**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) Identity 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)

**D2O3**

(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)

**2F(s) + O2(g) 2FO(s)**

**3F(s) + N2(g)  F3N2(s)**

(g) Stat e 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.

(i) CH3CH2CH(Br)CH3

**2, 3 – dibromo – 2 - chloropentane**

O

O

(ii) CH3-CH2CH2-CH2-C-OH

OH

**Butanoic acid**

(iii) CH2CHCH2CH(Br)CH3

**4 – bromopent-i-ene**

(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 – 250oC, nickel catalyst**

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

Cl Cl

│ │

Cl ─ C ─ C ─ Cl

│ │

Cl Cl

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

**OSO3-Na+**

R

(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) 50cm3 of 1M copper (II) Sulphate solution was placed in a 100cm3 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 oC |  | 2.63 | 31.7 | 22.0 |
| Initial temperature (oC) |  | 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 T.**

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

**A is more reactive than Copper because it displaces Cu2+ 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 -239Kjmol-1

(i) Write the thermal chemical equation for the standard enthalpy change of formation of

methanol. (1 mk)

**C(s) + 2H2(g) + ½ O2(g) H3OH(g)**

(ii) Use the following data to calculate the enthalpy change for the manufacture of methanol

from carbon (II) oxide and hydrogen. (3 mks)

CO(g) + ½ O2(g) CO2; Hɵ  = -283Kj/mol

H2(g) + ½ O2(g) H2O(l); = Hɵ = -286Kj/mol

CH3OH + CO2(g) + 2H2O; Hɵ = -715Kj/mol

**C + 2H2 + ½ O2 CH3OH**

**H= -283Kj/mol**

**O2 O2 O2**

**CO2 + H2O**

**σCH3OH = HcC + HcH2 - HcCH3OH**

**= -283 + 2(-286) – (-715)**

**= -283 – 576 + 715**

**= -859 + 715**

**f CH3OH = - 144Kj/mol**

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

|  |  |
| --- | --- |
| Bond | Bond energy (Kjmol-1 |
| C – H  Cl – Cl  C – Cl  H - Cl | 414  244  326  431 |

Calculate the enthalpy change for the reaction. (3 mks)

**CH4(g) + Cl2(g)  CH3Cl(g) + HCl(g)**

**H H**

**│ │**

**H ─C─H + Cl─H H─C─Cl + H─Cl**

**│ │**

**H H**

**Bond breaking energy – Bond formation energy**

**BBE - BFE**

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

**(1900 – 1999) = -99Kj**

**= -99Kj**

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)

**CO32-(s) + 2H+(aq)  CO2(g) + H2O(l)**

(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)

**Step A: CaCO3(s) + H2O(l) + CO2(g) Ca(HCO3)2(aq)**

Boil

**Step B: Ca(HCO3)2(aq) CaCO3(s) + CO2(g) + H2O(l)**

**Step C: Ca(OH)2(g) CaCO3(s) + H2O**

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 2400cm3 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 = 24dm3)

(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)

**2C2H5OH(l) + 2Na(s) 2C2H5ONa(l) + H2(g)**

**2 moles Na gives 1 mole H2 at r.t.p.**

**46g Na gives 24.000cm3**

**2400cm3**

**2400cm3 x 46g**

**24000cm3 = 4.6g of sodium**

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

(2 mks)

**2 moles of C2H5OH 1 mole of H2 gas**

**(2 x 46)g C2H5OH gives 24000cm3**

**X 2400cm3**

**2 x 46 x 2400**

**2400 = 9.2g**

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

(iv) The ethanol was distilled off at 80oC, 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 sulplhate**

**Q – Copper metal**

**X – Oxygen**

**Y – nitrogen gas**

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

catalyst

**4NH3(g) + 5O2(g)  4NO(g) + 6H2O(l)**

**2NO(s) + O2(g) 2NO2**

**4NO2(g) + 2H2O(g) + O2(g)  HNO3(aq)**

(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.

Eɵ (volts)

A2+(aq) + 2e- A(s) -2.90

B2+(aq) + 2e- B(s) -2.38

C+(aq) + 2e- ½ C(g) -0.00

D2+(aq)  + 2e- D(s) +0.34

½ F2(g) + e- F-(aq) +2.87

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

**C+/C2 = hydrogen is used as the reference electrode**

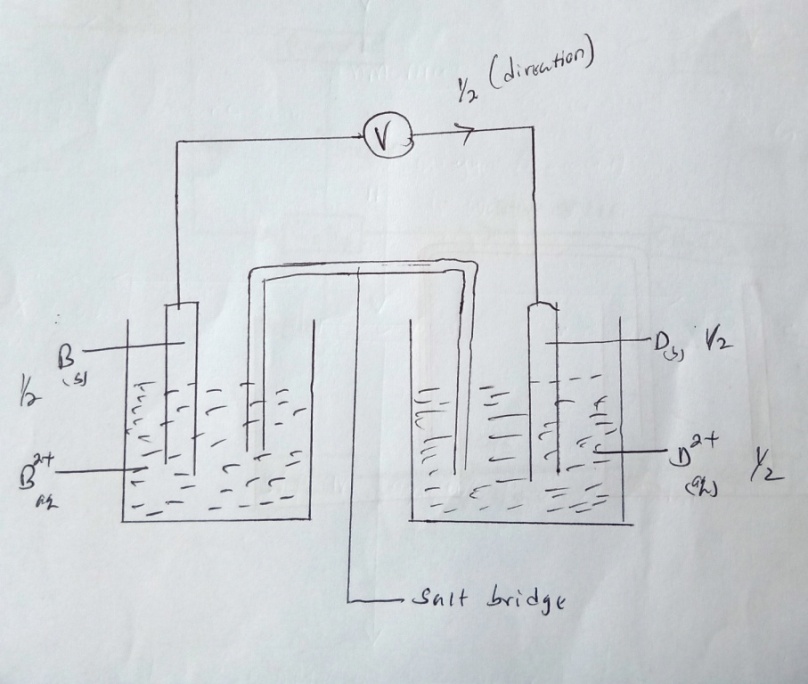
**Eɵ value is 0.00/standard electrode potential**

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

**Eɵ = -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 Eɵ 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, al 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)

**Cu(s)  Cu2+(aq) + 2e-**

**or**

**Cu(s) Cu2+(aq)**

(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 x 5 x 60 x 60)**

**0.2 x 5 x 60 x 60 x 63.5**

**2 x 96500**

**63 .5g Cu requires 2 x 96500**

**3600 C produces 63. 5 x 3600**

**2 x 96500**

**= 1.18gm**