

NAME: ..... ADM NO: ..... CLASS: ...

233/2

CHEMISTRY

PAPER 2

MARKING SCHEME

**INSTRUCTIONS TO CANDIDATES:**

**Answer all the questions in the spaces provided.**

**Mathematical tables and electronic calculators may be used.**

**All working must be clearly shown where necessary.**

1. The grid below represents part of the periodic table. Study it and answer the questions that follow.

(a) Identify the family name to which element F and G belong. (1 mk)

**Alkaline earth metals**

(b) Name the type of bond formed when a and F belong. (1 mk)

**Ionic bond**

(c) Write the formula of the oxide formed when D reacts with oxygen. (1 mk)

**D<sub>2</sub>O<sub>3</sub>**

(d) What type of oxide is formed in (c) above. (1 mk)

**Amphoteric oxide**

(e) Compare the atomic radii of F and D. Explain. (2 mks)

**- Has a smaller atomic radius than F because D has more protons hence stronger nuclear attraction compared to F.**

(f) Element F burns in air to form two products. Write two equations of the two products formed. (3 mks)



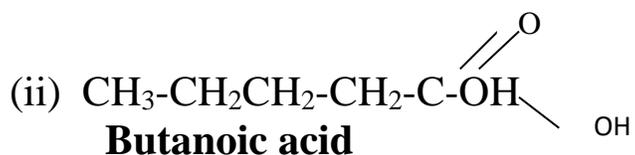
(g) State two uses of element K and its compounds. (2 mks)

**- K cyanide is used in the extraction of gold**  
**- Mixture of K and potassium is used as nuclear coolant.**

2. (a) Name the following organic compounds.



## 2, 3 – dibromo – 2 - chloropentane



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



Name:-

(i) The process that occur in steps marked I, II and IV. (1 mk)

**I – cracking**

**II- Hydrogenation**

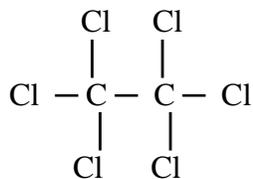
**IV – Oxidation**

(ii) The reagent and conditions in step II. (1½ mks)

**Reagent – hydrogen**

**Conditions – temp 150 – 250°C, nickel catalyst**

(iii) Draw the structural formula of substance X, give the name of the substance. (2 mks)



(c) The diagram below shows a structure of a cleansing agent.



(i) Name the cleansing agent above. (1 mk)  
**Sodium alkylbenzene sulphonate**

(ii) State the type of cleansing agent above. (1 mk)  
**Soapless detergent**

(iii) Name the material added to the cleansing agent in order to improve its cleansing property.  
**Tetraoxophosphate materials**

3. (a)  $50\text{cm}^3$  of 1M copper (II) Sulphate solution was placed in a  $100\text{cm}^3$  plastic beaker. The temperature of the solution was measured. Excess metal A powder was added to the solution, the mixture stirred and the maximum temperature was repeated using powder of metal B and C. The results obtained are given in the table below.

	A	B	C
Maximum temperature $^{\circ}\text{C}$	2.63	31.7	22.0
Initial temperature ( $^{\circ}\text{C}$ )	22.0	22.0	22.0

(i) Arrange the metal A, B, C and Copper in order of reactivity starting with the least reactive. Give reasons for the order. (3 marks)

**C, Copper, A, B.**

**B is the most reactive because it has highest  $\Delta T$ .**

**C is the least reactive because it cannot displace ions of copper from solution.**

**A is more reactive than Copper because it displaces  $\text{Cu}^{2+}$  from solutions.**

(ii) Other than temperature change, state one other observation that was made when the most reactive metal was added to the copper (II) Sulphate solution. (1 mk)

**- Blue colour of the solution fades /disappeared**

**- Black deposit is formed.**

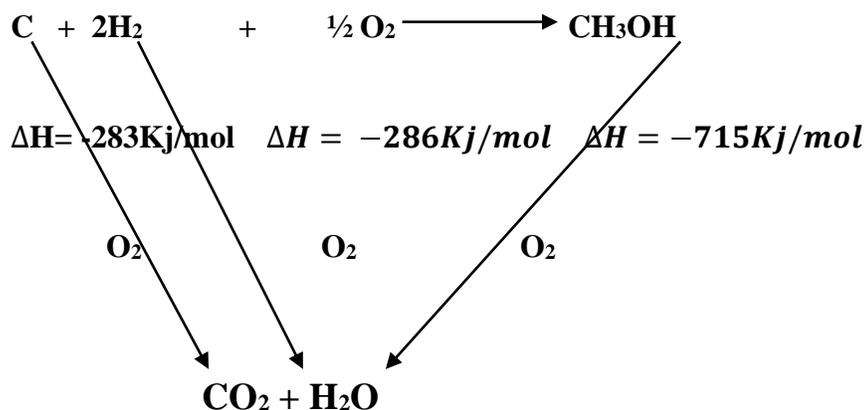
(b) The Standard enthalpy change of formation of methanol is  $-239\text{KJmol}^{-1}$

(i) Write the thermal chemical equation for the standard enthalpy change of formation of methanol. (1 mk)



(ii) Use the following data to calculate the enthalpy change for the manufacture of methanol from carbon (II) oxide and hydrogen. (3 mks)





$$\Delta H_f \text{CH}_3\text{OH} = \Delta H_c \text{C} + \Delta H_c \text{H}_2 - \Delta H_c \text{CH}_3\text{OH}$$

$$\begin{aligned} &= -283 + 2(-286) - (-715) \\ &= -283 - 576 + 715 \\ &= -859 + 715 \end{aligned}$$

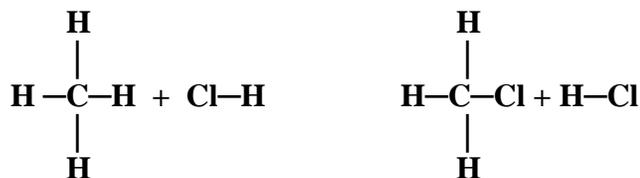
$$\Delta H_f \text{CH}_3\text{OH} = -144\text{Kj/mol}$$

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

Bond	Bond energy ( $\text{Kjmol}^{-1}$ )
C - H	414
Cl - Cl	244
C - Cl	326
H - Cl	431

Calculate the enthalpy change for the reaction.

(3 mks)



**Bond breaking energy – Bond formation energy**

**BBE - BFE**

$$4(414) + 244 = 3(414 + 326) + 431$$

$$(1900 - 1999) = -99\text{Kj}$$

$$\underline{\underline{= -99\text{Kj}}}$$

4. Carbon IV oxide is produced when solid X is heated strongly. It can also be prepared by adding dilute hydrochloric acid to solid X. The reaction between X and dilute Sulphuric acid, however gradually slows down and stops.

(a) (i) Name solid X. (1 mk)

**Calcium carbonate**

(ii) Write an ionic equation for the reaction of X and acid. (1 mk)



(b) A gas jar full of Carbon (IV) oxide was inverted over burning candle.

(i) State the observations made. (1 mk)

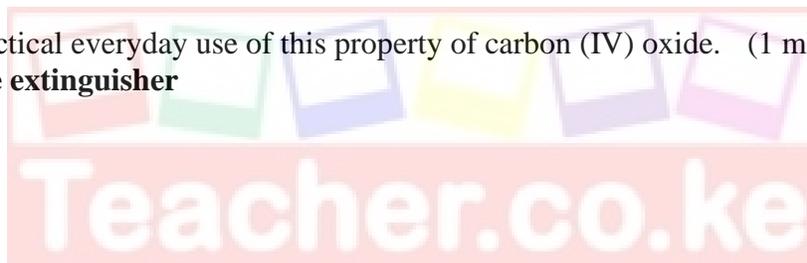
**Candle is immediately extinguished**

(ii) What two properties of carbon (IV) oxide does this observation illustrate. (2 mks)

**- It does not support combustion and it is denser than air since it is poured downwards from gas jar.**

(iii) Name a practical everyday use of this property of carbon (IV) oxide. (1 mk)

**As a fire extinguisher**



(c) The flow diagram below shows some reactions of calcium compounds.

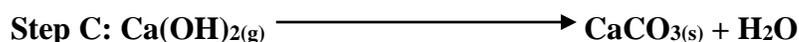
(i) Name compound F and G. (2 mks)

**F = Calcium carbonate**

**G = Calcium hydroxide**

(ii) Write equations for reactions in step A, B and C.

(3 mks)



5. A piece of sodium metal which had been exposed to air, was found to be covered with a white powder. The piece was dropped into 50g of ethanol and 2400cm<sup>3</sup> of hydrogen gas measured at room temperature and pressure was obtained. The unused ethanol was distilled off and a white solid remained (Na = 23, molar gas volume at room temperature and pressure = 24dm<sup>3</sup>)

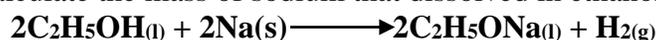
(i) Name the other substance formed other than hydrogen.

(1 mk)

**Sodium ethoxide**

(ii) Calculate the mass of sodium that dissolved in ethanol.

(2 mks)



**2 moles Na gives 1 mole H<sub>2</sub> at r.t.p.**

**46g Na gives 24.000cm<sup>3</sup>**

→ **2400cm<sup>3</sup>**

$$\frac{2400\text{cm}^3 \times 46\text{g}}{24000\text{cm}^3} = 4.6\text{g of sodium}$$

(iii) What mass of ethanol was distilled off assuming there was no loss during the process?

(2 mks)

**2 moles of C<sub>2</sub>H<sub>5</sub>OH**

**1 mole of H<sub>2</sub> gas**

**(2 x 46)g C<sub>2</sub>H<sub>5</sub>OH gives 24000cm<sup>3</sup>**

**X → 2400cm<sup>3</sup>**

$$\left( \frac{2 \times 46 \times 2400}{2400} \right) = 9.2\text{g}$$

**Mass of distilled = (50g – 9.2g) = 40.8g**

(iv) The ethanol was distilled off at 80°C, while the white solid remained unaffected at this temperature. What is the difference in structure of ethanol and the white solid.

(2 mks)

**Ethanol is molecular structure with hydrogen bonds between molecules while white solid must be giant ionic structure with strong ionic bonds.**

(b) Name another liquid which produces;

(i) Hydrogen with sodium metal.

(1 mk)

**Water**

(ii) What difference would you observe if identical pieces of sodium were dropped separately into small beakers containing ethanol and this other liquid? (2 mks)

In ethanol	In water
Sinks, gas bubbles are formed	Floats on surfaces, reacts vigorously and darts on surface producing a hissing sound.

(c) (i) Name the white powder coating the original piece of sodium, explain how it was formed.

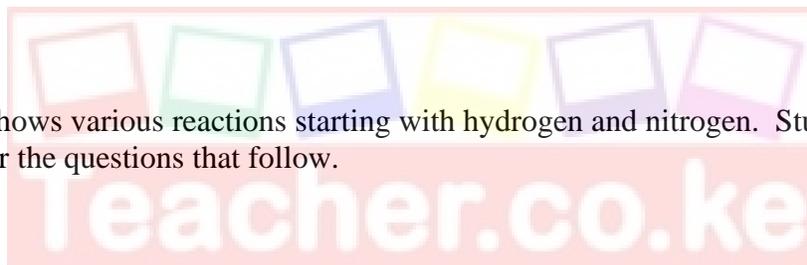
(3 mks)

**Sodium in air forms sodium oxide, which in presence of moisture forms sodium hydroxide, which reacts with carbon (iv) oxide in air to form sodium carbonate.**

(ii) Describe one test by which you could identify white powder which originally covered sodium. (2 mks)

**Add dilute HCl acid. Effervescence occurs and colourless gas is given off which forms a white precipitate in lime water.**

6. The scheme below shows various reactions starting with hydrogen and nitrogen. Study it carefully and answer the questions that follow.



(i) Give one condition other than the of a catalyst that would favour the reaction in step I.

(1 mk)

**High pressure**

(ii) Name the catalysts used in step I and II.

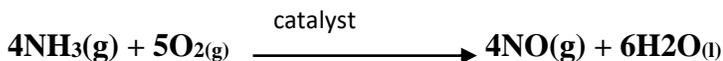
(2 mks)

**Step I - finely divided iron**  
**Step II – Vanadium V oxide/platinum**

(iii) Name substances P, Q, X and Y . (2 mks)

**P – ammonium sulphate**  
**Q – Copper metal**  
**X – Oxygen**  
**Y – nitrogen gas**

(iv) Write equations for the reactions that takes kplace in step II. (3 mks)



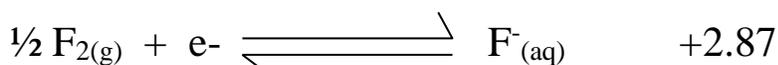
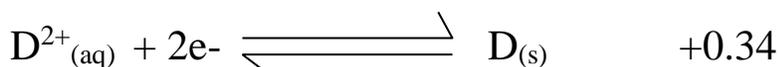
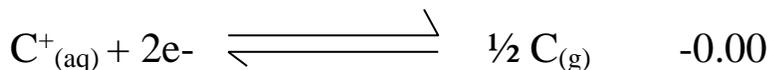
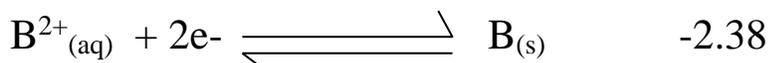
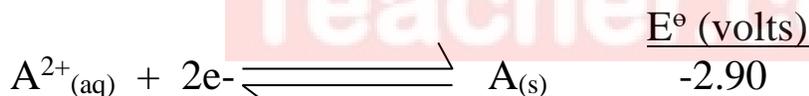
(v) Name the oxidizing agent for the reaction that takes place in step IV. (1 mk)

**Nitric acid**

(vi) Why is a concentrated nitric acid transported on aluminium container and not copper? (1 mk)

**Concentrated nitric acid with copper oxidizes it to Copper(II) nitrate, while aluminium forms layer of aluminium oxide which is a passive and stops any further action by the acid.**

7. Use standard electric potentials for elements A, B, C, D and F given below to answer the questions that follow.



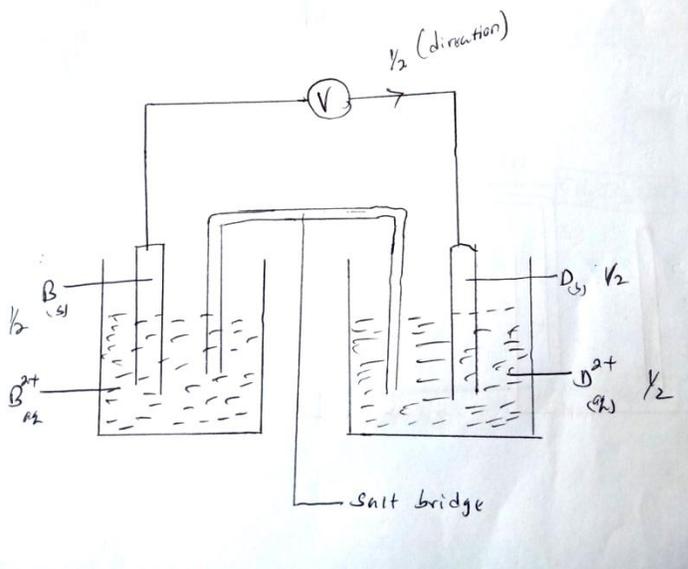
(i) Which element is likely to be hydrogen? Give a reason for your answer. (2 mks)

**C<sup>+</sup>/C<sub>2</sub> = hydrogen is used as the reference electrode**  
**E° value is 0.00/standard electrode potential**

(ii) What is the E° value of the strongest reducing. (1 mk)

$$E^{\circ} = -2.90V$$

- (iii) In the space provided, draw a labeled diagram of the electrochemical cell that would be obtained when half-cells of elements B and D are combined. (3 mks)



- (iv) Calculate the  $E^{\circ}$  value of the strongest reducing agent. (2 mks)

$$2.38 + 0.34 = 2.72$$

$$0.34 - (-2.38) = +2.72$$

$$(0.34 + 2.38) = +2.72V$$

- (b) During the electrolysis of aqueous copper II Sulphate using copper electrodes, a current of 0.2 amperes was passed through the cell for 5 hours.

- (i) Write an ionic equation for the reaction that took place at the anode. (1 mk)



OR



- (ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process. (C.u = 63.5, 1 Faraday = 96,500 coulombs) (2 mks)

$$C = AI$$

$$(0.2 \times 5 \times 60 \times 60)$$

$$\frac{0.2 \times 5 \times 60 \times 60 \times 63.5}{2 \times 96500}$$

$$2 \times 96500$$

$$63.5\text{g Cu requires } 2 \times 96500$$

$$3600 \text{ C produces } \underline{63.5 \times 3600}$$

$$2 \times 96500$$

$$= 1.18\text{gm}$$

