

**1. Choose the correct answer for each of the following: -**

1. Next balanced interaction in

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ,  $\Delta H = -92KJ$ ; You can increase the concentration of ammonia by:

- a. reduce the amount of nitrogen  
 reduce the amount of hydrogen
- b. increase temperature  
 c. increase pressure

2. By adding barium chloride solution to sodium sulphate solution, deposit consists .....

- a. whit      b. Yellow      c. Blue.      d. Purple

3. The number of similar Isomers compound of  $C_4H_{10}$  is .....

- a. 2      b.4      c. 6      d. 10

4. The compound  $FeCl_2$  .....

- a. Paramagnetic and color      b. Diamagnetic and colorless  
 c. diamagnetic and color      d. Paramagnetic and colorless .

5. If a values of equilibrium constant less than (one) it means that .....

- a. the reverse reaction is predominate .  
 b. the reaction is complete and often momentary  
 c. the reactants 's concentration less than the concentration of products.  
 d. reverse reaction is predominate.

6. Deposition of 18 grams of Aluminum  $^{27}Al_{13}$  by electrolysis of Aluminum Chloride  $AlCl_3$ , needs quantity Of electricity equal ..... Faraday.

- a. 0.5      b. 0.1      c. 0.2      d. 0.3

7. Transition element have electronic configuration  $(_{18}\text{Ar})4s^2, 3d^1$  .....is  
 a scandium      b. vanadium      c. Mn      d. copper
8. When adding lead acetate to a solution of..... consists of a  
 black precipitate.  
 a. sodium sulphate   b. sodium nitrate   c. sodium phosphate   d. sodium sulphide
9. Interaction in  $4\text{NO}_{(g)} \rightleftharpoons 2\text{N}_{2(g)} + 2\text{O}_{2(g)}$ ,  $\Delta H = +180\text{kJ/mol}$  ..... leads to a lack of oxygen gas ratio of the reaction medium:  
 a. addition to nitric oxide      b. add helium gas to the reaction medium  
 c. heating the reaction medium      d. cooling the reaction medium
10.  $\text{Ni}_{(s)} + \text{Zn}^{2+}_{(aq)} \rightarrow \text{Ni}^{2+}_{(aq)} + \text{Zn}_{(s)}$ , Given the reduction potential of zinc =  $-0.76\text{V}$  and reduction potential of Ni =  $-0.23\text{V}$  The EMF equal ..... volts  
 a. -0.53      b. 0.175      c. 0.53      d. 0.99
11. Ethyne gas produces by adding water to .....  
 a. soda lime   b. calcium oxide      c. calcium carbide   d. calcium carbonate
12. the organic compound 1,2,3 -tri- hydroxy benzene called .....  
 a. ethanol      b. picric acid      c. pyrogallol      d. catechol

## 2. Type the scientific term :

1. Dipping process steel in molten zinc to protect steel from corrosion.
2. the material mass which have the ability to have or acquire one mole of electrons during a chemical reaction
3. elements that sub level 3d fills by the electrons sequentially which located at the fourth period of the periodic table.
4. chemicals that change its color depending on the nature of the chemical medium to detect the neutralization point.
5. the equilibrium that occurs between molecules of weak electrolytic materials and its ions .
6. The amount of material deposited or consumed at any pole directly proportional to the amount of electricity passing through the solution.
7. organic compounds consisting only of the elements of carbon and hydrogen .
8. Combination process a large number of small molecules to obtain a big one have great mass .
9. Is the minimum amount of energy that must be gained by a molecule to start the reaction at collision.
10. chemical compound that gives carbon dioxide and iron oxide II by thermal decomposition
11. Electrical amount required to precipitate equivalent mass of an element .
12. atomic group derived from corresponding alkane , the general format is  $C_nH_{2n+1}$ .

### **3. Give reason**

- 1) car battery works as a cell galvanic and works as a electrolytic cell
- 2) added fluorspar when extracted Aluminum from bauxite .

- 3) phenol more acidic than ethanol .
- 4) catalyst does not affect the equilibrium in the reversible reactions 5) the up normal electronic structure of chromium , copper for electronic structure of the elements of the first series transition .
- 6) Indicators used to identify the end point of the neutralization reactions
- 7) Identification of basic radical is more complicated than that of acidic radicals
- 8) boiling point of carboxylic acids higher than the boiling point of the corresponding alcohols .
- 9) sulphuric acid is added at the preparation of esters .
- 10) difficult oxidation of manganese ions (II) to manganese ions (III).
- 11) used dilute hydrochloric acid to distinguish between sodium carbonate and sodium nitrite salts.
- 12) lead acid battery is the reversible galvanic cell .

#### **4. Mention one use:**

1. Catalyst in industrial processes.
2. The salt bridge in the galvanic cell.
3. Ethylene glycol .
4. Potassium Permanganate
5. the natural gas in medical furnace
6. Teflon

**5. How to distinguish between the practical experience of all Mmaaly**

1. iron (II) chloride and iron (III)chloride.
- 2 .ethanol and acetic acid
3. hydrochloric acid and sulphuric acid .
4. sodium chloride and sodium bromide
5. 1. bropanol and 2. bropanol

**6. *By Balanced chemical equations show how do you get :***

1. iron II hydroxide from Iron III hydroxide
2. iron III oxide from iron II Oxalate
- 3 . Black Carbon from sodium acetate.
4. iron II sulfide from magnetic iron oxide.
5. ethylene glycol from ethanol .
6. ethyl acetate ester from ethanol.
7. Toluene of benzene.
8. phenol from acetylene.

**7. Problems :**

1. Calculate the time required for the deposition of 5.4 grams of silver by passed an electric current 9.65 amperes in Silver Nitrate solution (Ag = 108) ( if the reaction at the cathode equation :  $\text{Ag}^+ + \text{e}^- \longrightarrow \text{Ag}$  )
2. Calculate the volume of water necessary to add to the 200 milliliter of sodium hydroxide solution 0.3 mol/l to convert it to 0.1 mol/l solution.



3. A sample of 9.56 gm of hydrated cobalt chloride salt ( $\text{CoCl}_2 \cdot x\text{H}_2\text{O}$ ) is heated strongly till mass 5.24 gm, find the % of water of crystallization of hydrated cobalt chloride and the chemical formula of hydrated cobalt chloride (Co = 60, Cl = 35.5, H = 1, O = 16)
4. by passing the current intensity 7 A in a solution of nitrate one of metals for a period of time of 4 minutes. If the cathod mass befor passage of electric current 12 gm and became and after the passage of electric current 13.88 gm . calculate the equivalent mass of this element .
5. Solution of acetic acid concentration of 0.5 molar with ionization degree 3%. Calculate the value pOH for this solution.
6. Calculate the mass of deposited copper on the cathode when the passage of electric current intensity of 10 A for half an hour during the copper II sulphate (Cu = 63.6.)
7. Calculate the concentration of ion  $\{\text{OH}^-\}$  [ Note that the solution concentration is equal  $3 \times 10^{-7}$  mol/l
8. Following reaction occurs in the galvanic cell : -
- $$\text{Ni}^{+2}_{\text{aq}} + \text{Fe}_{\text{s}} \longrightarrow \text{Fe}^{+2}_{\text{aq}} + \text{Ni}_{\text{s}}$$

Calculate the emf that knowing that the reduction potential of Iron and nickel are respectively ( -0.4 , -0.23 )V

8. Calculate the degree of solubility of silver sulphate  $\text{Ag}_2\text{SO}_4$  in the water if you know that the product of solubility (  $K_{sp}$  ) equal to  $1.4 \times 10^{-4}$

**8. What is with all of the following: -**

1. Markownikoff's rule.
2. The electromotive series of elements.
3. standard hydrogen electrode
4. catalytic activity of the transition elements
5. the law of mass action
6. the faraday

**9. Mention the role of all the world , which follows the progress of chemistry**

1. Ostwald .
2. kekule .
3. Goldberg and Waag .
4. Wohlr
5. Markownikoff
6. Le Chatelier



**1. Choose the correct answer for each of the following: -**

1. in the following reaction:  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ,  $\Delta H = -92KJ$ : You can increase the concentration of ammonia by:

- a. Reduce the amount of nitrogen.                      b. Increase temperature.  
c. Reduce the amount of hydrogen.                      d. **increase pressure.**

2. By adding **barium chloride** solution to **sodium sulphate** solution, ..... ppt is formed.

- a. **white.**                      b. Yellow.                      c. Blue.                      d. Purple.

3. The number of isomers compound of  $C_4H_{10}$  is .....

- a. 2.                      b. 4.                      c. 6.                      d. 10.

4. The compound  $FeCl_2$  .....

- a. **Paramagnetic & colored**                      b. Diamagnetic & colorless.  
c. diamagnetic & colored.                      d. Paramagnetic & colorless.

5. If a values of equilibrium constant less than (one) it means that .....

- a. **the reverse reaction is dominating.**  
b. the reaction is complete and instantaneous.  
c. the reactants' concentration less than the concentration of products.  
d. reverse reaction is dominating.

6. Deposition of 18 grams of Aluminum  $^{27}Al_{13}$  by electrolysis of Aluminum Chloride  $AlCl_3$ , needs quantity of electricity equal ..... Faraday.

- a. 0.5                      b. 0.1                      c. **2**                      d. 0.2

7. Transition element have electronic configuration  $(_{18}Ar) 4s^2, 3d^1$  is...

- a. scandium                      b. vanadium                      c. Mn                      d. **copper**

8. When adding lead acetate to ..... solution a black ppt is formed.

- a. sodium sulphate.                      b. sodium nitrate.                      c. sodium phosphate                      d. **sodium sulphide**

9. Interaction in  $4NO(g) \rightleftharpoons 2N_2(g) + 2O_2(g)$ ,  $\Delta H = +180kj / mole$  ..... leads to a lack of oxygen gas:

- a. addition of nitric oxide                      b. adding helium gas to the reaction medium.  
c. heating the medium of the reaction.                      d. **cooling the medium of the reaction.**

10.  $Ni(s) + Zn^{+2}(aq) \rightarrow Ni^{+2}(aq) + Zn(s)$ , Given the reduction potential of zinc = - 0.76 V and reduction potential of Ni = - 0.23 V The EMF equal ..... volts

- a. -0.53                      b. 0.175                      c. **0.53**                      d. 0.99

11. Ethyne gas produces by adding water to .....

- a. soda lime                      b. calcium oxide                      c. **calcium carbide.**                      d. calcium carbonate

12. the organic compound 1,2,3 -tri- hydroxy benzene called .....

- a. ethanol                      b. picric acid                      c. **pyrogallol**                      d. catechol

**2. write the scientific term:**

1. process of dipping steel in molten zinc to protect steel from corrosion.

**[galvanization]**

2. mass of a substance which have the ability to gain or lose one mole of electrons during a chemical reaction. **[Equivalent mass]**

3. Elements are successively filled in the sublevel 3d which located at the fourth period of the periodic table. **[1<sup>st</sup> transition series]**

4. Chemical substances change its color according to the medium to detect the end point. **[indicator]**



5. Equilibrium that occurs between molecules of weak electrolyte and its ions. [**ionic equilibrium**]
6. The amount of material deposited or consumed at any pole directly proportional to the amount of electricity passing through the solution. [**Faraday's 1<sup>st</sup> law**]
7. organic compounds consisting only of the elements of carbon and hydrogen. [**hydrocarbons**]
8. Combination process a large number of small molecules to obtain a big one have great mass. [**polymerization**]
9. Is the minimum amount of energy that must be gained by a molecule to start the reaction at collision. [**activation energy**]
10. chemical compound that gives carbon dioxide and iron oxide II by thermal decomposition. [**iron II carbonate**]
11. Electrical amount required to precipitate equivalent mass of an element. [**Faraday**]
12. Atomic group derived from corresponding alkane, its general formula  $C_nH_{2n+1}$ . [**Alkyl**]

### 3. Give reason

**1) Car battery works as a galvanic cell and works as an electrolytic cell.**

Because Car battery works as galvanic cell during discharge and consuming its energy, while in the case of recharging it is considered as an electrolytic cell.

**2) Adding fluorspar when extracted Aluminum from bauxite.**

To decrease the melting point of the mixture from  $2045^{\circ}\text{C}$  to  $950^{\circ}\text{C}$ .

**3) Phenol more acidic than ethanol.**

Because benzene ring of phenol increases the length of bond O - H and causes its weakness which facilitates the separation of +ve hydrogen ion. So, it considered as an acid named in industry carbolic acid.

**4) Catalyst does not affect the equilibrium in the reversible reactions.**

Because it increases the rate of the chemical reaction in the both directions forward and backward by the same degree at the same time.

**5) The up normal electronic structure of chromium, copper for electronic structure of the elements of the first series transition.**

In case of chromium ( $\text{Cr}_{24}$ )

sublevels 4s and 3d becomes half-filled this makes the atom has low energy and more stability.



In case of Copper ( $\text{Cu}_{29}$ )

sublevels 4s becomes half-filled & sublevel 3d become completely filled this makes The atom has low energy & more stability.



**6) Indicators used to identify the end point of the neutralization reactions.**

Because it changes its color according to the medium.

**7) Identification of cations is more complicated than that of anions.**

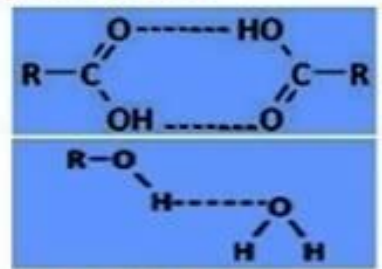
Because there is a large number of cations and one cation may have more than oxidation NO.



### 8) Boiling point of carboxylic acids higher than the boiling point of the corresponding alcohols.

Because: Each acid molecule is linked to another molecule by two hydrogen bands.

While Each alcohol molecule is linked to another molecule by one hydrogen band.

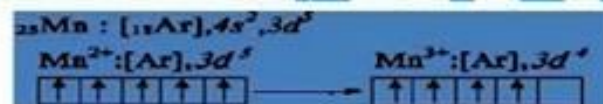


### 9) Sulphuric acid is added at the preparation of esters.

To absorb water and prevent the reversible reaction so, the reaction shifts forward to form the ester.

### 10) Difficult oxidation of manganese ions (II) to manganese ions (III).

$Mn^{+2}$  is more stable because the (3d) sublevel is half-filled. So,  $Mn^{+2}$  is not readily oxidized to  $Mn^{+3}$ .



### 11) using dilute hydrochloric acid to distinguish between sodium carbonate and sodium nitrite salts.

Because HCl acid is more stable than ( $H_2CO_3$  &  $HNO_2$ ) which these anions are derived. So, HCl replacing less stable acid which easy to volatile or decompose to gases which we can detect them using suitable reagent  $\rightarrow$  sodium carbonate gives  $CO_2(g)$  turbid lime water & sodium nitrite gives colorless nitric oxide (NO) turned reddish brown on the mouth of the tube.

### 12) Lead acid battery is the reversible galvanic cell.

Because it produces electric energy through a spontaneous & reversible redox reaction and it can be recharged by passing an electric current from external source between their poles in direction opposite to the discharge process.

#### 4. Mention one use for the following:

##### 1. Catalyst in industrial processes.

Catalysts increase rate of reaction by decrease activation energy and are used in more than 90% of the industrial processes such as food and petrochemical industries.

##### 2. The salt bridge in the galvanic cell.

- ① It connects between the solutions of the two half cells indirectly.
- ② It neutralize both the solutions of the two half cells so; it forms a difference potential between the two half-cells.

##### 3. Ethylene glycol.

As antifreeze substance in car radiators in cold countries - in the hydraulic break - printing ink. (PEG) in manufacture of Dacron, photographic films and cassette tapes.

##### 4. Potassium Permanganate.

Oxidizing agent – as an antiseptic

##### 5. The natural gas in midrex furnace.

source of water the reducing agent to convert iron oxide (hematite) into iron.

##### 6. Teflon.

- Lining cooking utensils. -Surgical threads.



**5. By practical experiment How to differentiate between the following:****1. iron (II) chloride and iron (III)chloride.**

	<b>iron (II) chloride</b>	<b>iron (III)chloride</b>
By adding $\text{NaOH}_{(aq)}$	$\text{Fe}(\text{OH})_2 \downarrow$ Green ppt	$\text{Fe}(\text{OH})_3 \downarrow$ Brown ppt

**2. Ethanol and Acetic acid.**

	<b>acetic acid</b>	<b>ethanol</b>
Adding $\text{KMnO}_{4(aq)}/\text{H}_2\text{SO}_4$	No effect	The violet color disappeared forming vinegar smell
Adding $\text{Na}_2\text{CO}_3$	Effervescence & $\text{CO}_2 \uparrow$ turbid lime water	No effect

**3. Hydrochloric acid and Sulphuric acid.**

	<b>Hydrochloric acid</b>	<b>Sulphuric acid</b>
By adding $\text{NaCl}_{(aq)}$	No effect	Colorless HCl gas evolves forming white fumes with ammonia

**4. sodium chloride and sodium bromide.**

	<b>sodium chloride</b>	<b>sodium bromide</b>
By adding $\text{AgNO}_{3(aq)}$	White ppt formed turned violet in light & dissolve in conc. ammonia solution.	Yellowish white ppt formed dissolve slowly in conc. ammonia solution.

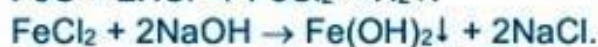
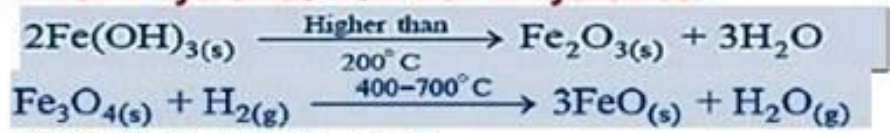
**5. 1- Propanol and 2- Propanol.**

	<b>1- Propanol (primary)</b>	<b>2- Propanol (secondary).</b>
Adding $\text{KMnO}_{4(aq)}/\text{H}_2\text{SO}_4$	The violet color disappeared forming an acid turned litmus paper to red.	The violet color disappeared forming ketone has no effect on litmus paper.



**6. By Balanced chemical equations show how do you get:**

**1. iron II hydroxide from iron III hydroxide.**

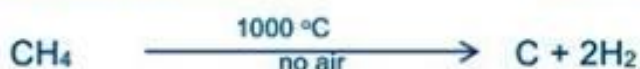
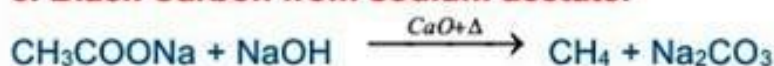


**2. iron III oxide from iron II Oxalate.**

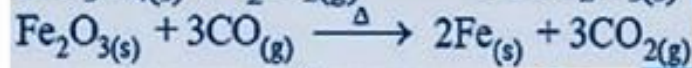
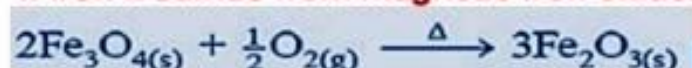
By heating in absence of air then oxidation to iron II oxide.



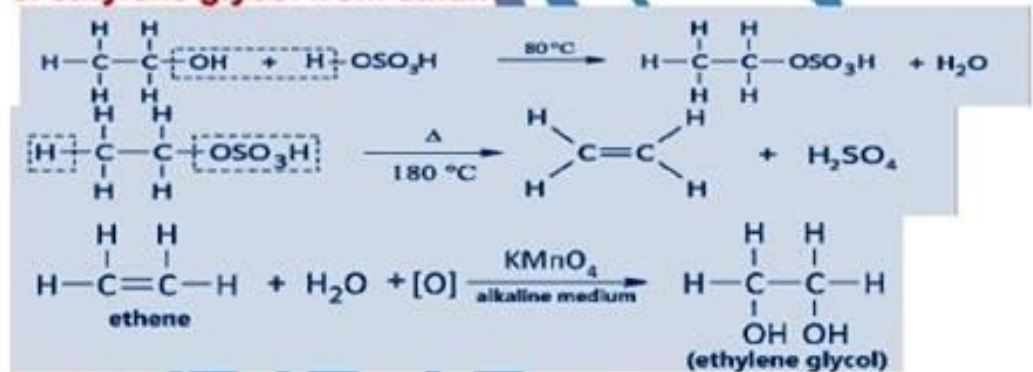
**3. Black Carbon from sodium acetate.**



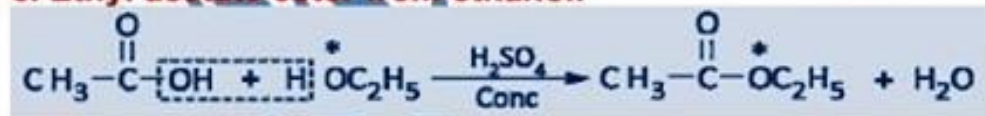
**4. iron II sulfide from magnetic iron oxide.**



**5. ethylene glycol from ethanol.**



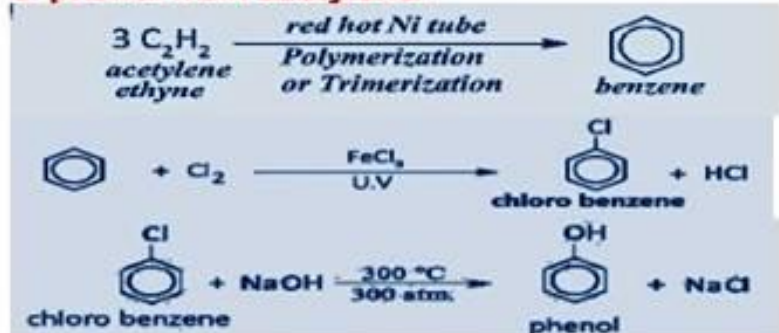
**6. Ethyl acetate ester from ethanol.**



**7. Toluene from benzene.**



**8. phenol from acetylene.**





**7. Problems:**

**1. Calculate the time required for the deposition of 5.4 grams of silver by passed an electric current 9.65 amperes in Silver Nitrate solution (Ag = 108) (if the reaction at the cathode equation:  $(Ag^+ + e^- \rightarrow Ag)$ )**

$$1 \text{ mol} \rightarrow z \times F$$

$$108 \text{ (gm)} \rightarrow 1 \times 96500 \text{ (C)}$$

$$5.4 \text{ (gm)} \rightarrow 9.65 \times t \text{ (C)}$$

$$T = \frac{\text{Mass} \times \text{valency} \times F}{\text{Molar Mass} \times I} = \frac{5.4 \times 1 \times 96500}{108 \times 9.65} = 500 \text{ sec.}$$

**2. Calculate the volume of water necessary to add to the 200 milliliter of sodium hydroxide solution 0.3 mole/L to convert it to 0.1 mole/L solution.**

NO. of solute moles doesn't change after diluting.

$$M \times V \text{ (before diluting)} = M \times V \text{ (after diluting)}$$

$$0.3 \times 200 = 0.1 \times V$$

$$V \text{ (after diluting)} = 600 \text{ ml}$$

$$V \text{ (added)} = 600 - 200 = 400 \text{ ml.}$$

**3. A sample of 9.56 gm of hydrated cobalt chloride salt ( $CoCl_2 \cdot X H_2O$ ) is heated strongly till mass 5.24 gm, find the % of water of crystallization of hydrated cobalt chloride and the chemical formula of hydrated cobalt chloride (Co = 60, Cl = 35.5, H = 1, O = 16)**

$CoCl_2 \cdot$	$X H_2O$	
131 gm	18 X gm	
5.24 gm	$(9.56 - 5.24 = 4.32)$ gm	

$$[\% \text{ of water} = \frac{4.32}{9.56} \times 100 = 45.188 \%]$$

$$18 X = \frac{4.32 \times 131}{5.24} = 108 \text{ gm}$$

$$X = 108 / 18 = 6 \quad (CoCl_2 \cdot 6 H_2O)$$

**4. by passing the current intensity 7 A in a solution of nitrate one of metals for a period of time of 4 minutes. If the cathode mass before passage of electric current 12 gm and became and after the passage of electric current 13.88 gm. calculate the equivalent mass of this element.**

$$\text{ppted mass} = 13.88 - 12 = 1.88 \text{ gm.}$$

$$\text{Eq mass (gm)} \rightarrow F$$

$$\text{Eq mass (gm)} \rightarrow 96500 \text{ (C)}$$

$$1.88 \text{ gm} \rightarrow 7 \times 4 \times 60 \text{ (C)}$$

$$\text{Eq mass} = \frac{\text{Mass} \times F}{q \times I} = \frac{1.88 \times 96500}{7 \times 4 \times 60} = 107.988 \text{ gm}$$

**5. Solution of 0.5 molar acetic acid if degree of ionization is 3%. Calculate the value POH for this solution.**

$$K_a = \alpha^2 \times C \quad K_a = (0.03)^2 \times 0.5 = 4.5 \times 10^{-4}$$

$$[H^+] = \sqrt{K_a \times C_a} = \sqrt{4.5 \times 10^{-4} \times 0.5} = 0.015 \text{ mol / L}$$

$$PH = -\log [H^+] = -\log 0.015 = 1.823$$

$$POH = 14 - PH = 14 - 1.823 = 12.176.$$



6. Calculate the mass of deposited copper on the cathode when the passage of electric current intensity of 10 A for half an hour during the copper II sulphate. (Cu = 63.6.)

$$1 \text{ mol} \rightarrow z \times F$$

$$63.6 \text{ (gm)} \rightarrow 2 \times 96500 \text{ (C)}$$

$$\text{mass (gm)} \rightarrow 10 \times 30 \times 60 \text{ (C)}$$

$$\text{ppted mass} = \frac{q \times I \times \text{M.M}}{\text{valency} \times 96500} = \frac{10 \times 30 \times 60 \times 63.6}{2 \times 96500} = 5.93 \text{ gm.}$$

7. Calculate the concentration of  $[\text{OH}^-]$  ion in a solution (knowing that the concentration of  $[\text{H}^+] = 3 \times 10^{-7}$  mole/L)

$$[\text{H}^+] \times [\text{OH}^-] = 10^{-14}$$

$$[\text{OH}^-] = \frac{10^{-14}}{[\text{H}^+]} = \frac{10^{-14}}{3 \times 10^{-7}} = 3.33 \times 10^{-8}$$

8. Following reaction occurs in a galvanic cell: -

$\text{Ni}^{+2}_{(\text{aq})} + \text{Fe}^0_{(\text{s})} \rightarrow \text{Fe}^{+2}_{(\text{aq})} + \text{Ni}^0_{(\text{s})}$ . Calculate the emf . knowing that the reduction potential of iron and nickel are respectively ( -0.4, -0.23) V.



$$\begin{aligned} \text{e. m. f} &= \text{oxidation potential of iron} - \text{oxidation potential of nickel} = 0.4 - (0.23) \\ &= 0.17 \text{ V} \end{aligned}$$

8. Calculate the degree of solubility of silver sulphate  $\text{Ag}_2\text{SO}_4$  in the water if you know that the product of solubility ( $K_{\text{sp}}$ ) equal to  $1.4 \times 10^{-4}$



$$K_{\text{sp}} = [\text{Ag}^+]^2 \cdot [\text{SO}_4^{2-}]$$

$$K_{\text{sp}} = [2X]^2 \cdot [X]$$

$$K_{\text{sp}} = 4X^3$$

$$X^3 = \frac{1.4 \times 10^{-4}}{4} = 3.5 \times 10^{-5}$$

$$\text{degree of solubility } X = \sqrt[3]{3.5 \times 10^{-5}} = 0.0327$$