K. K. Wagh Institute of Engineering Education and Research, Nashik

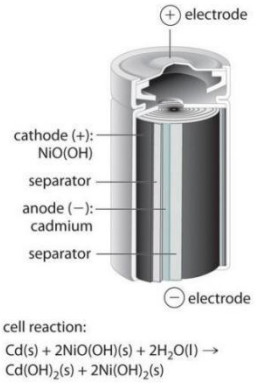
(An Autonomous Institute from A. Y. 2022-23)

Model Answers

End-Sem Examination-I, Winter 2025

Academic Year: 2025-2026	Semester: I
Class: FY	Program: B.Tech
Branch Code: All	Pattern: 2023
Name of Course:Applied chemistry	Course Code:2300104A

Q. No.	Details	Max. Marks
Q.1	What is secondary battery. Describe the construction and working of a Ni-Cd battery with a neat labelled diagram and chemical reactions (6 marks) ***(Def-1M, Construction and working- 4M, chemical reatcions -1M)*** ***Ans:*** **Secondary batteries:** These are rechargeable cells, the redox reaction converts chemical energy into electrical energy which can be reversed by passage of electric current. **Construction :** 1.A nickel vessel containing nickel oxide paste or nickel oxide hydroxide and at the centre of container metallic cadmium rod placed, a separator is made of a thin non – woven fabric, an alkaline electrolyte (aq. KOH and small amount of LiOH) and a metal case provided with a self –sealing safety valve . **2.Anode composition:** The composition of the active materials of the anode are spongy Cd with 78% Cd(OH)2, 18 % Fe, 1 % Ni and 1 % graphite which are pressed into a tablet form and wrapped in nickel wire gauge . **3. Cathode Composition:** The outer cap contains NiO2 paste or a mixture of 80% NiOOH and Ni (OH) 2, 2% Co (OH) 2, 18% graphite and very minute quantities of barium hydroxide to increase the efficiency of the active materials and also the cycle life. 4. The two electrodes are separated by absorbent material soaked with 6M KOH as electrolyte. An insulated washer at the top separates the anode and the cathode compartments without any contact **Working:** When the load (for example, a bulb) is connected to the Ni-Cad cell, the cadmium (Cd) combines with two moles of hydroxide ions (-OH) to produce cadmium hydroxide, with two free electrons. This reaction is known as oxidation. In this Nicad cell, the reduction (on cathode) is the process by which the free electrons on the anode migrate from the anode to the cathode (Nickel's vessel) through load and combine with nickel oxide paste or oxide- hydroxide to yield nickel hydroxides with two moles of hydroxides.When all active cadmium turns into cadmium hydroxides(Cd(OH)2, then it	[6]

	can be said that Nicad cell would be discharged. The following reactions occur during the discharging of cell on the anode and cathode **Reaction:** **Reactions during discharging:** At Anode: $Cd(s) + 2OH^- \rightarrow Cd(OH)_2 + 2e^-$ At Cathode: $2\,NiO(OH) + 2H_2O + 2e^- \rightarrow 2Ni(OH)_2 + 2OH^-$ Overall Cell Reaction : $Cd(s) + 2\,NiO(OH) + 2H2O \rightarrow Cd(OH)_2 + 2Ni(OH)_2$ **Reactions during charging:** At Anode: $2Ni(OH)_2 + 2OH^- \rightarrow 2NiO(OH) + 2H_2O + 2e$ At Cathode: $Cd(OH)_2 + 2e^- \rightarrow Cd(s) + 2OH^-$ Overall Cell Reaction: $Cd(OH)_2 + 2Ni(OH)_2 \rightarrow Cd(s) + 2\,NiO(OH) + 2H_2O$  	
Q.2	a) What are the characteristics of an ideal fuel? (3 marks) ***(Three characteristics - 3M)*** ***Ans :*** ***1`)*** **High calorific values:** A good fuel should the high caloric values, so that large amount of energy is obtained on combustion of smaller amount of fuel. Solid fuel has smaller calorific values as compared to liquid and gaseous fuel 2) **Moderate Ignition Temperature:** The minimum temperature at which continuous combustion of fuel start. Solid fuel has higher calorific values as compared to liquid and gaseous fuel; hence ideal fuel should have moderate ignition temperature. ***3)*** **Harmless product of combustion:** a good fuel does not liberate any polluting or poisonous gases. b) 1.8 gm of coal on heating at 105°C for 1 hr, leaves 1.3 gm residue. Then the coal was heated at 950°C with cover on crucible gives 1.1 gm residue. The residue on burning gives 0.11 gm constant weight. Calculate % moisture, volatile matter and ash. (3 marks) *Ans :* ***(% Moisture-1M, %Volatile matter-1M, %Ash-1M)***	[6]

	• % **Moisture** $= \frac{\text{Loss in weight}}{\text{Weight of coal sample}} \times 100$ =27.77% • % **VM** $= \frac{\text{Loss in weight}}{\text{Weight of coal sample}} \times 100$= 11.11 % % **Ash** $= \frac{\text{wt of ash left}}{\text{Weight of coal sample}} \times 100 = 6.11$ %	
Q.3	**a)** Calculate number of atoms per unit cell for SC, BCC and FCC crystal systems. (6 marks) ***(Number of atoms for SC-2 M, FCC-2 M, BCC-2 M)*** ***Ans : No of atoms per unit cell for*** ***A) SC :*** • In simple cubic unit cell, atoms are situated at the corners of the cube. • Each corner atom is shared between eight (8) unit cells in the space lattice. • Hence only 1/8th part of the atom lies at the corner of the unit cell. • There are eight such corner atoms in simple cubic unit cell. Therefore, Number of atoms per unit cell of SC = 1/8 × 8 = **1 atom per unit cell.** ***B) BCC:*** In body centred cubic unit cell, there are eight (8) corner atoms and one (1) body centred atom present. • Each corner atom is shared between eight unit cells in the space lattice. • Hence only 1/8th part of the atom lies at the corner of unit cell. • Whereas, body centred atom belongs to the same unit cell and is not shared in space lattice. Therefore, Number of atoms per BCC unit cell = = (1/8 × 8) + 1 = **2 atoms per unit cell.** **C) FCC:** **Number of atoms per unit cell of FCC**: In face centred cubic unit cell there are eight (8) corner atoms and six (6) face centre atoms present. Each corner atom is shared between eight unit cells in the space lattice. Hence only $1/8^{th}$ part of the atom lies at the corner of unit cell. Whereas, each face centred atom is shared between 2 unit cells in the space lattice. Hence only $1/2^{th}$ part of the atom lies with the unit cell. Therefore Number of atoms per FCC unit cell = $(\frac{1}{8} \times 8) + (\frac{1}{2} \times 6)$ = 1 + 3 = **4 atoms per unit cell** **OR** **b)** Explain the term atomic radius .Obtain the atomic packing factor (APF) for SC and FCC structure. (6 marks) ***(Def-1 M, APF calculation for SC -2M and FCC- 3 M)*** ***Ans :*****Atomic radius** is defined as half the distance between the centres of two immediate neighbour atoms in a unit cell.	[16]

APF for SC :

APF = $\frac{\textit{Total volume of atoms in a unit cell}}{\textit{Volume of unit cell}} = \frac{u}{v}$

u = Volume of atoms in unit cell × Number of atoms per unit cell

$= \frac{4}{3}\pi r^3 \times 1$

v = Volume of unit cell = a^3

$APF = \frac{1 \times \frac{4}{3}\pi r^3}{a^3}$

APF = $\frac{\pi}{6}$ **= 0.52**

APF for FCC :

APF = $\frac{\textit{Total volume of atoms in a unit cell}}{\textit{Volume of unit cell}} = \frac{u}{v}$

u = Volume of atoms in unit cell × Number of atoms per unit cell

$= \frac{4}{3}\pi r^3 \times 4$

v = Volume of unit cell = a^3

$APF = \frac{4 \times \frac{4}{3}\pi r^3}{a^3}$

$= \frac{4 \times \frac{4}{3}\pi (\frac{\sqrt{2}}{4} a)^3}{a^3}$

APF = $\frac{\pi}{3\sqrt{2}}$ **= 0.74**

C)What are conducting polymers? Discuss p-doping and n-doping with chemical reactions and state any two applications of conducting Polymer
(6 marks)

(Def-1 M ,p and n-doping with an examples-4 M, Application- 1 M)

Ans : The polymers which are capable of conducting the electric current either due to availability of free electrons in their polymer structure or by mixing conducting material with them are called as **conducting polymers.**

Types of doped polymer :

P-doping:

In this doping the ICP is subjected to undergo oxidation reaction. For oxidation reaction oxidizing agents like **Lewis acids** are used like **I_2, Br_2, $FeCl_3$, PF_6** .These oxidizing agents are also called as **P-dopants.**

Example- Consider the P-doping of polyacetylene

$(C_2H_2)_n + I_2 \xrightarrow{\text{oxidation}} (C_2H_2)_n^+ + I^-$

Polyactylene **Doped polyacetylene**

N-**doping:**

In this doping the ICP is subjected to undergo reduction reaction. For reduction reaction reducing agents like **Lewis base** are used like **Lithium, Sodium metal, naphthyl amines**, can be used.

These reducing agents are also called as **N-dopants.**

Example- Consider the N-doping of polyacetylene

$$(C_2H_2)_n + Na \xrightarrow{\text{Reduction}} (C_2H_2)_n^- + Na^+$$

Polyactylene **Doped polyacetylene**

Applications :

1) In rechargeable light weight batteries

2) In electronic devices like transistors, photodiodes and light emitting diodes(LEDs)

OR

c) Define biodegradable polymers. Discuss the key factors that affect biodegradation process.State any two applications. (6 marks)

((***Def-1 M , Factor-4 M, Properties-1 M)***

Ans : The polymers which undergo biodegradation (decomposition) in presence of certain microorganisms (Generally bacteria, fungi), water by enzymatic action and forms simple harmless gaseous products are called as **biodegradable polymers.**

Factors involved in bio-degradation:

1) Presence of microorganisms- Microorganisms such as bacteria, fungi and algae are responsible for biodegradation of polymers, by breaking C-C bond.

2) Environment- Suitable temperature, moisture, PH, oxygen, pressure, light etc are also required for biodegradation.

3) Nature of polymer- The polymer chain of biodegradable polymers must contain atoms other than carbon in the backbone (like O, N, S).

Structural requirement for biodegradable polymer: 1) Mostly natural polymers are biodegradable.

2) The polymer chain of biodegradable polymers contains atoms other than carbon in the backbone (like O, N, S)

3) Biodegradable polymers are amorphous in nature.

4) Biodegradable polymers contain functional groups which easily undergo hydrolysis, oxidation and reduction reactions.

5) Biodegradable polymers are hydrophilic in nature as the process of biodegradation takes place in presence of water.

6) Biodegradable polymers have low molecular weight.

Applications of biodegradable polymer:

1) As packaging material-

Food packaging, foam for industrial packaging, film wrapping, disposable plastic,

	single serve cups, disposable food service items. **2) Medical applications-** Controlled (Sustained) drug delivery, absorbable surgical implants and surgical sutures, absorbable skin grafts, fractured bone recovery material.	
	d) Define nanomaterials and discuss any six applications of nanomaterials. (4 marks) (***Nanomaterials-1 M, Six application- 3 M)*** ***Ans :*** **Nanomaterials** are defined as a set of substances where at least one dimension is less than approximately 100 nanometres. **Applications of Nanomaterials:** 1) **Medical Applications:** Drug delivery system, targeting cancer cells, glucose detection biosensors, DNA bio-detection, excellent imaging agents. 2) **Optical applications:** Nanomaterials are used in infrared optoelectronic devices, window layers in solar cells, Optical computing. 3) **As filtration Material:** Filtration of air, water, to remove offensive odour from air 4) For high density information storage and magnetic refrigeration. 5) **Chemical Applications:** Air pollution filter, Water filtration purpose, sensors for detection of temperature, air pressure, gases like CO, NH3, molecular pressure etc. CNT nanowires, using gold, zinc oxide, gallium arsenide, etc which are used in detection of certain chemicals. 6) **As Catalyst**: e.g. Quantum dots used as catalyst to make hydrocarbons from carbon dioxide 7) Quantum dots are used as Superior dyes **OR** **e)** Discuss the composition, properties and applications of Gun Metal Alloys. (4 marks) ***(Composition-2M, Properties-1M, Applications -1M)*** ***Ans :*** Cu= 85 %, Sn= 8 %, Zn= 4%, Pb= 3 % **Properties:** hard, tough, capable of withstanding at high Pressure **Application:** Parts of high pressure boiler, Marine pumps and water fittings, Hydraulic fittings,	
Q.4	a) Describe the zeolite process used for water softening. Include a labeled diagram, the procedure, and the chemical reactions involved in both softening and regeneration. (6 marks) ***(Construction with dig. -2 M, Water softening reaction -2 M, Regeneration Reaction - 2 M)*** ***Ans :*** **Principle:** Sodium zeolite (hydrated sodium aluminosilicate) has the property of	[16]

capturing the heavy metal ions from water and released the Na^+ in water due to removal of heavy water ions (Ca^{++}, Mg^{++}, etc.) from water, the hard water is converted into soft water, by zeolite.

Process: The zeolite softener consists of a cylindrical pot in which powder of sodium zeolite is placed over a plate. There is an inlet on the top for hard water and an outlet for collecting soft water from bottom. There is another inlet for adding 10 %NaCl solution (brine) to regenerate the exhausted Zeolite bed.

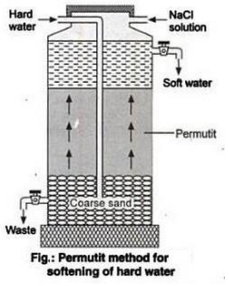


Fig.: Permutit method for softening of hard water

When hard water percolates through the zeolite bed, the hardness causing Ca^{++}, Mg^{++}, etc. cation is retained in the bed and Na^+ ions are released in water.

The soft water obtained and it contains an equivalent quantity of sodium salts.

There is reaction during treatment:

$$Na_2P + CaCl_2 \longrightarrow CaP + 2NaCl$$

Sodium Zeolite — Hard Water — Soft water

Regeneration: The regeneration can be done by passing a suitable volume of 10% NaCl (Brine) solution.

$$CaP + 2NaCl \longrightarrow Na_2P + CaCl_2$$

Exhustaed Zeolite — Brine — Regenerated Sodium Zeolite — waste water

OR

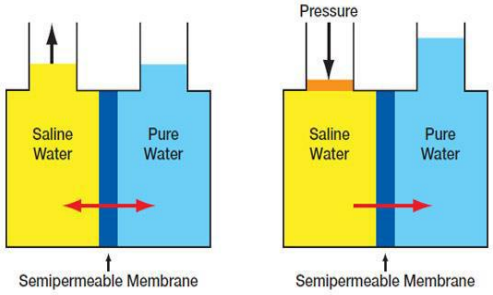
b)What is Reverse osmosis (RO).Discuss the RO method for desalination of brackish water, along with a diagram and its key advantages
(6 marks)

(Defination-1 M, Explanation with diagram -4 M, Application – 1 M)

Ans : **Reverse Osmosis:** The flow of solvent from higher concentration to lower concentration solution through semi-permeable membrane by applying slightly higher external pressure than osmotic pressure of higher conc. Solution.

This is the reverse process than normal osmosis.

Process:



In the reverse osmosis, we apply external pressure on the higher conc. solution, thus solvent (water) flows from higher concentration solution to lower concentrated solution and impurities remained behind.

Thus water separates from the impurities.

Semi permeable membrane made up from polymeric materials like acrylics, polyamides, aramids etc. Hard water or sea water is filled in a reverse osmosis cell. When pressure 200 psi is applied on it, the water passes through the Semipermeable membrane and impurities remain on the Semi permeable membrane. Pure water collected from the lower outlet.

Advantages :

1. Ionic, colloidal, non-ionic impurities are removed from water.

2. Pure water for high pressure boilers can be obtained.

b) Define vapour pressure and viscosity with their SI units. compare between alkaline and nonalkaline hardness. (6 marks)

(Vapour pressure with unit- 1 M, viscosity with unit-1 M, alkaline and nonalkaline (4 points - 4M)

Ans : Vapour Pressure The pressure that a liquid's vapours exert on the surface when they are in an equilibrium state with the supplied liquid is known as the vapour pressure of a liquid at a constant temperature.

Viscosity: Viscosity may be defined as the force of friction (internal resistance), which one part of the liquid (one layer of liquid) offers t another part of the liquid (another layer of liquid).

The units of viscosity are dyne cm^{-2}or g cm^{-1}sec. It is also known as 1 poise. In S.I. Unit, it expressed in Nms^{-2}.

Sr. No.	**Alkaline Hardness**	**Non alkaline hardness**
1	If the water contains the dissolved salts of carbonates and bicarbonates of heavy metal is known as Carbonat**e/** Temporary hardness	If the water contains the dissolved salts oth than carbonates and bicarbonates of hea metal, this hardness is known as No Carbonate/ Permanent hardness

	2	It is also called as Alkaline or Carbonat**e** hardness	It is also called as non-alkaline or No Carbonate hardness
	3	It can be removed by simple boiling	It can be removed by simple boiling, chemic method is required to remove the same
	4	After boiling bicarbonates or some carbonates can be precipitated into carbonates or hydroxide	After boiling sulphate, nitrate and chlorid no any change in solubility
	5	e.g. $MgCO_3$, $Ca(HCO_3)_2$, $Mg(HCO_3)_2$, Fe_2CO_3	e.g. $CaCl_2$, $MgCl_2$, $CaSO_4$, $MgSO_4$, $Ca(NO_3$ $Mg(NO_3)_2$ etc.

OR

c) Define soft and hard water. Explain different types of impurities present in water . (6 marks)

(Soft and Hard water- 2M, four types of Impurities - 4 M)

Ans :

Hard water: The water which does not produce foam or lather with soap, this water is known as **hard water**

Soft water : produces foam or lather with soap.

Types of Imputities :

Impurities

1) **Suspended :** Particles like soil, sand, organic waste. size of particles greater than $1000A_o$ and visible. They produce colour, odour and turbidity to water .

Removal : Simple filtration.

2) **Colloidal Impurities**

Clay, fine mud, decayed leaves, and Organic or inorganic matter. Colloidal particle size 10 to $1000A_o$ .Makes water turbid.

Removal : Coagulation followed by sedimentation **or** filtration.

3) **Dissolved Impurities**

Dissolved salts/ions Ca^{+2}, Mg^{+2} , Fe^{+2}, Mn^{+2} , Cl^- , NO_3^- , HCO_3^- , SO_4^{2-} and dissolved gases O_2, SO_2, NH_3, CO_2, SO_2, H_2S.

Removal : Special softning method

4) **Biological Impurities**

Bacteria, algae, fungi, viruses and other small size aquatic animals. This water is more harmful to human being

Removal : Sterilization,Use of chemicals for sterilization like Bleaching powder,

	sodium hypochlorite, Ozone, chlorine, chloramines, UV light.	
	d) 100 ml water sample requires 7.5 ml of 0.025 M disodium EDTA to reach the end point. After boiling and filtering, 100 ml of the same sample requires 5.3 ml of the same EDTA solution. Calculate the total hardness and non-alkaline hardness of the water sample. (4 marks) ***(Total hardness-2 M, Non-alkaline hardness-2 M)*** **OR** **Ans :** Total Hardness of water sample $= \frac{\text{B.R. } \times \text{M of EDTA} \times 10^5}{\text{Volume of Water}} ppm$ Total Hardness of water sample $= \frac{7.5 \times 0.025 \times 10^5}{100} ppm$=187.5 **ppm** $\text{Non} - \text{alkaline Hardness of water sample} = \frac{\text{B. R. } \times \text{ M of EDTA } \times 10^5}{\text{Volume of Water}} ppm$ Non − alkaline Hardness of water sample $= \frac{5.3 \times 0.025 \times 10^5}{100} ppm$=**132.5 ppm** e) 85 ml water sample is titrated using Mohr's method and consumes 8.6 ml of 0.01 N $AgNO_3$ to reach the brick-red end point. Determine the concentration of chloride ions in the sample. (4 marks) (***(Given and calculation -2M, Correct ans with unit-2M)*** ***Ans:*** Total Amount of $Cl^- = \frac{\text{B.R.(V1)} \times \text{Normality of AgNO3} \times 35.5 \times 10^3}{\text{Volume of Sample}} ppm$ $\text{Total Amount of } Cl^- = \frac{8.6 \times 0.01 \times 35.5 \times 10^3}{85} ppm = 35.91\ ppm$	
Q.5	a) List and briefly explain any three factors affecting the nature of a metal and any three factors affecting the nature of the environment. (6 marks) ***(Three factors based on nature of metal - 3M, Three factors based on nature of environment -3 M)*** ***Ans :*** **Based on Nature of metal :** 1. **Position of metal in galvanic series (Electrode potential/oxidation potential):** The extent of corrosion depends upon the position of the metal in the galvanic and electrochemical series. When two metals are in electrical contact in the presence of an electrolyte, the metal placed higher (more active) in the galvanic series becomes anodic and suffers corrosion. The rate, extent and severity of corrosion depend upon the potential difference of the two metals. More the two metals are apart in the galvanic series, the greater will be the difference in their oxidation potential and hence, the faster will be the corrosion of the anodic metal. 2. **Physical state of the metal**: The smaller the grain size of the metal or alloy, the greater will be the solubility and hence greater will be its corrosion. Also areas under stress even in a pure metal tend to be anodic and corrosion takes place at these areas. **3.Nature of oxide film**:	

The nature of oxide film will decides the rate and extent of corrosion. In aerated area, all metals get covered with film of metal oxide. The ratio of volume of oxide formed to the volume of metal is known as specific volume ratio. If film formed is porous and less protective corrosion tales place till whole metal get destructed. (e.g. Li, Na) but if oxide film formed is nonporous ,protective, there is no corrosion (e.g. Al, Cr)

Based on Environment :

1.Temperature:

The rate of chemical reactions and rate of diffusion increases with temperature. As,corrosion involves a series of chemical reactions. Hence, in general corrosion increases with temperature**.**

2.Humidity:

The corrosion of metal is very fast in humid atmosphere than in dry atmosphere. Because moisture acts as a solvent for atmospheric gases like oxygen, carbon dioxide etc.

3.**pH of solution:** Acidic media are more corrosive than alkaline and neutral media. The corrosion of iron is slow above pH 5 and in absence of oxygen. Most of the metals are easily attacked by acids but are resistant to alkalis. The corrosion of aluminium is minimum at pH 5.5 but is maximum in alkaline pH.

OR

b) Define corrosion. Explain the different types of oxide films formed on metallic surfaces, including their chemical reactions and suitable examples. (6 marks)

(***Definition -1M,, Four types of oxide film- 4 M)***

Ans : Corrosion is defined as the destruction of metal through unwanted or unintentional chemical or electrochemical reaction which occurs between the surface of metal and the environment.

Types of metal oxide films :

Porous oxide film (Non-protective):

The alkali metals and alkaline earth metals like **Li, K, Na, Mg** forms porous oxide film. If the oxide film is porous, then through pores O_2 gas molecule penetrate and corrosion continue till whole metal gets destructed. i.e.

$4Na + O_2 \rightarrow 2Na_2O$

Nonporous oxide film (Protective):

Metals like **Al, Cr, Cu, Ni** etc forms nonporous oxide films. If the oxide film is stable, nonporous then further corrosion stops, as the oxide film formed acts as a barrier between metal surface and atmospheric oxygen. Therefore further corrosion stops. e.g.

$2\ Al + 3/2O_2 \rightarrow Al_2O_3$

Unstable oxide film:

Metals like **Ag, pt, Au** forms unstable oxide film. When the oxide film formed is

unstable that is it decomposes back into metal and oxygen then there is no corrosion e.g.

$4\ Ag + O_2 \rightarrow 2Ag_2O$

Volatile oxide film:

If the metal oxide film is volatile, then its evaporation takes place so underlying fresh metal is exposed for further attack by O_2 and causes continuous and extensive corrosion of metal. e.g. **Molybdenum** metal

$4Mo + 3O_2 \rightarrow 2Mo_2O_3$

c) What is immersed corrosion? Explain the hydrogen evolution mechanism with a labelled diagram and chemical reactions. (6 marks)

(Definition -1M, dig-2M, reactions with explanation -3M)

Ans : Immersed corrosion : Corrosion of metals by liquids corroding media with the formation of electrochemical cell is called Immersed corrosion.

Hydrogen evolution mechanism:

This type of corrosion occurs **in acidic** environment. e.g. a steel tank containing acid industrial waste and a small copper are in contact. The piece of copper and steel tank in contact with each other in presence of acid electrolyte give rise to an electrochemical cell. In this, steel act as anode and copper act as acathode. it is obeserved that the steel tank portion in contact with copper piece is corroded.

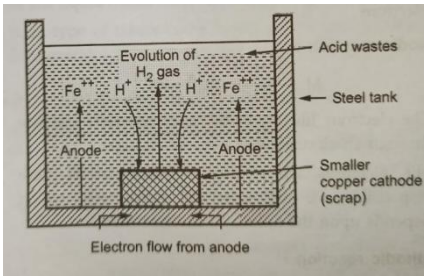
At anode : At steel tank : iron passes into solution as Fe^{+2} ions

$$Fe \longrightarrow Fe^{+2} + 2e^{-1}$$ **(oxidation)**

At cathode : At copper piece: hydrogen ions from acidic electrolyte take up the free electrons and hydrogen gas formed is liberated in the form of bubbles at cathode.

$2H^+ + 2e^{-1} \longrightarrow H_{2\,(g)}$ **(reduction)**

Net reaction : $Fe + 2\,H^+ \longrightarrow Fe^{+2} + H_{2(g)}$



OR

d) Define cathodic protection. Explain the sacrificial anode method with a neat labelled diagram, and mention any two applications of the sacrificial anode method . (6 marks)

(Definition -1M,Dig.with explanation-4M , two applications-1 M)

Ans : **Principle of Cathodic protection:** In cathodic protection, the metal to be protected is forced to behave like a cathode.

Sacrificial anode method or galvanic protection method:

In this method the metallic structure to be protected from corrosion is connected to the more active metal. (i.e. the metal placed higher in galvanic series than that the metal to be protected from corrosion) by an insulated wire. The more active metals like Zn, Al, Mg etc. act as anode and gets corroded, protecting the main metal hence it is called as sacrificial anode. For the purpose of increasing electrical contact the active metal is placed in a back fill (Coke breeze or gypsum). Metals commonly used as sacrificial anodes are Zn, Al, Mg etc.

The corrosion attack is concentrated at this more active metal and it slowly undergoes corrosion. The main metallic structure to be protected acts as cathode and remains protected from corrosion.

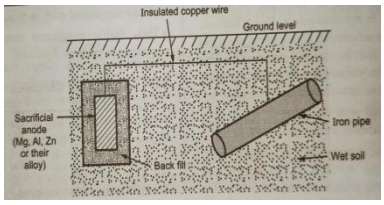


Diagram:

Applications :

1.Buried pipelines

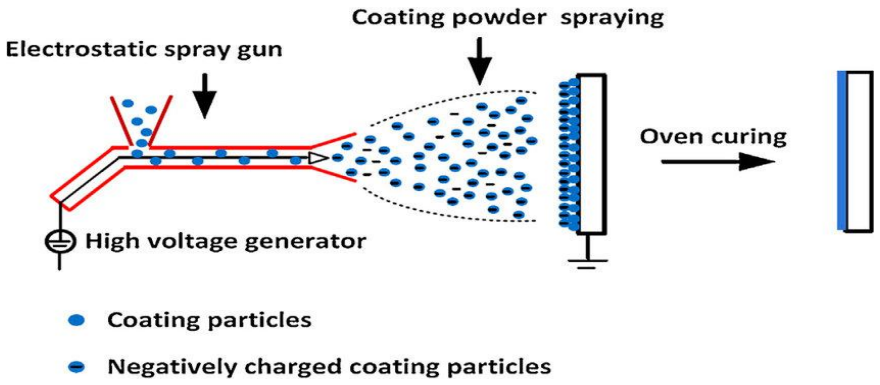
2.Underground cables

e) Explain the electrostatic spraying method used for corrosion control.Give any two applications of powder coating. (4 marks)

(E***xplanation-3M , two applications-1 M))***

Ans : **Electrostatic spraying:** The dry powder coating ingredients, such as thermo softening plastic, pigment (colour), filler, and other additives, are crushed and ground to particles between 40 and 90 microns. Next the resulting mixture is sieved to remove larger particles (which also can be recycled).

These coating particles are spread out in the air and then passed through a high voltage pistol (or a friction gun), where the coating particles acquire a negative electrostatic charge.



Due to the force of attraction between electropositive metal and negatively charged powder particles, electrostatic powder particles adhere to the base metal. The base metal

with the electrostatic powder deposited is then baked, where the powder particles melt to form a homogeneous, sturdy coating.

Applications

1) **Decoration** of domestic appliances, heating and air conditioning equipments, computer, car accessories, etc.

2) **Corrosion resistance** of metals in outdoor and indoor applications like military, rtansportation, aerospace applications.

OR

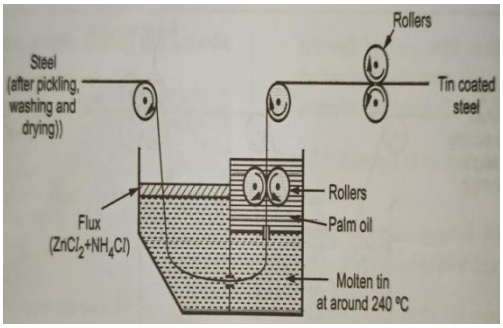
f) Briefly explain the tinning process with a labelled diagram and list its two applications. (4 marks)

(*Dig.with explanation-3M , two applications-1 M))*

Ans : **Tinning:** The process of Coating the iron or steel (base metal) with thin coat of tin by hot dipping process to prevent base metal from corrosion is called **tinning.**

Process:

In this method, the clean surface of metal article is treated with dil.H2SO4 to remove any oxide film, washed with water and dried. Then it is immersed in a flux (ZnCl2 and NH4Cl) which will facilitate better adhesion of coating. The metal article is then passed through a tank of molten Tin maintained at about 2400 C. Finally, it is passed through a series of rollers kept submerged in the palm oil. The rollers removes the excess of tin and makes uniform coating. Palm oil protects hot tin coated surface against oxidation. Tinning is a cathodic coating.



Uses:

1) Because of nontoxic nature of tin, tinning is used for coating of Fe, steel, Cu used for manufacturing container to store foodstuffs, oils, ghee, kerosene etc.

2) Tinned copper sheets are used for making cooking utensils and refrigeration equipment.