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.		**Answer any NINE:**		**18**
	a)	**Name two oxide ores of iron. Write their chemical formulae**. Oxide ores of Iron **Name of Ores** | **Chemical Formula** Haematite | Fe_2O_3 Magnetite | Fe_3O_4 Limonite | $2Fe_2O_3, 3H_2O$ (Any two oxide ore along with chemical formula -1 mark each)	**1** **1**	**2**
	b)	**Why do a blast furnace attain maximum temperature in the fusion zone?** The blast furnace attains the maximum temperature in the zone of fusion because in this zone the coke present in the charge gets oxidized by hot blast of air introduced through twyers and forms CO_2 along with the liberation of heat. $C + O_2 \longrightarrow CO_2 + 97$ KCal	**1** **1**	**2**
	c)	**Define alloy steel. Give any two examples of alloy steel.** **Alloy Steel:** - Alloy steels are those steels which are prepared by addition of small amount of one or more alloying elements (such as Nickel, Chromium, Cobalt, Vanadium, Manganese, etc) into plain carbon steel. **Example: -** Spring Steel, Tool steel, High speed steel, Magnetic steel, Shock absorbing steel **(Any two examples : 1 mark)**	**1** **1**	**2**
	d)	**Name factors affecting atmospheric corrosion**. Factors affecting atmospheric corrosion are 1. Presence of impurities in the atmosphere. 2. Presence of moisture in the atmosphere.	**1 mark each**	**2**
	e)	**State two constituents of paint and one function of each.** Constituent of Paint | Function 1. Pigment | 1.Impart Color, opacity, aesthetic look 2. Protect paint film by reflecting ultra violet light.		**2**

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1.		2. Drying oil or medium: 1. Film forming constituent. 2. Impart water proofness and durability. 3. Thinner: 1. Reduce the viscosity of the paint. 2. Dissolve film forming constituent and suspend the pigment. 4. Driers: 1.Acts as the oxygen carrier catalyst and 2.Improve the drying quality of the paint. 5. Extenders: 1. Increases the durability of the paint 2. Acts as a pigment carrier. 6. Plasticizers.: 1. Prevent cracking. 2. Impart elasticity. **(Any two constituent along with one function-1 mark each)**	2	
	f)	**What is cathodic protection? Give an example.** **Cathodic protection:-** In this process base metal is made cathodic either by connecting it with some more active metal or by using impressed current in order to protect it from corrosion. **Example: -** To protect underground steel pipes they are connected to Zn or Mg bars. (**Any other example-1 mark)**	1 1	2
	g)	**Distinguish between galvanizing and tinning.** **Galvanizing** vs **Tinning**: 1. It is the process of coating iron or steel sheet with zinc metal in order to protect it from corrosion. vs 1. It is the process of coating iron or steel sheets with tin metal in order to protect it from corrosion.. 2. It is coating of more active metal. vs 2. It is the coating of less active metal. 3. Galvanized containers cannot be used for storing food stuffs. vs 3. Tinned containers are widely used for storing food stuffs. 4. In galvanizing articles zinc continues to protect the underlying iron by galvanic cell action even if coating of zinc is punctured or broken at some places. vs 4. In tin coated articles, tin is non-toxic and protects the underlying iron till the coating is perfect. Any break in coating cause rapid corrosion of iron. **(Any two points -1 mark each)**	1 mark each	2

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1	h)	**Write simple test to identify soft water and hard water.** Simple test to identify the soft water and hard water is a soap test. If the water forms good lather with the soap solution then it is soft water. If the water does not form a good lather but forms a white scum with the soap solution then it is hard water.	1 1	2
	i)	**How can the exhausted permutit or zeolite be regenerated.** Exhausted Permutit or Zeolite regenerated by using 10 % brine (NaCl) solution. $CaP + 2NaCl \longrightarrow Na_2P + CaCl_2$ $MgP + 2NaCl \longrightarrow Na_2P + MgCl_2$ **(Any one reaction-1 mark)**	1 1	2
	j)	**How is sterilisation of water carried out by bleaching powder? Write chemical reaction.** About 1 Kg of bleaching powder is added per 1000 litres of water and the resulting mixture is allowed to stand for several hours. Bleaching powder reacts with water to form chlorine gas which further reacts with water to form hypochlorus acid and nascent oxygen,both are powerful germicides. Following chemical reactions takes place during the process, $CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2$ $Cl_2 + H_2O \longrightarrow HOCl + HCl$ $HOCl \longrightarrow HCl + [O]$	1 1	2
	k)	**Write two properties of Plaster of Paris.** Properties- 1.When Plaster of Paris is mixed with water it forms a plastic mass which quickly sets to a hard mass. 2.The mass formed after setting is water proof	1 mark each	2
	l)	**What is slaking of lime?** When 3 parts of lime is mixed with 1 part of water the chemical reaction takes place between them it is known as slaking of lime. **$CaO + H_2O \xrightarrow{\text{Hydration}}$ $Ca(OH)_2$ + Heat (15.9 KCal)** **Quick time slaked lime**	1 1	2

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2		**Answer any FOUR**		16
	a)	**Write the chemical reactions taking place in the zone of heat absorption of a blast furnace.** Chemical reactions taking place in the zone of heat absorption: 1. $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO\uparrow$ 2. $CO_2 + C \longrightarrow 2\,CO - 39$ Kcal 3. $CaO + SiO_2 \longrightarrow CaSiO_3$ Flux gangue slag 4. $SO_2 + 2C \longrightarrow S + 2CO\uparrow$ 5. $SiO_2 + 2C \longrightarrow Si + 2\,CO\uparrow$ 6. $P_2O_5 + 5C \longrightarrow 2P + 5CO\uparrow$ 7. $MnO_2 + 2C \longrightarrow Mn + 2CO\uparrow$ **(Any four reactions: 1 mark each)**	1 mark each	4
	b)	**How are steels classified on the basis of percentage of Carbon? Write composition, properties and applications of any one of them.** Classification of steel on the basis of percentage of carbon : 1. Low carbon Steel 2. Medium carbon Steel 3. High carbon steel • **Low Carbon Steel :** **Composition :** It contains **0.05 to 0.3 % of carbon** and remaining is iron. **Properties :** 1. It is soft ,malleable and ductile. 2. It responds to heat treatment. 3. It is weldable. 4. It has low tensile strength. **Applications:** It is used for preparation of soft wires, chains, nails, bolts, rivets, boiler tubes etc. • **Medium Carbon Steel :-** **Composition:** - It contains **0.3 To 0.6 % of Carbon** and remaining is iron. **Properties :-** 1. It is harder and tougher than low carbon steel. 2. It is hardened by heat treatment. 3. It has high tensile strength than low carbon steel. 4. It is shock proof. 5. It cannot be welded easily	1 3	4

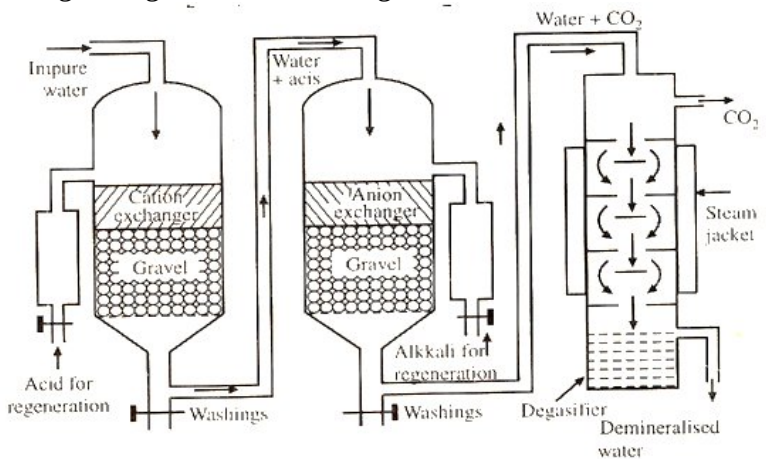
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		**Applications :-** 1. It is widely used in railway industry for rail road, wheel, and axels. 2. It is also used for fish plates, armature and crank shaft, turbine rotors, springs, gun parts and machine parts. • **High Carbon Steel:-** **Composition:** - It contains **0.6. To 1.5 % of Carbon** and remaining is iron. **Properties :-** 1. It is very hard and has high wear and tear resistance. 2. It produces keen cutting edges. 3. It is unweldable. 4. It has highest tensile strength. **Applications :-** 1. It is used for wood working tools like files ,chisels, saws, drills. 2. It is used for metal cutting tools like cutter, knives, blades razors etc. **[Note: For any one steel Composition: 1mark, Any two properties:1 mark, Any two applications: 1 mark]**		
	c)	**Define heat treatment. Name its methods. Explain any one of them.** **Heat treatment:-**The process of heating steel to a certain high temperature and then cooling it at a controlled rate in order to develop certain physical properties without changing its chemical composition is known as heat treatment of steel. **Methods of heat treatment :-** 1. Hardening or quenching 2. Tempering 3. Annealing 4. Normalizing **Hardening or Quenching** In this process steel is heated to a high temperature at about **800^{o}C-900^{o}C** and then suddenly cooled it by dipping or quenching in some suitable quenching medium The quenching medium generally used is either cold water or mineral oil or animal oil or vegetable oil or 4-6% caustic soda or 6-20 % sodium chloride solution etc. The steel is formed is known as hardened or quenched steel. Due to hardening steel becomes hard and brittle	1 1 2	4

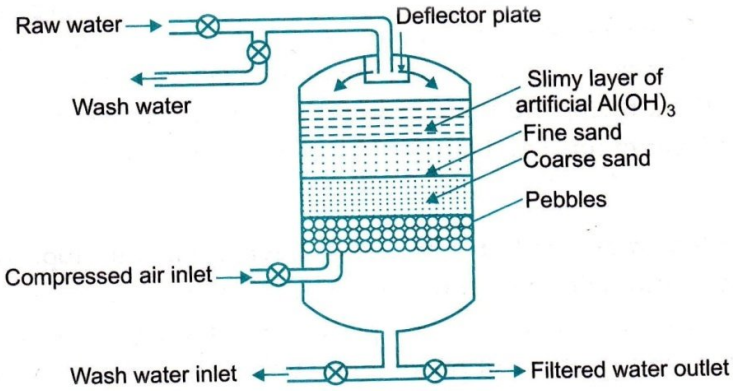
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		**Purposes :-** 1. To increase its resistance to wear and abrasion. 2. To increase its ability to cut other metals 3. To improve its strength, hardness, toughness etc • **Tempering** The process of reheating the hardened or quenched steel to a definite temperature between **200^{o}C-600^{o}C** and then cooling it at a suitable rate is known as tempering. **Purposes :-** 1. To reduce hardness or brittleness of hardened steel. 2. To remove the stress and strain developed into the structure during hardening. 3. To increase ductility, malleability and tensile strength. • **Annealing** :- The process of heating steel at about **760^{o}C-925 ^{o}C** and holding it at that temperature for some time and then cooling it at a controlled and slow rate inside the furnace is called annealing. **Purposes :-** 1. To soften the steel. 2. To improve its machinability. 3. To increase or restore its ductility and toughness. 4. To refine grain size and to have uniform structure. • **Normalizing:-** The process of heating steel to a definite temperature that is about **50^{o}C above the critical temperature** and then cooling it freely in air at the rate of 5^{o}C per second is known as normalizing. **Purposes :-** 1. To remove the coarse grain structure. 2. To remove internal stresses which are caused by working. 3. To impart ductility and toughness to steel. 4. To improve mechanical properties of steel. **[Note:Any one method Definition: 1 mark, Any two purposes : 1 mark]**		
	d)	**Explain the role of oxide film formed during corrosion.Give examples.** 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.	1	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		**2.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.	1 1 1	
	e)	**In any structure two dissimilar metals should not be allowed to come in contact with each other. Why? Explain with an example**. In any structure when two dissimilar metals are in contact with each other then there is a formation of galvanic cell. In this galvanic cell more active metal becomes anodic and undergoes corrosion and less active metal becomes cathodic and is protected from corrosion **Example:-** 1. Rusting of steel pipes connected to copper plumbing. 2. Rusting of iron nails used to join copper sheets. **Explanation:**In this case iron is more active metal hence become anodic and undergoes corrosion while copper is less active metal hence become cathodic and is protected from corrosion. **[Any relevant example can be considered]**	2 1 1	4
	f)	**Explain process of cementation**. It is also known as diffusion coating. In this process, article which is to be protected from corrosion is heated in a drum containing the powder of coating metal. At a high temperature diffusion of coating metal into the base metal takes place resulting into formation of base metal coating metal alloy on the surface.This alloy has more corrosion resistance than the base metal hence protect base metal from corrosion.		4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		The coating metal used is either Zn, Al or Cr which can easily form alloy with iron. When Zn is used as a coating metal then process is called as sherardizing. When Cr is used as a coating metal then process is called as chromizing. When Al is used as a coating metal then process is called as colorizing. **Applications -** It is used for protecting uneven surfaces and small odd shaped steel articles like bolts, screws, nuts, threaded parts ,washers, valves, gauge, tools etc.	4	
3.		Answer any FOUR		16
	a)	**Define scale. State disadvantages of scale formation in boilers**.		4
		Scales: The hard and adherent coating formed on the inner walls of the boiler is called as scales	1	
		Disadvantages: **1) Wastage of fuel** **2) Lowering safety of boilers** **3) Danger of explosion** **4) Decrease in efficiency of boiler** **(Any three disadvantages-1 mark each)**	3	
	b)	**Name types of impurities present in natural water. Suggest one method for removal of each of them**.		4
		Type of impurity / **Method of removal** Suspended impurities — Screening Colloidal impurities — Coagulation Dissolved impurities, Dissolved salts — Ion exchange method Dissolved gases — Boiling Biological impurities — Sterlisation **[Note:Name of impurities: 2 marks. Methods to remove them: 2 marks]**	4	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.	c)	**Calculate the temporary hardness present in a 25ml of sample of water, if** **i)Total hardness = 310 mg/litre** **ii)Permanent hardness = 133 mg/litre** Total hardness = Temporary hardness +Permanent hardness Hence: Temporary hardness = Total hardness - Permanent hardness = 310 - 133 = 177 Temporary hardness = 177 mg/ litre 1000 ml water sample contains = 177 mg of temporary hardness Hence 25 ml water sample contains = $\frac{177 \times 25}{1000}$ mg of temporary hardness = 4.425 mg of temporary hardness **25 ml water sample contains 4.425 mg of temporary hardness**	1 1 2	4
	d)	**Describe ion exchange process of water softening with a labeled diagram. Write chemical reactions.** In ion exchange process, the softening agent used is synthetic organic polymers such as cation exchange resin and anion exchange resin. Cation exchange resins have exchangeable H^+ and anion exchange resins have exchangeable OH^- ions. Process :- It consist of three cylindrical towers, the first tower contains cation exchange resin ($R\text{-}H_2$) and the other contains anion exchange resin ($R'\text{-}OH_2$).Both towers are also connected to acid and alkali tanks for regeneration of exhausted cation exchange resin and anion exchange resin respectively. Third tower is degasifier.	1	4

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.		**Working :-** $RH_2+CaCl_2 \longrightarrow RCa+2HCl$ $RH_2+MgSO_4 \longrightarrow RMg+H_2SO_4$ **[Note: Any one reaction: 1 mark]** This acidified water is then passed through tank containing anion exchange resins. Here all the anions are replaced by OH- ions. $R'(OH)_2+2HCl \longrightarrow R'Cl_2+ 2H_2O$ $R'(OH)_2+H_2SO_4 \longrightarrow R'SO_4+ 2H_2O$ **[Note: Any one reaction: 1 mark]** Thus water becomes free from all ions. This water is then passed through a degasified to remove gases like CO_2.  	1 1 1	
	e.	**What is filtration? Explain pressure filtration process with the help of a figure.** **Filtration**-It is the process of removing insoluble colloidal and bacterial impurities by passing water through a bed of proper sized material. **Pressure filter:-** It consists of a cylindrical steel tank containing three layers of filtering media one above the other. 1] Pebbles layer 2] Coarse sand layer 3] Fine sand layer	1	4

Que. No.	Sub. Que.	Model answers	Marks	Total Marks
3.		Impure sedimented water is first mixed with a small amount of alum and then forced in under pressure from the top of the tank. With the help of deflector plate added alum forms an artificial slimy uniform layer of $Al(OH)_3$ on the surface of the filter bed which helps to remove colloidal and bacterial impurities. Filtered water comes out from the bottom of the filter under pressure. It is used only on small scale.  	2 1	
	f)	**Write two properties and two applications of water proofing cement and concrete.** • **Water proofing cement** – **Properties-** 1] It is water- proof hence resist absorption of water 2] It makes the concrete impervious to water under pressure **Applications-** 1] It is used to make water proof surfaces like swimming tanks, 2] It is used to fill the pores and cracks. • **b) Concrete-** **Properties-** 1] It can be moulded into any desired shape. 2] It forms compact, rigid, strong and durable stony mass on setting. **Applications-** 1]. It is the most important construction material used for construction of roads, buildings, tanks, floors, columns, roofs etc. 2]. It is used to construct water proof structures.	 1 1 1 1	4