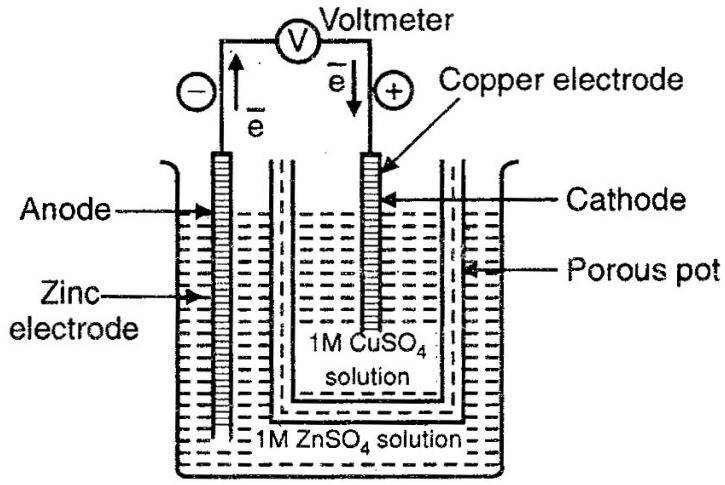
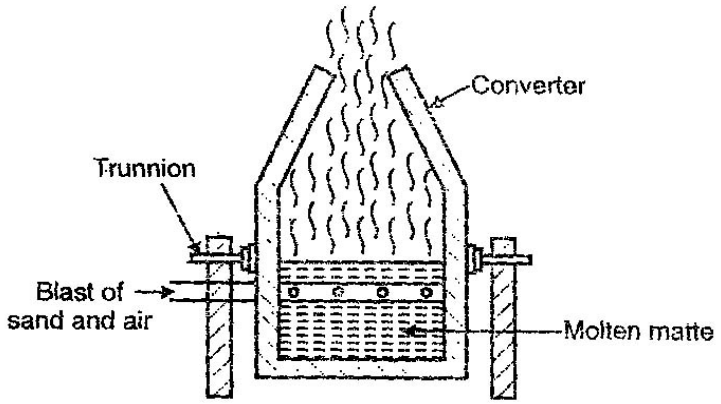
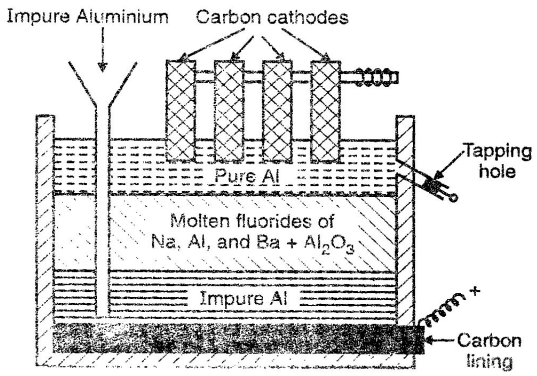
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the 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)	**Define the term metallurgy. Name the process of extraction of Aluminium.** **Metallurgy:-**The process of extraction of metal from its ore economically & profitably is called as metallurgy. The process used for extraction of Aluminium metal is **Bayer's process, Electrolytic reduction of alumina, Electrolytic refining.**	**1** **1**	**2**
	b)	**Name any two ores to Copper and Aluminium each.** **(Any two ores of Copper or Aluminium: 1 mark each)**	**1** **1**	**2**
	c)	**Write the action of Nitric acid on Aluminium** Aluminium metal **does not react** with dilute as well as concentrated Nitric acid	**2**	**2**
	d)	**State the two methods of Hot dipping.** Two methods of hot dipping-1. **Galvanizing** 2. **Tinning**	**1 Mark each**	**2**
	e)	**Why tinned container's are used for storage of food.** Tin coated containers are used for storing the food stuffs because tin is a less active metal and hence does not react with the food stuffs.	**2**	**2**
	f)	**Define paint. Name the constituents of paint.** **Paint:-** Paint is a mechanical dispersion mixture of one or more pigment in a vehicle **Constituents of paint-1.**Pigment **2.** Drying oil or vehicle **3.**Thinner **4.** Drier **5.** Plasticizer **6.** Extenders **(Any two constituents)**	**1** **1/2 Mark each**	**2**

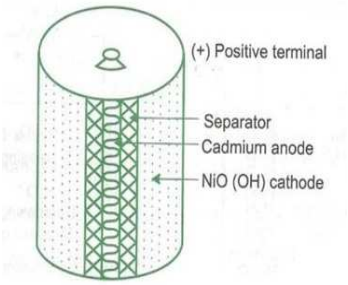
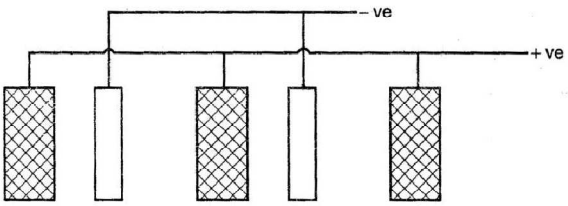
Sr.No.	Ores of Copper	Ores of Aluminium
1	Cuprite or ruby copper	Bauxite
2	Copper glance	Corundum
3	Copper pyrite	Cryolite
4	Malachite	Feldspar
5	Azurite	Alunite or Alumstone

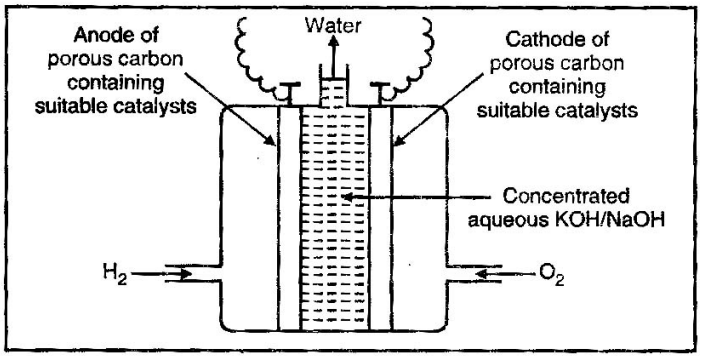
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	**g)**	**State the factors affecting the rate of atmospheric corrosion.** The factors affecting the rate of atmospheric corrosion are:- 1. Moisture present in the atmosphere 2. Impurities present in the atmosphere.	**1** **Mark each**	**2**
	h)	**Draw the labeled diagram of Daniel cell.**  	**2**	**2**
	i)	**Distinguish 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)	**Define extrinsic polymers with example.** **Extrinsic polymer-** The electrical conductivity of polymers can be increased by doping with a charge transfer agent or by making their composites with other conducting materials like carbon black,metal fibers etc. Such polymers which are formed by doping are called as extrinsic polymer Examples-Trans-polyacetylene, polyparaphenylene, polypyrrole, polyaniline etc. **(Any one example)**	1 1	2

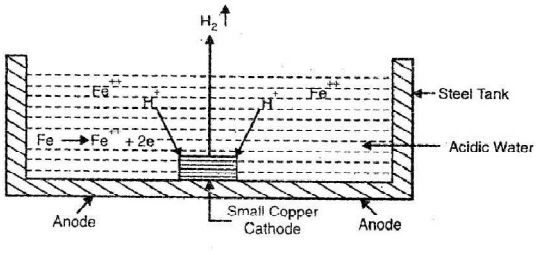
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1	k)	**Define dieletric's and insulators with examples.**		2
		Dielectrics: The materials which are used to prevent the loss of electricity through certain parts of an electrical system are known as dielectrics	1	
		Insulators: Insulators or insulating materials are the substances which retard the flow of heat or electricity or sound through them		
		Examples- Air, N_2 gas , CO_2 gas, Silicon fluid etc	1	
		Examples- Rubber, Plastics etc.		
		(Any one example of each)		
	l)	**Write two applications of Teflon.**		2
		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.	1 Mark each	
		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.		
		(Any Two applications)		
2		**Attempt any FOUR of the following**		
	a)	**Describe Bessimerisation process with neat labeled diagram.**		16
		Bessemer converter		4
			1	

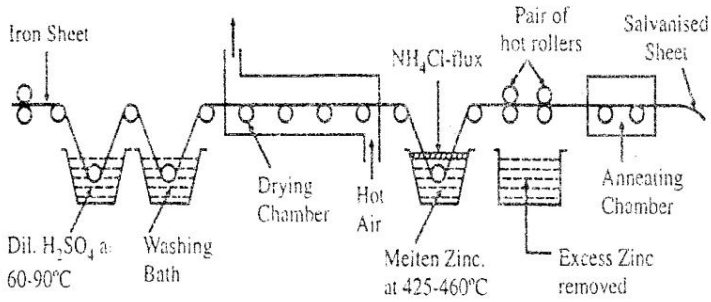
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		After smelting the molten matte is then transferred to a Bessemer converter which is a pear shaped furnace made up of steel and internally lined with lime or magnesia. It is mounted on turnnions and can be tilted in any position. Furnace is provided 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 $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2\uparrow$ $FeO + SiO_2 \longrightarrow FeSiO_3$ (b) Partial oxidation of Cu_2S to Cu_2O $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2\uparrow$ (c) Reduction of Cu_2O by Cu_2S to metallic copper $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2\uparrow$ 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.	**1** 2	
	b)	**Explain the process electrolytic refining of Aluminium**  The electrolytic cell consists of an iron tank lined at the bottom with carbon, which serve as anode. A no. of graphite rods serve as cathode. The cell is filled with three liquid layers of different densities 1.The top most layer consists of molten pure aluminium which acts as cathode. 2.The middle layer is of electrolyte which consist of a mixture of molten fluorides of Al , Ba & Na.	1	4

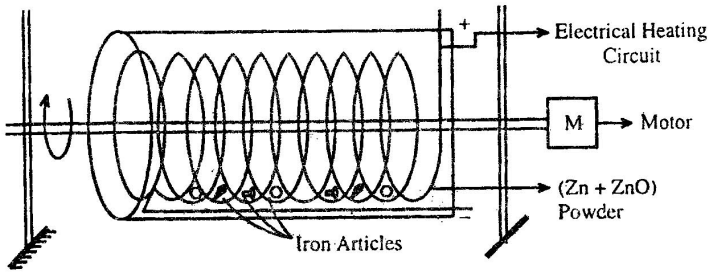
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		3. The bottom layer consists of molten impure aluminium. On passing electric current, the aluminium ions from the middle layer discharged at the cathode and get collected in the top most layers. Same amount of aluminium ions from the bottom layer 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.	**3**	
	c)	**Write composition, properties and applications of rose metal** **Rose metal:** **Composition:** Bi = 50% Pb = 28% Sn = 22% **Properties:** **1.**It is easily fusible alloy **2.** It's melting point is 89 ^{0}C **Applications:** **1**. It is used for making fire – alarms, fuses wires. **2**. It is used for casting dental works **3**. It is used in automatic sprinkler system. **(Any two applications)**	**2** 1 1	**4**
	d)	**Write down properties and use of ceramics.** **Properties of ceramics:-** **1.** They are hard, brittle and impervious materials made up of clay, feldspar and quartz. **2.** They have very high softening point above 1800^{0}C. **3.** They are thermally stable upto softening point. **4.** They are good electrical insulators. **5.** They have high thermal conductivity. **6.** They are stable in oxidizing and reducing atmosphere. **7.** They have very high chemical resistance. **8**. They have low coefficient of expansion and hence they can withstand sudden change in temperature. **9**. They are resistant to corrosion and abrasion. **10**. They are rigid solid insulators. **Uses of ceramics:-** **1**. They are used for low frequency insulation such as bushings, pin type insulators in telephones, switch bases, wire beds etc. **2**. They are used for high frequency insulation at high temperature such as heater elements, arc chembers, in high voltage circuits. **3**. Due to their good dielectric properties they are used in tube sockets, radio, radar and T.V. switches, in condensers, in ultra violet lamps and in scientific instruments. (**Any two properties & any two uses)**	**2** **2**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2	**e)**	**Explain the construction and working of Ni-Cd cell.**		**4**
			**1**	
		Or		
				**4**
		(Consider any of these two diagrams.)		
		Construction: 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. 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: $\mathbf{NiO_{2(s)} + 2H_2O\ (l) + 2e^- \longrightarrow Ni\ (OH)_{2\ (s)} + 2OH^-}$ Negative Plate: $\mathbf{Cd_{\ (s)} + 2OH^-_{(aq)} \longrightarrow Cd\ (OH)_{2(s)} + 2e^-}$ Net reaction: $\mathbf{NiO_{2\ (s)} + Cd_{(s)} + 2H_2O \longrightarrow Ni(OH)_{\ 2} + Cd(OH)_2}$	1	
		B) Charging:- Positive Plate: $\mathbf{Ni(OH)_{2(s)} + 2OH^-_{(aq)} \longrightarrow NiO_{2(s)} + 2H_2O + 2e^-}$ Negative Plate: $\mathbf{Cd(OH)_{\ 2(s)} + 2e^- \longrightarrow Cd_{(s)} + 2OH^-_{(aq)}}$ Net reaction: $\mathbf{Ni(OH)_2 + Cd(OH)_2 \longrightarrow NiO_{2(s)} + Cd_{(s)} + 2H_2O}$	1	
		Thus, discharging & charging reactions can be shown simultaneously as: $\mathbf{NiO_{2(s)} + Cd_{\ (s)} + 2H_2O \longrightarrow 2Ni(OH)_{\ 2} + Cd(OH)_2}$		
		Cell has an e.m.f. of 1.4 v when fully charged.		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.	**f)**	**Define fuel cell with proper labeled diagram, give its advantages, applications and limitations.**		**4**
			**1/2**	
		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.	**1/2**	
		Advanteges:- (Any two) 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. H2 – O2 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 H2 – O2 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	**1**	
		Applications:- (Any two) 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	1	
		Limitations:-(Any two) 1. High initial cost. 2. Large weight & volume of gas fuel storage systems. 3. High cost of pure hydrogen. 4. Lack of infrastructure for distributing hydrogen.	1	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		5. Liquification of hydrogen requires 30% of the stored energy. 6. Life time of the cells is not accurately known.		
3.		**Attempt any FOUR of the following**		
	a)	**Explain different types of oxide film formed due to attack of oxygen. Which is the most protective ones?**		**16**
		There are four types of oxide films: **1.Stable porous oxide film** In this case the volume of metal oxide formed is less than the volume of the metal from which it is formed. Hence this film possesses pores or cracks in the structure. Through these pores, atmospheric oxygen can enter and attack the metal. Hence it is non protective oxide film. **Examples.-**Such type of oxide film is formed in alkali metals like Li, K, Na and alkaline earth metals like Ca, Sr, Mg. **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. **Example:** Such type of oxide film is formed in the metals like Al, Sn, Cu, Pb etc. **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. **4.Volatile oxide film:-** In this case, metal oxide formed is volatile. It vaporizes as soon as it is formed. Hence fresh metal surface is exposed to the atmospheric oxygen.In these metals rate of corrosion is very fast. Example- Such type of oxide film is formed in the metals like Mo.	**3**	**4**
		Stable nonporous oxide film or Unstable oxide film are more protective. **(Any three relevant film 1 mark each)**	1	
	b)	**Explain the process hydrogen evolution mechanism**  	1	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.		**Steel tank: - Anode** **Cu – strip:- Cathode** Such type of corrosion occurs usually in acidic environments like acidic industrial waste, solutions of non – oxidizing acids. Consider 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. **Reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^-$** 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** **2**	**4**
	c)	**Describe the process galvanizing for protection of metal from corrosion. Write its applications and limitations.**  It is the process of coating iron or steel sheets with a thin coat of zinc to prevent it from rusting. **Process:** The iron or steel sheet to be galvanized is first cleaned with dilute H_2SO_4 to remove any oxide layer or impurities. It is then washed with water to remove acid completely. Then it is dipped in a bath of zinc ammonium chloride solution which helps to adhere the molten zinc and then sheet is passed through drier to dry it completely. Then the sheet is dipped in a bath of molten zinc at 425 °C to 460 °C temperature and passed through series of rollers to remove excess zinc and to get uniform coating. Finally it is annealed at 650°C. **Applications:-** It is widely used for protecting iron article which are exposed to the atmosphere such as roofing sheets, fencing wires, pipes, bolts, screws, nails, buckets, tubs etc.	1 1 1	**4**

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.		**Limitations:-** **1.**Galvanised containers can not be used for storing food stuffs because zinc react with weak organic acids present in the food stuffs to produce poisonous zinc compounds.	**1**	**4**
	d)	**Explain the sherardising process with proper diagram.**  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 hrs. and its temp. is kept between 350 – 400^{0}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.	**1** **3**	**4**
	e)	**Define charging, discharging, specific resistance and Ohm's law.** **Charging:-** It is the operation of the cell in which external source of current reverses the electrochemical cell reaction in order to restore the battery to its original fully charged state. **Discharging:**- It is the operation of the cell in which current flows spontaneously from the battery into the external circuit. **Specific resistance**:- It is the resistance offered by the conducting material having unit length and unit area of cross section. **Ohm's law:-** The strength of current (I) passing through a conductor is directly proportional to the potential difference (E) applied across the conductor & inversely proportional to the resistance (R) of a conductor.	**1** Mark each	4

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3	**f)**	**Define adhesives, give its characteristics and advantages** **Adhesives:-** Any substance which is capable of holding the materials together by surface attachment is called as an adhesive. **Characteristics:-** i)Adhesive should form rigid ,strong and durable bond ii)It should be economical in use iii) It should be odourless iv) It should not lose the adhesion property on storage v) It should be resistant to heat, chemicals and water. **Advantages:-** i)Adhesives have an advantages 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 (**Any three characteristics and any three advantages)**	**1** **1 &1/2** **1 &1/2**	**4**