**WINTER–20 18 EXAMINATION**

**Subject Name: Applied Chemistry** **Model Answer** Subject Code: 17211

**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

| Q. No. | Sub Q. N. | Answers | Marking Scheme |
|---|---|---|---|
| 1. | | **Attempt any nine of the following:** | **18** |
| | a) | **Write two ores of copper with chemical formulae.** | **2** |

| Type of ore | Name | Chemical formula |
|---|---|---|
| **Oxide** | Cuprite or ruby copper | $Cu_2O$ |
| **Sulphide** | Copper glance | $Cu_2S$ |
| | Copper pyrite | $CuFeS_2$ |
| **Carbonate** | Malachite | $CuCO_3.Cu(OH)_2$ |
| | Azurite | $2CuCO_3.Cu(OH)_2$ |

1 mark each

b) **Write the action of water on copper.** **2**

Water at ordinary temperature has no action on copper. If it is heated to white heat, 1

steam gives Cupric oxide.

$Cu + H_2O \longrightarrow CuO + H2 \uparrow$ 1

c) **Write two applications of aluminum.** **2**

1) For preparing utensils, surgical instruments, heating appliances, parts of aeroplanes, containers for chemical industry etc.

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| 1. | c) | 2) For making electric wires and cables for transmission lines.<br>3) Aluminum foils are used for wrapping cigarettes, sweets and confectionary.<br>4) Al – powder is used for making silvery paints.<br>5) As a reducing agent in the production of Cr, Mn etc.<br>6) In thermite welding process.<br>7) As a deoxidizer in the manufacture of steel.<br>8) For winding the moving coils of dynamos and motors.<br>9) Highly pure Al is used as an absorber in the preparation of antibiotics (chloromycines).<br>10) Al – powder + $NH_4NO_3$ mixture is used in bombs.<br>11) For making many useful alloys.<br>12) For chemical plants and transporting and storing nitric acid.<br>13) As refractory for lining of furnace and for making refractory bricks. | 1 mark each |
| | d) | **Define corrosion and write its two types .** | **2** |
| | | **Corrosion**: Any process of chemical or electrochemical decay or destruction of a metal due to the action of surrounding medium is called as corrosion. | 1 |
| | | **Types of corrosion:**<br>1) Atmospheric corrosion (or direct chemical corrosion or Dry corrosion )<br>2) Immersed corrosion (or electro chemical corrosion or wet corrosion) | 1 |
| | e) | **Why tinned containers are used for storage of food?** | **2** |
| | | Tin coated utensils are used for storing the food stuffs because tin is a less active metal and hence does not react with the food stuffs. | |
| | f) | **Write two points of similarity between sherardizing and galvanising process.** | **2** |
| | | 1) Sherardizing and galvanizing are the processes of avoiding corrosion of metal. | 1 |
| | | 2) Zinc is used as coating metal on iron base metal. | 1 |

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| 1. | g) | **Why metal cladding is done on plane surfaces only?**<br><br>The base metal to be protected against corrosion is sandwiched or cladded between two sheets of coating metal. This sandwich is then passed through two heavy rollers maintained at high temperature, so that metal cladding is done on plane surface only. | **2**<br><br>2 |
| | h) | **Distinguish between primary cell and secondary cell. (two points)**<br><br>**Primary cell** / **Secondary cell**<br>1. Non- rechargeable cells are known as primary cells / 1. Rechargeable cells are known as secondary cells.<br>2. Chemical reaction is irreversible. / 2. Chemical reaction is reversible.<br>3. They are light in weight. / 3. They are heavy.<br>4. They have short life. / 4. They have long life<br>5. They can not be recharged & reused. / 5. They can be recharged & reused.<br>6. e.g..- Dry cell, Daniel cell, Leclanche cell / 6. e.g. Lead acid storage cell, Nickel- cadmium storage cell | **2**<br><br>1 mark each |
| | i) | **Define the terms : i) Specific conductance ii) Equivalent conductance**<br>**i) Specific conductance (k) :** Specific conductance is the conductance of a 1 $cm^3$ of the substance or solution. **OR**<br>The conductance offered by a solution of length 1 cm & area of unit cross section is known as specific conductance.<br>**ii) Equivalent conductance (λv)** : It is the conductance of the solution containing 1gm equivalent of solute / electrolyte when placed between two sufficiently large electrodes 1 cm apart. | **2**<br><br>1<br><br>1 |
| | j) | **Define the terms: i) Photo conductive polymers ii) Liquid crystal polymers**<br>**i) Photo conductive polymers:** These are the polymers which conduct electricity only in the presence of light.<br>**ii) Liquid crystal polymers:** These are a class of aromatic polyester polymers. These polymers have tendency to align their chains parallel over a long distance from their melt or solution. | **2**<br><br>1<br><br>1 |
| | k) | **Write two applications of Teflon.**<br>**Applications of Teflon:**<br>i) Teflon used as capacitor dielectrics & insulating material for all kinds of windings.<br>ii) Heat resistant materials are prepared by combining Teflon with glass cloth. | **2**<br><br>1 mark each |

| Q. No. | Sub Q. N. | Answers | Marking Scheme |
|---|---|---|---|
| 1. | k) | iii) It is used for Insulation of motors, generators, coils, transformers and capacitors etc.<br>iv) It is used in chemical equipments e.g. variety of seals, gaskets, pumps, valve packing's, pump-parts and stop-cocks for burettes.<br>v) It is used in non-lubricating bearings.<br>vi) It is used in non-stick cookware.<br>vii) Teflon coating is applied on vehicle to protect them from corrosion and scratches. | |
| | l) | **Distinguish between dielectrics and insulators (two points).** | **2** |
| | | **Dielectrics** / **Insulators**<br>1. The materials which are used to prevent the loss of electricity through certain parts of an electrical system are known as dielectrics / 1. Insulators or insulating materials are the substances which retard the flow of heat or electricity or sound through them.<br>2. The main function is storage of electrical charge. / 2. The main function of such materials is that of insulation.<br>3. All dielectrics are insulators because they avoid the flow of electric current through them. / 3.All insulators are not dielectrics because they can not store charges like dielectrics. | 1 mark each |
| **Q.2)** | | **Attempt any four of the following**: | **16** |
| | a) | **Describe smelting process with neat labeled diagram.** | **4** |
| | | Roasted copper ore is then mixed with coke & sand particles & then strongly heated at about $1350^0$C in a water jacketed blast furnace. At high temperature ferrous sulphide (FeS) is oxidised & converted into ferrous oxide (FeO) which further reacts with sand particles to form a fusible slag ($FeSiO_3$) | 1 |
| | | $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$ | |
| | | $FeO + SiO_2 \longrightarrow FeSiO_3 \uparrow$ | 1 |

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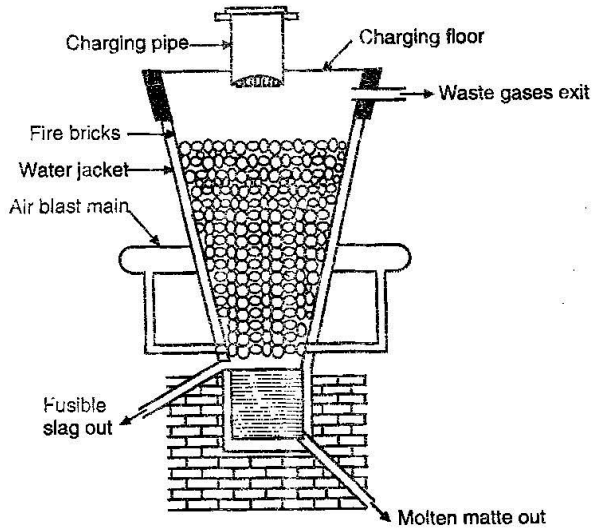
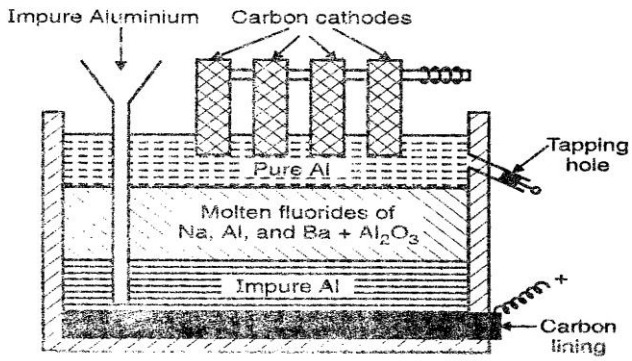
| 2. | a) |  | 1 |
| | | Further cuprous oxide ($Cu_2O$) formed during roasting combines with ferrous sulphide (FeS) to form ferrous oxide ( FeO ) & cuprous sulphide ($Cu_2S$). The ferrous oxide ( FeO ) formed futher react with silica particals to form slag.<br>$Cu_2O + FeS \longrightarrow FeO + Cu_2S$<br>Thus during smelting process most of the ferrous sulphide impurity is converted into the fusible slag ($FeSiO_3$)which is then removed from the upper slag outlet. The molten mass containing mostly cuprous sulphide ($Cu_2S$) & little quantity of ferrous sulphide (FeS) is called as matte which is then removed from the lower outlet. | 1 |
| | b) | **Describe the process of purification of aluminium by electrolytic refining with the help of neat, labelled diagram.** | **4** |
| | |  | 1 |

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| Q. No. | Sub Q. N. | Answers | Marking Scheme |
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| 2. | b) | **Process:**<br>1) The electrolytic cell consists of an iron tank lined at the bottom with carbon, which serve as anode. A number of graphite rods serve as cathode.<br><br>2) The cell is filled with three liquid layers of different densities.<br>i) The top most layer consists of molten pure aluminum which acts as cathode.<br>ii) The middle layer is of electrolyte which consist of a mixture of molten fluorides of Al , Ba & Na.<br>iii) The bottom layer consists of molten impure aluminum.<br><br>3) On passing electric current, the aluminum ions from the middle layer discharged at the cathode and get collected in the top most layers. Same amount of aluminum ions from the bottom layer goes into the middle layer. Pure Al collected at the top is tapped out from time to time. Crude or impure Al is added to the bottom layer from time to time. The process is thus continued. | 1<br><br>1<br><br>1 |
| | c) | **State composition, properties and applications of Tinmann's solder.** | **4** |
| | | **Solder** / **Composition** / **Properties** / **Applications**<br>**Tinmann's solder:** / Sn = 66 %, Pb = 34 % / 1. It melts at $180^0$C . / It is used for joining articles of tin.<br>**( 2 marks)** **( 1 Mark)** **(1 Mark)** | |
| | d) | **Write four properties and four applications of urea formaldehyde resin.**<br><br>**Properties:**<br><br>1) The bond film produced by Urea – Formaldehyde resin is quite rigid & transparent.<br>2) It is good resistant to moisture, insects & fungi.<br>3) However action of acids & alkalies deteriorate the resin film after some time.<br>4) It can be used in cold but a little heating helps in accelerating the setting process | **4**<br><br>1/2 mark each |

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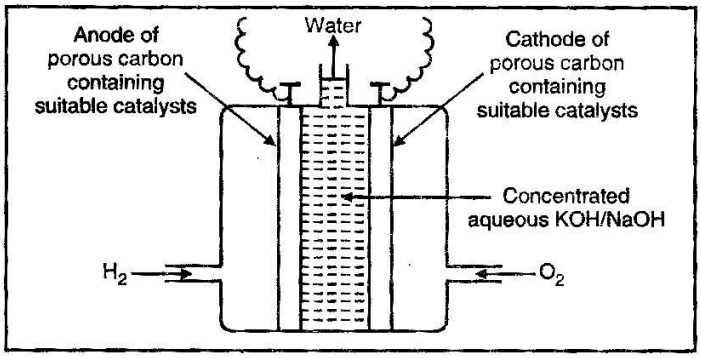
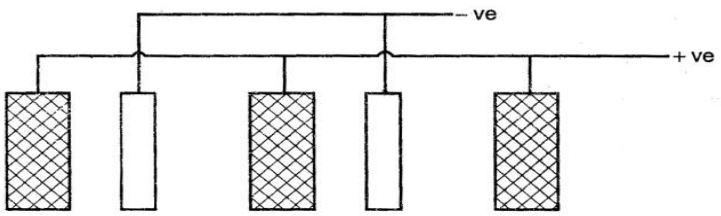
| 2. | d) | **Uses :-**<br>1) Used for bonding wooden surfaces.<br>2) Used for bonding water proof plywood laminates<br>3) Used as bonding articles in aircraft.<br>4) Used as bonding articles in ship building industries etc.<br>**(Note: Consider any relevant property and application)** | 1/2 mark each |
| | e) | **Describe construction and working of hydrogen oxygen fuel cell.** | **4** |
| | |  | 1 |
| | | **Construction:-**<br>1. It consists essentially of an electrolytic solution such as 25% KOH or NaOH solution, & two inert porous electrodes (like porous carbon) containing suitable catalyst.<br>2. Hydrogen & oxygen gases are bubbled through the anode & cathode compartment respectively. | 1 |
| | | **Working**:<br>**At anode: $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$**<br>**At cathode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$**<br>---<br>**Net cell reaction: $2H_2 + O_2 \rightarrow 2H_2O$** | 2 |
| | f) | **Explain construction and working of Ni- Cd cell with diagram.** | **4** |
| | |  | |
| | | OR | |

| Q. No. | Sub Q. N. | Answers | Marking Scheme |
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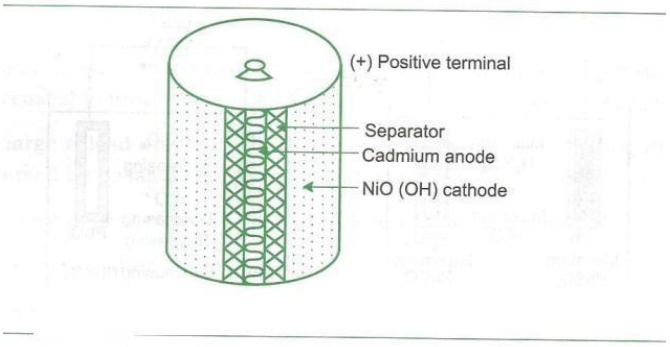
| 2. | f) |  | 1 |
| | | **Construction:**<br>i) Positive plates are made up of nickel plated tubes, containing a mixture of nickel oxide ($NiO_2$) & hydroxide + 17% flakes of graphite or metallic nickel for increasing conductivity.<br>ii)They also contain an activated additive 2% $Ba(OH)_2$ which increases the life of plates.<br>iii) Negative plates consist of spongy Cadmium.<br>iv) The electrolyte is 20- 15% solution of KOH to which small quantity of lithium hydroxide (LiOH) is added to increase the capacity of cell. | 1 |
| | | **Working:**<br>**A) Discharging:-**<br>Positive Plate:<br>$\mathbf{NiO_2(s) + 2H_2O\ (l) + 2e^- \rightarrow Ni\ (OH)_2\ (s) + 2OH^-}$<br>Negative Plate:<br>$\mathbf{Cd\ (s) + 2OH^-(aq) \rightarrow Cd\ (OH)_2(s) + 2e^-}$<br>Net reaction:<br>$\mathbf{NiO_2\ (s) + Cd(s) + 2H_2O \rightarrow Ni(OH)_2 + Cd(OH)_2}$ | 1 |
| | | **B) Charging:-**<br>Positive Plate:<br>$\mathbf{Ni(OH)_2(s) + 2OH^-(aq) \rightarrow NiO_2(s) + 2H_2O + 2e^-}$<br>Negative Plate:<br>$\mathbf{Cd(OH)_2(s) + 2e^- \rightarrow Cd(s) + 2OH(s)}$<br>Net reaction:<br>$\mathbf{Ni(OH)_2 + Cd(OH)_2 \rightarrow NiO_2(s) + Cd(s) + 2H_2O}$<br>Thus, discharging & charging reactions can be shown simultaneously as: -<br>$\mathbf{NiO_2(s) + Cd\ (s) + 2H_2O \leftrightarrows 2Ni(OH)_2 + Cd(OH)_2}$ | 1 |

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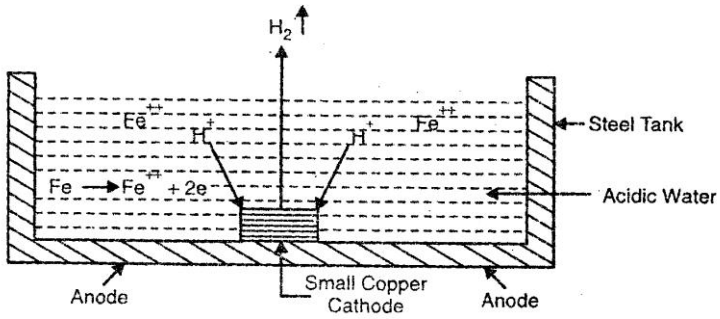
| Q.3) | | **Attempt any four of the following:** | **16** |
| | a) | **Describe the hydrogen evolution mechanism of immersed corrosion** | **4** |
| | | **Steel tank: - Anode**<br>**Cu – strip:- Cathode**<br>  <br> | 1 |
| | | These types of corrosion occur usually in acidic environments, like industrial waste, solutions of non – oxidizing acids (like HCl).<br>**Process:** A steel tank containing acidic industrial waste and small piece of copper scrap in contact with steel. The portion of the steel tank in contact with copper is corroded most with the evolution of hydrogen gas.<br>**The reactions:**<br>**At Anode:**<br>**$Fe \longrightarrow Fe^{++} + 2e^-$**<br>These electrons flow through the metal from anode to the cathode<br>**At cathode**<br>**$H^+$ ions are eliminated as $H_2$ gas**<br>**$2H^+ + 2e^- \longrightarrow H_2 \uparrow$**<br>Over all reaction is<br>**$Fe + 2H^+ \longrightarrow Fe^{++} + H_2 \uparrow$** | 1<br>1<br>1 |
| | b) | **Explain four factors affecting rate of immersed corrosion.**<br>**A) Nature of metal**:<br>**1) Position of metal in a galvanic series**: A metal having higher position in a galvanic series has more chemical reactivity and therefore, it gets attacked by gaseous and | **4**<br>1 mark each |

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| 3. | b) | corroding medium faster. In the series the noble metals are at the bottom whereas the alkali metals are at the top.<br><br>**2) Purity of the metal**: - Impurities present in a metal cause heterogeneity and forms a large no. of tiny galvanic cells when an aqueous medium comes in contact with such metal if the impurity metal is highly placed in a galvanic series then it acts as a anode and gets corroded to produce small depressions on the surface of the base metal. If the metal is pure it is corrosion resistant.<br><br>**3) Physical state of the metal**:-The physical state of metal means orientation of crystals, grain size, stress The larger grain size of the metal the smaller will be its solubility and hence lesser will be its corrosion.eg :- mild steel grains are smaller than cast iron grains therefore mild steel gets corrodes faster. Areas under stress tend to be anodic and corrosion takes place at these stressed areas.<br><br>4) **Solubility of the corrosion products:-**Insoluble corrosion products function as a physical<br>barrier thereby suppresses further corrosion. But if the corrosion product is soluble in the corroding medium the corrosion of the metal proceeds faster.<br><br>**B) Nature of Environment:-**<br><br>1) **Effect of PH**:-Acidic media are more corrosive than alkaline and neutral media.<br>e.g. corrosion of Zn can be minimized by increasing the pH to 11<br><br>2) **Differential aeration**: Corrosion occurs where oxygen access is least. eg :- When pipeline passes through moist soil as well as dry soil the part passing through moist soil having restricted oxygen access becomes anodic while the part passing through dry soil having more access of air becomes cathodic. This causes corrosion of pipe embedded in moist soil.<br><br>3) **Presence of impurities in the atmosphere**:- Corrosion of metals is more in industrial areas because corrosive gases like $H_2S$, $SO_2$, $CO_2$ and fumes of $H_2SO_4$ and HCl in industrial areas increases conductivity of the liquid layer in contact with the metal surface thereby increases the rate of corrosion.<br><br>4) **Humidity**:- The greater the humidity greater is the rate and extent of corrosion. Moisture dissolves the atmospheric gases or chemical vapours and the reaction between such dissolved gases with metallic surface become faster. Hence water can acts as a conducting medium and promotes corrosion. e.g. Rusting of Fe is promoted in humid atmosphere. | |

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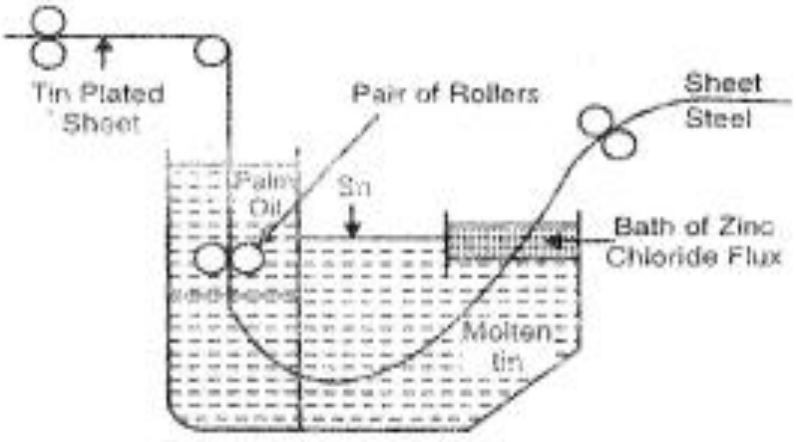
| 3. | c) | **Describe the tinning process. Write its two applications.** | **4** |
| | | **Tinning: -**The process of covering **iron or steel sheets with a thin coat of tin** to prevent it from rusting is called as tinning.   | 1 |
| | | **Process:**<br>**i)** The sheet of steel to be protected is first cleaned by dilute $H_2SO_4$ acid to remove any oxide film and impurities.<br>ii) After this it is passed through a bath of molten flux of $ZnCl_2$ which helps the molten metal to get adhered to the metal sheet.<br>iii) Then sheet of steel passes through a tank of molten tin.<br>iv) Finally it is dipped in a suitable vegetable oil like palm oil to protect the hot tin coated surface against oxidation.<br>v)Then sheet is passed through a series of hot rollers to remove any excess of tin, and make the coating uniform all over the surface of metal sheet. | 2 |
| | | **Applications of tinning process:**<br>i) Tinning is used in manufacturing various types of cans for storing food stuff biscuit tins, kitchen utensils, oil, ghee, pickles, medicines, kerosene etc. because tin protects the metal from corrosion and avoids food poisoning.<br>ii) Tin plated sheets are used for making trunks, boxes, for roofing, for vessels of storing petroleum etc.<br>iii) Copper wire to be insulated with rubber is first tinned to protect it from sulpher attack of the rubber.<br>iv) Tinned copper sheets are used for cooking utensils and refrigeration equipment. Cu tubes are used in refrigeration.<br>**( Note: Consider any two applications)** | 1 |

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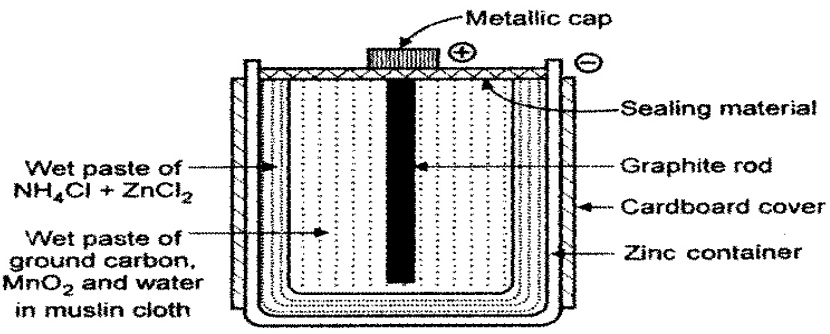
| 3. | d) | **Write the chemical reactions taking place during charging and discharging of lead acid storage cell.** | **4** |
| | | • **Discharging:** - | |
| | | At Anode: - | |
| | | $Pb \rightarrow Pb^{2+} + 2e^-$ **( Oxidation)** | 1 |
| | | $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow$ | |
| | | At Cathode:- | |
| | | $PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$ **(Reduction)** | 1 |
| | | $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow$ | |
| | | Net reaction during Discharging: - | |
| | | $Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4 \downarrow + 2H_2O$ | |
| | | • **Charging: -** | 1 |
| | | At Cathode: | |
| | | $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$ | |
| | | At Anode: | 1 |
| | | $PbSO_4 + 2H_2O + 2e^- \rightarrow PbO_2 + 4H^+ + SO_4^{2-}$ | |
| | | Net reaction during Charging: | |
| | | $2PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 4H^+ + 2SO_4^{2-}$ | |
| | e) | **Describe construction and working of dry cell.** | **4** |
| | |  | 1 |

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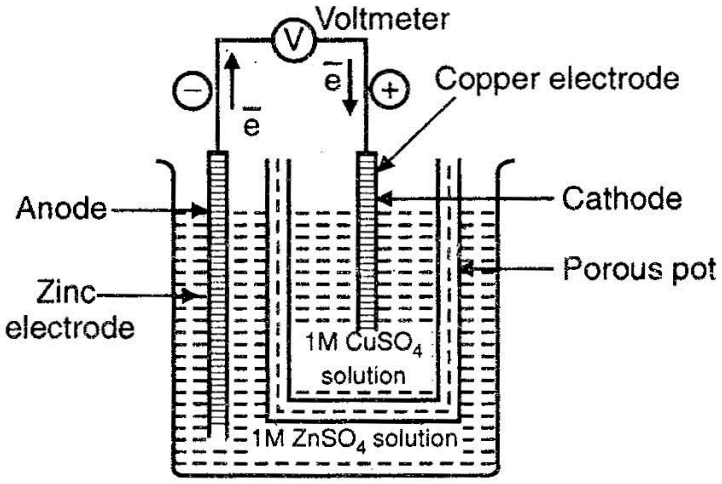
| 3. | | **Construction:** It consists of zinc container (vessel) which acts as an anode. Cathode is a Graphite rod. It acts as inert electrode. The Graphite rod is surrounded by a paste of $MnO_2$ (Manganese dioxide) & powdered Carbon (Black).The cell is filled with a paste of $NH_4Cl$ & $ZnCl_2$ prepared in water. The cell is sealed at the top by wax or resin.<br>**Working**<br>**At zinc anode: -**<br><br>Dissolution of zinc electrode to form zinc ions.<br>**$Zn \longrightarrow Zn^{++} + 2e^-$ (oxidation)**<br>$Zn^{2+}$ combines with ammonia to form its complex.<br>**$Zn^{2+} + 4\ NH_3 \rightarrow Zn(NH_3)_4^{++}$**<br><br>**At the graphite cathode: -**<br><br>Manganese dioxide ($MnO_2$) reaction with $NH_4^+$ (ammonium) ions to liberate ammonia.<br>**$2NH_4^+ + 2\ MnO_2 + 2\ e^- \rightarrow Mn_2O_3 + H_2O + 2NH_3 \uparrow$**<br>**EMF / potential of cell is 1.5 V** | 1<br><br>1<br><br>1 |
| | f) | **Describe construction and working of Daniel cell.**<br><br>**Construction:**<br><br>  <br> | **4**<br><br>1 |

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| 3. | f) | It consists of zinc electrode dipped in $ZnSO_4$ Solution & Copper electrode dipped in $CuSO_4$ solution.<br>The two solutions are separated by a porous pot.<br>The two solutions can seep through the pot & so comes in contact with each other automatically. Thus, porous partition acts as a salt bridge.<br><br>**Working:-** The tendency of Zn to form $Zn^{++}$ is greater than the tendency of $Zn^{++}$ to get deposited as Zn on the electrode. Therefore Zn goes into the solution forming $Zn^{++}$. On the other hand tendency of Copper to go into the solution is less than the tendency of $Cu^{++}$ to get deposited as Cu & hence copper electrode becomes positively charged.<br>The emf of cell is 1.1 volt.<br><br>**At Anode :** $Zn \longrightarrow Zn^{++} + 2e^-$<br><br>**At Cathode:** $Cu^{++} + 2e^- \longrightarrow Cu$<br><br>**Net Reaction:** $Zn + Cu^{++} \longrightarrow Zn^{++} + Cu$ | 1<br><br>2 |