WINTER– 2019 EXAMINATION

Model Answer

Subject Code: 17208

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)	**Define heat treatment of steel.**	**2**
		Heat Treatment: It is the process of heating steel to a certain high temperature and then cooling it at a controlled rate, in order to develop certain desirable physical properties in it without changing its chemical composition.	2
	(b)	**Write the products of Blast Furnace.**	**2**
		i) Pig Iron ii) Slag iii) Flue Gases	2
	(c)	**Write two applications of wrought iron.**	
		Applications: wrought iron is used for making	**2**
		1.Chains, 2. wires, 3. bolts, 4. crane hooks, 5. nails, 6. railway couplings,	1mark each
		7. Carriages, 8. cores of electromagnets and 9. Agricultural implements.	
	(d)	**Why Galvanized containers are not used for storing food stuffs?**	**2**
		Galvanized container contains zinc coating. Since Zn is more active metal it readily reacts with the acids present in the food stuffs forming Zn compounds which are highly poisonous & it may poison the food stuffs. Therefore galvanized containers can not be used for storing food stuff.	2

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1.	**(e)**	**Write two applications metal spraying.** It is used for - i) Corrosion Protection, ii) Electrical Conductivity, iii) Thermal Conductivity. iv) Soldering surface v) Hard and Noble surface.	**2** 1mark each
	(f)	**Name the types of metal oxide films formed due to corrosion.** 1) Stable porous oxide film, 2) Stable non – porous oxide film, 3) Unstable oxide film, 4) Volatile oxide film	**2** ½ mark each
	(g)	**List any four constituents of paint.** 1) Pigments, 2) Drying Oil / Medium, 3) Thinners 4) Driers, 5) Extenders, 6) Plasticizers	**2** 1/2mark each
	(h)	**Name four types of impurities present in natural water.** i) Suspended impurities , ii)Dissolved impurities iii)Colloidal impurities, iv)Biological impurities.	**2** 1/2mark each
	(i)	**How can the exhausted permutit or zeolite be regenerated.** Exhausted Permutit or Zeolite regenerated by using 10 % brine (NaCl) solution. $CaP + 2NaCl \longrightarrow Na_2P + CaCl_2$ $MgP + 2NaCl \longrightarrow Na_2P + MgCl_2$ **(Consider any one reaction)**	**2** 2
	(j)	**Write four characteristics of potable water.** i) Water should be clear, colorless & odorless. ii) It should be pleasant in taste. iii) It should be free from disease causing micro-organisms. iv) It should be soft. v) Its turbidity should not be more than 10 ppm. vi) Its color should not exceed 20 ppm. vii) Its dissolved solids should not be more than 500 ppm.	**2** 1/2mark each

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(k)	**What is slaking of lime?** Reaction of lime with water is called slaking of lime. When lime is mixed with water (3:1), it absorbs water begins to burst & swell with evolution of heat. This heat brings entire mass to boil with hissing sound & solid lime crumbles into fine dry white powder resulting in a suspension of finely divided calcium hydroxide in water called slaked lime. The process is called slaking of lime. $CaO + H_2O \rightarrow Ca(OH)_2 + 1.5$ Kcal Quick lime slaked lime (Heat)	**2** **1** 1
	(l)	**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	**2** 1 mark each
2.		**Attempt any FOUR of the following:**	**16**
	(a)	**Write the chemical reaction in the zone of heat absorption for the extraction of iron in blast furnace.** **Chemical reactions taking place in the zone of heat absorption:** 1. $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO \uparrow$ 2. $CO_2 + C \longrightarrow 2CO - 39$ Kcal 3. $CaO + SiO_2 \longrightarrow CaSiO_3$ Flux gangue slag 4. $SO_2 + 2C \longrightarrow S + 2CO \uparrow$ 5. $SiO_2 + 2C \longrightarrow Si + 2CO \uparrow$ 6. $P_2O_5 + 5C \longrightarrow 2P + 5CO \uparrow$ 7. $MnO_2 + 2C \longrightarrow Mn + 2CO \uparrow$	**4** 1 1 1 1

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2.	**(b)**	**Write composition, two properties and two applications of low carbon steels.**	**4**
		Composition : It contains **0.05 to 0.3 % of carbon** and remaining is iron.	2
		Properties : 1. It is soft, malleable and ductile. 2. It responds to heat treatment. 3. It is weldable. 4. It has low tensile strength.	1
		Applications: It is used for preparation of soft wires, chains, nails, bolts, rivets, boiler tubes etc.	1
	(c)	**Differentiate between annealing and normalizing**	**4**

Annealing	**Normalizing**
1.It is the process of heating the steel at a temperature (760- 925^{0}C) and cooling it slowly in the furnace	1.It is the process of heating the steel at a temperature of 50^{0}C above the critical temperature (725^{0}C) and cooling it freely in air at a rate of 5 ^{0}C/Sec
2. Due to annealing steel becomes more soft, pliable, malleable & ductile.	2. Due to normalizing steel becomes homogenous & more soft. The mechanical properties of steel are more improved than annealing.
3.Time required for annealing is more than normalizing	3.Time required for normalizing is less than annealing
4. Consumption of fuel or electric power is more.	4. Consumption of fuel or electric power is less.

1 mark each

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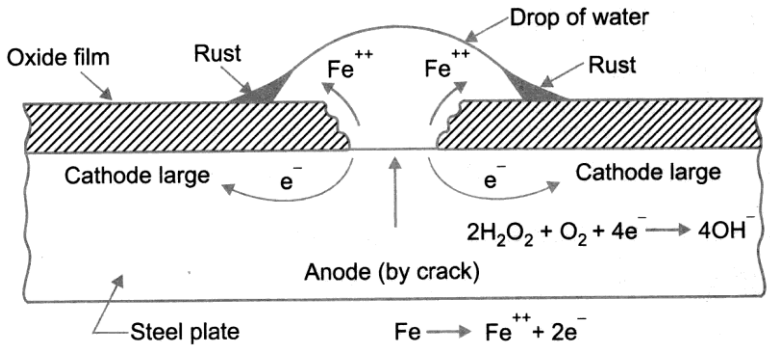
Q. No.	Sub Q. N.	Answer	Marking Scheme
2	(d)	**Write mechanism of electrochemical corrosion by absorption of oxygen gas.**	**4**

Anode: - By crack
Cathode :- Coated metal part



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:-

$Fe \longrightarrow Fe^{++} + 2e^{-}$

The liberated electrons flow from anode to cathode areas. The electrons are reacting with water and dissolved O_2.

At Cathode:- 2

$2H_2O + O_2 + 4e^{-} \longrightarrow 4OH^{-}$

The Fe^{2+} ions at anode and OH^{-} ions at cathode diffuse and when they meet $Fe(OH)_2$ is precipitated.

$Fe^{2+} + 2(OH)^{-} \longrightarrow Fe(OH)_2$

	(e)	**Explain the sacrificial anodic protection with suitable diagram.**	**4**

The metallic structure to be protected from corrosion is connected to the anodic metal by an insulating wire. The more active metals like Zn, Al, Mg etc. acts as anode and get corroded hence it is known as sacrificial anode. For increasing electrical contact the active metal is placed in back fill. (Coal + NaCl) When the sacrificial metal is consumed completely it is replaced by fresh piece. 2

This method is applicable to protect buried pipelines, buried cables, hot water tank, ship hull etc.

Mg or Zn rods are bolted along the sides of ship, hot water tank or inserted into boiler to prevent corrosion

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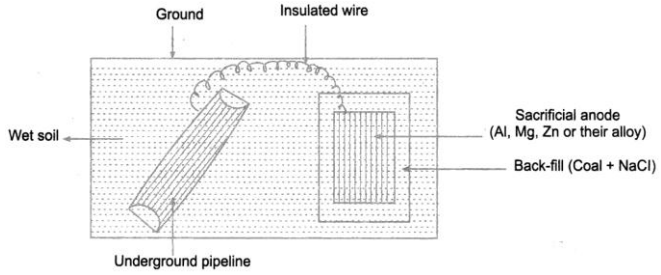
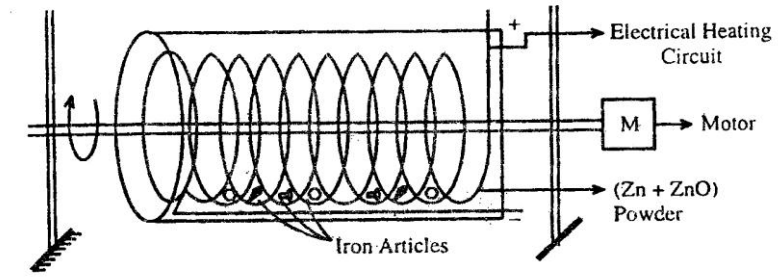
2	(e)		2
	(f)	**Explain sherardizing process with suitable diagram.**	**4**
		The method used to coat small and irregular shaped articles is **sherardizing.**	
			2
		Process:	
		i) The iron articles (bolts, screws, nails etc.) to be coated are first cleaned and then packed with Zn dust and ZnO powder in a steel drum, which is provided with electrical heating circuit arrangement.	
		ii) The drum is slowly rotated for 2-3 hours and its temp is kept between $350^0 – 400^0$C during this process Zn gets diffused slowly into iron forming Fe - Zn alloy at the surface which protects iron surface from corrosion.	2

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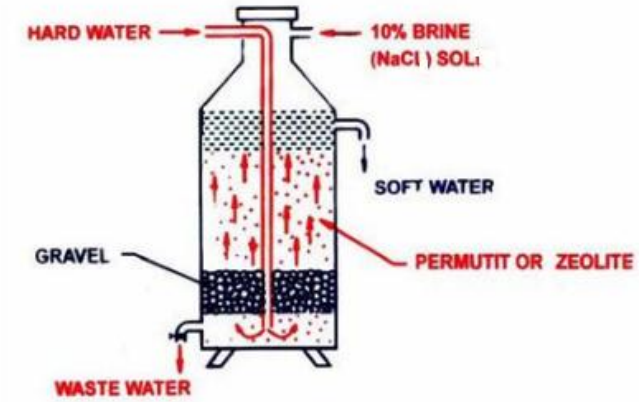
3.		**Attempt any FOUR of the following:**	**16**
	(a)	**Write two disadvantages each of using hard water in dyeing and sugar industry.** **Dyeing industry:** i) Dye is a coloring material used for coloration of textiles, wool, silk, etc.Ca Mg Fe salts in hard water reacts with dyes to form undesirable precipitates which gives impure shades of dyes. ii) Fe salts produces spots or yellow stains on the clothes. **Sugar industry –** 1) If hard water used in sugar industry then sugar may not crystallize well. 2) Sugar may be deliquescent. 3) Sugar may get decomposed during storage. **(consider any two points)**	**4** 2 2
	(b)	**Differentiate between scale and sludge.**	**4**

Scale	sludge
1. If the precipitated matter forms a hard adhering coating on the inner walls of the boiler is called scale.	1. If the precipitation takes place in the form of loose and slimy precipitate is called sludge.
2. Scale is harmful for boiler.	2. Sludge is not harmful for boiler.
3. Scale can be removed by either external or internal treatment or hammering.	3. Scale can be removed from bottom of the boiler time to time.
4. Scale increases the maintenance and operation cost.	4. Sludge increases the discharging cost of the waste.

1mark each

	(c)	**Describe permutit process of water softening with neat labeled diagram and chemical reactions.** **Explanation**:-In this process sodium permutit is placed in a suitable container and hard water is allowed to pass through it. The calcium & magnesium salts present in the hard water react with the sodium permutit to form water insoluble calcium & magnesium permutit which are retained by filter bed. Thus water obtained is free from calcium & magnesium salts.	**4** 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	(c)	 **PERMUTIT'S PROCESS OF SOFTENING OF HARD WATER**	1
		Reaction with temporary hardness causing salts:- $Ca(HCO_3)_2 + Na_2P \rightarrow Na_2(HCO_3)_2 + CaP$ $Mg(HCO_3)_2 + Na_2P \rightarrow Na_2(HCO_3)_2 + MgP$	1
		Reaction with permanent hardness causing salts:- $CaCl_2 + Na_2P \rightarrow 2NaCl + CaP$ $MgCl_2 + Na_2P \rightarrow 2NaCl + MgP$ $CaSO_4 + Na_2P \rightarrow Na_2SO_4 + CaP$ $MgSO_4 + Na_2P \rightarrow Na_2SO_4 + MgP$ **(consider any two reactions)**	1
	(d)	**Explain the sterilization of water by using chlorine gas and bleaching powder.** The process of destroying diseases causing bacteria and micro-organisms from the water is called as sterilization. **Sterilization by chlorine gas:** **1) $Cl_2 + H_2O \longrightarrow$ HOCl + HCl** [Hypochlorous acid] **2) HOCl $\longrightarrow$ HCl + [O]** (Nascent oxygen) **3) Germs + [O] $\longrightarrow$ Germs are killed**	**4** 2

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3.	**(d)**	**Sterilization by bleaching powder:** About 1 Kg. of bleaching powder is mixed per 1000 litres of water and resulting solution is allowed to stand for several hours when the following chemical reactions take place. **$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2$** [Bleaching powder] **$Cl_2 + H_2O \rightarrow HOCl + HCl$** **HOCl $\longrightarrow$ HCl + [O]** [Hypochlorous acid] [Nascent oxygen] **Germs + [O] $\longrightarrow$ Germs are killed** Thus bleaching powder helps to kill microorganisms.	2
	(e)	**What is carbonate and non- carbonate hardness of a sample of water in ppm containing, $Ca(HCO_3)_2$ = 16.2 mg/lit, $Mg(HCO_3)_2$ = 7.3 mg/lit, $MgCl_2$ = 9.5 mg/lit, $CaSO_4$ = 13.6 mg/lit.**	**4**

Sr. No.	Impurities	Quantity in mg/lit	Molecular weight	Type of hardness	$CaCO_3$ equivalent
1	$Ca(HCO_3)_2$	16.2	162	Carbonate	16.2 x 100/162 = 10
2	$Mg(HCO_3)$	7.3	146	Carbonate	7.3 x 100/146 = 5
3	$MgCl_2$	9.5	95	Noncarbonate	9.5 x 100/95 = 10
4	$CaSO_4$	13.6	136	Noncarbonate	13.2 x 100/136 =9.7 ~10

2

Carbonate hardness = [$CaCO_3$ equivalent of $Ca(HCO_3)_2 + Mg(HCO_3)_2$]

= [5 + 10]

= **15 ppm**.

Noncarbonate hardness =[$CaCO_3$ equivalent of $CaSO_4 + MgCl_2$]

=[10 + 10]

= 20 ppm.

2

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3.	**(f)**	**Describe setting and hardening of cement. Write chemical reaction taking place in same.**	**4**
		Setting and Hardening of cement: - The setting and hardening of cement is due to hydration and hydrolysis reaction taking place between the different constituents of cement and water. Anhydrous compounds undergo hydration forming insoluble gels and crystalline products. **Setting:** It is defined as stiffening of the original plastic mass due to initial gel formation. **Hardening:** It is the development of strength due to crystallization. **Following chemical reaction taking place during setting and hardening.** **1] Hydrolysis:** $C_3S + (x+1)\ H_2O \rightarrow C_2S.\ xH_2O + C.H_2O$ $C_4AF + 7\ H_2O \rightarrow C_3A.\ 6H_2O + CF.H_2O$ **2] Hydration:** $C_3S + xH_2O \rightarrow C_2S\ .x\ H_2O + CaO$ $C_3A + 6\ H_2O \rightarrow C_3A.6\ H_2O$ ----------END----------	2 1 1