WINTER– 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 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 two ores of copper with their chemical formulae.**	**2**
		Cuprite/Ruby copper: Cu_2O	
		Copper pyrite $CuFeS_2$	1 Mark each
		Copper Glance: Cu_2S	
		Malachite:$CuCO_3$, $Cu(OH)_2$	
		Azurite:$2CuCO_3$, $Cu(OH)_2$	
		(Note: Any Two Names with Chemical Formula, 1Mark Each)	
	(b)	**What is the action of Conc. HCl on Aluminium metal? Give chemical reaction.**	**2**
		Aluminium metal readily dissolves in the concentrated hydrochloric acid to form aluminium chloride with evolution of hydrogen gas	1
		$2Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2 \uparrow$	1

WINTER– 17 EXAMINATION
Model Answer

17211

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	**(c)**	**Give the composition of rose metal and its one application**.	**2**
		Composition: Bi = 50% Pb = 28% Sn = 22%	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.	1
		(Any one application)	**2**
	d)	**Define Atmospheric corrosion. State the factors affecting rate of atmospheric corrosion.**	
		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.	1 1
		Factors affecting rate of atmospheric corrosion:- 1) Impurities in the atmosphere. 2) Moisture in the atmosphere.	
	(e)	**Write two applications of metal cladding process.**	**2**
		Applications : 1)Al clad sheets used in aircraft industry in which a plate of duralumin is sandwiched between two layers of 99.5% pure Al	1
		2) Cu – clad steel wire is obtained by forcing steel rod into closely fitted cu-tube is used for electrical conductors possessing combining strength of steel with the high conductivity of Cu.	1
	(f)	**Give any four constituents of paint.**	**2**
		The constituents of paint are:- 1) Pigments 2) Drying Oil / Medium 3) Thinners 4) Driers 5) Extenders 6) Plasticizers	½ mark Each
		(Any four constituents)	

WINTER– 17 EXAMINATION

17211

Model Answer

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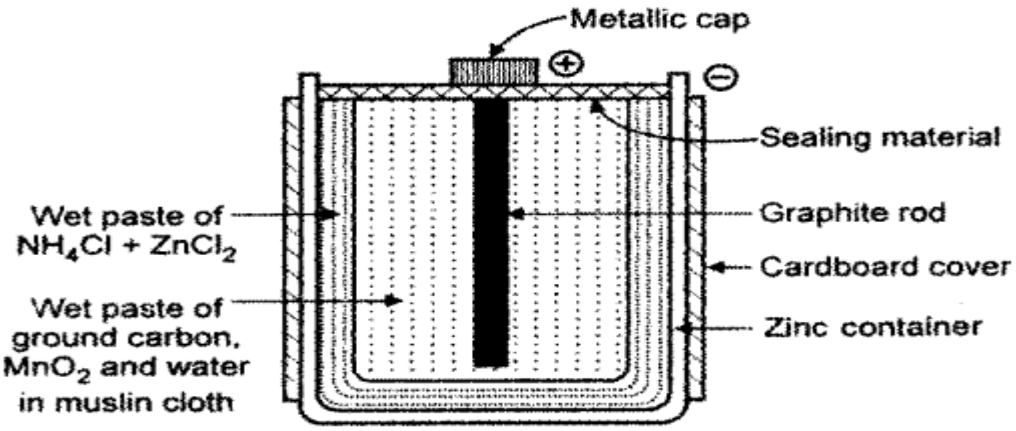
1	(g)	**Write any two examples of sacrificial anodic protection.** **Examples:** 1) To protect buried water or gas pipelines. 2) To protect buried cables. 3) To protect hot water tank, etc. 4) Mg or Zn rods are bolted along the sides of ship, hot water tanks or inserted into boiler to prevent corrosion. 5) To protect open water box coolers. 6) To protect water tanks. 7) To protect transmission line towers, etc. **(Note: Write Any Two examples)**	**2** 1 Mark Each
	(h)	**Define Equivalent Conductance. Give its unit.** **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. **Unit:** $ohm^{-1}\ cm^2$ / equivalent **OR** $mhos.cm^2$ /equivalent	**2** 1
	(i)	**Draw a neat labelled diagram of Dry Cell.**  	**1** **2**

17211

WINTER– 17 EXAMINATION

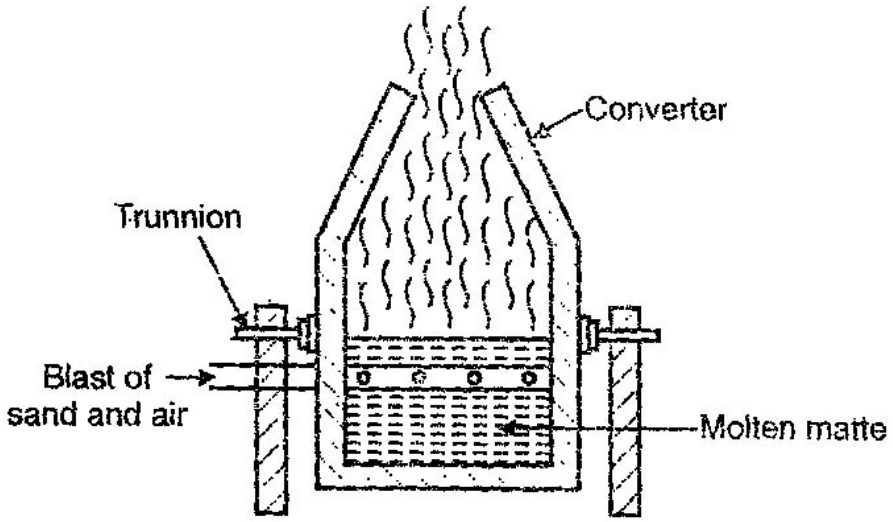
Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(j)	**Write the working of Daniel cell.**	2
		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.	1
		The emf of cell is 1.1 volt.	
		Cell reactions-	1
		At Anode $Zn \rightarrow Zn^{++} + 2e^-$	
		At Cathode $Cu^{++} + 2e^- \rightarrow Cu$	
		Net Reaction $Zn + Cu^{++} \rightarrow Zn^{++} + Cu$	
	(k)	**Write any two applications of silicon fluid.**	2
		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 repellence.	1
		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.	Mark each
		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.	
	(l)	**Define adhesive. Write two characteristics of Adhesive.**	2
		Adhesives- Any substance which is capable of holding the materials together by surface attachment is called as an adhesive	1
		Characteristics:- (Any two)	
		i) Adhesive should form rigid, strong and durable bond.	
		ii) It should be economical in use.	1
		iii) It should be odorless.	
		iv) It should not lose the adhesion property on storage.	Mark each
		v) It should be resistant to heat, chemicals and water.	

WINTER – 17 EXAMINATION

17211

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any FOUR of the following**	**16**
	a)	**Describe Bessemerisation process with the help of chemical reaction & diagram.**	**4**
			1
		After smelting the molten matte is then transferred to a Bessemer converter which is a pear shaped furnace made up of steel and internally lined with lime or magnesia. It is mounted on trunnions and can be tilted in any position. Furnace is provided with pipes known as twyers through which sand and hot air is blown into it. Following chemical reactions takes place in the Bessemer converter. (a) Conversion of FeS to slag	1
		$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$ **$FeO + SiO_2 \rightarrow FeSiO_3$** (b) Partial oxidation of Cu_2S to Cu_2O	
		$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ (c) Reduction of Cu_2O by Cu_2S to metallic copper **$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$** The molten metal obtained from the Bessemer converter is then poured into sand moulds and allowed to cool. On cooling dissolved SO_2 escapes out causing blisters on the surface of copper hence it is called as blister copper. It is 96 to 98% pure.	2

WINTER– 17 EXAMINATION

17211

Model Answer

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	b)	**Describe Bayer's process for extraction of Aluminium from bauxite.**	**4**
		Process:	
		i) The powered bauxite ore is roasted to convert ferrous oxide (FeO) to ferric oxide (Fe_2O_3).	1
		ii) This roasted ore is then heated with conc. NaOH.	1
		Aluminium oxide dissolves forming sodium meta aluminate, while Fe_2O_3 remains undissolved.	
		$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$	1
		Sodium meta aluminate	
		iii) Undissolved Fe_2O_3 is removed by filtration.	
		iv) The filtrate is diluted with water to form a precipitate of aluminium hydroxide [$Al(OH)_3$].	
		$NaAlO_2 + 2H_2O \rightarrow NaOH + Al(OH)_3 \downarrow$	1
		v) The precipitate of $Al(OH)_3$ is then filtered out, dried and heated at 1500^oC to get pure alumina.	
		$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$	
	C)	**Write the comoposition, properties & application of Tinmann's solder**.	4 2
		Composition = Sn = 66 % Pb = 34 %	1
		Properties: It melts at 180^oC .	
		Application:	1
		It is used for joining articles of tin.	
	d)	**Explain the mechanism of oxidation corrosion & name the type of oxide films.**	4
		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 equation.	
		$2M + O_2 \rightarrow 2MO$ (Metal Oxide) (Metal) (Oxygen)	
		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.	
		$M \rightarrow M^{2+} + 2e^-$ (loss of electrons) (Metal ion)	2
		$O + 2e^- \rightarrow O^{2-}$ (gain of electrons)	
		$M + O \rightarrow M^{2+} + O^{2-} \rightarrow MO$ (Metal oxide)	

WINTER– 17 EXAMINATION

Model Answer

Subject Code: 17211

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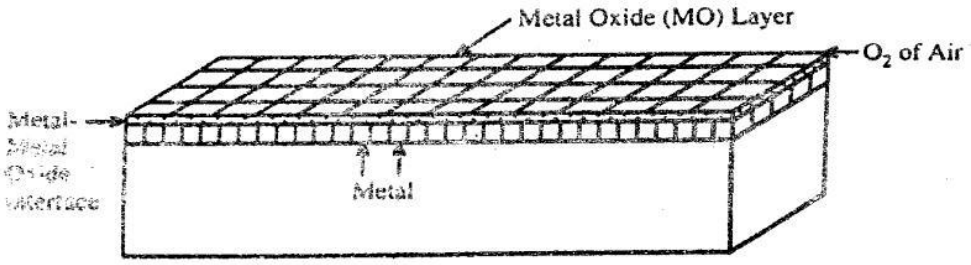
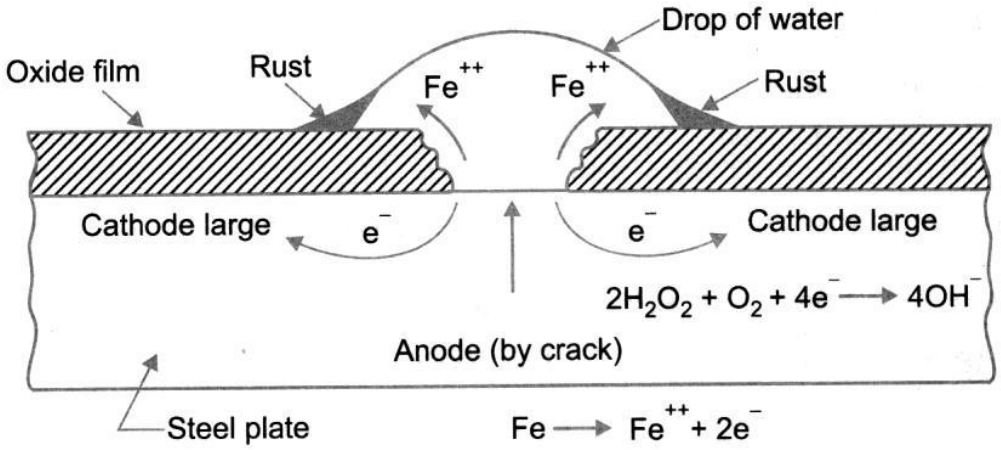
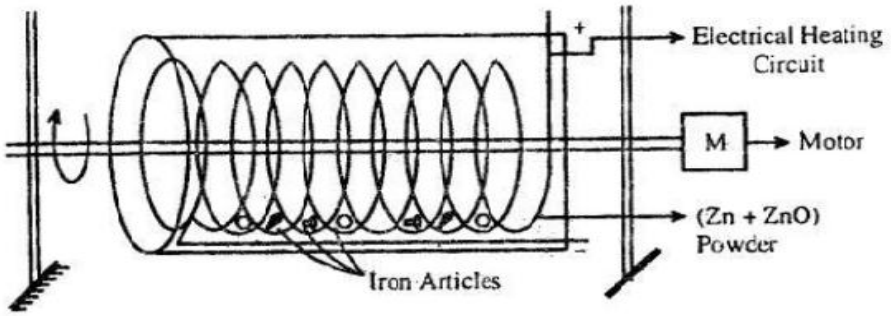
2.		 **Types of oxide films-** 1. Stable porous oxide film 2. Stable non porous oxide film 3. Unstable oxide film 4. Volatile oxide film **(Note: ½ Mark each of the types of oxide film)**	2
	e)	**Explain the mechanism of immersed corrosion by absorption of oxygen gas with diagram.** **Anode:** - Portion of crack **Cathode :-** Coated metal part 	4 **1**

WINTER– 17 EXAMINATION

17211

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.		**Process:** i) The surface of iron is usually coated with a thin film of iron oxide. However if this iron oxide film develops some cracks, anodic areas are created on the surface while the coated metal part acts as cathode. **At Anode:-** $Fe \rightarrow Fe^{++} + 2e^{-}$ The liberated electrons flow from anode to cathode areas. The electrons are reacting with water and dissolved O2. **At Cathode:-** $2H_2O + O_2 + 4e^{-} \rightarrow 4OH^{-}$ The **Fe^{2+}** ions at anode and **OH^{-}** ions at cathode diffuse and when they meet $Fe(OH)_2$ is precipitated. $Fe^{2+} + 2(OH)^{-} \rightarrow Fe(OH)_2 \downarrow$ If enough oxygen is present, $Fe(OH)_2$ gets converted into $Fe(OH)_3$ i.e. yellow rust. $4\,Fe(OH)_2 + O_2 + 2H_2O_4 \rightarrow Fe(OH)_3 \downarrow$	1 1 **1**
	f)	**Define cementation. Describe sherardizing with help of neat labeled diagram.** **Cementation: "**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."  **Process:** i) The iron 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 hours and its temp. is kept between 350 – 400^{o}C. iii) During this process Zn gets diffused slowly into iron forming Fe - Zn alloy at the surface which protects iron surface from corrosion.	4 **1** 1 2

WINTER– 17 EXAMINATION

Model Answer

17211

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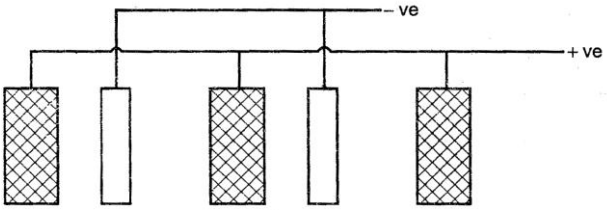
3.		**Attempt any FOUR of the following**	**16**
	a)	**Differentiate between primary and secondary cell.**	**4**

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 cannot 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

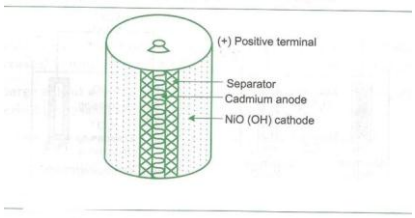
1

Mark each

b) **Explain the construction and working of Ni-Cd Cell.** **4**



OR **1**



WINTER – 17 EXAMINATION

17211

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.		**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. iii) Negative plates consist of spongy Cadmium. 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. **Working:** **A) Discharging:-** Positive Plate: $\mathbf{NiO_2(s) + 2H_2O\ (l) + 2e^- \rightarrow Ni\ (OH)_2\ (s) + 2OH^-}$ Negative Plate: $\mathbf{Cd\ (s) + 2OH^-(aq) \rightarrow Cd\ (OH)_2(s) + 2e^-}$ Net reaction: $\mathbf{NiO_2\ (s) + Cd(s) + 2H_2O \rightarrow Ni(OH)_2 + Cd(OH)_2}$ **B) Charging:-** Positive Plate: $\mathbf{Ni(OH)_2(s) + 2OH^-(aq) \rightarrow NiO_2(s) + 2H_2O + 2e^-}$ Negative Plate: $\mathbf{Cd(OH)_2(s) + 2e^- \rightarrow Cd(s) + 2OH(s)}$ Net reaction: $\mathbf{Ni(OH)_2 + Cd(OH)_2 \rightarrow NiO_2(s) + Cd(s) + 2H_2O}$ Thus, discharging & charging reactions can be shown simultaneously as: - $\mathbf{NiO_2(s) + Cd\ (s) + 2H_2O \leftrightarrows 2Ni(OH)_2 + Cd(OH)_2}$ **(Note: Consider 1 Mark each for Charging and Discharging Reaction)**	1 **1** **1**
	c)	**Define fuel cell. Give the advantages and limitations of H_2-O_2 fuel cell.** **Fuel cell:** Fuel cell is an electrochemical cell which converts the chemical energy of fuel directly into the electrical energy by an electrochemical process, in which the fuel is oxidized at the anode. **OR** Fuel cells are the devices which convert the energy produced during combustion of fuels directly into electrical energy (electricity).	4 2

WINTER– 17 EXAMINATION

Model Answer

Subject Code: 17211

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.		**Advantages of H_2-O_2 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. **(Note : Consider ½ Mark each)**	1
		Limitations of H_2-O_2 fuel cell: 1. They are carbonized when the air is blown through them. 2. The reduction of oxygen in alkaline solutions may lead to the formation of H_2O_2 instead of H_2O. 3. High initial cost. 4. High cost of pure hydrogen. 5. Lack of infrastructure for distributing hydrogen. 6. Liquefaction of hydrogen requires 30% of the stored energy. 7. Life span of the cells is not accurately known. **(Note : Consider ½ Mark each)**	1
	d)	**Write the charging and discharging reactions of lead –acid storage cell.**	4
		Discharging: - While discharging chemical energy gets converted into electrical energy.	1
		At Anode: - $\mathbf{Pb \rightarrow Pb^{2+} + 2e^-}$ **(Oxidation)** $\mathbf{Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4 \downarrow}$	1
		At Cathode:- $\mathbf{PbO_2 + 4\,H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O}$ **(Reduction)** $\mathbf{Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4\downarrow}$	1
		Net reaction during Discharging: - $\mathbf{Pb + PbO_2 + 4H^+ + 2SO_4^{2-} \rightarrow 2PbSO_4 \downarrow + 2H_2O + Energy}$	
		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.	1
		At Cathode: $\mathbf{PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}}$ At Anode: $\mathbf{PbSO_4 + 2\,H_2O \rightarrow PbO_2 + 4\,H^+ + SO_4^{2-} + 2e^-}$	1
		Net reaction during Charging: $\mathbf{2PbSO_4 + 2H_2O + Energy \rightarrow Pb + PbO_2 + 4\,H^+ + 2SO_4^-}$	

WINTER – 17 EXAMINATION

Model Answer

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3.	**e)**	**Define photo conductive polymer. Give its examples and applications.**	4
		Photo conductive polymer: These are the polymers which conduct electricity only in the presence of light.	1
		Examples: i) PVK or poly(N-vinyl carbazole) ii) Poly (vinylpyrene),iii) poly(2-vinyl carbazole)	1
		(Note : Any 1 example consider as 1 mark)	
		Applications: 1. Used extensive in photocopying (xerography), in laser printers. 2. Used as transistors and detectors. 3. Used in electronic devices, solar cells, batteries, photo-integrated circuit, space application etc. 4. Photoconductive material is connected as a part of circuit; it functions as a resistor, photo resistor. 5. Application of photoresist or is as photo detectors. 6. Some photo detector applications in which photo resistors are often used include camera light meters, street lights, clock radios and infrared detectors. **(Note: Applications to be consider as ½ mark each)**	2
	f)	**Give the applications of phenol formaldehyde resin.** 1) Insulation of electrical wires & cables electrical switches, switch board sockets, plugs for handles of iron & heaters. 2) Moulded articles like telephone parts, cabinets for radio & television. 3) Used as adhesive for grinding wheels & brake linings. 4) Hydrogen exchanger resin in water softening. 5) Paints, varnishes, bearings. 6) Propellers, Shafts for paper industry, rolling mills. 7) For impregnating fabrics, wood, paper for producing decorative laminates, wall covering & industrial laminates for electrical parts including printed circuits.	**4** **1** **Mark each**