SUMMER– 2018 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 i) flux ii) Slag** **i) Flux:** The substance which is used to remove the gangue during the smelting process is known as flux. **ii) Slag:** Flux reacts with gangue to form some fusible mass known as Slag.	**2** 1 Mark each
	(b)	**Write the names of any two different zones of blast furnace with their temperature.** **Different zones of blast furnace with their temperature are as follows:** i) Zone of reduction (300-800^{0}c i.e.dull red heat) ii) Zone of heat absorption (800-1200^{0}c i.e.bright red heat) iii) Zone of fusion (1200-1500^{0}c i.e. white heat) **(any two zones-1 mark each)**	**2** 1 Mark each

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	(c)	**What are the types of heat treatment methods?** **Methods of heat treatment :-** 1. Hardening or quenching 2. Tempering 3. Annealing 4. Normalizing	**2** ½ mark each
	(d)	**Define corrosion. State its two main types.** **Corrosion:** The process of chemical or electrochemical decay or destruction of a metal due to the action of surrounding medium is called as corrosion. **Types:** i) Atmospheric corrosion or Direct chemical corrosion or Dry corrosion. ii) Immersed corrosion or electro chemical corrosion or Wet corrosion.	**2** 1 1/2 mark each
	(e)	**Define Paint.Write the names of any two constituents of paint.** **Paint:** Paint is a mechanical dispersion mixture of one or more pigments in a vehicle. **Constituents of paint: (Any two)** 1) Pigments 2) Drying Oil / Medium 3) Thinners 4) Driers 5) Extenders 6) Plasticizers	**2** 1 ½ mark each
	(f)	**Why galvanised containers are not used for storage of food? Explain.** 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** 2

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(g)	**Give one advantage and one disadvantage of metal cladding.**	**2**
		Advantages: **(Any One)** 1. To develop surface properties like corrosion resistance in steel sheets. 2. To produce combining advantage of strength due to steel wire and electrical conductivity due to copper by producing copper-cladded steel wire. 3. By producing alclad sheets (i.e.aluminium is cladded on duralumin sheets), the light and strong alloy required in air-craft industry can be obtained. 4.The cladding metal (i.e.coating metal) provides the electrolytic protection for the base metal.	1
		Disadvantages : (Any One) 1.By metal cladding only plain surfaces can be protected. 2.Cladding is not perfect, the irregular surfaces provide galvanic cell action in the presence of moisture. Hence, the corrosion cannot be absolutely prevented by this method.	1
	(h)	**List the common types of impurities present in the water** i) Suspended impurities ii) Dissolved impurities iii) Colloidal impurities iv) Biological impurities	**2** ½ mark each
	(i)	**Write any two advantages of zeolite process for water purification.** **Advantages: (Any Two)** i. Water having zero hardness can be obtained. ii. Equipment used is compact. iii. It is a clean process as no impurities are precipitated. iv. It requires less time.	**2** 1 mark each

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1	(j)	**Write down the chemical reactions for sterilization of water using chlorine gas.**	**2**
		Chemical reactions: **1) $Cl_2 + H_2O \longrightarrow HOCl + HCl$** [Hypochlorous acid]	1
		2) HOCl $\longrightarrow$ HCl + [O] (Nascent oxygen)	1
		3) Germs + [O] $\longrightarrow$ Germs are killed	
	(k)	**Define setting and hardening of cement.**	**2**
		Setting: It is defined as stiffening of the original plastic mass due to initial gel formation.	1
		Hardening: It is defined as the development of strength due to crystallization.	1
	(l)	**Note down any two properties of fat lime.**	**2**
		Properties : (Any two) 1.It slakes vigorously, so it should be slake carefully, as the excessive slaking makes the lime inert. 2. It is more expensive than the other types of lime. 3. It hardens very slowly, hence it produces less hard mortar. 4. It has high degree of plasticity. 5. It has large sand carrying capacity. 6. It is perfectly white in colour.	1 mark each

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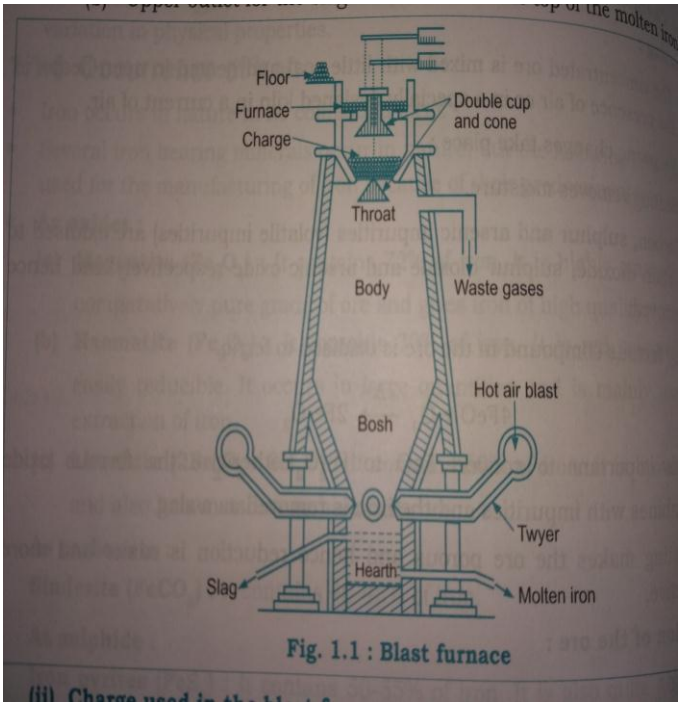
Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any FOUR of the following:**	**16**
	(a)	**Draw a neat labelled diagram of blast furnace. Name the products of blast furnace.** **Diagram :**	**4**
		 Fig. 1.1 : Blast furnace	2
		Diagram of the Blast furnace	2
		Products : i) Pig Iron ii) Slag iii) Flue Gases	

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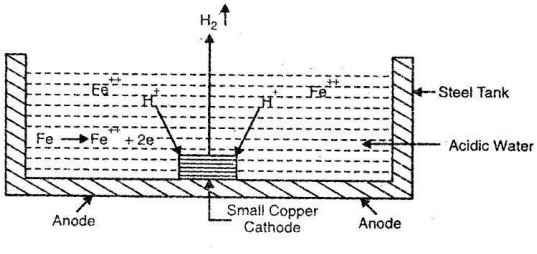
<table>
<tr><th>Q. No.</th><th>Sub Q. N.</th><th>Answer</th><th>Marking Scheme</th></tr>
<tr><td>2</td><td>(b)</td><td>Differentiate between Annealing and Normalizing.
<table>
<tr><th>Annealing</th><th>Normalizing</th></tr>
<tr><td>1.It is the process of heating the steel at a temperature (760- 925^{0}C) and cooling it slowly in the furnace</td><td>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</td></tr>
<tr><td>2.Due to annealing steel becomes more soft, pliable, malleable & ductile.</td><td>2.Due to normalizing steel becomes homogeneous & more soft. The mechanical properties of steel are more improved than annealing.</td></tr>
<tr><td>3.Time required for annealing is more than normalizing</td><td>3.Time required for normalizing is less than annealing</td></tr>
<tr><td>4.Consumption of fuel or electric power is more.</td><td>4.Consumption of fuel or electric power is less.</td></tr>
</table></td><td>4
1 mark for each point</td></tr>
<tr><td></td><td>(c)</td><td>What is tempering? Why steel is tempered after quenching? What are its effects on steel?
Tempering :
“ Tempering is the process of reheating the hardened or quenched steel to a definite temperature (generally below 200-600^{0}c) and then cooling it at a suitable rate.”
Reason:
By quenching, the hardness of the steel is increased but it becomes very brittle and liable to crack while in use. To minimize this defect, steel is tempered.</td><td>4
1
1</td></tr>
</table>

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.		**Effects on steel : (Any two)**	2
		1.The properties like hardness, brittleness and internal stresses developed in a quenched steel are reduced.	
		2.It imparts toughness and elasticity to steel.	
		3.It improves ductility of metal.	
	(d)	**Explain hydrogen evolution mechanism of electrochemical corrosion.**	**4**
			1
		Steel tank: - Anode **Cu – strip:- Cathode**	1
		These types of corrosion occur usually in acidic environments like 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 acts as anode & is corroded most with the evolution of hydrogen gas. **Reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^-$ (Oxidation)**	1
		These electrons flow through the metal from anode to the cathode that is piece of copper metal where they are accepted by H^+ ions to form H_2 gas **At cathode :** H^+ ions are eliminated as H_2 gas **$2H^+ + 2e^- \longrightarrow H_2$ (Reduction)** Thus, over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2$**	1

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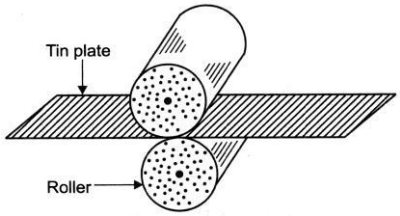
2.	(e)	**Name the types of oxide films formed in atmospheric corrosion with examples. Which oxide film is more protective? Why?**	4
		Types of oxide films : a) Porous (Non-protective) b) Nonporous (Protective) c) Unstable film d) Volatile film	2
		Non – Porous oxide film is protective. **Reason:** In Non – Porous oxide film, volume of oxide is greater than the volume of metal. Due to absence of any pores in the oxide film, it forms a protective layer and hence the rate of corrosion of metal rapidly decreases. **Unstable oxide film is protective.** **Reason:** As soon as the film is formed it decomposes to give original metal again.Therefore corrosion is not possible here. **(Note: Any one of these film can be considered)**	2
	(f)	**Describe the process of metal cladding with suitable diagram.**	4
		Definition: Metal cladding involves bonding firmly and permanently a dense, homogeneous layer of a coating metal to the base metal on one or both sides.	1
		Process: i) The base metal is sandwiched or cladded between the two sheets of coating metal. ii) This sandwich is then passed through two heavy rollers maintained at high temperature & pressure. iii) Cladded metal is cathodic with respect to the base metal so that electrolytic protection is provided.	1
			2
		OR	

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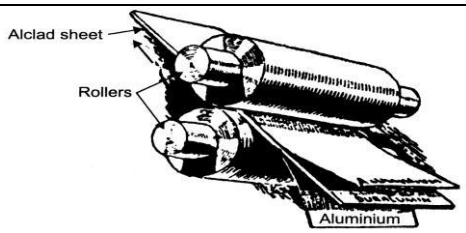
Q. No.	Sub Q. N.	Answer	Marking Scheme
3	(a)	 **Attempt any four of the following:** **What are the disadvantages of scale and sludge formation in boiler?** **Disadvantages: (Any four)** **1. Wastage of fuel :** The scales are hard and bad conductors of heat. Hence does not show the ready transfer of heat from the hot plates of boiler to the water inside. Therefore, in order to get a steady supply of steam more heat has to be applied. This results in a large consumption of fuel. **2. Lowering safety of boilers :** Due to scale formation, overheating of boiler is to be done in order to maintain a constant supply of steam. This makes the boiler material softer and weaker. This causes distortion in boiler tube and make the boiler unsafe to bear the pressure of the steam, especially in high pressure boilers. **3. Danger of explosion:** When thick scales crack due to uneven expansion of scale and boiler material, the water comes suddenly in contact with overheated iron plates of boiler. This causes the formation of a large amount of steam suddenly inside the boiler. Hence, sudden high pressure is developed, which may cause explosion of the boiler. **4. Decrease in efficiency of boiler:** Scales may sometimes deposit in the valves and condensers of boiler and choking them partially. This results in decrease in efficiency of the boiler**.** **5. Shortening of the life of the boiler:** **The life of the boiler is shortened due to the following reasons:** a. The steam reacts with red hot iron plates of the boiler forming non-adherent iron oxide and liberates the hydrogen gas. This causes thinning of the boiler plates with the continuous reaction of steam. b. Magnesium chloride, if present in the scale will bring about corrosion of tubes and boiler plates like a chain reactions producing HCl again and again.	**16** **4** 1 mark each

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3.	(b)	**Write down any two physical characteristics and any two chemical characteristics of water.**	4
		Physical characteristics: (Any two) 1. Pure water is colourless, odourless and tasteless. 2. Its density at 20^0c is 0.998 and maximum density is 1 at 4^0c. 3. Its freezing point is 0^0c and boiling point is 100^0c. 4. Water has a solvent action on many substances and it is therefore called a 'universal solvent'. 5. It is neutral to litmus. 6. Its latent heat of fusion is 79.7 cal/gm and latent heat of vaporization is 539 cal/gm. 7. Its surface tension at 20^0c is 72.8 dyne/cm and its refractive index is 1.333. 8. Its viscosity at 20^0c is 10.09 millipoise. 9. Its dissociation constant at 25^0c is $1.0 \times 10^{-14.}$ 10.Pure water is a bad conductor of electricity as it is only very slightly ionized.	2
		Chemical characteristics : (Any two) **1. Stability** : it is very stable and does not decompose easily. Decomposition of water is not more than 2% even when heated to a high temperature such as 2000^0c. **2. Behaviour with metals**: metals like Na, K, Ca, Mg, Fe etc react chemically with water producing their hydroxides or oxides. **3. Reactions with metallic and non-metallic oxides**: water react with metallic oxides to form bases and with non-metallic oxides to form acids. **4. Water of hydration** : It combines with many salts during crystallization to form hydrates. E.g.$CuSO_4.5H_2O$, $FeSO_4.7H_2O$. The water present in the hydrates is called water of hydration or water of crystallization. **5. Water as a catalyst**: water acts as a effective catalyst in many reactions. Perfectly dry gas invariably fail to react and traces of moisture is enough to produce chemical changes.	2

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3.	**b)**	**6. Cause of ionization** : water being a strong ionizing solvent causes acids, bases and salts to dissociate and give ions. **7. Cause of hydrolysis** : water brings about hydrolysis of salts, weak acid or weak bases. Water reacts with hydrides, nitrites, phosphides and carbides to liberate hydrogen, ammonia, phosphine etc **8. Test for water**: Anhydrous copper sulphate turns blue when it comes in contact with water. This fact is used as a test for water	
	(c)	**Calculate the carbonate and non-carbonate hardness of water sample which has following impurities per litre**. **$Mg(HCO_3)_2$ = 146 mg/lit** **$MgCl_2$ = 95 mg/lit** **NaCl = 50 mg/lit** **$Ca(HCO_3)_2$ = 81 mg/lit** **$CaCl_2$= 111 mg/lit** **$CaSO_4$ = 68 mg/lit.**	**4**

Sr. No.	Impurities	Quantity in mg/lit	Molecular weight	Type of hardness	$CaCO_3$ equivalent
1	$Mg(HCO_3)_2$	146	146	Carbonate	146 x 100/146 =100
2	$MgCl_2$	95	95	Noncarbonate	95 x 100/95 = 100
3	NaCl	50	58.5	Does not cause any hardness	
4	$Ca(HCO_3)_2$	81	162	Carbonate	81 x 100/162 = 50
5	$CaCl_2$	111	111	Noncarbonate	111 x 100/111 =100
6	$CaSO_4$	68	136	Noncarbonate	68 x 100/136 =50

2

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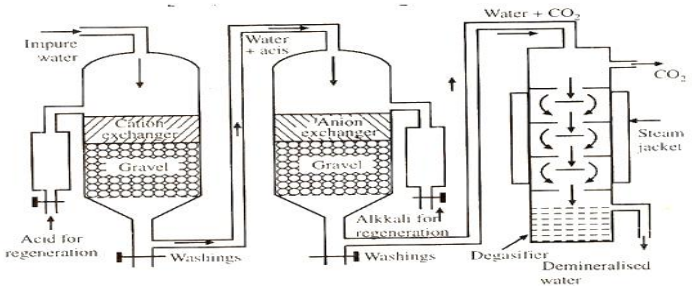
3.	c)	**Carbonate hardness** = [$CaCO_3$ equivalent of $Mg(HCO_3)_2 + Ca(HCO_3)_2$] = [100 + 50] = 150 ppm	1
		Noncarbonate hardness =[$CaCO_3$ equivalent of $MgCl_2 + CaCl_2 + CaSO_4$] =[100 + 100+ 50] = 250 ppm	1
	(d)	**Describe in brief Ion-exchange process for hard water with neat labelled diagram.**	**4**
		Ion exchange process: i) Hard water is first passed through the cation exchange resin. It removes all the cations like Ca^{++}, Mg^{++} and releases H^+ ions. $R\text{-}H_2 + CaCl_2 \longrightarrow R\text{-}Ca + 2HCl$ $R\text{-}H_2 + MgSO_4 \longrightarrow R\text{-}Mg + H_2SO_4$ Thus water is free from cations but it is acidic.	1
		ii) The acidic water is then passed through anion exchange resin where acid is converted into water $R'\text{-}(OH)_2 + 2HCl \longrightarrow R'\text{-}Cl_2 + 2H_2O$ $R'\text{-}(OH)_2 + H_2SO_4 \longrightarrow R'\text{-}SO_4 + 2H_2O$ Thus water is free from all cations and anions	1
		iv) Finally water is made free from dissolved gases like CO_2 , O_2 etc. by passing it through third tower of degasifier	
		Diagram:	2



Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	(e)	**Define sterilization of water. Explain the process of sterilization using bleaching powder.**	**4**
		Sterilization: The process of destroying diseases causing bacteria and micro-organisms from the water is called as sterilization.	1
		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.	1
		$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2$ [Bleaching powder]	
		$Cl_2 + H_2O \longrightarrow HOCl + HCl$	1
		$HOCl \longrightarrow HCl + [O]$ [Hypochlorous acid] [Nascent oxygen]	1
		Germs + [O] ⟶ Germs are killed Thus bleaching powder helps to kill microorganisms.	
	(f)	**Give the chemical reactions, which takes place in the setting and hardening of Portland cement.**	**4**
		Chemical reactions in the setting and hardening of Portland cement:	
		1] Hydrolysis:	2
		$C_3S + (x+1)\,H_2O \longrightarrow C_2S.\,xH_2O + C.H_2O.$	
		$C_4AF + 7\,H_2O \longrightarrow C_3A.\,6H_2O + CF.H_2O.$	
		2] Hydration:	2
		$C_3S + xH_2O \longrightarrow C_2S.x\,H_2O + CaO.$	
		$C_3A + 6\,H_2O \longrightarrow C_3A.6\,H_2O + Heat$	