WINTER– 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)**	**Name two methods used for preparation of steel**	**2**
		i) Open hearth process or Siemen-Martin's process. ii) Basic oxygen steel (BOS) Process or L-D process.	2
	(**b)**	**Name two oxide ores of Fe. Write their chemical formulae.**	**2**
		i) Hematite – Fe_2O_3 ii) Magnetite - Fe_3O_4 iii) Limonite –2 $Fe_2O_3.3H_2O$ iv) Siderite – $FeCO_3$ v) Iron Pyrite – FeS_2	1 mark each
	(c)	**Write any four properties of mild steel.**	**2**
		i) Soft, tough, malleable, ductile. ii) Suitable for welding. iii) Responds to heat treatment. iv) Tensile Strength is low. v) Can be magnetized permanently. vi) Can resist shock and impact. vii) Undergo corrosion quickly.	1 mark each

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1	(d)	**Distinguish between galvanizing and sherardizing (any two points).**	**2**

Galvanizing	Sherardizing
1) It is the process of coating iron or steel sheets with a thin coat of Zn by hot dipping.	1) It is the process of coating small iron or steel article by alloying at the surface of base metal (iron)
2) This process is carried out in large tanks by dipping iron sheet in a bath of molten Zinc at a temp of about 425 – 460^{0}C by covering the bath with a flux of NH_4Cl.	2) This process is carried out in rotating closed drum like furnace by packing the small iron or steel article in Zinc powder at a temp of about 350 – 400^{0}C in reducing atmosphere.
3) In galvanizing a layer of Zn – Fe alloy is formed to which the outer layer of Zinc sticks.	3) In sherardizing Zinc gets diffused into iron forming Fe – Zn alloy at the surface only.
4) This process is widely used for protecting iron exposed to the atmosphere as in the case of roofs, wire fences, pipes & fabricated articles from galvanized sheets like buckets, tubes etc.	4) This process is used for protecting small iron and steel articles like bolts, screws, nails nuts etc. There is very little change in dimensions of small articles due to the formation of very thin layer of Zinc.

1 mark each

	(e)	**State the constituents of paint and one function of each.**	**2**

1) Pigments

Functions: -1) Provide opacity and colour to paint film.

2) Give strength to the film.

3) Give protection to the paint film

4) Provide resistance to paint film against abrasion, moisture and weather.

5) It gives an aesthetical appeal to the paint film.

1 mark each

2) Drying Oil / Medium

Functions: -

1) It is a main film forming constituent.

2) it provides durability and water proofness to the film.

3) It improves toughness and adhesion of the paint film.

4) It forms protective film by oxidation.

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1	(e)	**3) Thinners** **Functions: -** 1) They are suspended pigments. 2) They dissolve film forming materials. 3) They reduce viscosity of paints for proper handling and to impart better covering power. 4) They help the drying of film by evaporation. **4) Driers** **Functions of driers:** 1) They improve drying quality of paint film. 2) They act as oxygen carrier catalysts. 3) They accelerate the drying of oil film. **5) Extenders** **Function: -** 1) They reduce the cost of paint. 2) They increase durability of paint. 3) They help to reduce the cracking of dry paint. 4) They act as carriers for pigmented colour. **6) Plasticizers** 1) To give elasticity to the film. 2) To prevent cracking of the film. **(Note: Consider two constituents and one function of each)**	
	(f)	**Define corrosion. Give its types.**	**2**
		Definition: The process of chemical or electrochemical decay or destruction of a metal due to the action of surrounding medium is called as corrosion.	1
		Types: i) Atmospheric corrosion / Direct chemical corrosion / Dry corrosion. ii) Immersed corrosion / Electrochemical corrosion / Wet corrosion.	1

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1	(g)	**Give two applications of metal cladding process**	**2**
		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
	(h)	**Write four characteristics of potable water.**	**2**
		i) It should be clear, colourless, odourless with pleasant in taste. ii) It should be free from diseases producing micro-organisms. iii) Its hardness should be 150-250 ppm $CaCO_3$ equivalent. iv) It should not contain any poisonous or objectionable matter. v) The total dissolved solids should not exceed 500 mg/lit. vi) Turbidity & colloidal impurities should not be more than 10 ppm.	½ mark each
	(i)	**State two causes of hardness of water.**	**2**
		1) Rain water absorbs CO_2 from air and also from decaying plants. It forms carbonic acid. $H_2O + CO_2 \longrightarrow H_2CO_3$ (Carbonic Acid) Such a water flows over the rocks containing calcium carbonate and Magnesium carbonate. These react with carbonic acid present in water and forms calcium bicarbonate and magnesium bicarbonate, which are highly soluble in water. These salts i.e. $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ give hardness to water. $H_2CO_3 + CaCO_3 \longrightarrow Ca(HCO_3)_2$ $H_2CO_3 + MgCO_3 \longrightarrow Mg(HCO_3)_2$	1
		2) Chlorides and sulphates of Ca and Mg are highly soluble in water. Theses salts are present over the earth surface. Therefore when water flows over the surface these salts enters in water and water becomes hard water.	1

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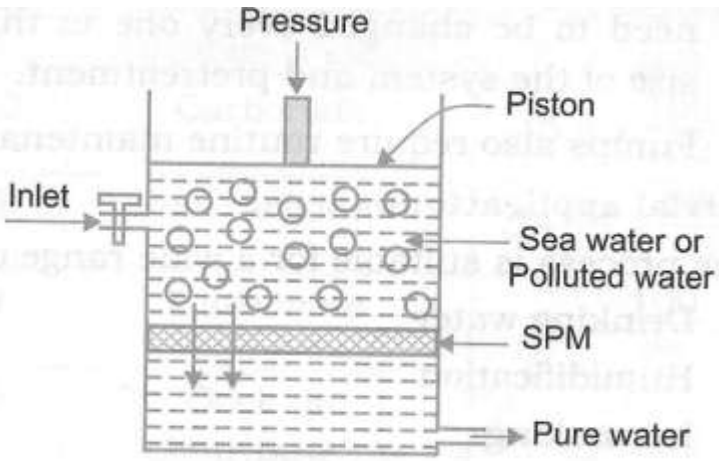
1.	(j)	**Draw diagram of reverse osmosis cell for desalination of sea water.**  	**2** 2
	(k)	**Name two constituents of cement with its formulae.** **Constituents** / **Formula** Lime — CaO Silica — SiO_2 Alumina — Al_2O_3 Iron Oxide — Fe_2O_3 Magnesia — MgO Sulphur trioxide — SO_3 Soda & Potash — $Na_2O + K_2O$ Gypsum — $CaSO_4.2H_2O$	**2** 1 mark each
	(l)	**Give chemical composition of lean lime.** It contains 75% CaO and 25% clay, reminder being mostly silica, alumina, Fe_2O_3, MgO.	**2**

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2		**Attempt any four of the following:**	**16**
	(a)	**Write chemical reactions taking place in the zone of reduction in blast furnace.** The reduction is done in stages as given below:- $Fe_2O_3 \rightarrow Fe3O_4 \rightarrow FeO \rightarrow Fe$ i) In between 300 – 500^{0}C, when charge is heated, Fe_2O_3 (Ferric oxide) is reduced to Fe_3O_4 (Ferroso ferric oxide) $3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$ This Fe_3O_4 is stable upto 650^{0}C in presence of CO, CO_2 & free coke. ii) In between 650 – 700^{0}C, Fe_3O_4 is reduced to FeO $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$ iii) At temperature between 700 – 800^{0}C, FeO is reduced to metallic iron. $FeO + CO \rightarrow Fe + CO_2$ iv) Simultaneously, the limestone present in the charge is also decomposed to produce lime. $CaCO_3 \rightarrow CaO + CO_2$ v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4. $2Fe + 3CO \rightarrow Fe_2O_3 + 3C$ $3Fe + 4CO \rightarrow Fe_3O_4 + 4C$ **(Note: Consider any four reactions)**	**4** 1 mark each
	(b)	**Distinguish 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 & softer. 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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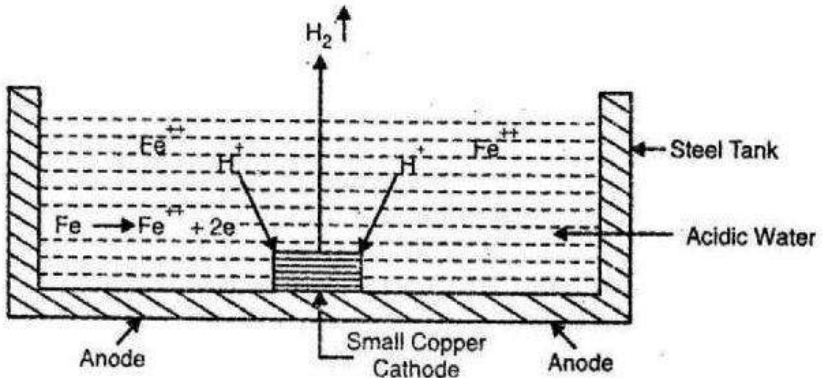
2.	**(c)**	**State the effect of alloying element Ni and Co on the properties of steel.**	4
		Effect of alloying element Ni:- i) It improves corrosion & heat resistance. ii) It also improves hardness, toughness, strength, elasticity & ductility.	2
		Effect of alloying element Co:- i) It also imparts strength & hardness to the steel which persists at red heat. ii) It also helps to retain permanent hardness.	**2**
	(d)	**Explain the mechanism of immersed corrosion with evolution of H_2 – gas.**	**4**
			1
		Steel tank: - Anode ,Cu – strip:- Cathode 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.	1
		Reactions:	
		At Anode: $\mathbf{Fe \rightarrow Fe^{++} + 2\ e^-}$ **(Oxidation)**	2
		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 $\mathbf{2H^+ + 2\ e^- \rightarrow H_2 \uparrow}$ **(Reduction)**	
		Thus, over all reaction is $\mathbf{Fe + 2H^+ \rightarrow Fe^{++} + H_2 \uparrow}$	

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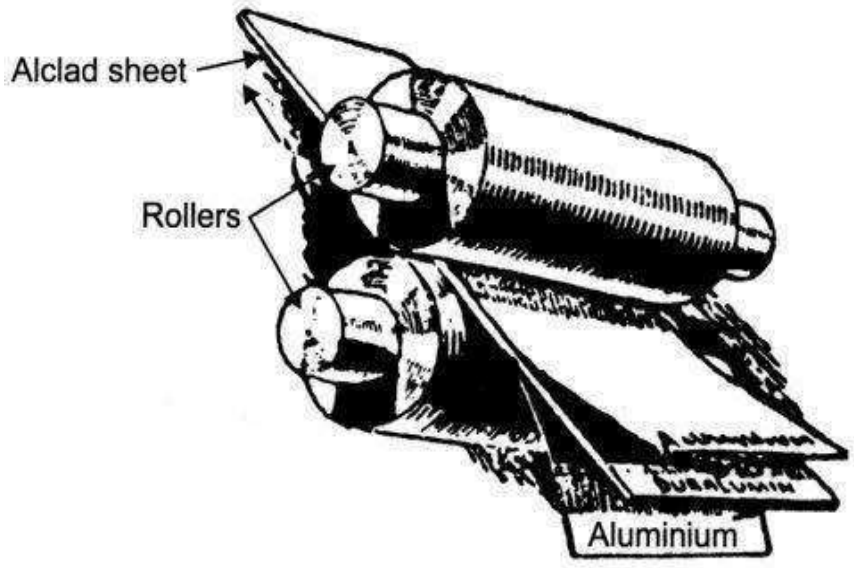
2.	**(e)**	**Explain any two factors affecting rate of atmospheric corrosion.**	**4**
		1) Impurities in the atmosphere Corrosion rate is fast in the presence of all impurities such as H_2S, SO_2, CO_2, Cl_2, gases along with vapors of HCl & H_2SO_4 etc. Atmospheric air in industries areas contains these impurities.	2
		2) Moisture in the atmosphere Atmospheric gases & chemical vapors dissolve in moisture and reaction between such dissolved gases and metal becomes faster. Therefore moisture acts as conducting medium and enhances the corrosion	2
	(f)	**Explain metal cladding process with suitable diagram.**	**4**
		Metal cladding involves bonding firmly and permanently a dense, homogenous layer of a coating metal to the base metal on one or both sides.	
			2
		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.	2
		iii) Cladded metal is cathodic with respect to base metal so that electrolytic protection is provided.	

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3.		**Attempt any four of the following:**	**16**
	(a)	**Define: i) Hard water ii) Soft water iii) Degree of hardness iv) Filtration**	**4**
		i) Hard water: The water which does not produce good lather but develops white scum (White curd) with the soap solution is called as hard water.	1
		(ii) **Soft water:** The water which readily produces good lather (foam) but not develops white scum (White curd) with the soap solution is called as soft water.	1
		(iii) **Degree of hardness:** The degree of hardness of water can be measured in 1) degree Clark 2) degree French 3) Parts per million. **OR** It is a measure of the concentration of divalent metal ions such as calcium and magnesium per volume of water.	1
		(iv) **Filtration:** A process of removing insoluble colloidal and bacterial impurities present in the water by passing it through a bed of proper sized material is called as filtration.	1
	(b)	**Write any two causes of scale and sludge formation in boiler. Give two disadvantages.**	**4**
		1) Chemical Decomposition Calcium bicarbonate & Magnesium bicarbonate decomposes at higher temperature to form insoluble carbonates which precipitates to form scale. $Ca(HCO_3)_2 \longrightarrow CaCO_3 + H_2O + CO_2$ Scale	1
		2) Decrease in solubility of salts Some salts present in hard water become insoluble at higher temperature. e.g. $CaSO_4$, $CaSiO_3$, $MgSiO_3$. These salts form hard scale at high temperature.	1
		Disadvantages:	
		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.	

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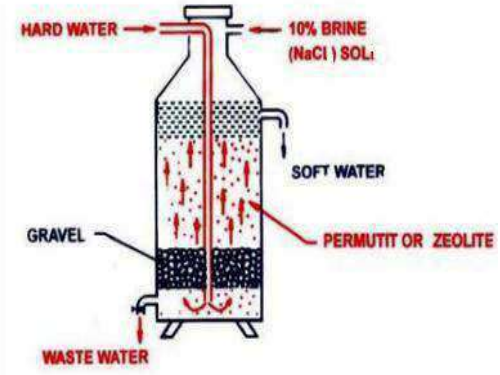
3.	**(b)**	**2) Lowering safety of boilers :** Due to scale formation, overheating of boiler is to be done in order to maintain a constant supply of steam. This makes the boiler material softer and weaker. This causes distortion in boiler tube and makes the boiler unsafe to bear the pressure of the steam, 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 the life of the boiler:** **The life of the boiler is shortened due to the following reasons:** iii) 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. ii) 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.	1 mark each
	(c)	**Explain the permutit process of water softening with neat sketch diagram and write the reactions of regeneration.**	**4**
		 **PERMUTIT'S PROCESS OF SOFTENING OF HARD WATER**	1

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3	(c)	**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. **Regeneration reactions:** When the permutit is exhausted i.e. completely converted into CaP and MgP, it is regenerated by treating with 10% brine (NaCl) solution for a few minutes, sodium permutit (Na_2P) is formed and can again be used for softening of more hard water. **OR** $CaP + 2NaCl \rightarrow Na_2P + CaCl_2$ $MgP + 2NaCl \rightarrow Na_2P + MgCl_2$	1 2
	(d)	**Name the types of impurities present in water. Explain the process of sterilization of water using bleaching powder.** **Impurities:** i) Suspended impurities. ii) Dissolved impurities. iii) Colloidal impurities. iv) Biological impurities. **Sterilization of water using bleaching powder:** About 1 Kg. of bleaching powder per 1000 litres of water is mixed and resulting solution is allowed to stand for several hours. Following reactions takes place. 1) $CaOCl_2 + H_2O \rightarrow Ca(OH)_2 + Cl_2$ [Bleaching powder] 2) $Cl_2 + H_2O \rightarrow HOCl + HCl$ 3) HOCl → HCl + [O] [Hypochlorous acid] [Nascent oxygen] 4)Germs + [O] → Germs are killed Thus bleaching powder helps to kill microorganisms.	**4** 2 2

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3	(e)	**Describe a bad effect of using hard water in following industries:** i) **Paper industry** **ii) Textile industry** **Paper industry: (Note: Consider any two points)** 1) If hard water used in textile industry then large quantity of soap is wasted. 2) If hard water is used in paper manufacturing, then Ca^{2+} and Mg^{2+} ions react with the paper material to form unwanted precipitates. Hence, paper will not have desired smoothness and glossiness. 3) Iron & manganese impurities in hard water affect whiteness of colors. **Textile industry : (Note: Consider any two points)** 1) If hard water is used in textile industry, then large quantity of soap is wasted while washing the yarn. 2) At the same time, undesirable precipitate is formed which adheres to the fabrics and the exact shades of color are not obtained. 3) Fe and Mn salts may cause spots on fabrics.	4 **2** **2**
	(f)	**Define concrete. State any three properties of concrete.** **Concrete:** A building material made from a mixture of broken stone/gravel, sand, cement, and water, which can be spread/poured into moulds and form stone like mass on hardening is called concrete. **Properties:** 1) **Fineness:** The size of the particles of the cement is its fineness. 2) **Soundness:** It refers to the ability of cement to not shrink upon hardening. 3) **Consistency:** The ability of cement paste to flow is consistency. 4) **Strength:** Three types of strength of cement are measured – compressive, tensile and flexural. 5) **Setting time:** Cement sets and harden when water is added. This setting time can vary depending on multiple factors such as fineness of cement, cement-water ratio, chemical content and admixture. 6) **Heat of hydration:** When water is added to cement, the reaction that takes place is called hydration. 7) **Loss of** ignition**:** Heating a cement sample at 900-1000^{0}c causes weight loss. This loss weight upon is calculated as loss of ignition. 8) **Specific gravity:** it is generally used in mixture proportioning calculations. Portland cement has specific gravity of 3.15, but others may have 2.90. **(Note: Consider any two relevant property)**	4 1 1 mark each