SUMMER– 17 EXAMINATION

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 themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.	Answer	Marking Scheme
1		**Attempt any NINE of Following:**	**18**
	a)	**Write any two important ores of Copper with 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	$2CuCO_3,Cu(OH)_2$

1 mark each

b) **What is the action of air on Copper?** **2**

When copper is heated to redness in air or oxygen, it first gives cupric oxide(CuO), which on further heating (above 1100°C) is converted to cuprous oxide(Cu_2O). 1

$2Cu + O_2 \longrightarrow 2CuO$

$2CuO + 2Cu \xrightarrow{\text{above } 1000^oC} 2Cu_2O$ or 1

$4Cu + O_2 \xrightarrow{\text{above } 1000^oC} 2Cu_2O$

(consider any one reaction)

c) **Write the action of HCl on Aluminium.** **2**

Aluminium dissolves in HCl to form aluminium chloride ($AlCl_3$)and liberate Hydrogen. 1

Reaction:

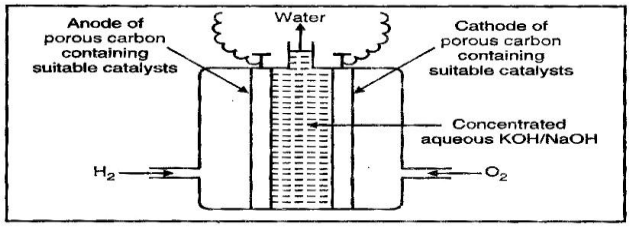
$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2\uparrow$ 1

SUMMER – 17EXAMINATION
Model Answer Subject Code: 17211

Q. No.	Sub Q.N.	Answer	Marking Scheme
1	**d)**	**Define atmospheric corrosion with one example.**	**2**
		Atmospheric corrosion: -This type of corrosion occurs when **metals come incontact directly with atmospheric gases** like O_2, Cl_2, Br_2, I_2, H_2S, CO_2, SO_2, NO_2 etc and moisture. **OR**	1
		The corrosion which is brought about by the atmospheric conditions is called atmospheric corrosion. **Examples:- (any one)** 1 Rusting of Iron 2 Formation of green film on the surface of copper **(Consider any relevant example)**	1
	e)	**Write four characteristics of good paint.**	**2**
		i) It should be able to resist the atmospheric conditions. ii) It should have desired consistency. iii) It should have high hiding power. iv) Its film should be washable. v) Its film should not crack or shrink on drying. vi) It should form uniform, nonporous, adherent, durable and glossy film. vii) When paint is applied on a metal, it should resist corrosion.	½ mark each **2**
	f)	**Why tinned container preferred over galvanized container for food storage.**	
		Tinned containers preferred over galvanized containers for food storage because Tin metal is less active and have corrosion resistance. It is nontoxic and does not react with food stuff and does not cause food poisoning. Whereas zinc is more electropositive (active metal) than iron hence it reacts with weak organic acids present in food stuffs to produce poisonous compound.	2
	g)	**Show the two point of similarity between galvanizing and sherardizing.**	**2**
		1) In both the processes Zinc is used as a coating metal.	1
		2) Both processes are used to protect Iron or steel articles (base metal)	1
	h)	**Define primary cell with example.**	**2** 1
		Primary cell :-The **non rechargeable cell** is called primary cell.	1
		Examples:- Dry cell, Daniel cell, Leclanche cell **(consider any one example)**	

SUMMER– 17 EXAMINATION

Model Answer Subject Code: 17211

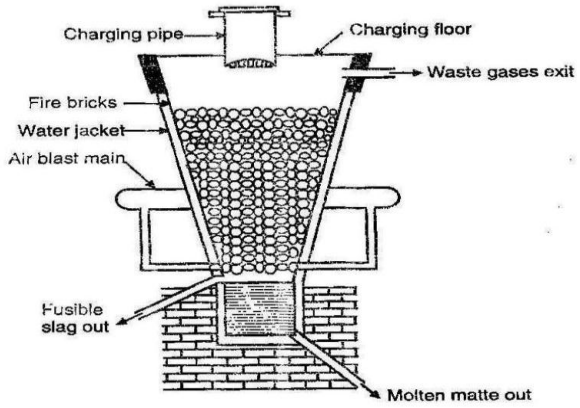
Q. No.	Sub Q.N.	Answer	Marking Scheme
1	i)	**Draw a neat labeled diagram of H_2-O_2 fuel cell.**  	**2** 2
		State the properties of liquid crystal polymer.	
	j)	1) They have high mechanical strength at high temperature. 2) They are extreme chemical resistance. 3) They have good weatherability. 4) They are inert. 5) They resist stress, cracking in the presence of most chemicals at elevated temperatures. 6) It has high coefficient of thermal expansion. 7) It is highly resistant to fire. **(Consider any two properties)**	**2** 1 mark each
	k)	**Name two types of adhesives and give their uses.**	**2**

Sr. No.	Types of adhesives	Uses of adhesives
1.	Thermosetting synthetic resins	It is used for making water-proof plywoods, laminates, bonding articles in aircraft and ship building industries, for bonding metals, ceramics, plastics, rubbers etc.
2.	Thermoplastic synthetic resin	It is used in cloth & footwear industries, in bonding paper, glass, leather, metals etc.
3.	Natural resin adhesives	It is used in making belts & conveyers, in bonding paper, cloth, metals etc.
4.	Starch adhesive	For manufacturing envelopes, stamps, notebooks, binding books and other paper goods.
5.	Inorganic adhesive	For making packing kits, paper boxes, card-board containers etc.
6.	Vegetable or protein glues	For common adhesive jobs
7.	Animal glues	In manufacturing furniture, radio-cabinates and card-boxes etc.

1 mark each

SUMMER– 17 EXAMINATION

Model Answer Subject Code: 17211

Q. No.	Sub Q.N.	Answer	Marking Scheme
1	l)	**Write two applications of Teflon.** **Applications of Teflon:-** i) Teflon used as capacitor dielectrics & insulating material for all kinds of windings. ii) Heat resistant materials are prepared by combining Teflon with glass cloth. iii) It is used for Insulation of motors, generators, coils, transformers and capacitors etc. iv) It is used in chemical equipments e.g. variety of seals, gaskets, pumps, valve packings, pump-parts and stop-cocks for burettes. v) It is used in non-lubricating bearings. vi) It is used in non-stick cookwares vii)Teflon coating is applied on vehicle to protect them from corrosion and scratches.	**2** 1 mark each
2	a)	**Attempt any four of the following:** **Explain process of smelting of copper ore in the blast furnace.**	**16** **4**
			1
		Process: i) Roasted copper ore is 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 (FeSiO3). **$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$** **$FeO + SiO_2 \longrightarrow FeSiO_3$ (slag)** 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. **$Cu_2O + FeS \longrightarrow FeO + Cu_2S$** 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 1 1

Q. No.	Sub Q.N.	Answer	Marking Scheme
2	b)	**Describe electrolytic reduction of alumina.**	**4**

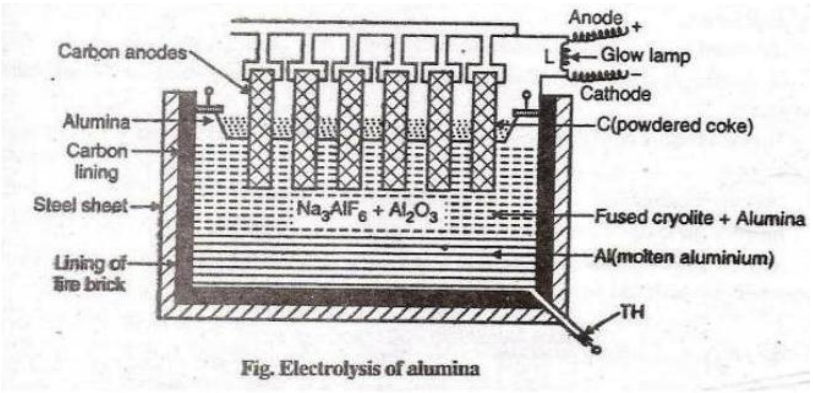


Fig. Electrolysis of alumina

1

i) Aluminium is extracted from alumina by electrolysis of mixture of alumina (20%) , Cryolite (60%) & Calcium fluoride (20%). Addition of cryolite& fluorspar not only makes alumina a good conductor of electricity but also lowers melting point.

1

ii)The molten electrolyte is covered with a layer of powder coke to prevent oxidation.
Following reactions taking place during electrolysis are:

$Na_3AlF_6 \rightleftharpoons 3NaF + AlF_3$

$AlF_3 \rightleftharpoons Al^{+3} + 3F^-$

At Cathode : $Al^{+3} + 3e^- \longrightarrow Al$

2

At Anode : $F^- \longrightarrow F + e^-$

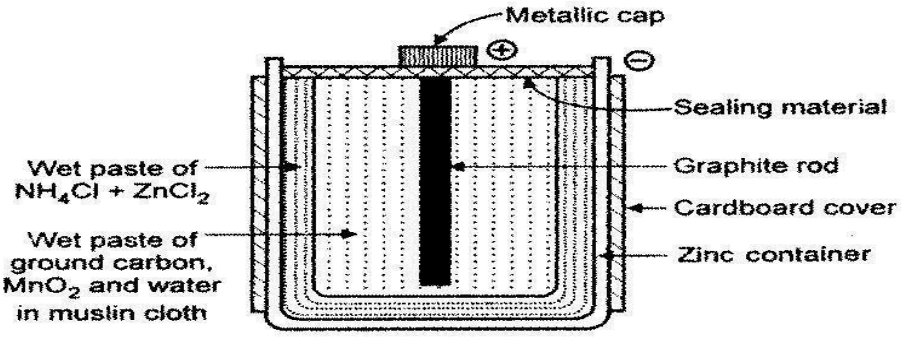
$2Al_2O_3 + 12F_2 \longrightarrow 4AlF_3 + 3O_2$

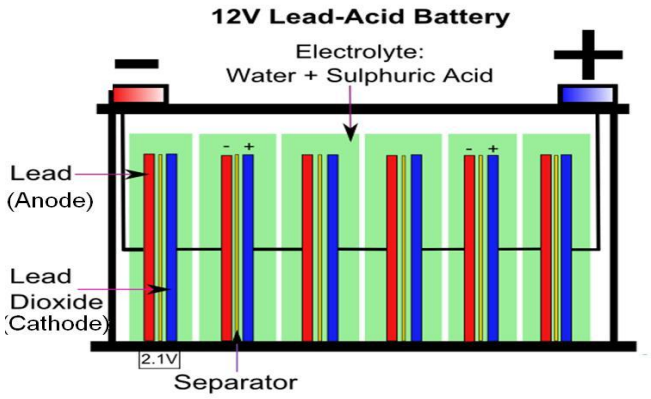
$2C + O_2 \longrightarrow 2CO\uparrow$

$2CO + O_2 \longrightarrow 2CO_2\uparrow$

iii) The oxygen liberated at anode reacts with carbon of anode producing CO and CO_2. Hence anode get consumed therefore it should be replaced time to time.
iv) Aluminium set free at the cathode is removed periodically in the molten condition from bottom of the cell.

	c)	**Write composition and properties of Wood's Metal.**	**4**
		Composition: Bi=50% Pb=25% Sn =12.5% Cd=12.5%	2
		Properties: 1) Easily fusible alloy. 2) Low melting point (71^0C)	2

Q. No.	Sub Q.N.	Answer	Marking Scheme
2	d)	**Write the properties and applications of epoxy resin.**	**4**
		Properties:	
		i) They have good chemical resistance. ii) They have low shrinkage during curing. iii) They possess good electrical resistance. iv) These compounds can be used in solid and liquid form. v) They have good adhesive property as they can be cured without application of heat.	2
		(consider any two points.)	
		Applications :- 1. Epoxy resins are best suited for bonding of insulating materials such as porcelain, wood, metal, ceramic, glass articles. 2. Laminates as well as insulating varnishes are prepared from epoxy resins. 3. A trade name for common epoxy resin type adhesive is araldite which is used in air-craft industry, automobiles, bicycles, golf club, snow boards etc. 4. Due to their electrical resistance they are widely used in making insulators, bushings etc. for high voltage.	2
		(consider any two points.)	
	e)	**Describe the Dry cell with application.**	**4**
		Diagram:	
			1
		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.	

Q. No.	Sub Q.N.	Answer	Marking Scheme
2.		**Working** **At zinc anode: -** Dissolution of zinc electrode to form zinc ions. **$Zn \rightarrow Zn^{++} + 2e^-$ (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. **$2NH_4^+ + 2\ MnO_2 + 2\ e^- \rightarrow Mn_2O_3 + H_2O + 2NH_3\uparrow$** 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.	2
		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. 3) The cell develops a potential 1.5 volts. **(Note: Any one point for one mark.)**	1
	f)	**Explain the construction and working of Lead acid storage cell with the help of diagram.**	**4**
			1
		(Consider any relevant diagram)	
		Construction i)A group of lead plates packed with spongy lead serves as anode (negative electrode). ii) Another group of lead plates bearing lead dioxide serve as cathode (positive electrode).The two types of plates are alternately arranged in acid proof container. iii) The electrodes are immersed in an aqueous solution of 38% (by mass) of H_2SO_4 of density about 1.2 g/ml which serve as electrolyte.	1

Q. No.	Sub Q.N.	Answer	Marking Scheme
2		**Working:** • **Discharging: -** At Anode: - $Pb \rightarrow Pb^{2+} + 2e^-$ **(Oxidation)** $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow$ 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: - $Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4 \downarrow + 2H_2O + Energy$ • **Charging: -** 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: $2PbSO_4 + 2H_2O + Energy \rightarrow Pb + PbO_2 + 4H^+ + 2SO_4^{-2}$ **[Note: 1mark each to be given to Discharging reaction &Charging reaction]**	1 1
3	a)	**Explain any four factors affecting the rate of electrochemical corrosion.** **A) Nature of metal**: **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 corroding medium faster. In the series the noble metals are at the bottom whereas the alkali metals are at the top. **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. **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.The grain size in a metal can be increased by hardening operation or by alloying with a suitable element.	**4** 1 mark each

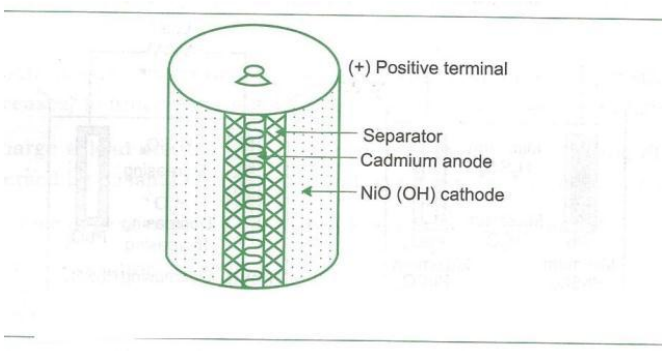
Q. No.	Sub Q.N.	Answer	Marking Scheme
3		4) **Solubility of the corrosion products:-**Insoluble corrosion products function as a physical barrier thereby suppresses further corrosion. But if the corrosion product is soluble in the corroding medium the corrosion of the metal proceeds faster. **B) Nature of the Environment:-** 1) **Effect of PH**:-Acidic media are more corrosive than alkaline and neutral media.e.g. corrosion of Zn can be minimised by increasing the pH to 11 2) **Differential aeration**: Corrosion occures 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. 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. 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. **(Note: write any four factors, any relevant factor may be consider)**	
	b)	**Write the different types of oxide films formed on the metal surface. Explain the oxide film which is more protective against corrosion.**	**4**
		Types of oxide films- 1. Stable porous oxide film 2. Stable non porous oxide film 3. Unstable oxide film 4. Volatile oxide film	2
		i) Stable nonporous oxide film ii) Unstable oxide films are protective against corrosion.	1
		Stable Non-porous oxide film:- In this case the volume of metal oxide formed is more than volume of the metal from which it is formed. Hence this film is a continuous film and it does not possess any pores in the structure. Hence this film is protective oxide film.Once formed it acts as barrier and protect the metal from further corrosion.	1

Q. No.	Sub Q.N.	Answer	Marking Scheme
3.		**Unstable oxide film** :- In this case, metal oxide formed is unstable it decomposes back into the metal and oxygen as soon as it is formed. $2M + O_2 \longrightarrow 2MO \longrightarrow 2M + O_2$ Hence corrosion is not possible in this case. **Example: -** Such type of oxide film is formed in the metals like Ag, Au, and Pt. **(write any one oxide film)**	
	c)	**Differentiate between galvanizing and tinning.**	**4**

Sr.No.	Galvanizing	Tinning
i)	A process of covering iron or steel with a thin coat of **Zinc** to protect it from corrosion.	A process of covering iron or steel with a thin coat of **Tin** to protect it from corrosion.
ii)	In galvanising, zinc protects the iron as it is more electropositive than iron.It does not allow iron to pass into solution.	Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.
iii)	In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.	In tinning tin protects the iron, till the coating is perfect. Any break in coating causes rapid corrosion of iron.
iv)	Galvanized containers can not be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.	Tin coated containers and utensils can be used for storing any food stuff since Tin is non toxic and protects the metal from corrosion and does not causes food poisoning.

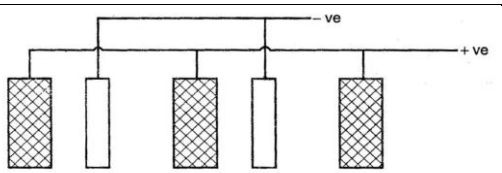
1 mark each

d) **Explain construction and working of Ni-Cd storage cell.**



1

OR

Q. No.	Sub Q.N.	Answer	Marking Scheme
3			
		Construction: Positive plates are made up of nickel plated tubes, containing a mixture of nickel oxide (NiO2) & 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: $NiO_2(s) + 2H_2O(l) + 2e^- \longrightarrow Ni(OH)_2(s) + 2OH^-$ Negative Plate: $Cd(s) + 2OH^-(aq) \longrightarrow Cd(OH)_2(s) + 2e^-$ Net reaction: $NiO_2(s) + Cd(s) + 2H_2O \longrightarrow Ni(OH)_2 + Cd(OH)_2$	1
		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: - $NiO_2(s) + Cd(s) + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$	1
		OR **A) Discharging:** At anode: $Cd + 2OH^- \longrightarrow Cd(OH)_2 + 2e^-$ At Cathode : $NiO(OH) + 2H_2O + 2e^- \longrightarrow Ni(OH)_2 + 2OH^-$ **B) Charging:** At anode: $Cd(OH)_2 + 2e^- \longrightarrow Cd + 2OH^-$ At Cathode: $Ni(OH)_2 + 2OH^- \longrightarrow NiO(OH) + 2H_2O + 2e^-$ **Net reaction:** $NiO(OH)_2 + Cd + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$	

Q. No.	Sub Q.N.	Answer	Marking Scheme
3.	e)	**Give the difference between Primary cell and 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

(consider any four points)

f) **Show the fuel cell differ from battery. What are the advantages of fuel cell?** **4**

Fuel cell : Fuel cell is an electrochemical cellwhich converts the chemical enrgy of fuel directly into the electrical energy by an electrochemical process, in whichthe fuel is oxidised at the anode. 2

Battery : Battery is the term generally used to denote one or more electrically connected Galvanic cells.

(Marks should be given for any relevant answer)

Advanteges:- (Any two) 2

1. High efficiency of energy conversion (75 to 82.8%) from chemical energy to electrical energy.
2. No emission of gases & pollutants within permissible limits.
3. Fuel cells offer excellent method for efficient use of fossil fuels.
4. $H_2 – O_2$ systems produce drinking water of potable quality.
5. Low noise pollution & low thermal pollution.
6. Modular & hence parts are exchangeable.
7. Low maintenance costs.
8. Fast start up time of low temperature systems.
9. The regenerative $H_2 – O_2$ system is an energy storage system for space applications.
10. Low cost fuels can be used with high temperature systems.
11. The regeneration of heat will increase the efficiency of high temperature systems.
12. Fuel cells are suitable for future nuclear solar hydrogen economy.
13. Hydrogen & air electrodes are useful in other battery systems. e.g. Ni – Hydrogen, zinc – air, aluminium – air etc.
14. Saves fossil fuels
15. Fuel cell automotive batteries can render electric vehicles efficient & refillable