Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		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.		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.		**Attempt any nine:**		**18**
	a)	**Name any two ores of copper with their 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	$2CuCO_3$,$Cu(OH)_2$

(Any two names with formula: 1 mark each) — **1 Mark each**

b) **Give chemical reaction for action of conc. Hydrochloric acid(conc.HCl) on Aluminium** — **2**

Aluminium metal readily dissolves in the concentrated hydrochloric acid to form aluminium chloride with evolution of hydrogen gas — **1**

$$2Al + 6\,HCl \longrightarrow 2\,AlCl_3 + 3\,H_2\uparrow$$ — **1**

c) **Write any four uses of copper.** — **2**

Uses of copper:

1. Making electrical wires, cables & conducting apparatus.
2. Making coins, ornaments & utensils.
3. Making jewellery hard.
4. Making water stills, kettles, vacuum pans, steam pipes, fire boxes of locomotive engines.
5. Making scientific apparatus like hyposometer, colorimeter
6. Electro plating, electro typing
7. Copper salts are largely used as insecticides & colouring materials.
8. For making alloys like brass, bronze, gun metal etc

(Any Four) — **½ Mark each**

d) **State the types of corrosion.Give one example of each type.** — **2**

Types of corrosion	Example
Atmospheric Or Direct chemical Or Dry corrosion	**1** Rusting of Iron 2. Formation of green film on the surface of copper
Electrochemical Or Immersed Or Wet Corrosion	1Rusting of fencing wire under joints. 2.corrosion of steel pipe connected to copper plumbing 3. Corrosion of lead antimony solder around the copper wire. 4. Corrosion of steel screws in marine brass hardware. 5.Corrosion of iron nails which are used to join copper sheets

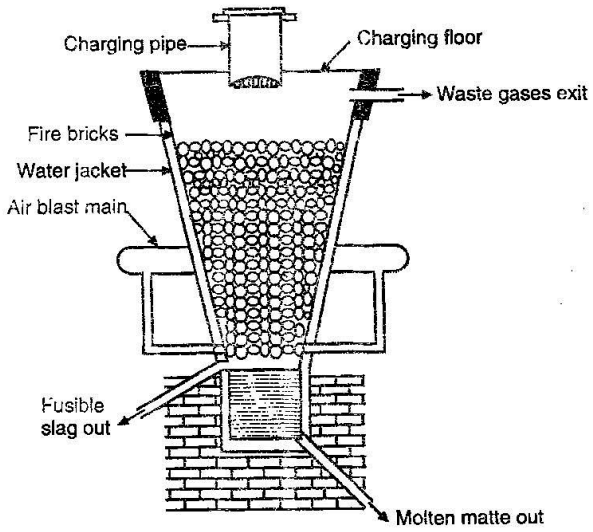
(Types- 1mark , Examples -1mark) — **1 Mark each**

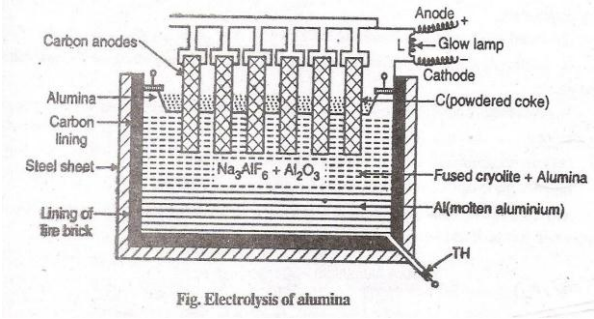
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answer</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>1.</td><td>e)</td><td>Mention the types of oxide film formed in the atmospheric corrosion. Which film is protective.
Types of oxide films-
1. Stable porous oxide film
2. Stable non porous oxide film
3. Unstable oxide film
4. Volatile oxide film
Stable nonporous oxide film or Unstable oxide film are protective.</td><td>1

1</td><td>2</td></tr>
<tr><td></td><td>f)</td><td>“Tin coated utensils are more preferred to zinc coated utensils for storing food stuffs.” Explain.
Zinc coated utensils are not used for storing food stuffs because zinc is a active metal hence it readily react with the weak organic acids present in the food stuffs to form poisonous zinc compounds which spoils the food.
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.</td><td>1

1</td><td>2</td></tr>
<tr><td></td><td>g)</td><td>Give two points of difference between galvanizing & sherardizing
<table>
<tr><th>Galvanizing</th><th>sherardizing</th></tr>
<tr><td>1 It is process of coating iron or steel sheets with a thin coat of zinc by hot dipping method</td><td>1 It is process of coating small iron or steel articles by alloying at surface with zinc metal</td></tr>
<tr><td>2 In galvanizing surface of iron sheet is covered by a thin layer of zinc metal which protect the base metal from corrosion</td><td>2 In sherardizing surface of iron or steel article is covered by a Zinc-iron alloy layer which protect the base metal from corrosion</td></tr>
<tr><td>3 This process is carried out in a large tanks by dipping iron sheet in a bath of molten zinc at a temperature of about 425-460^0 C</td><td>3 This process is carried out in a constantly rotating drum by packing the small iron or steel article in zinc powder at a temperature of about 350 -400^0 C</td></tr>
<tr><td>4 This process is widely used for protecting iron articles like fencing wires, roofing sheets etc.</td><td>4.This process is used for protecting small & irregular iron articles like bolts, screws,nails, nuts etc.</td></tr>
</table>
(Any Two points)</td><td>1
Mark each</td><td>2</td></tr>
<tr><td></td><td>h)</td><td>Mention two applications of hydrogen –Oxygen fuel cell.
Applications of hydrogen –oxygen fuel cell .-
1. Used in Space shuttles, Space Stations.
2. Remote, off-grid locations (telecom towers, weather stations).
3. Public , industrial ,Marine and Military transportation.
4. They can be used in small personal vehicles.
5.By product i.e. water can be used for drinking by astronauts.
(Any two applications)</td><td>1
Mark each</td><td>2</td></tr>
</table>

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1	**i)**	**Write discharging reactions in lead acid storage cell** Discharging: - While discharging chemical energy gets converted into electrical energy. **At anode**: - 1 The lead electrode loses electrons, which flow through the wire. **$Pb \longrightarrow Pb^{2+} + 2e^-$** 2 The **$Pb^{2+}$** ions then reacts with sulphate **SO_4^{2-}** ions to form lead sulphate. **$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$** The electrons released from the anode flow to the cathode electrode. **At cathode:-** **1**Lead oxide undergoes reduction reaction in presence of **H^+** ions **$PbO_2 + 4\,H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$.** 2 The **Pb^{2+}** ions then reacts with sulphate **SO_4^{2-}** ions to form lead sulphate. **$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$** **Net reaction during Discharging: -** **$Pb + PbO_2 + 4H^+ + SO_4^{2-} \rightarrow 2PbSO_4 + 2H_2O$ + Energy** Lead sulphate is precipited at both the electrodes. As sulphuric acid is utilized & H_2O is formed in the process, concentration of H_2SO_4 decreases.	**1** **1**	**2**
	j)	**What is difference between dielectrics and insulator.** **Dielectrics** / **Insulators** 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 2.The main function is storage of electrical charge. / 2. The main function of such materials is that of insulation 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 4.**Examples-** Air, N_2 gas , CO_2 gas, Silicon fluid etc / 4.**Examples-** Rubber, Plastics etc. **(Any two points)**	**1 Mark each**	**2**
	k)	**Define adhesives. Give two examples of it** **Adhesives-** Any substance which is capable of holding the materials together by surface attachment is called as an adhesive. **Examples-** 1 Epoxy resins 2 Urea formaldehyde 3 Phenol formaldehyde **(Any Two examples: ½ mark each)**	**1** **1**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	l)	**Mention two applications of electrically conducting polymers** **Applications of Electrically conducting polymers** :- 1 They are used in rechargeable batteries 2 They are used as analytical sensors to detect pH, O_2 ,NO_2, SO_2,NH_3, Glucose etc 3. They are used as antistatic materials in offices, theatres etc. 4. They are used as electro chromic materials 5. They are used in optical filters to absorb radiations from computer, T.V..screens. 6. They are used for photo diodes, light emitting wall papers, light emitting diodes &data storage 7. They are used in construction of photo voltaic cell **(Any two Applications)**	**1 Mark each**	**2**
	m)	**State two applications of liquid crystal polymers** i. Mechanical parts, food-containers ii. Used in telecommunication & optical fibres In electrical & electronic applications. iii. Transport, automotive & military applications. iv. Aircraft & aerospace applications. v. Chemical & consumer applications. **(Any two Applications)**	**1 Mark each**	**2**
2.		**Attempt any FOUR**		**16**
	a)	**Describe the process of smelting of copper ore with labelled diagram**  	**1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		Roasted copper ore is then mixed with coke & sand particles & then strongly heated at about 1350^0Cin 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 ($FeSiO_3$) $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2 \uparrow$ $FeO + SiO_2 \longrightarrow FeSiO_3$ 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. $Cu_2O + FeS \longrightarrow FeO + Cu_2S$ 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** **1** **1**	
	b)	**What is the role of cryolite in electrolytic reduction of alumina.Explain the process.** **Role Of Cryolite:-** The pure alumina is bad conductor of electricity & its melting point is 2000^0c . Hence electrolytic reduction of alumina is carried out in presence of cryolite because the presence of cryolite decreases the melting point of alumina & also increases its electrical conductivity.	**1**	**4**
		 Fig. Electrolysis of alumina	**1**	
		Process: Figure shows electrolytic reduction of alumina(Al_2O_3) i. Alumina is dissolved in fused cryolite and electrolyzed in an iron tank lined inside with carbon which acts as cathode ii. The anode consists of number of carbon rods, suspended vertically from the copper clamps. iii. The electrolyte is a mixture of alumina (20%), cryolite (60%) and calcium fluoride (20%). iv. The temp of both is kept at about 900-1000c v. On passing current, alumina decomposes to aluminium and oxygen.	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		$2\,Al_2O_3 \longrightarrow 4Al + 3O_2\uparrow$ vi) The molten aluminium sinks to the bottom (cathode), while oxygen appears at anodes gets oxidized to CO and CO2. vii) The process is continuous and fresh quantity of Al2O3 is added time to time.		
	c)	**Write composition properties and applications of rose metal** **Composition:** Bi = 50% Pb = 28% Sn = 22%	**2**	**4**
		Properties: 1.It is easily fusible alloy. 2. Its melting point is 89^0C	**1**	
		Applications: 1.It is used for making fire – alarms. 2 It is used in electrical fuse wires, 3. It is used for casting for dental works 4. It is used in automatic sprinkler system. **(Any two applications)**	**1**	
	d)	**Write two properties and two uses of Bakelite.**		**4**

Properties	Uses
Hard,Rigid,strong,scratch resistant & brittle material.	insulation of electrical wires & cables electrical switches, switch board sockets, plugs for handles of iron & heaters
Excellent heat & moisture resistant.	Moulded articles like telephone parts,cabinets for radio & television.
Resistance to chemical and fire.	used as adhesive for grinding wheels & brake linning.
Good electrical insulation property	hydrogen exchanger resin in water softening.
High Abrasion resistance.	Paints,Varnishes,Bearings
Lower Molecular grades have excellent bonding strength	Propellers,Shafts for paper industry
High Adhesive property.	Rolling mills, Decorative laminates wall covering & industrial laminates for electrical parts.

1 Mark each

(Any two properties: 2 Marks & any two uses: 2 Marks)

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.	**e**	**Differentiate between primary & secondary cell**		**4**

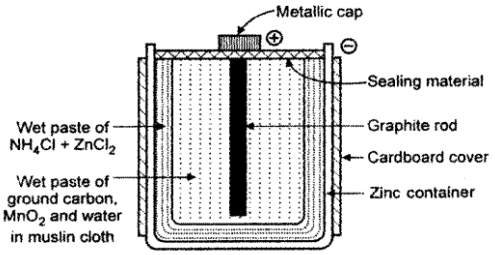
Primary cell	Secondary cell
1. Non- rechargeable cells are known as primary cells	1. Rechargeable cells are known as secondary cells.
2. Chemical reaction is irreversible.	2. Chemical reaction is reversible.
3. They are light in weight.	3. They are heavy.
4. They have short life.	4. They have long life
5. They can not be recharged & reused.	5. They can be recharged & reused.
6. e.g..- Dry cell, Daniel cell, Leclanche cell	6. e.g.Lead acid storage cell, Nickel- cadmium storage cell

1

Mark each

(**Any four points)**

f) **Explain construction and working of Dry cell with diagram.** **4**



1

Construction:

i) It consists of zinc container (vessel) which acts as an anode.

ii) 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) and water placed in muslin cloth.

1

iii)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.

Working

At zinc anode: -

Dissolution of zinc electrode to form zinc ions.

$Zn \longrightarrow Zn^{++} + 2e^{-}$ (oxidation)

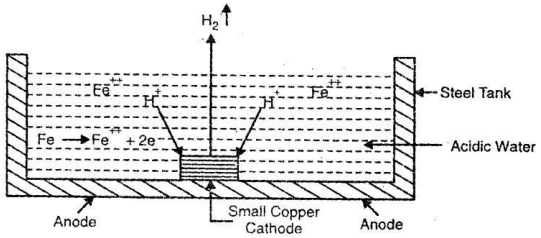
Zn++ combines with ammonia to form its complex.

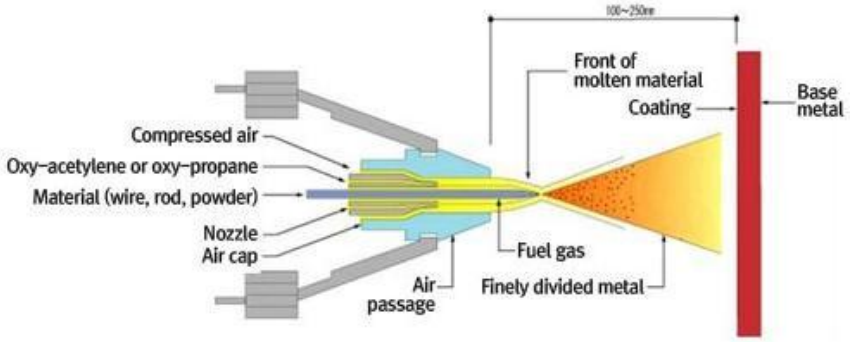
$Zn^{2+} + 4\ NH_3 \rightarrow (Zn(NH_3)_4)^{++}$

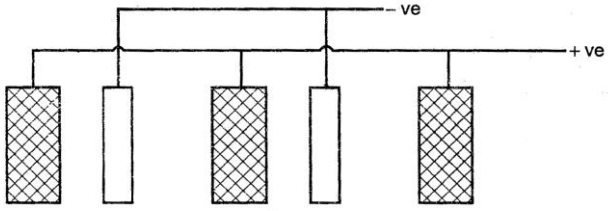
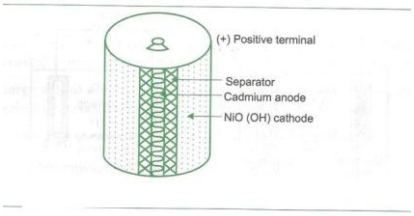
1

At the graphite cathode: -

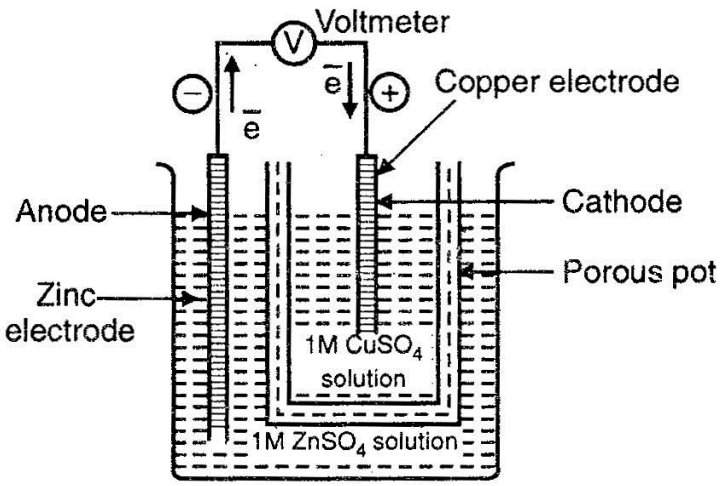
Manganese dioxide (MnO2) reduced in presence of NH_4^+ (ammonium) ions to form **Mn_2O_3** & liberate ammonia.

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		**$2NH_4^+ + 2\,MnO_2 + 2\,e^- \rightarrow Mn_2O_3 + H_2O + 2NH_3 \uparrow$** Ammonia thus produced is liberated as a gas but it combines with Zn^{2+} to form a $[Zn(NH_3)_4]^{2+}$ ions complex at the zinc anode. The cell develops a potential 1.5 volts.	**1**	
3.	**a)**	**Attempt any four** **Describe the mechanism of electrochemical corrosion by evolution of hydrogen**		**16** **4**
		 	**1**	
		Steel tank: - Anode **Cu – strip:- Cathode** These types of corrosion occur usually in acidic environments like industrial waste, solutions of non – oxidizing acids. 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. **Reactions:** **At Anode:**	**1**	
		$Fe \longrightarrow Fe^{++} + 2\,e^-$ These electrons flow through the metal from anode to the cathode **At cathode** H^+ ions are eliminated as H_2 gas	**1**	
		$2H^+ + 2\,e^- \longrightarrow H_2 \uparrow$(Reduction) Thus, over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2 \uparrow$** **[Note: 1mark each to be given to reaction at anode & cathode.]**	**1**	
	b)	**Explain the factors affecting rate of atmospheric corrosion** **Factors affecting atmospheric corrosion:-** **1) Impurities in the atmosphere:-** Corrosion rate is fast in the presence of all impurities such as H_2S, SO_2, CO_2, Cl_2, gases along with vapors of HCl & H_2SO_4 etc. Atmospheric air in industries areas contains these impurities.	**2**	**4**
		2) Moisture in the atmosphere:- Atmospheric gases & chemical vapours dissolve in moisture and reaction between such dissolved gases and metal becomes faster. Therefore moisture acts as conducting medium and enhances the corrosion.	**2**	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.	c)	**Name the method is used for the protection of irregular surface of metal? Explain it with diagram.** 	1	4
		Method: Used for protection of irregular surfaces is **metal spraying**.	1	
		Process:- In this method ,coating metal sprayed on the surface of base metal with the help of spraying gun or pistol.The spraying gun consist of a duct for compressed air and is fitted with the oxy-hydrogen flame. The coating metal in the form of wire is fed into the gun which is then melted inside the gun with the help of oxy hydrogen flame. The molten metal then sprayed on the surface of base metal with the help of compressed air.	2	
	d)	**Define:** **1 Specific conductance** **2 Equivalent conductance** **3 Electrolytic cell** **4 Electrochemical cell**		4
		Specific conductance (k) : Specific conductance is the conductance of a 1 cm^3 of the substance or solution. **OR** The conductance offered by a solution of length 1 cm & area of unit cross section is known as specific **conductance**.	1	
		Equivalent conductance (λv) : It is the conductance of the solution containing 1 gm equivalent of solute / electrolyte when placed between two sufficiently large electrodes 1 cm apart.	1	
		Electrolytic cell : A cell which converts electrical energy into chemical energy is known as electrolytic cell.	1	
		Electrochemical cell A cell which converts chemical energy into electrical energy is known as electrolytic cell	1	

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.	e)	**Explain construction and working of Ni-Cd cell with diagram.**		4
			1	
		OR		
				
		Construction: 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. They also contain an activated additive 2% $Ba(OH)_2$ which increases the life of plates. Negative plates consist of spongy Cadmium. 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: **A) Discharging:-** Positive Plate: $\mathbf{NiO_2(s) + 2H_2O\ (l) + 2e^- \longrightarrow Ni\ (OH)_2\ (s) + 2OH^-}$ Negative Plate: $\mathbf{Cd\ (s) + 2OH^-(aq) \longrightarrow Cd\ (OH)_2(s) + 2e^-}$ Net reaction: $\mathbf{NiO_2\ (s) + Cd(s) + 2H_2O \longrightarrow Ni(OH)_2 + Cd(OH)_2}$	1	
		B) Charging:- Positive Plate: $\mathbf{Ni(OH)_2(s) + 2OH^-(a) \longrightarrow NiO_2(s) + 2H_2O + 2e^-}$ Negative Plate: $\mathbf{Cd(OH)_2(s) + 2e^- \longrightarrow Cd(s) + 2OH(s)}$ Net reaction: $\mathbf{Ni(OH)_2 + Cd(OH)_2 \longrightarrow NiO_2(s) + Cd(s) + 2H_2O}$ Thus, discharging & charging reactions can be shown simultaneously as: - $\mathbf{NiO_2(s) + Cd\ (s) + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2}$	1 1	

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3	**f)**	**Explain construction and working of Daniel cell**		**4**



1

Construction:-

It consists of zinc electrode dipped in $ZnSO_4$ Solution & Copper electrode dipped in $CuSO_4$ solution.

The two solutions are separated by a porous pot. **1**

The two solutions can seep through the pot & so comes in contact with each other automatically. Thus, porous partition acts as a salt bridge.

Working:- The tendency of Zn to form Zn^{++} is greater than the tendency of Zn^{++} to get deposited as Zn on the electrode. **1**

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.

The emf of cell is 1.1 volt.

Cell reactions-

At Anode $\quad Zn \longrightarrow Zn^{++} + 2e^-$

At Cathode $\quad Cu^{++} + 2e^- \longrightarrow Cu$

Net Reaction $\quad Zn + Cu^{++} \longrightarrow Zn^{++} + Cu$ **1**