SUMMER– 2018 EXAMINATION

Subject Name: Applied Chemistry **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.	Answers	Marking Scheme
1.		**Attempt any NINE of the following:**	**18**
	a)	**Name two ores of Aluminum with chemical formulae.**	**2**
		Ores of Aluminum:(Any two) i) Bauxite - $Al_2O_3 .2H_2O.$ ii) Corundum- Al_2O_3, iii) Feldspar - $KAlSi_3O_8$, iv) Mica - $[KAlSi_2O_{10}(OH)_2]$ v) Cryolite - Na_3AlF_6 vi) Alunite (Alumstone)- $K_2SO_4 .Al_2(SO_4)_3 .4Al(OH)_3$	1 mark each
	b)	**Name the sequential steps involved in extraction of copper from its copper pyrite ore.**	**2**
		i) Crushing and pulverization (powdering). ii) Concentration: a) Physical concentration by froth floatation. b) Chemical concentration by roasting. iii) Reduction by smelting. iv) Bessemerisation of copper matte. v) Electrolytic refining of blister copper.	½ mark each

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1.	c)	**Write the action of Conc. HNO_3 on Aluminium metal.**	**2**
		Aluminum metal **does not react** with dilute as well as concentrated Nitric acid.	2
	d)	**State the factors affecting immersed corrosion.**	**2**
		(Any Four): i) Position of metal in electrochemical series. ii) Purity of metal iii) Nature of the oxide film. iv) Solubility of corrosion products. v) Physical state of the metal vi) Relative areas of anode and cathode. vii) Effect of pH viii) Humidity ix) Temperature x) Differential aeration xi) Environmental impurities xii) Conductance of medium.	½ mark each
	e)	**Write two application 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)	**Galvanized containers are not used for storage of food. Give reason.**	**2**
		Galvanized utensils (zinc coated) cannot be used for preparing and storing food stuff, which are acidic in nature because zinc gets dissolved in dilute acids in food forming poisonous zinc compounds which will poison the content.	2

Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	g)	**Name any two constituents of paints with two functions of each.**	2
		Constituents of paint:(Any two) 1. Pigments 2. Vehicle or medium (drying oil) 3. Thinners 4. Driers 5. Fillers 6. Plasticizers	½ mark each
		Functions of various constituents: **Pigments:** i) Provides opacity and desired colour to the paint film. ii) Gives pleasing (aesthetical) look to the paint. iii) Gives protection to the paint by reflecting U.V.light. iv) Provide resistance to the paint film against abrasion or wear and weather.	½ mark each
		Vehicle or medium (drying oil) : i) It is a film forming constituent of paint. ii) It provides a durability and water proof-ness to the film. iii) It provides toughness to the film. iv) It provides adhesion to the film.	
		Thinners: i) They hold pigments in paint. ii) They dissolve film forming materials. iii) They reduce the viscosity of paint. iv) They help drying of paint. v) They increase the elasticity of paint film.	
		Driers : i) They improve the drying quality of paint. ii) They act as oxygen carrier catalyst. iii) They accelerate the drying of paint film by oxidation, polymerization & evaporation.	
		Fillers or Extenders : i) They reduce the cost of paint. ii) They provide durability to the film. iii) They reduce the cracking of the paint film. iv) They increase the random arrangement of pigmented particles. v) They help to fill the voids in the film. vi) They act as carrier for the pigment colour.	

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Q. No.	Sub Q. N.	Answers	Marking Scheme
1.		**Plasticizers :** i) To give elasticity to the paint film. ii) To prevent the cracking of the film. **[Note: Any two functions of any two constituents 1 mark]**	
	h)	**Define the term equivalent conductance. Write its unit.**	**2**
		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	1 1
	i)	**Why does a dry cell became dead after a long time even if it has been not used?**	**2**
		Acidic NH_4Cl slowly corrodes the zinc container of the dry cell, even when the cell is not in use. Hence dry cell becomes dead after a long time, even if it is not used.	2
	j)	**Write any two advantages of Adhesives.**	**2**
		i) Adhesives have an advantage of joining material such as glass & metal, metal – metal, metal & plastic, plastics-plastic, ceramic & ceramic. ii) Surfaces are easily & rapidly attached to each other by adhesives. iii) Adhesives introduce heat as well as electrical insulating layers in between the bonding surfaces. iv) The process of applying adhesives is very simple, so it does not require highly specialized person. v) In several cases of bonding by adhesives, no high heat is required. vi) Metal joined by an adhesive can resist corrosion. vii) Adhesive joints are leak proof for gases & liquids. So adhesive bonding is used in preparing water tight wood boats	1 mark each

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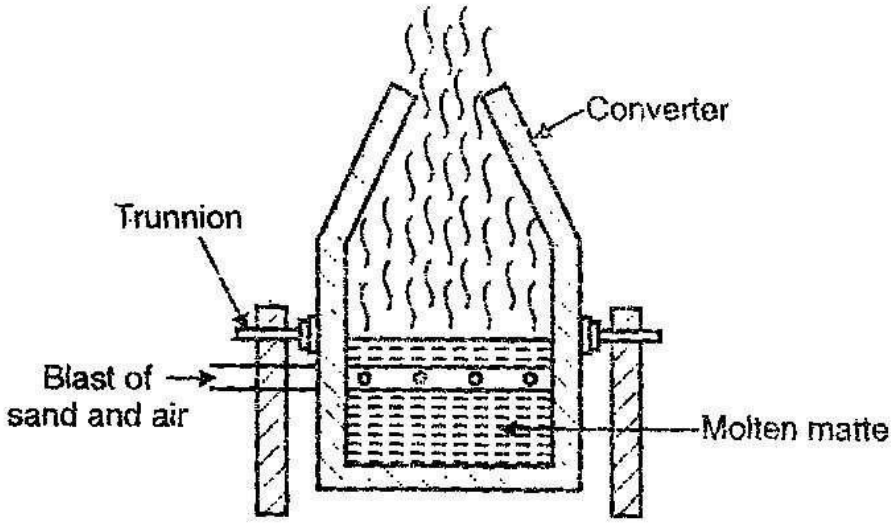
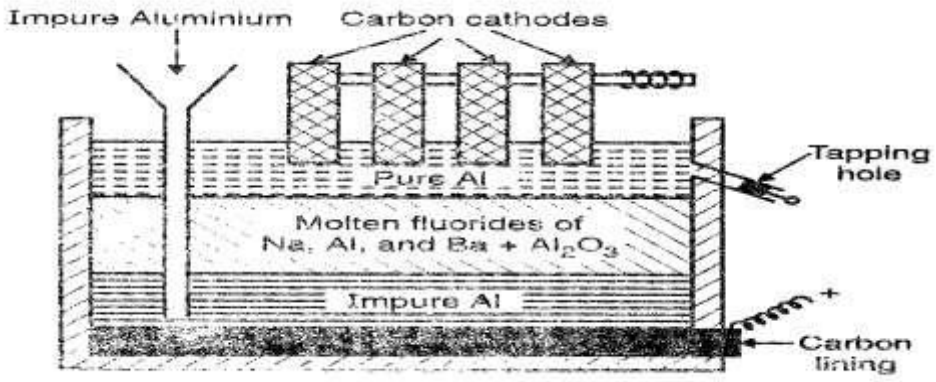
Q. No.	Sub Q. N.	Answers	Marking Scheme
1.	k)	**Give any two points of difference between Dielectrics and insulators**	2

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.

1 mark each

	l)	**Writ two applications of phenol formaldehyde resin as an adhesives.** i) Adhesive for grinding wheels & brake linings. ii) Used for making water proof plywood' laminate and bonding article in aircraft and ship building industries.	2 1 mark each

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.		**Attempt any four of the following**:	**16**
	a)	**Describe Bessemerization process with neat labeled 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.	1
		(a) Conversion of FeS to slag **$2FeS + 3O_2 \xrightarrow{\text{FO NE}} 2FeO + 2SO_2$** **$FeO + SiO_2 \xrightarrow{\text{FO NE}} FeSiO_3$**	2
		(b) Partial oxidation of Cu_2S to Cu_2O **$2Cu_2S + 3O_2 \xrightarrow{\text{FO NE}} 2Cu_2O + 2SO_2$**	
		(c) Reduction of Cu_2O by Cu_2S to metallic copper **$2Cu_2O + Cu_2S \xrightarrow{\text{FO NE}} 6Cu + SO_2$**	
		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	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2	b)	**Explain electrolytic refining of aluminium with neat labelled diagram.**	4
			1
		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 1 1
	c)	**Write composition, properties and applications of rose metal.**	4
		Composition: Bi = 50% , Pb = 28% , Sn = 22%	2
		Properties: 1. It is easily fusible alloy 2. It's melting point is 89 ^{0}C	1
		Applications: 1. It is used for making fire – alarms, fuses wires. 2. It is used for casting of dental works 3. It is used in automatic sprinkler system. **(Consider any two properties and two applications)**	1

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	d)	**Differentiate 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 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

[Note: Consider any four difference points]

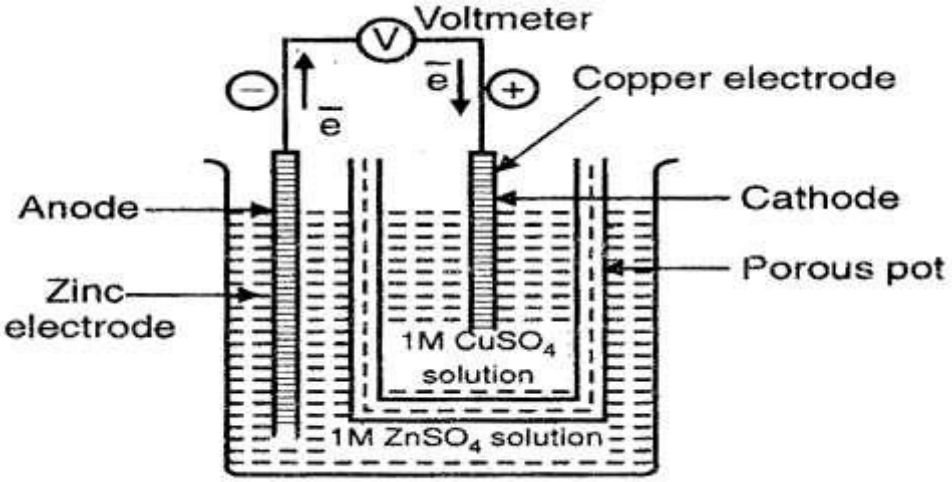
e) Explain construction and working of Daniel cell. **4**

Construction:-

It consists of zinc electrode dipped in $ZnSO_4$ Solution & Copper electrode dipped in $CuSO_4$ solution. 1

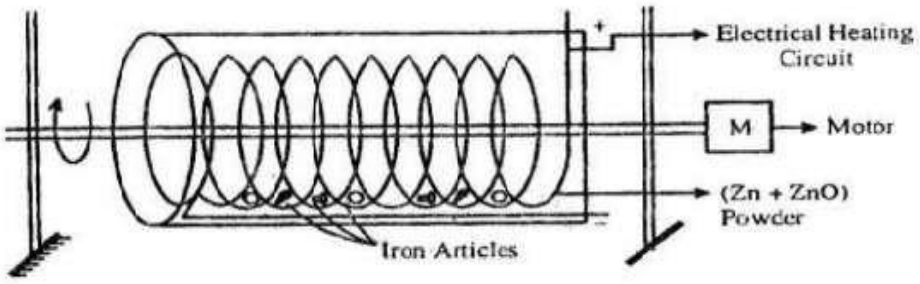
The two solutions are separated by a porous pot.

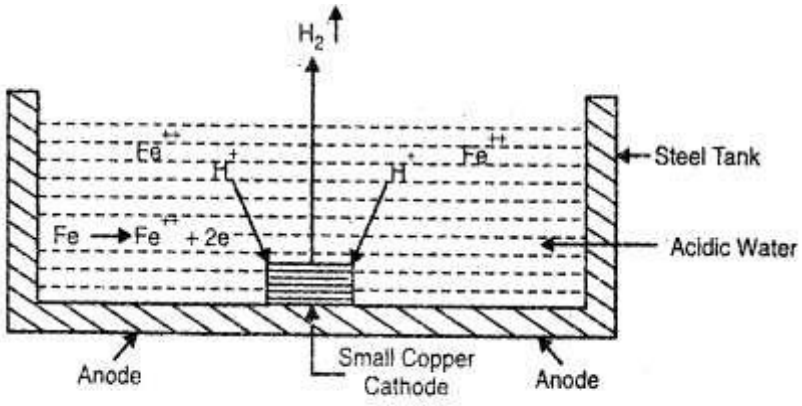
The two solutions can seep through the pot & so comes in contact with each other automatically. Thus, porous partition acts as a salt bridge.

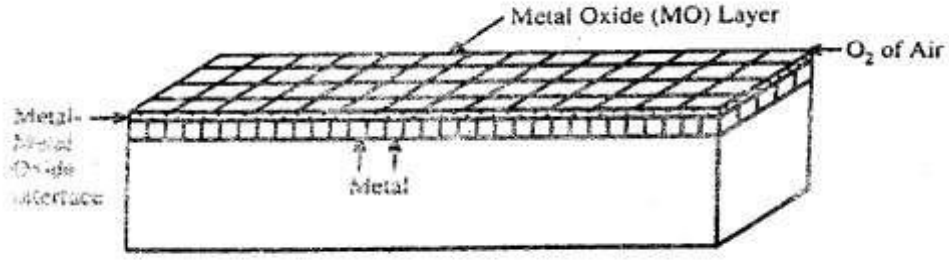
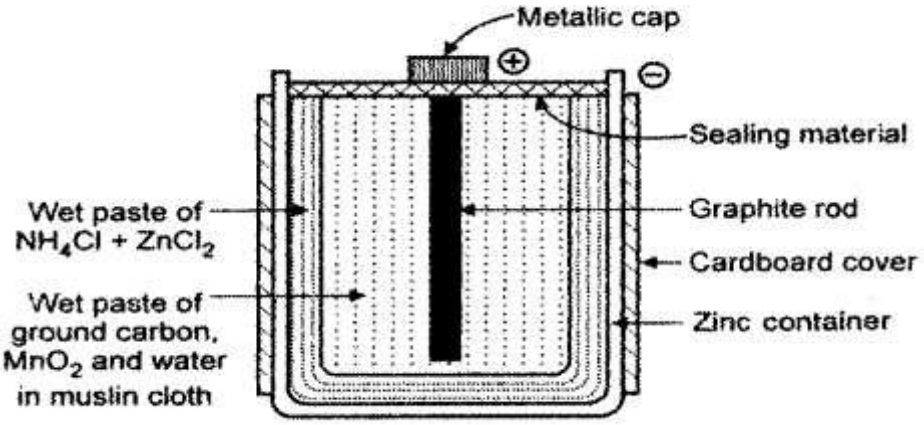


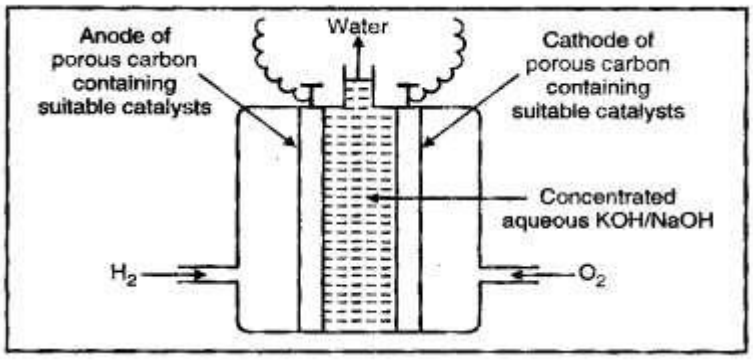
1

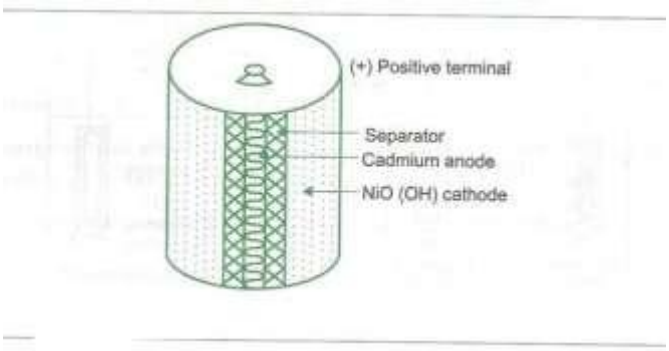
Working:- The tendency of Zn to form Zn^{++} is greater than the tendency of Zn^{++} to get deposited as Zn on the electrode. Therefore Zn goes into the solution forming Zn^{++}. On the other hand tendency of Copper to go into the solution is less than the tendency of Cu^{++} to get deposited as Cu & hence copper electrode becomes positively charged. The emf of cell is 1.1 volt.

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	e)	**At Anode** $Zn \longrightarrow Zn^{++} + 2e^{-}$ **Oxidation** **At Cathode** $Cu^{++} + 2e^{-} \longrightarrow Cu$ **Reduction** **Net Reaction** $Zn + Cu^{++} \longrightarrow Zn^{++} + Cu$ **[Note: 1mark each to be given to reaction at anode & cathode.]**	2
	f)	**Give any four application of electrically conducting polymers.** **(Any Four):** 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	**4** 1 mark each
3.		**Attempt any four of the following:**	**16**
	a)	**Draw diagram and explain sherardizing process.**	**4**
			2
		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. It is used for protecting small steel articles like bolts, screws, nuts, threaded parts, washers, valves, gauge, tools etc.	2

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	b)	**Describe hydrogen evolution mechanism of immersed corrosion.**	**4**
			1
		Steel tank: - Anode **Cu – strip:- Cathode** This types of corrosion occurs usually in acidic environments, like industrial waste, solutions of non – oxidizing acids (like HCl).	1
		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. **The reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^-$** These electrons flow through the metal from anode to the cathode	1
		At cathode **H^+ ions are eliminated as H_2 gas** **$2H^+ + 2e^- \longrightarrow H_2$** Over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2$** **[Note: 1mark each to be given to reaction at anode & cathode.]**	1
	c)	**Define atmospheric corrosion. Write mechanism of atmospheric corrosion with diagram.**	**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.	1

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	c)	 **Mechanism:** Metallic surfaces when exposed to air undergo oxidation and the process of corrosion is represented by the equation. $2M + O_2 \xrightarrow{\text{FORE}} 2MO$ (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. $M \xrightarrow{\text{FORE}} M^{2+} + 2e^-$ (loss of electrons) (metal ion) $O + 2e^- \xrightarrow{\text{FORE}} O^{2-}$ (gain of electrons) --- $M + O \xrightarrow{\text{FORE}} M^{2+} + O^{2-} \xrightarrow{\text{FORE}} MO$ (Metal oxide)	1 2
	d)	**Describe construction and working of dry cell with neat labeled diagram.** 	**4** 1

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	d)	**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. **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. **$2NH_4^+ + 2\ MnO_2 + 2\ e^- \rightarrow Mn_2O_3 + H_2O + 2NH_3 \uparrow$** EMF / potential of cell is 1.5 V	1 2
	e)	**Describe construction and working of H_2-O_2 fuel cell.**	**4**
			1
		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

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	e)	**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)	**Explain construction and working of Ni-Cd cell with labeled diagram.**	**4**
			1
		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.	1

Q. No.	Sub Q. N.	Answers	Marking Scheme
3.	f)	**Working:** **A) Discharging:-** Positive Plate: $NiO_2(s) + 2H_2O(l) + 2e^- \rightleftharpoons Ni(OH)_2(s) + 2OH^-$ Negative Plate: $Cd(s) + 2OH^-(aq) \rightleftharpoons Cd(OH)_2(s) + 2e^-$ Net reaction: $NiO_2(s) + Cd(s) + 2H_2O \rightleftharpoons Ni(OH)_2 + Cd(OH)_2$ **B) Charging:-** Positive Plate: $Ni(OH)_2(s) + 2OH^-(aq) \rightleftharpoons NiO_2(s) + 2H_2O + 2e^-$ Negative Plate: $Cd(OH)_2(s) + 2e^- \rightleftharpoons Cd(s) + 2OH(s)$ Net reaction: $Ni(OH)_2 + Cd(OH)_2 \rightleftharpoons NiO_2(s) + Cd(s) + 2H_2O$ Thus, discharging & charging reactions can be shown simultaneously as: - $NiO_2(s) + Cd(s) + 2H_2O \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$ **(Note: Consider 1 Mark each for Charging and Discharging Reaction)**	1 1