NAME: MARKING SCHEME ADM.NO:.....CLASS:.....

ALLIANCE HIGH SCHOOL
FORM FOUR CHEMISTRY
END OF TERM 1 2020
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

a) Write your name an admission number.
b) Answer all the questions in the spaces provided.
c) Mathematical tables or calculator may be used.
d) All working must be clearly shown.

Question	Max Score	Candidate Score
1	11	
2	12	
3	12	
4	12	
5	11	
6	12	
7	9	

1. Study the information in the table below and answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Atomic number	Melting point °c
A	11	97.8°c
B	13	660
C	14	1410
D	17	-101
E	19	63.7

a) Write the electron arrangement for the ions formed by element B and D. (1 mk)

B 2·8 ½ D - 2·8·8 ½

b) State the element which is

(i) The most reactive non metal. (1 mk)

D ✓1

(ii) Has a giant atomic structure (1 mk)

C ✓1

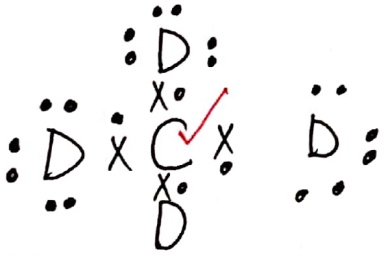
c) In which period of the periodic table does element E belong. (1 mk)

4 ✓1

d) Element E loses its outermost electron more readily than A. Explain. (1 mk)

E has a larger atomic radius than A hence loses its outermost electron more ✓1 readily.

e) Using dots (•) and cross (x) to represent the outermost, show bonding in the compound formed when elements C and D combine. (2 mks)



f) Explain why the melting point of element B is higher than that of element A. (1 mk)

B has more delocalised ½ electrons hence a stronger metallic ½ bond.

g) Describe how a solid mixtures of the sulphate of element E and Barium sulphate can be separated into solid samples. (3 mks)

Add distilled water to the mixture ½ and stir ½ to dissolve sulphate of E ½ filter ½ to obtain $BaSO_4$ as residue ½ ½ Heat ½ the filtrate to saturation and cool ½ to obtain crystals of E sulphate

2

2. a) Give the systematic names of the following compounds.

(i) $CH_3 CH_2 \underset{\underset{CH_3}{|}}{CH} \underset{\underset{CH_3}{|}}{CH} CH_3$ (1 mk)

2,3-Dimethylpentane ✓1

(ii) $HOCH_2 CH_2 OH$ - Ethan-1,2-diol (1 mk)

(iii) $CH_3 CH_2 CH_2 \overset{\overset{O}{\|}}{C}-O-CH_2 CH_2 CH_3$ (1 mk)

propylbutanoate ✓1

b) State the observations made when propan-1-ol reacts with

(i) Acidified potassium dichromate (VI) solution (1 mk)

changes from orange to green ✓1

(ii) Potassium metal (1 mk)

bubbles of a colourless gas ✓1

c) Describe a chemical test that can be used to distinguish between methanol and methanoic acid. (3 mks)

Add $NaHCO_3$ ✓½

Methanol - No bubbles

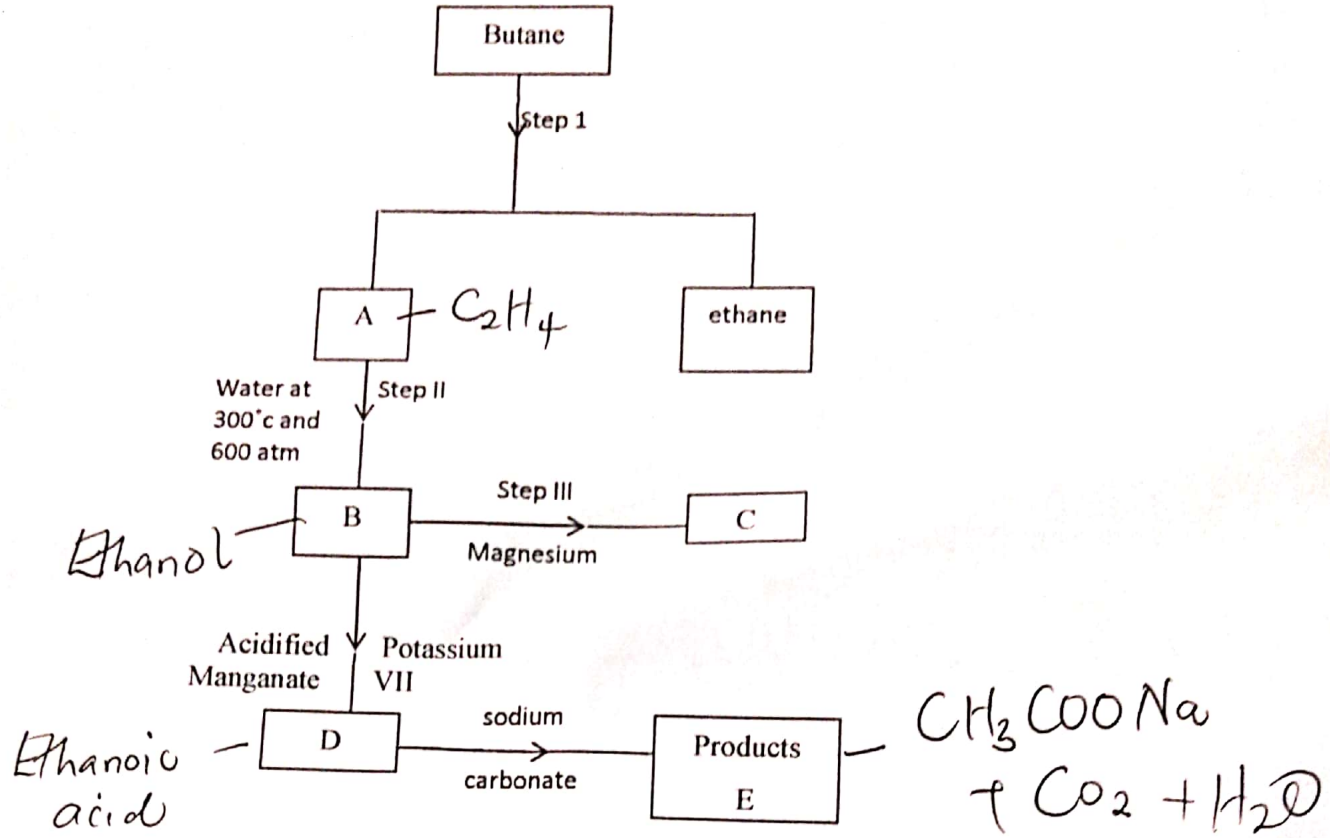
Methanoic acid - bubbles ✓1

Add $K_2Cr_2O_7$ ✓½

Methanol - turns from Orange to green ✓1

Methanoic acid Orange $K_2Cr_2O_7$ does not turn green.

d) Study the flow chart below and answer the questions that follow.



(i) State the conditions necessary for the reaction in Step 1 to occur. (2 mks)

high temperature | Catalyst |

(ii) Identify substance B and write chemical equation between B and acidified Potassium Manganate VII (2 mks)

B - Ethanol

$C_2H_5OH \xrightarrow[2H^+]{MnO_4^-} CH_3COOH + H_2O$

(iii) Identify products E. (1 mk)

E - Sodium Ethanoate
Water + Carbon (IV) oxide

3. a) (i) State two factors that should be considered when choosing a fuel for cooking. (1 mk)

- Cost
- Pollution effect

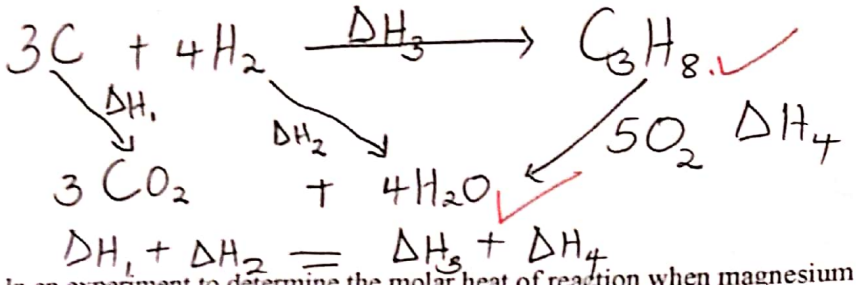
(ii) Calculate the heat of formation of propane from the following date.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}, \quad \Delta H = -395kJ/mol$

3X-39

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

$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_{2(l)}O$ $\Delta H = -2209\ kJ/mol$ (3 mks)



$\Delta H_1 + \Delta H_2 = \Delta H_3 + \Delta H_4$

b) In an experiment to determine the molar heat of reaction when magnesium displaces copper, 0.15g of magnesium powder were added to $20cm^3$ of 2M copper (II) Sulphate solution. The temperature of copper (II) sulphate solution was 24.0°c while that of the mixture was 45.0°c.

(i) Other than increase in temperature, state and explain the observations which were made during that reaction. (2 mks)

Brown solid deposited – Mg displaces copper ions from the solution to form copper metal. Blue colour of the solution fades and solution changes from blue to colourless as Cu^{2+} are removed from the solution

(ii) Calculate the heat change during the reaction (specific heat capacity of solution $= 4.2 Jg^{-1}k^{-1}$, density of the solution $= 1 g/cm^3$. (2 mks)

$$\frac{20 \times 4.2 \times 21}{1000} = 1.764 kJ$$

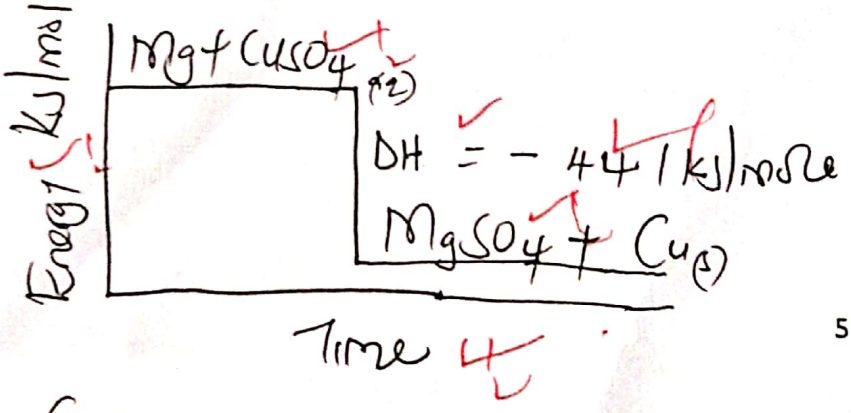
(iii) Determine the molar heat of displacement of copper by magnesium. (2 mks)

Moles of copper $= \frac{20 \times 2}{1000} = 0.04$

$0.04 \rightarrow 1.764$

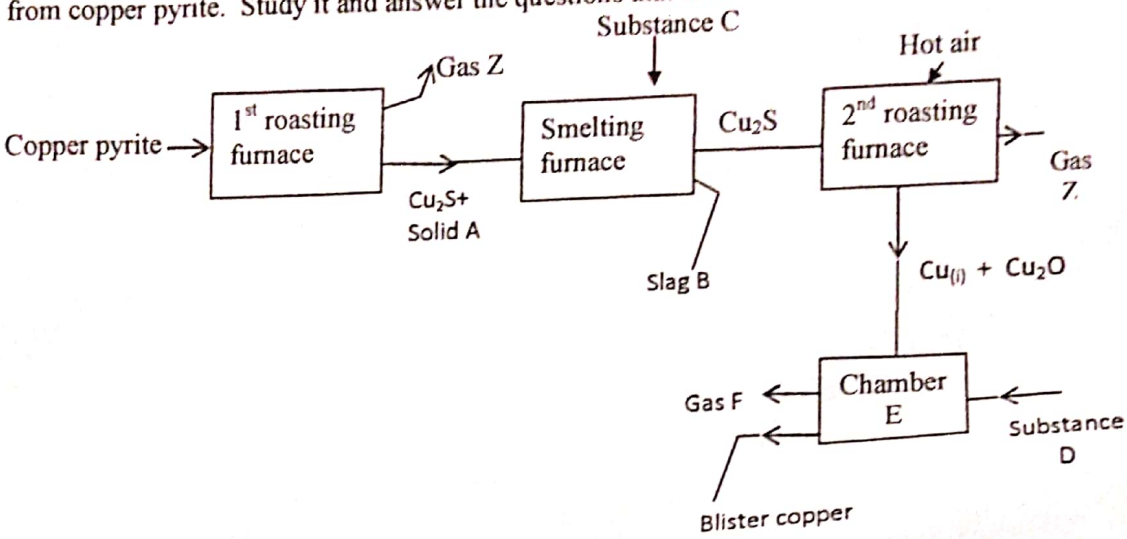
$1 \rightarrow ?$ $= -44.1 kJ/mol$

(iv) Sketch an energy level diagram for the reaction. (2 mks)



$(3X - 395) + (4X - 286) = (\Delta H_3 + -2209)$

4. The flow chart below outlines some of the processes involved during extraction of copper from copper pyrite. Study it and answer the questions that follow.



(1 mk)

a) (i) Write the formula of copper pyrite.

$CuFeS_2$ ✓1

(ii) Write the equations for the reactions taking place in the 2nd roasting furnace. (2 mks)

$2Cu_2S_{(s)} + 3O_{2(g)} \rightarrow 2Cu_2O_{(s)} + 2SO_{2(g)}$ ✓1

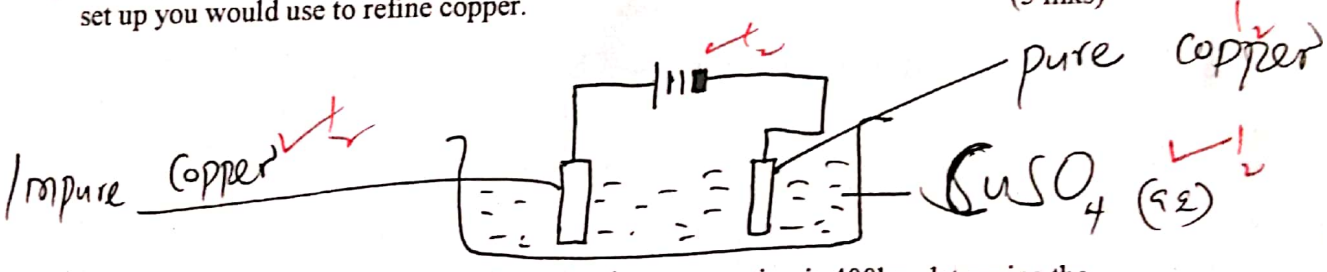
$Cu_2S_{(s)} + 2Cu_2O_{(s)} \rightarrow 6Cu_{(l)} + SO_{2(g)}$ ✓1

(iii) Identify substance C and write an equation for the reaction that takes place in smelting furnace. (2 mks)

C – Silica / SiO_2 ✓1

$FeO_{(l)} + SiO_{2(l)} \rightarrow FeSiO_{3(l)}$ ✓1

b) The copper obtained in chamber E is impure. Draw a well labelled diagram showing the set up you would use to refine copper. (3 mks)



c) Given the mass of copper obtained from the above extraction is 400kg, determine the percentage purity of the ore if 2000kg of it was fed to the 1st roasting furnace.
(Cu = 63.5, Fe =56, S = 32) (3 mks)

$CuFeS_2 \rightarrow Cu$

183.5 → 63.5 ✓1

2000 → ?

$\frac{2000 \times 63.5}{183.5} = 692.0981$

$\frac{400}{692.0981} \times 100$ ✓½ ✓½

$= 57.7953^{6}\%$ ✓½

(1 mk)

d) State two uses of copper.

Making coin ✓

Making electrical ✓ wires

5. a) The table below shows the solubility of ammonium phosphate in water at different temperatures.

Temperature (°c)	Solubility of ammonium phosphate in g/100g of water
10	63.0
20	69.0
30	75.0
40	82.0
50	89.0
60	97.0

(i) On the grid provided draw the solubility curve of ammonium phosphate. (3 mks)

Mass of Saturated Soln — Mass of Salt

178·5 — 78·5 g = $\frac{120 \times 78.5}{178.5}$ = 52·773g

120 — ?

(ii) Using the graph, determine the solubility of ammonium phosphate at 35°c (1 mk)

78·5 g/100 g of water

b) 120g of a saturated of ammonium phosphate was prepared at 35°c.

(i) What is meant by a saturated solution? (1 mk)

A solution that contains maximum amount of solute of a particular temperature

(ii) Calculate the mass of ammonium phosphate which was used to prepare the saturated solution. Mass of solution = 78·5+100=178·5 (2 mks)

Salt + water = Saturated soln.

78·5 + 100 = 178·5

c) (i) Potassium in fertilizer may be in the form of potassium nitrate.
Describe how a sample of a fertilizer may be tested to find out if it contained nitrate ions. (2 mks)

Dissolve the fertiliser in distilled water
Add freshly prepared $FeSO_4$ to the solution
followed by conc. H_2SO_4 formation of a brown Ring confirms presence of NO_3^-

(ii) Calculate the mass of nitrogen present in 50kg bag contained pure ammonium phosphate. (N = 14, P = 31, H = 1, O = 16) (2mks)

$(NH_4)_3PO_4$ — N

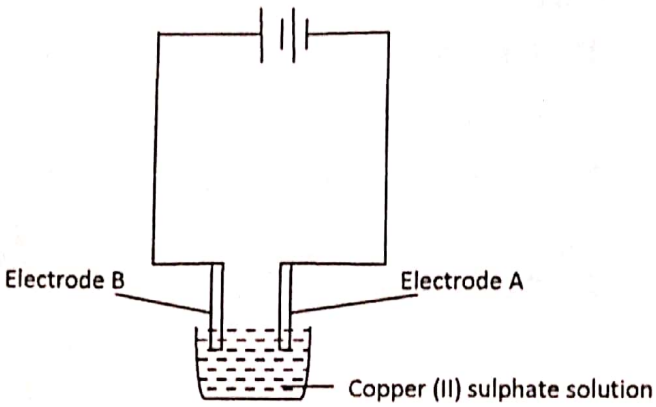
149 — 42

50 — ?

$\frac{50 \times 42}{149}$

= 14.094

6. I Students performed an experiment of electrolysis of copper (II) sulphate using copper electrodes.



a) State two observation made during the experiment. (1 mk)

- Electrode B dissolved / decreased in mass
- Electrode A Increased in mass

b) Write the equation for the reaction at
- electrode A
- electrode B

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

$Cu_{(s)} \longrightarrow Cu^{2+} + 2e$

c) Unknown current was passed for 40 minutes through copper (II) sulphate solution and a mass of 4.8g was deposited at the cathode Cu = 64, IF = 96500c.

a) Calculate the quantity of electricity passed. (1 mk)

$64 \rightarrow 2 \times 96500$

$4.8 \rightarrow ?$

$\frac{4.8 \times 2 \times 96500}{64} = 14.475\ C$ (1 mk)

b) Calculate the current used.

$\frac{14.475}{40 \times 60} = 40 \times 60 \times C = 6.03125\ A$

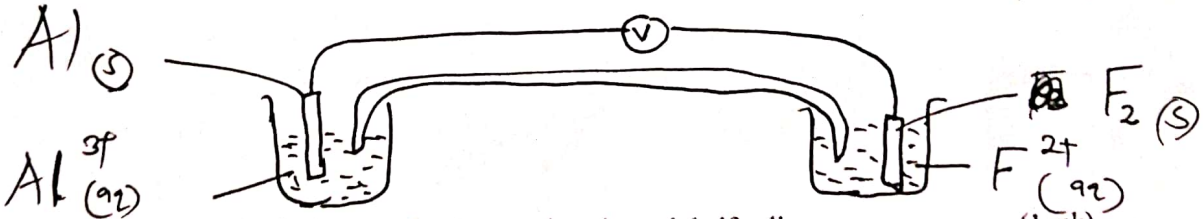
II Study the standard electrode potentials below and answer the questions that follow.

	(Eθvolts)
$Al_{(aq)}^{3+} + 3e \rightleftharpoons Al_{(s)}$	-1.66V
$Cu_{(aq)}^{2+} + 2e \rightleftharpoons Cu_{(s)}$	+0.34V
$Fe_{(aq)}^{2+} + 2e \rightleftharpoons Fe_{(s)}$	-0.44V
$Zn_{(aq)}^{2+} + 2e \rightleftharpoons Zn_{(s)}$	-0.76V

a) Which substance is the strongest oxidising agent? Explain. (1 mk)

Cu^{2+} has highest +ve electrode potential / most electronegative

b) Draw a diagram for an electrochemical cell made using Aluminium and iron electrodes. (2 mks)



c) Write the half equations for the reactions in each half cell. (1 mk)

$Al_{(s)} \longrightarrow Al^{3+} + 3e^-$

$Fe^{2+} + 2e^- \longrightarrow Fe_{(s)}$

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

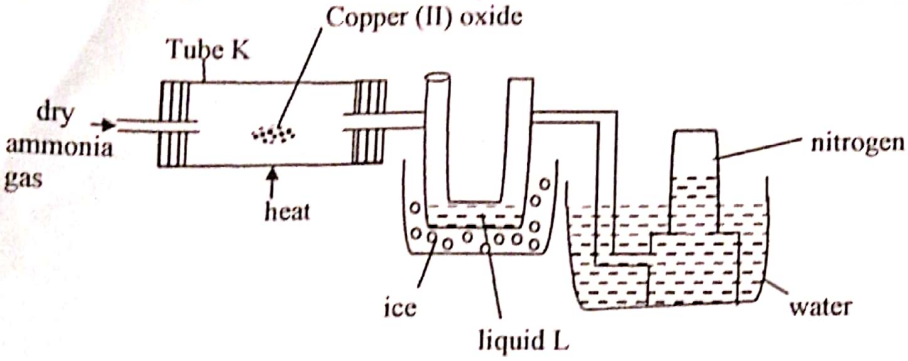
$E_R - E_{(R)}$

$-0.44 - (-1.66) = +1.22\ V$

e) Write the cell representation for the above cell. (1 mk)

$Al_{(s)} / Al^{3+}_{(aq)} // Fe^{2+}_{(aq)} / Fe_{(s)}$

7. The diagram below shows a set up that can be used to obtain nitrogen gas in an experiment.



(i) Name liquid L. (1 mk)

Water

(ii) What observations would be made in tube K after heating for sometime? (1 mk)

black solid changes to brown

(iii) Write a chemical equation for the reaction that took place in tube K. (1 mk)

$3CuO_{(s)} + 2NH_{3(g)} \rightarrow 3Cu_{(s)} + 3H_2O_{(l)} + N_{2(g)}$

(iv) If 400cm^3 of ammonia gas reacted completely with copper (II) oxide. Calculate.

(a) Volume of nitrogen gas produced. (2 mks)

$2NH_3 \longrightarrow N_2$

$24000 \times 2 \rightarrow 24000$

$400 \rightarrow ?$

$\frac{400 \times 24000}{24000 \times 2} = 200cm^3$

(b) Mass of copper (II) oxide that reacted Cu = 63.5, O = 16, molar gas volume at r.t.p = 24 litres. (2 mks)

$3CuO \longrightarrow 2NH_3$

$79.5 \times 3 \longrightarrow 2 \times 24000$

$? \longleftarrow 400$

$\frac{79.5 \times 3 \times 400}{2 \times 24000} = 1.9875$

(v) At the end of the experiment the pH of water in the beaker was found to be about 10. Explain. (2 mks)

Excess ammonia dissolved in the water forming alkaline solution