WINTER– 16 EXAMINATION

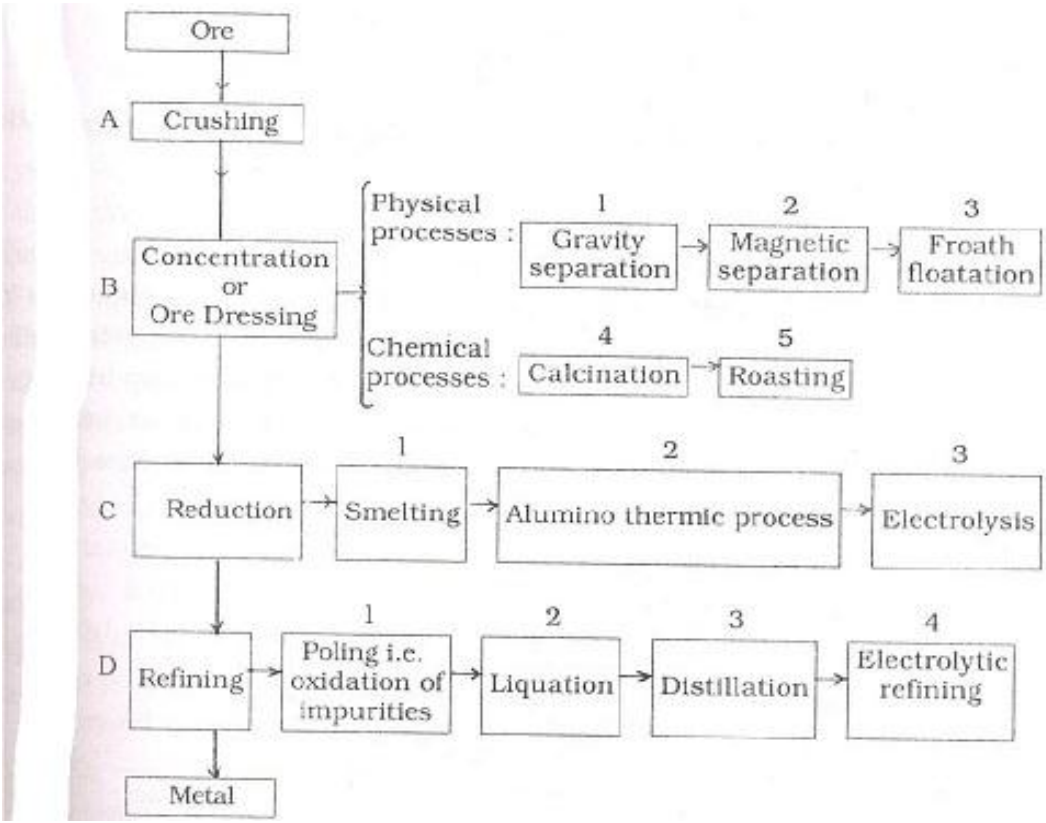
Model Answer

Subject Code: 17211

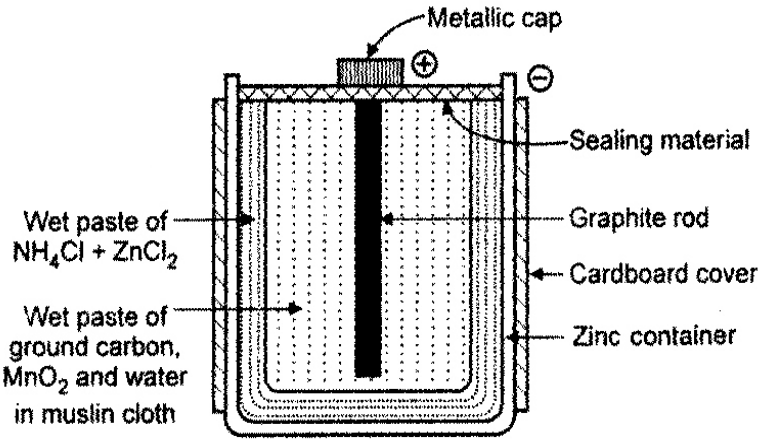
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in 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.	Answer	Marking Scheme
1		**Attempt any NINE of the following:**	**18**
	a)	**Write any four 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. 14) For preparation of mirrors for telescope **(Note: Write any four points.)**	**2** **1 /2 Mark each**

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	b)	**State the composition of Rose metal.** **Composition:** Bi = 50% Pb = 28% Sn = 22%	**2** 2
	c)	**Give the general flow chart for the extraction of metal from its ore.**  	**2** 2
	d)	**Define corrosion. Mention the types of corrosion.** **Corrosion:** Any process of chemical or electrochemical decay or destruction of a metal due to the action of surrounding medium is called as corrosion.	**2** 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	d)	**Types of corrosion:** 1) Atmospheric corrosion or direct chemical corrosion or Dry corrosion. 2) Immersed corrosion or electro chemical corrosion or wet corrosion	½ **Mark each**
	e)	**Define colorizing.** "Colorizing is the process of cementation using aluminum powder as a coating metal."	**2** 2
	f)	**Explain cathodic protection. Give one example.** **Cathodic protection**: "It is the method in which the metal to be protected is forced to behave as a cathode." **Examples:** 1) To protect buried water or gas pipelines. 2) To protect buried cables. 3) To protect hot water tank, etc. 4) Mg or Zn rods are bolted along the sides of ship, hot water tanks or inserted into boiler to prevent corrosion. 5) To protect open water box coolers. 6) To protect water tanks. 7) To protect transmission line towers, etc. **(Note: Any one example for one mark)**	**2** 1 1
	g)	**Define paint. Give its two properties.** **Paint: -** Paint is a mechanical dispersion mixture of one or more pigment in a vehicle. **Properties of paint:** 1) Paint imparts opacity and colour to the surface on which it is applied. 2) It protects the surface against UV rays. 3) Paint provides resistance against abrasion, moisture and weather. 4) Paint imparts luster, gloss and durability to the surface on which it is applied. **(Note: Any two properties)**	**2** 1 ½ mark each

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	h)	**Explain fuel cell. State two advantages.**	**2**
		Fuel cell- Fuel cell is a electrochemical cell which converts the chemical energy of fuels directly into electrical energy by an electrochemical process in which the fuel is oxidized at the anode.	1
		Advanteges:- 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 **(Note: Any two advantages ½ mark each.)**	½ Mark each
	i)	**Draw labeled diagram of dry cell.**	**2**
			2

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	j	**Write the difference between dielectrics and insulators.**	**2**

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 cannot store charges like dielectrics.
4.**Examples-** Air, N_2 gas , CO_2 gas, Silicon fluid etc.	4.**Examples-** Rubber, Plastics etc.

1 Mark each

(Note: Any two points for two marks.)

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	k	**Give two applications of epoxy resins.** **2**

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.

1 Mark each

(Note: Any two points for two marks.)

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	l)	**Define glass. Give its two characteristics.** **2**

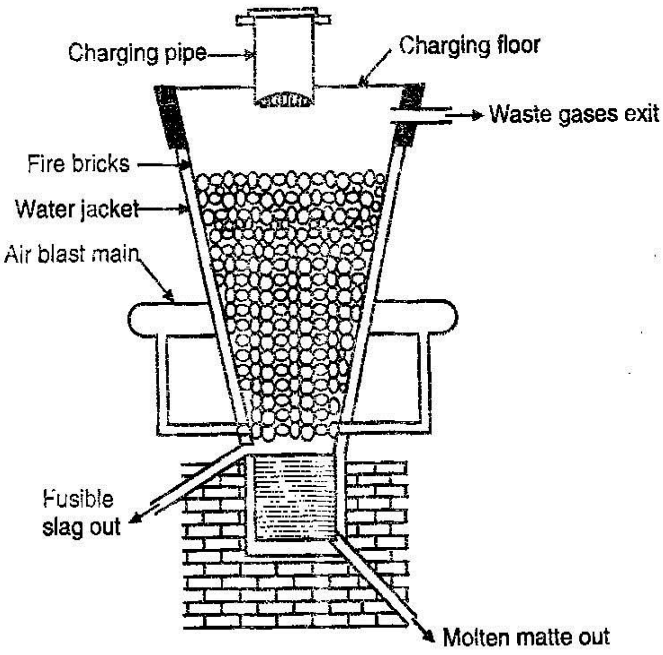
"Glass is amorphous material which is a mixture of silicates, phosphates, borates and other material with 50-80-% silica". 1

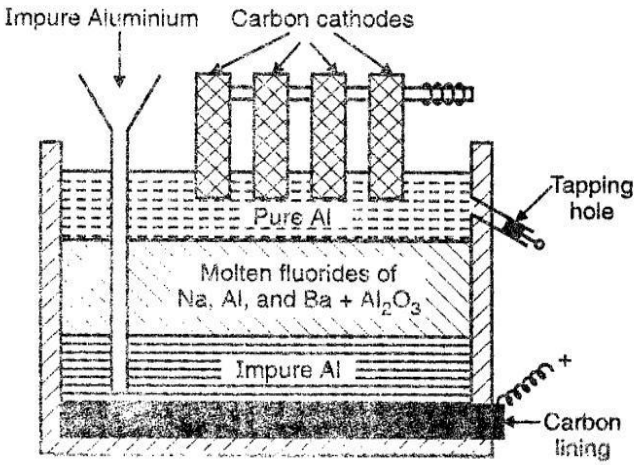
Characteristics:

1**)** Glass is most widely used as an insulator.
2) Glass is low in cost.
3) Glasses are having low temperature coefficient.
4) Glasses are having high electric constant.
5) Pyrex glass is most chemically stable and having excellent electrical properties.

½ mark each

(Note: Any two characteristics.)

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any four of the following:**	**16**
	a)	**Describe the process of smelting of copper ore with labeled diagram.**	**4**
		Diagram: 	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 ($FeSiO_3$). $\mathbf{2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2}\uparrow$ $\mathbf{FeO + SiO_2 \longrightarrow FeSiO_3}$	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. $\mathbf{Cu_2O + FeS \longrightarrow FeO + Cu_2S}$	1
		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. ----------	

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	b)	**Explain the electrolytic refining of aluminum.**	**4**
		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 consists 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 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.	**3**
		Diagram:  	1
	c)	**Write composition, properties and applications of Wood's metal.**	**4**
		Composition: Bi=50% Pb=25% Sn =12.5% Cd=12.5%	**2**

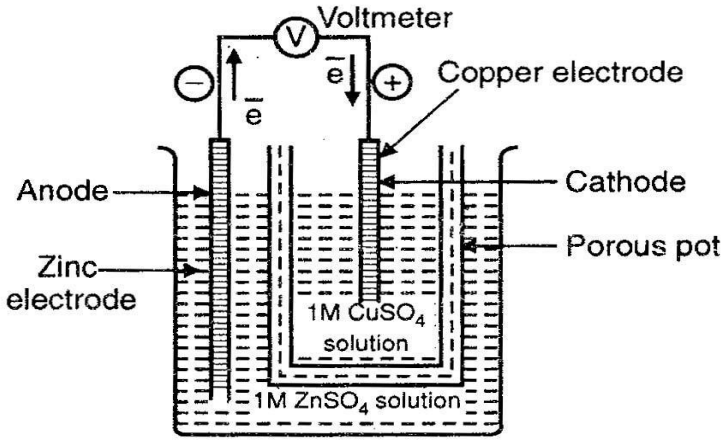
<table>
<tr><th>Q. No.</th><th>Sub Q. N.</th><th>Answer</th><th>Marking Scheme</th></tr>
<tr><td>2</td><td></td><td>Properties: 1) Easily fusible alloy.
2) Low melting point (71^0C)
Applications: 1) For making safety plugs of pressure cookers, boilers etc.
2) In soft solders.
3) For taking impressions of coins.
4) As casting for dental work.
5) In fuse wires.
6) In water sprinklers.
7) In fire alarms.
(Note: two properties and two applications)</td><td>½ mark each

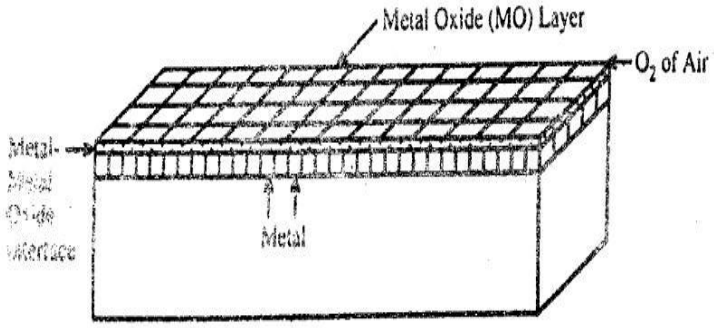
½ mark each</td></tr>
<tr><td></td><td>d)</td><td>Give two properties and corresponding applications of Teflon.
<table>
<tr><th>Properties</th><th>Applications</th></tr>
<tr><td>1) Good electrical and mechanical properties.</td><td>a) Teflon is used as capacitor dielectrics & insulating material for all kinds of windings.
b) It is used for insulation of motors, generators, coils, transformers and capacitors.</td></tr>
<tr><td>2) It is extremely resistant to corrosive reagents and solvents.</td><td>a) Teflon is used in chemical equipments e.g. variety of seals, gaskets, pumps, valve packings, pump-parts and stop-cocks for burettes.
b)Teflon coating is applied on vehicle to protect them from corrosion and scratches.</td></tr>
<tr><td>3) It is stiff, slippery and waxy to touch.</td><td>It is used in non-stick cookware.</td></tr>
<tr><td>4) Low coefficient of friction.</td><td>It is used in non-lubricating bearings.</td></tr>
</table>
(Note: Any two properties and its corresponding applications.)</td><td>4

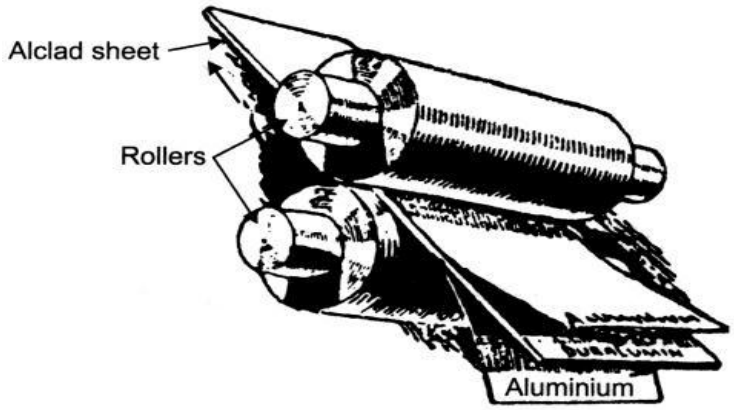
2 Marks each</td></tr>
<tr><td></td><td>e</td><td>Write charging and discharging chemical reactions of lead acid storage cell.

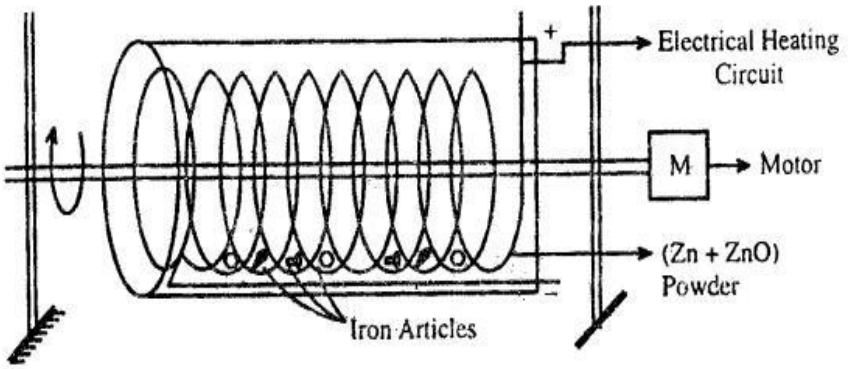
i) Discharging: -
At Anode: -
$Pb \rightarrow Pb^{2+} + 2e^{-}$ (Oxidation)
$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$</td><td>4

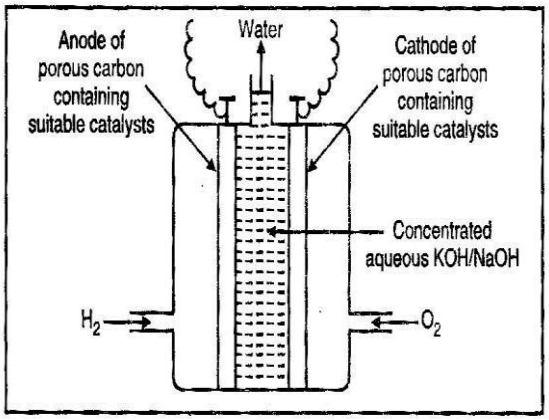
1</td></tr>
</table>

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	e)	**At Cathode:-**	
		$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$ **(Reduction)**	1
		$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$	
		Net reaction during discharging: -	
		$Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4 + 2H_2O$	1
		ii) Charging: -	
		At Cathode:	
		$PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$	
		At Anode:	
		$PbSO_4 + 2H_2O \rightarrow PbO_2 + 4H^+ + SO_4^{2-} + 2e^-$	1
		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]	
	f	**With the help of a sketch describe the construction and working of Daniel cell.**	**4**
			1

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	f)	**Construction:-** 1) It consists of zinc electrode dipped in $ZnSO_4$ Solution & Copper electrode dipped in $CuSO_4$ solution. 2) The two solutions are separated by a porous pot. 3) 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. 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:** $Zn \longrightarrow Zn^{++} + 2e^-$ **At Cathode:** $Cu^{++} + 2e^- \longrightarrow Cu$ **Net Reaction:** $Zn + Cu^{++} \longrightarrow Zn^{++} + Cu$	**1** **1** **1**
		---	**16**
3		**Attempt any Four of the following**	
	a	**Write the mechanism of corrosion of metal due to action of oxygen.**  	**4** **1**

Q. No.	Sub Q. N.	Answer	Marking Scheme
3	a)	**Mechanism:** Metallic surfaces when exposed to air undergo oxidation and the process of corrosion is represented by the equation. **$2M + O_2 \longrightarrow 2MO$** **(Metal) (Oxygen) (Metal Oxide)** 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)** **$O + 2e^- \longrightarrow O_2^-$ (gain of electrons)** **$M + O \longrightarrow M^{2+} + O_2^- \longrightarrow$ MO (Metal oxide)**	**1** **1** **1**
	b	**Explain metal cladding with neat labeled diagram.** 1) It is the process by which a dense, homogeneous layer of coating metal is bonded firmly and permanently to the base metal on one or both sides. 2) In this process, the base metal to be protected against corrosion is sandwiched between two sheets of coating metal. 3) This sandwich is then passed through two heavy rollers maintained at high temperature. 4) The base metal is hence protected.  	**4** 2 2
	c	**Define cementation. Explain sherardizing process.** **"**Cementation is the process in which metal coatings are obtained by heating the base metal in a revolving drum containing a powder of the coating metal."	**4** **1**

Q. No.	Sub Q. N.	Answer	Marking Scheme
3			**1**
		i) The articles (bolts, screws, nails etc) to be coated are first cleaned and then packed with Zn dust and ZnO powder in a steel drum, which is provided with electrical heating arrangement. ii) The drum is slowly rotated for 2-3 hrs. and it's temp. is kept between 350 – 400^{0}C. iii) During this process Zn slowly diffuses into iron surface forming Fe - Zn alloy at the surface which protects iron surface from corrosion.	**2**
	d	**Classify electrochemical cells. Give examples of each.**	**4**
		Electrochemical cells are classified as: 1) Primary cells. 2) Secondary cells.	**2**
		Examples of primary cells: Dry Cell (Leclanche's cell). Daniel Cell.	**1**
		Examples of secondary cells: Lead-acid storage cell. Ni-Cd battery. (Note: Any one example of primary cell and secondary cell 1 mark each)	**1**

Q. No.	Sub Q. N.	Answer	Marking Scheme
3	e	**Explain construction and working of Hydrogen-Oxygen fuel cell.**	4
		Construction:- 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. 2. Hydrogen & oxygen gases are bubbled through the anode & cathode compartment respectively.	1
		Diagram:  	1
		Working: **At anode: $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$** **At cathode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$** **Net cell reaction: $2H_2 + O_2 \longrightarrow 2H_2O$** The voltage of cell is **1.0 V**	2
		---	
	f	**Define the following: Electrolyte, conductivity of electrolytes, specific conductance and equivalent conductance.**	4
		Electrolyte: A substance which produces ions in solution or in fused state and allows the electric current to pass through it, is known as electrolyte.	1
		Conductivity of electrolytes: The power of electrolyte to conduct electric current is known as conductivity of an electrolyte.	1

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Q. No.	Sub Q. N.	Answer	Marking Scheme
3	f	**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. **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**