, H =1) (2 mks)

$\frac{4200}{42} = 100$ monomers ✓1 ✓1

e) Describe an experiment to distinguish propane and propyne using burning. (2 mks)

Propane burns with blue non-sooty flame ✓1

Propyne burns with yellow sooty flame. ✓1

e) In an experiment to electroplate an iron watch with silver a circuit of 0.5A was passed for 48 minutes. Calculate the amount of silver deposited on the watch. (IF – 96,500C, Ag = 108) (3 mks)

$Q = It$ ✓1

$0.5 \times 48 \times 60$

$= 1440\ c$

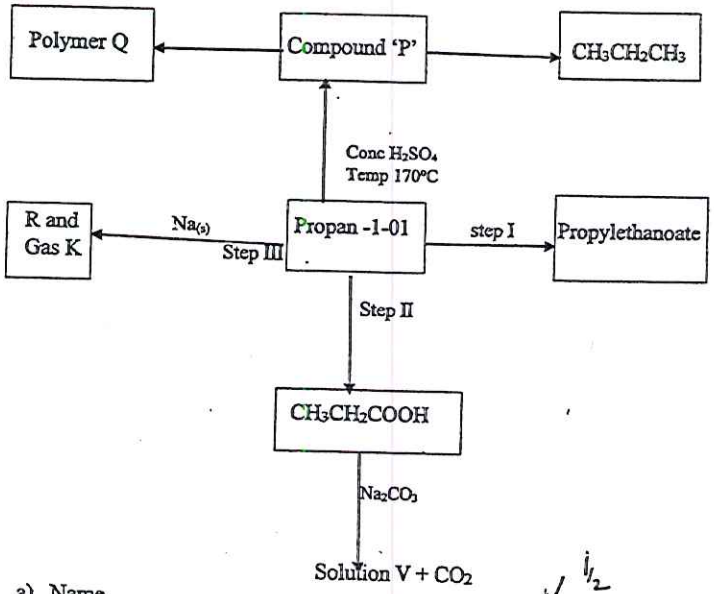
$Ag^+_{(aq)} + e^- \rightarrow Ag_{(s)}$

108 → 96,500 c ✓1

1440 c

$\frac{108 \times 1440}{96,500} = 1.6116g$ ✓1

2. Study the scheme below and answer the questions that follow.



a) Name (2 mks)

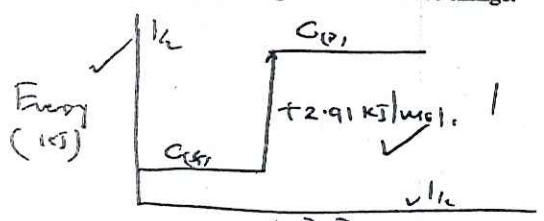
Compound 'P' Propene | prop-1-ene | C_3H_6 ✓½

Solution 'V' sodium ethanoate | CH_3CH_2COONa ✓½

Substance 'R' sodium propoxide | $CH_3CH_2CH_2ONa$ ✓½

Gas 'K' ~~Hydrogen~~ | $H_{2(g)}$ ✓½

Sketch a simple energy level diagram for the above change. (2 mks)



4. 0.12M aqueous standard nitric (v) acid was titrated against 25cm³ of aqueous sodium hydroxide solutions in a conical flask. 11.5cm³ of acid was required to react completely with alkali.

a) Name two apparatus that can be used in this experiment other than conical flask. (1 mk)

- Burette
- Pipette

b) Calculate the concentration of sodium hydroxide used in experiment. (2 mks)

$\frac{0.12 \times 11.5}{1000} = 0.00138$ moles

$HNO_3 : NaOH$ 1 : 1

0.00138 moles of NaOH → 25cm³

? → 1000cm³

= 0.0552 M

c) The table below shows the tests carried out on three portions of a compound and results obtained. Study it and answer the questions that follow.

Test	Observations
Addition of a few drops of aqueous ammonia to the first portion until excess	White precipitate soluble in excess
Addition of acidified barium nitrate to the second portion	White precipitate formed
Addition of few drops of lead (II) nitrate to the third portion	White precipitate formed

i) Identify the cation and anion present in the compound. (1 mk)

Al^{3+} and SO_4^{2-}

ii) Write the ionic equations in first portion and third portion. (3 mks)

$Pb^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow PbSO_{4(s)}$

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}$

$Al(OH)_{3(s)} + OH^-_{(aq)} \rightarrow [Al(OH)_4]^-_{(aq)}$

3 a) What is meant by the term enthalpy at formation. (1 mk)

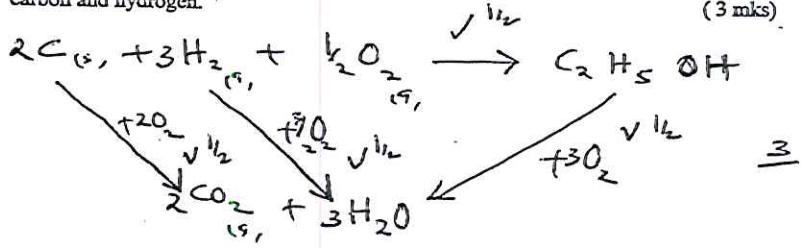
The heat change when a substance / compound is formed from it's constituent elements in standard state.

b) The enthalpies of combustion of carbon, hydrogen and ethanol are given below.

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -393 kJ/mol$

$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H = -286 kJ/mol$

(i) If the enthalpy of combustion of ethanol is – 1369kJ/mol. Draw the energy cycle diagram that links the enthalpy of formation of ethanol to enthalpies of combustion of carbon and hydrogen. (3 mks)

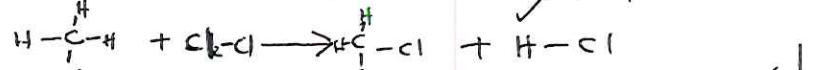


c) Study the information in the table below and answer the questions that follow.

BOND	BOND ENERGY (kJ/Mol)
C – H	414
C-Cl	326
Cl-Cl	244
H-Cl	431

Calculate the enthalpy changes for the reaction below. (3 mks)

$CH_3Cl_{(g)} + Cl_{2(g)} \xrightarrow{\text{U.V. light}} CH_2Cl_{2(g)} + HCl_{(g)}$



$(414 + 244) - (326 + 431) = -99 kJ$

d) At standard temperature and pressure graphite changes to diamond as shown in the equation below.

$C_{(graphite)} \rightarrow C_{(diamaid)}$ $\Delta H = +2.91 kg/mol$

c) Explain the difference between the atomic radius of element J and it's ionic radius (2 mks)

J - has larger ionic radius compared to atomic radius due to electron - electron repulsion when it forms ion.

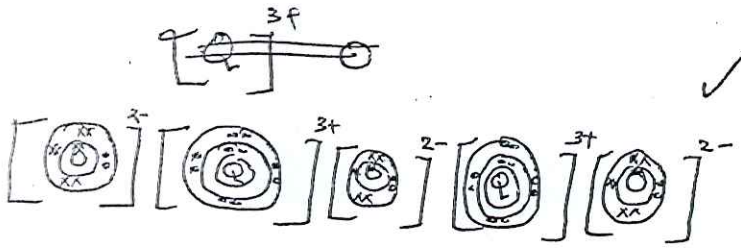
d) Write the formula of the most stable ion of element G when it ionizes. (1 mk)

G^{3-}

e) The ionization energies for elements A,B and L are 520Kj/mol, 500kJ/mol and 420Kj/mol Values. What does the valves indicate about their reactivity explain. (2 mks)

Reactivity increases down the group. The larger the atomic radius the lower the ionization energy

f) Draw the atomic structure of a compound formed when element Q reacts with oxygen. (Atomic number of oxygen = 8) (2 mks)



6.a) The following reversible reaction represents the formation of methanol from hydrogen and carbon (II) Oxide.

$CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$ $\Delta H = +91kJ/mol$

What would be the effect on equilibrium and the yield of methanol/when: (4 mks)

i) Increasing pressure

Yield increases - equilibrium shifts to the left. forward reaction favoured, large volume of reactants compared to product.

ii) Decreasing temperature

Yield decreases - equilibrium shifts to the right. backward reaction favoured. large volume reaction is endothermic.

iii) Define the following terms (3 mks)

a) Solubility Maximum amount of solute that can dissolve in 100cm³ of water at specific temperature.

b) Saturated solution A solution which cannot dissolve any more solute at agiven temperature.

c) Fractional crystallization.

A process of separating salts using their different solubilities at given temperature.

5. The grid below represents port of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.

A	F			C	D	E	M	
B			Q		G	H	J	
L								

a) Identify the most electronegative and electropositive element. Explain. (2 mks)

M - smallest atomic radius hence strongest nuclear attraction. L - largest atomic radius weakest nuclear attraction

b) Element Q reacted with steam at elevated temperatures to produce 150cm³ of a gas.

Determine the mass of Q which was reacted with steam

(M.G.V = 24dm³) (R.A.M of Q = 27) (2 mks)

$2Q_{(s)} + 3H_2O_{(g)} \rightarrow Q_2O_{3(s)} + 3H_{2(g)}$

moles of $H_{2(g)} = \frac{150cm^3}{24000} = 0.00625$ moles

Q : H_2

2 : 3

$\frac{2}{3} \times 0.00625 = 0.004$ moles

$0.0042 \times 27 = 0.1125g$

c) Calculate the rate of reaction of magnesium with hydrochloric acid at 50 seconds and 60 seconds. Explain. (3 mks)

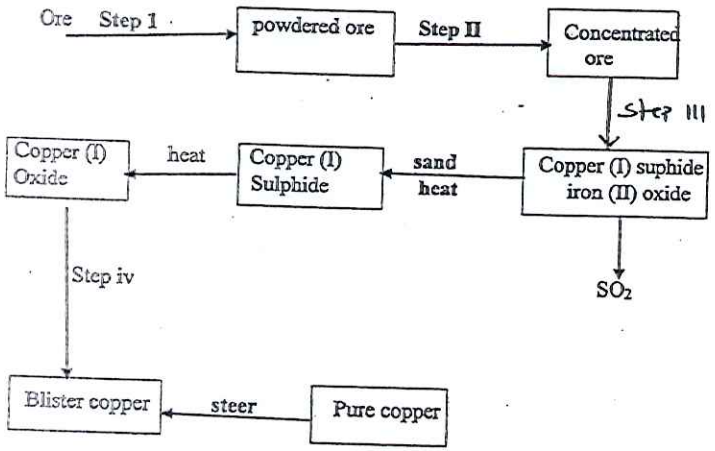
At 50s - determining the gradient ✓ 1½

At 60s - Determining the gradient. ✓ 1½ } Clear Correct SI units.

d) State two factors that can affect the above rate of reaction a part from the one investigated above. (2 mks)

- Size of particles ✓ 1
- Temperature ✓ 1

7. The diagram below is a flow chart for the extraction of copper. Study it and answer the question that follow.



a) Give the name and formula of the major ore from which copper is extracted. (1 mk)

Copper pyrites $CuFeS_2$ ✓ 1½

b) Give the name of the process carried out in step II and III. (1 mk)

II - Froth floatation ✓ 1½ III - Roasting ✓ 1½

iii) Using a catalyst.

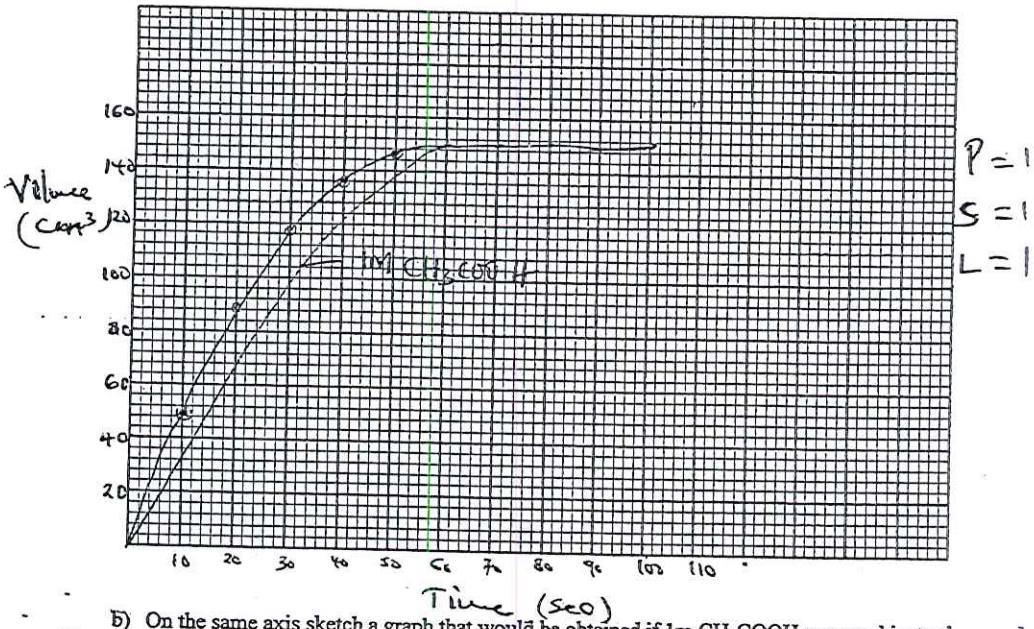
No effect on equilibrium. ✓ 1

iv) Adding ethanoic acid to the equilibrium in presence of few drops of concentrated sulphuric (vi) acid and warming equilibrium shifts to the right ✓ 1 ~~Yield increase~~ Yield reduces as the concentration of methane increases.

b) An experiment was carried out using a given mass of magnesium ribbon and 1mHcl the results are as shown below.

Time (sec	10	20	30	40	50	60	80	100
Volume of $H_{2(g)}$ (cm^3)	49	90	117	136	147	150	150	150

a) Plot a graph of volume of hydrogen gas produced against time. (3 mks)



b) On the same axis sketch a graph that would be obtained if 1m CH_3COOH was used instead of 1M HCl. (1 mk)

✓ 1

c) Write equation for the reactions taking place in step III and IV. (2 mks)

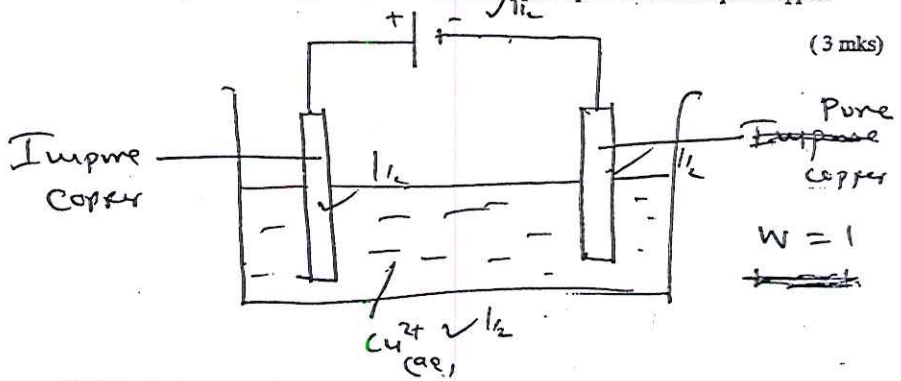
$2CuFeS_2 + 4O_2 \longrightarrow Cu_2S + 2FeO + 3SO_2$ ✓ ✓

$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$ ✓

d) Iron (ii) oxide is an impurity during extraction of copper. Write the equation for the reaction to show how it is removed. (1 mk)

$SiO_2 + FeO \longrightarrow FeSiO_3$ ✓

e) i) Draw a well labelled diagram of show blister copper is purified to form pure copper. (3 mks)



ii) Write the ionic equation for the anode and cathode reaction during purification of copper. (2 mks)

$Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e^-$ — Anode ✓

$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ — Cathode ✓

f) When copper is exposed to the atmosphere for a long period of time it forms a green coating. Name the green coating and write a balanced chemical equation for the reaction which leads to formation of green coating. (2 mks)

Basic copper (II) carbonate. ✓

$2Cu_{(s)} + O_{2(g)} + H_2O_{(l)} + CO_{2(g)} \longrightarrow CuCO_3 \cdot Cu(OH)_{2(s)}$ ✓

(Green coating)