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.		

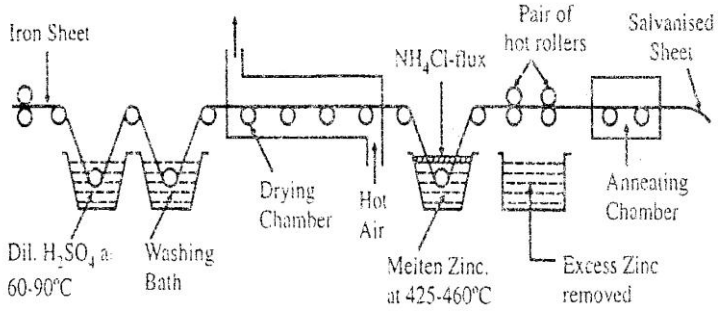
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.		**Attempt any NINE of the following:**		**18**
	a)	**Write the two ores of Copper with their chemical formula.**		**2**

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 ores of Copper with formula: 1 mark each)

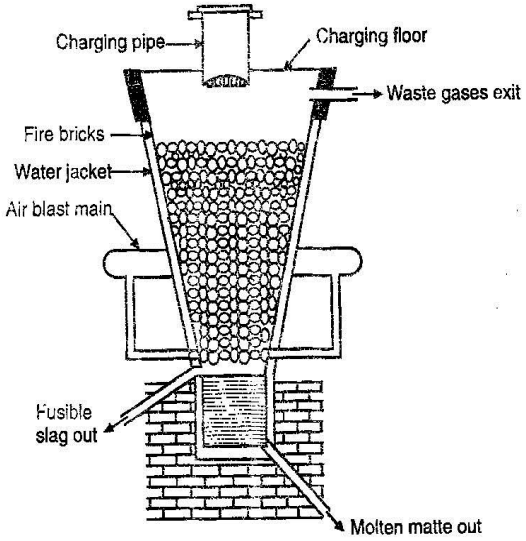
1 Mark each

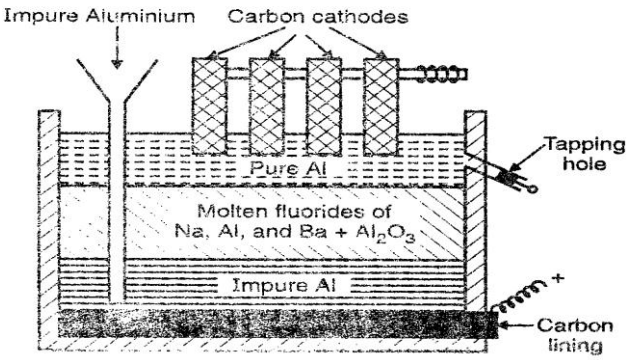
	b)	**What are the constituents of copper matte.** **Constituents :** Mixture of molten Cu_2S(Copper sulphide) FeS(Ferrous sulphide) traces.	**2** **2**
	c)	**Write two uses of aluminium.** 1) For preparing utensils, surgical instruments, heating appliances, parts of aeroplanes, containers for chemical industry etc. 2) For making electric wires and cables for transmission lines. 3) Aluminium foils are used for wrapping cigarettes, sweets and confectionary. 4) Al – powder is used for making silvery paints. 5) As a reducing agent in the production of Cr, Mn etc. 6) In thermite welding process. 7) As a deoxidizer in the manufacture of steel. 8) For winding the moving coils of dynamos and motors. 9) Highly pure Al is used as an absorber in the preparation of antibiotics (chloromycines). 10) Al – powder + NH_4NO_3 mixture is used in bombs. 11) For making many useful alloys. 12) For chemical plants and transporting and storing nitric acid. 13) As refractory for lining of furnace and for making refractory bricks.	**2** **1 Mark each**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	**d)**	**Define immersed corrosion**. **Definition:** The corrosion which is brought about through ionic reactions in the presence of moisture or solution as a conducting medium when two dissimilar metals are in contact with each other is called electro chemical corrosion.	**2**	**2**
	e)	**State the two functions of pigment.** 1) Provide opacity and colour to paint film. 2) Give strength to the film. 3) Give protection to the paint film by reflecting harmful ultraviolet light. 4) Provide resistance to paint film against abrasion, moisture and weather. 5) Give an aesthetical appeal (i.e pleasing to look at) to the paint film. **(Note: Any two functions)**	**1 Mark each**	**2**
	f)	**Draw neat and labelled diagram for application of metal on an article by galvanizing process.**  	2	**2**
	g)	**What are applications of sherardizing process?(Two points)** **Applications:-** i)Sherardizing is used especially for protecting small odd shaped steel articles like bolts, screws, nuts, threaded parts washers, valves, gauge, tools etc.against atmospheric corrosion. ii) The main advantage of sherardizing is that coating is quite uniform even if the surface has crevices or depression and there is practically no change in the dimensions of articles.	**1 Mark each**	2

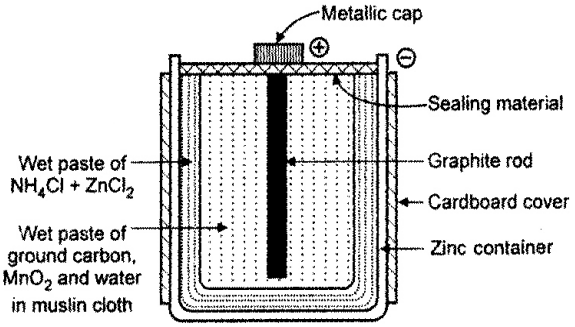
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	**h)**	**Define the terms:i)Specific conductance ii) Equivalent conductance** **i)Specific conductance (k) :** Specific conductance is the conductance of a 1 cm^3 of the substance or solution. **OR** The conductance offered by a solution of unit length & area of unit cross section is known as specific **conductance**. **ii) 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** **1**	**2**
	i)	**Write two points to differentiate between primary cell and secondary cell** **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 (**Any two points)**	**1 Mark each**	**2**
	j)	**State two uses of electrically conducting polymer.** 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 uses)**	**1 Mark each**	**2**
	k)	**State two applications of silione fluids.**		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.		**Applications:-** 1) **As a lubricant**: excellent lubrication for plastic and elastomeric surfaces. 2)**In polishes and chemical specialities**: It is used in automobile and furniture polishes due to its high gloss and water repellency. 3) **As a mechanical fluid:** It is used as hydraulic or transformer oils, damping mediums. 4) **As coolant:** They are used as coolant in radio, pulse and aircraft transformers. 5**) As a foam preventive:** effectively control foam in many machines like photocopiers and laser printers. 6) Also used in cosmetic and pharmaceutical industries. 7) **In electrical and chemical specialities:** Used as an insulator in medium and high voltage applications i.e. in transformers. 8) **As a release material** : an odourless ,non-toxic , non-carbonizing moulds release for rubber, plastics and metal die castings.	**1 Mark each**	
	l)	**Write two applications of phenol formaldehyde resin as an adhesive.** 1) Used as adhesive for grinding wheels & brake linning. 2) Used for decorative laminates wall covering & industrial laminates for electrical parts. 3) Used for making water-proof plywoods. 4) Used in bonding articles in air craft and ship building.	**1 Mark each**	2

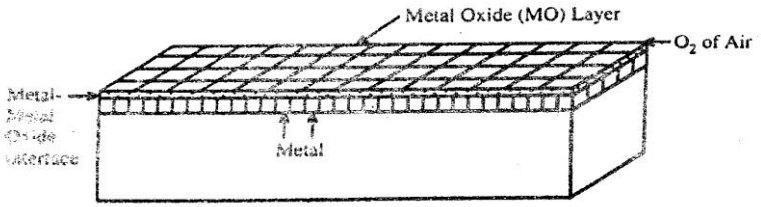
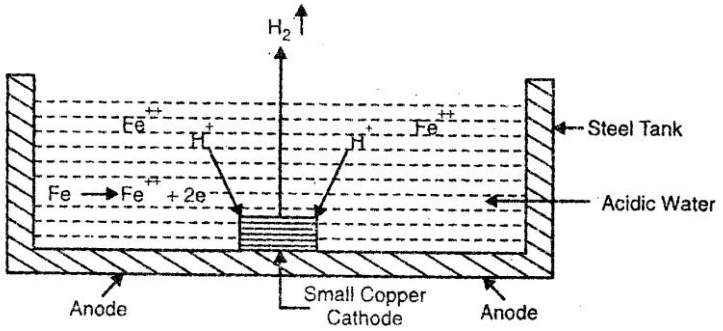
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2.		**Attempt any FOUR of the following:**		**16**
	a)	**How copper is obtained from its ore by smelting process? Write it with labeled diagram.**		**4**
			1	**4**
		Process: i) Roasted copper ore is then mixed with coke & sand particles & then strongly heated at high temperature in a water jacketed blast furnace. ii)At high temperature ferrous sulphide (FeS) is oxidised & converted into ferrous oxide (FeO) which further reacts with sand particles to form a fusible slag ($FeSiO_3$) $\mathbf{2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2}$ ↑ $\mathbf{FeO + SiO_2 \longrightarrow FeSiO_3}$	**2**	
		iii) 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. $\mathbf{Cu_2O + FeS \longrightarrow FeO + Cu_2S}$ iv) 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. v)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)	**Write the purification of aluminium with labelled diagram by electroytic refining.**		4

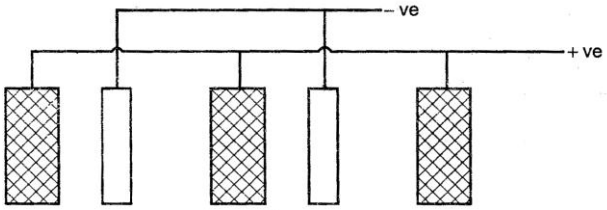
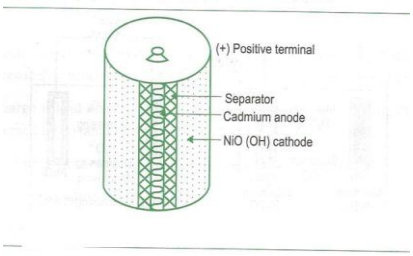
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2.		 **Process:** 1) The electrolytic cell consists of an iron tank lined at the bottom with carbon, which serve as anode. A number of graphite rods serve as cathode. 2) The cell is filled with three liquid layers of different densities. i)The top most layer consists of molten pure aluminium which acts as cathode. ii) The middle layer is of electrolyte which consist of a mixture of molten fluorides of Al , Ba & Na. iii) The bottom layer consists of molten impure aluminium. 3) On passing electric current, the aluminium ions from the middle layer discharged at the cathode and get collected in the top most layers. Same amount of aluminium 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** **3**	
	c)	**State composition properties and applications of Tinmann's solder or rose metal**	4	4

Solder	**Composition**	**Properties**	**Applications**
Tinmann's solder:	Sn = 66 % Pb = 34 %	1. It melts at 180^0C .	It is used for joining articles of tin.
Rose metal	Bi = 50% Pb = 28% Sn = 22%	1.It is easily fusible alloy. 2. Its melting point is 89^0C	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.

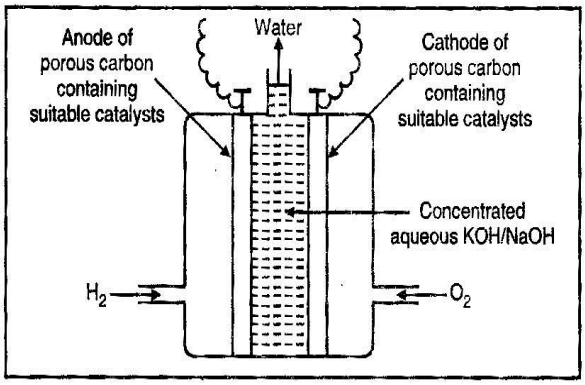
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		**(Note: 2 mark for composition,1mark for properties , 1mark for applications for any one alloy)**		
	d)	**Write four properties and applications of urea-formaldehyde resin.**		**4**
		Properties : 1) The bond film produced by urea – formaldehyde resin is quite rigid & transparent. 2) It is good resistant to moisture, insects & fungi. 3) However action of acids & alkalies deteriorate the resin film after some time. 4) It can be used in cold but a little heating helps in accelerating the setting process.	**2** 2	
		Applications: (Any two) 1) Used for bonding wooden surfaces. 2) Used for bonding water proof plywood , laminates. 3) Bonding articles in aircraft & ship building industries etc.		
	e)	**Give construction, working and application of Dry cell.**	1	**4**
				
		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.	1	
		Working **At zinc anode: -** Dissolution of zinc electrode to form zinc ions. **$Zn \longrightarrow Zn^{++} + 2e^-$ (oxidation)** Zn^{2+} combines with ammonia to form its complex. **$Zn^{2+} + 4\ NH_3 \rightarrow Zn(NH_3)_4^{++}$** **At the graphite cathode: -** Manganese dioxide (MnO_2) reaction with NH_4^+ (ammonium) ions to liberate ammonia. **$2NH_4^+ + 2\ MnO_2 + 2\ e^- \rightarrow Mn_2O_3 + H_2O + 2NH_3 \uparrow$**	1	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		Ammonia thus produced is liberated as a gas but it combines with Zn^{2+} to form a $Zn(NH_3)_4^{++}$ ions complex at the zinc anode. **Application:** 1) The dry cell useful for small amount of current required for short period of time. 2) Dry cells are used in torches, transistors, tape recorders, door bells, gas – engine ignition, wall clock, T. V. remote.c. 3) The cell develops a potential 1.5 volts. **(Any one application 1 mark)**	**1**	
	f)	**Write reactions taking place during charging and discharging of lead acid storage cell.**		**4**
		• **Discharging: -**	**1**	
		At Anode: - $Pb \rightarrow Pb^{2+} + 2e^-$ **(Oxidation)** $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow$	**1**	
		At Cathode:- $PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$ **(Reduction)** $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow$		
		Net reaction during Discharging: - $Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4 \downarrow + 2H_2O$		
		• **Charging: -**	**1**	
		At Cathode: $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$	**1**	
		At Anode: $PbSO_4 + 2H_2O \rightarrow PbO_2 + 4H^+ + SO_4^{2-} + 2e^-$		
		Net reaction during Charging: $2PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 4H^+ + 2SO_4^{-2}$ **[Note: 1mark each to be given to reaction at anode & cathode]**		
3.	**a)**	**Attempt any FOUR of the following:**		**16**
		Define atmospheric corrosion. Write mechanism when oxygen attacks on a metal.	**1**	
		Atmospheric corrosion: This type of corrosion occurs when metal surface comes in immediate contact directly with atmospheric gases like O_2, Cl_2, Br_2, I_2, H_2S, CO_2, SO_2, NO_2 etc. **Mechanism:** Metallic surfaces when exposed to air undergo oxidation and the process of corrosion is represented by the eq^n. $2M + O_2 \longrightarrow 2MO$ (Metal Oxide) (Metal) (Oxygen)	**4**	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.		A thin oxide layer is formed on the metal surface and the nature of this film decides further action depending upon the film so produced. $M \longrightarrow M^{2+} + 2e^-$ (loss of electrons) (Metal ion) $O + 2e^- \longrightarrow O^{2-}$ (gain of electrons) $M + O \longrightarrow M^{2+} + O^{2-} \longrightarrow$ MO (Metal oxide)	**1** **1**	
			**1**	
	b)	**Describe the hydrogen evolution mechanism of immersed corrosion.** 	1	**4**
		Steel tank: - Anode , Cu – strip:- Cathode These types of corrosion occur usually in acidic environments like industrial waste, solutions of non – oxidizing acids. **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. **At anode** $Fe \longrightarrow Fe^{++} + 2e^-$ (Oxidation) These electrons flow through the metal from anode to the cathode **At cathode** H^+ ions are eliminated as H_2 gas $2H^+ + 2e^- \longrightarrow H_2 \uparrow$(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 1 1 1	

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.	c)	**Describe metal spraying process for protection of metal from corrosion .Write its two applications.** **Process:-**i) In this method, coating metal sprayed on the surface of base metal with the help of spraying gun or pistol. ii) The spraying gun consist of a duct for compressed air and is fitted with the oxy- hydrogen flame. iii) 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. iv) The molten metal then sprayed on the surface of base metal with the help of compressed air. **Applications: (Any Two)** 1) Can be applied to non metallic bases made of wood plastic and glass. 2) Coating can be applied to fabricated structure. 3) Worn-out out machine parts can be reclaimed. 4) Coating of metals like Al, Zn, Ni, Sn, Pb etc. is made by the method of spraying. **(Note: mark should be given if diagram is drawn)**	**2** 2	**4**
	d)	**Write construction and working of Ni-Cd cell with labelled diagram.**  **OR**  **Construction:** 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. ii)They also contain an activated additive 2% $Ba(OH)_2$ which increases the life of plates. Negative plates consist of spongy Cadmium.	1 1	4

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.		iii) The electrolyte is 20- 15% solution of KOH to which small quantity of lithium hydroxide (LiOH) is added to increase the capacity of cell. **Working:** **A) Discharging:-** Positive Plate: $NiO_2(s) + 2H_2O(l) + 2e^- \longrightarrow Ni(OH)_2(s) + 2OH^-$ Negative Plate: $Cd(s) + 2OH^-(aq) \longrightarrow Cd(OH)_2(s) + 2e^-$ Net reaction: $NiO_2(s) + Cd(s) + 2H_2O \longrightarrow Ni(OH)_2 + Cd(OH)_2$ **B) Charging:-** Positive Plate: $Ni(OH)_2(s) + 2OH^-(a) \longrightarrow NiO_2(s) + 2H_2O + 2e^-$ Negative Plate: $Cd(OH)_2(s) + 2e^- \longrightarrow Cd(s) + 2OH(s)$ Net reaction: $Ni(OH)_2 + Cd(OH)_2 \longrightarrow NiO_2(s) + Cd(s) + 2H_2O$ Thus, discharging & charging reactions can be shown simultaneously as: - $NiO_2(s) + Cd(s) + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$ **OR** **A) Discharging:-** Positive Plate: $NiO(OH) + 2H_2O + 2e^- \longrightarrow 2Ni(OH)_2 + 2OH^-$ Negative Plate: $Cd + 2OH^- \longrightarrow Cd(OH)_2 + 2e^-$ Net reaction: $NiO(OH) + Cd + 2H_2O \longrightarrow 2Ni(OH)_2 + Cd(OH)_2$ **B) Charging:-** Positive Plate: $Ni(OH)_2 + 2OH^- \longrightarrow NiO(OH) + 2H_2O + 2e^-$ Negative Plate: $Cd(OH)_2 + 2e^- \longrightarrow Cd + 2OH^-$ Net reaction: $Ni(OH)_2 + Cd(OH)_2 \longrightarrow NiO(OH) + Cd + 2H_2O$ Thus, discharging & charging reactions can be shown simultaneously as: - $NiO(OH) + Cd(s) + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$	**1** **1** **1** **1**	

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.	e)	**Give Construction and working of hydrogen-oxygen fuel cell**		
			1	4
		Construction :- i)One of the simplest & most successful fuel cell is hydrogen – oxygen fuel cell. ii) It consists essentially of an electrolytic solution such as 25% KOH or NaOH solution, & two inert porous electrodes (like porous carbon) containing suitable catalyst. iii) Hydrogen & oxygen gases are bubbled through the anode & cathode compartment respectively.	1	
		Working: - **At anode: -** $2H_2 + 4\ OH^- \rightarrow 4H_2O + 4e^-$ **At cathode: -** $O_2 + 2\ H_2O + 4e^- \rightarrow 4OH^-$ **Net Reaction:** $2H_2 + O_2 \rightarrow 2H_2O$ **[Note: 1mark each to be given to reaction at anode & cathode.]**	2	
	f)	**Write discharging and charging process of lead acid storage cells.** **i) Discharging: -** While discharging chemical energy gets converted into electrical energy. **At Anode: -** $\mathbf{Pb \rightarrow Pb^{2+} + 2e^-}$ **(Oxidation)** $\mathbf{Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4} \downarrow$ **At Cathode:-** $\mathbf{PbO_2 + 4\ H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O}$ **(Reduction)** $\mathbf{Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4} \downarrow$ **Net reaction during discharging: -** $\mathbf{Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4} \downarrow \mathbf{+ 2H_2O}$	2	4

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.		Lead sulphate is precipited at both the electrodes. The voltage of each cell is 2.0 volts at 25^{o}C because the concentration of sulphuric acid varies from 5% to 40%. **ii) Charging: -** To recharge a lead storage cell, the reactions taking place during discharging are reversed by passing an external e.m.f. greater than 2 volts from a generator. **At Cathode: $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$** **At Anode:** **$PbSO_4 + 2H_2O \rightarrow PbO_2 + 4H^+ + SO_4^{2-} + 2e^-$** **Net reaction during Charging:** **$2PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 4H^+ + 2SO_4^{-2}$** During the process of charging, the electrodes of the cell are restored to their original conditions (to Pb and PbO_2 respetively).	**2**	