WINTER– 2017 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 any two ores of iron with their chemical formulae.**	**(2)**
		i) Haematite – 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
	(b)	**Give the functions of coke & limestone in extraction of iron by the blast furnace.**	**(2)**
		Function of Coke (any one) i) Coke (C) is used as a reducing agent for oxides of metals. ii) Coke (C) converts the ore into molten metal.	1
		Function of Limestone (any one) i) Limestone (CaO) is used as a flux in the blast furnace. ii) Flux (CaO) removes gangue in the form of fusible mass known as slag.	1

WINTER– 2017 EXAMINATION
Model Answer

17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(c)	**Give any four properties of high carbon steels.** **Properties:** 1) It consists 0.6 – 1.5% carbon content 2) It is quite hard. 3) It is unweldable. 4) It gets desired hardness on heat treatment. 5) Its tensile strength is highest.	**2** ½ Mark each
	(d)	**Define atmospheric corrosion.** **Atmospheric corrosion:** The corrosion which is brought about by the atmospheric conditions is called atmospheric corrosion. **OR** The corrosion occurs when metals come in contact directly with the atmospheric gases like O_2, CO_2 and moisture etc.	**2** 2
	(e)	**Which oxide film is most protective against corrosion? Why?** **Stable 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 can be considered)**	**2** 1 1
	(f)	**Name two constituents of paint and one function of each.** **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.	**2**

WINTER – 2017 EXAMINATION

Model Answer

17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**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. **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 any two constituents with one function of each)**	1 mark each

WINTER – 2017 EXAMINATION
Model Answer

17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(g)	**Why galvanized containers are not used for storing food stuff?**	**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 cannot be used for storing food stuff.	2
	(h)	**Name four impurities present in natural water.** i) Suspended impurities ii) Dissolved impurities iii) Colloidal impurities iv) Biological impurities	**2** ½ mark each
	(i)	**Define sterilization.** **Sterilization**: - It is the process of killing disease producing bacteria present in water. **OR** The process of destroying diseases causing bacteria and micro-organisms from the water is called as sterilization	**2** 2
	(j)	**How can the exhausted permutit be regenerated?** 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** $CaP + 2NaCl \rightarrow Na_2P + CaCl_2$ $MgP + 2NaCl \rightarrow Na_2P + MgCl_2$ **(consider explanation or any one reaction)**	**2** 2
	(k)	**What is function of silica and iron oxide in cement?** **Function of Silica (SiO_2): (any one)** 1. It gives strength to the cement by forming a gel. 2. It increases the setting time of cement.	**2** 1

WINTER– 2017 EXAMINATION

17208

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Function of Iron oxide (Fe_2O_3): (any one)** 1. It gives color to the cement. 2. It gives hardness and strength to the cement.	1
	(l)	**What is plaster of Paris?**	**2**
		Plaster of Paris: It is produced by heating pure gypsum to a temperature of about 120 – 160°C	1
		$CaSO_4 . 2H_2O \xrightleftharpoons{120^oC} CaSO_4 . ½ H_2O$ Gypsum — plaster of paris	1
2	(a)	**Attempt any Four of the following** **Distinguish between cast iron, wrought iron and steel (any 4 points).**	**16** **4**

Cast iron	Wrought iron	Steel
1. Carbon content 2.5-4.5%	Carbon content 0.25-0.5%	Carbon content 0.05-1.5%
2. Structure is crystalline	Structure is Fibrous	Structure varies according to impurities
3. Melting point is lowest i.e. 1100-1200^{0}c	Melting point is highest i.e. 1500 ^{0} c	Melting point is between 1200-1500 ^{0} c
4. Very hard and brittle	Soft	Harder than wrought iron
5. High Tensile strength	Medium Tensile strength	Highest Tensile strength
6. It is neither malleable nor ductile	malleable and ductile	malleable and ductile if % of C is low.
7. It cannot be magnetized permanently	Magnetized but temporarily	It can be magnetized permanently
8. It cannot be forged	It can be forged easily	It can be forged but not easily
9. It can neither be tempered nor welded	It cannot be tempered but can be welded	It can be tempered as well as welded

1 mark each

WINTER – 2017 EXAMINATION

Model Answer

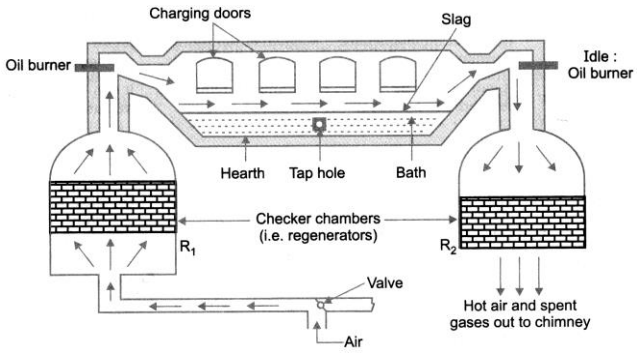
17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	(b)	**With neat and labeled diagram, describe open hearth process for preparation of steel.** **Procedure: -** 1) The charge consists of pig / cast iron (Cold or molten), scrap iron / steel & haematite (Ore). 2) Heating the charge on the hearth of furnace by the heat produced by burning fuel in air or by producer gas. 3) **First Phase of Cycle: -**Producer gas / air is passed through previously heated regenerator (R) while the products of combustion flow through the regenerator. 4) The charge is fed through a charging door & heated to 1600^0C to 1650^0C by means of producer gas. Fuel is fired through nozzles. 5) The hot gases formed in (R_1) pass over the hearth to its opposite end & metal charge supported on the hearth is openly exposed to the flames & is converted into molten metal. Metal charge is also heated by the radiations from the walls. 6) After passing over the hearth, the products of combustion pass through R_2 (Checker chamber) & heat it after about 25 to 30 min. **7) Second Phase Cycle:-**Idle burner fires the fuel. 8) Regenerators R_1, R_2store & release large quantities of heat which would have escaped to the atmosphere & thus wasted. 9) Tap hole in the lowest part of the hearth always closed with refractory plug until metal is ready to be poured. **Reaction: - (any two)** a) Oxidation of impurities of Mn, P and Si by hematite. $2Fe_2O_3 + 6Mn \rightarrow 4Fe + 6MnO$ $5\ Fe_2O_3 + 6P \rightarrow 10Fe + 3P_2O_5$ $2Fe_2O_3 + 3Si \rightarrow 4Fe + 3SiO_2$	**4** 2 1

WINTER– 2017 EXAMINATIONS

Model Answer

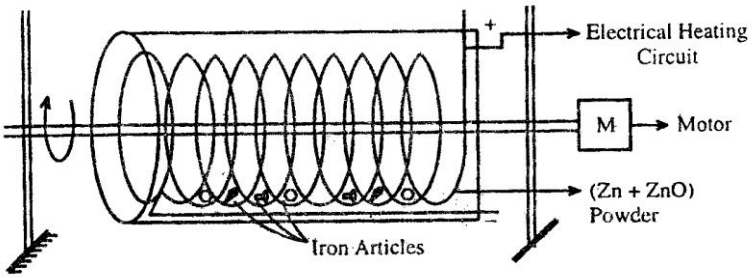
Subject Code: 17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.		b) Formation of slag for the removal of Mn, P & Si. $MnO + SiO_2 \rightarrow MnSiO_3$ $P_2O_3 + 3CaO \rightarrow Ca_3(PO_4)_2$ } Slag $SiO_2 + CaO \rightarrow CaSiO_3$ c) Finally, C & S from gaseous oxides which leave the furnace as flue gases $2\ Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2\uparrow$ $2Fe_2O_3 + 3S \rightarrow 4Fe + 3SO_2\uparrow$  	1
	(c)	**Explain the process of Normalizing of steel.**	**4**
		Normalizing Process: 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.	1
		1. Due to normalizing steel becomes homogenous & softer. 2. After normalizing treatment, ultimate structure in the steel consists of fine grains. 3. By cold working, the steel develops some hardness and looses ductility due to distortion. 4. Time required for normalizing is less than annealing. 5. Consumption of fuel or electric power is less. 6. The mechanical properties of steel are more improved than annealing. 7. Normalizing is used for the following purposes: **(any two)** a. To remove coarse grained structure. b. To give ductility and toughness.	2 1

WINTER– 2017 EXAMINATION

17208

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.		c. To remove internal stresses that may have been caused by working. d. To improve the mechanical properties of the steel.	
	(d)	**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
	(e)	**State and explain any four factors affecting rate of electrochemical corrosion** **A) Nature of metal:** **1) Position of metal in a galvanic series:** A metal having higher position in a galvanic series has more chemical reactivity and therefore, it gets attacked by gaseous and corroding medium faster. In the series the noble metals are at the bottom whereas the alkali metals are at the top.	**4**

WINTER– 2017 EXAMINATION

Model Answer

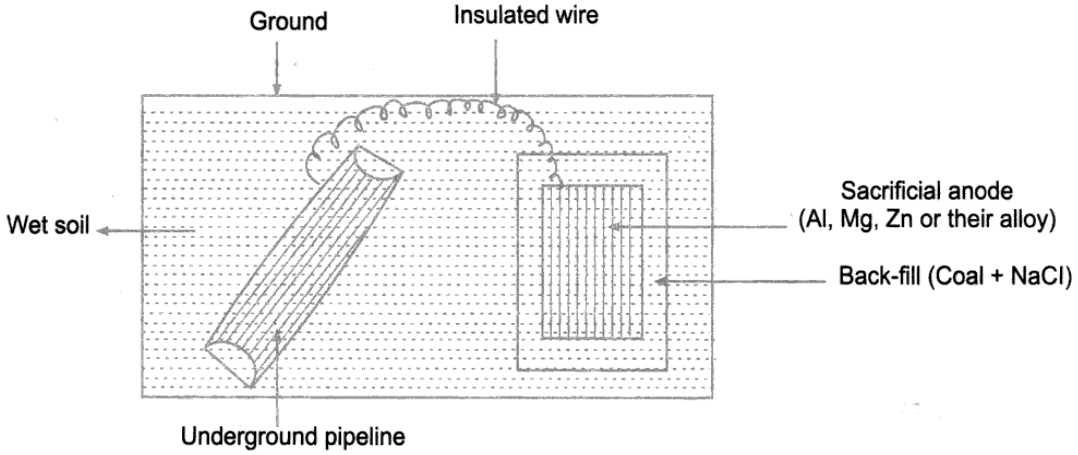
17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**2) Purity of the metal: -** Impurities present in a metal cause heterogeneity and forms a large no. of tiny galvanic cells when an aq. medium comes in contact with such metal. If the impurity metal is highly placed in a galvanic series, then it acts as a anode and gets corroded to produce small depressions on the surface of the base metal. If the metal is pure it is corrosion resistant. **3) Physical state of the metal: -**The physical state of metal means orientation of crystals, grain size, stress. The larger grain size of the metal the smaller will be its solubility and hence lesser will be its corrosion. eg :- mild steel grains are smaller than cast iron grains therefore mild steel gets corrodes faster. Areas under stress tend to be anodic and corrosion takes place at these stressed areas. The grain size in a metal can be increased by hardening operation or by alloying with a suitable element. **4) Solubility of the corrosion products:-**Insoluble corrosion products function as a physical barrier thereby suppresses further corrosion. But if the corrosion product is soluble in the corroding medium the corrosion of the metal proceeds faster. **B) Nature of the Environment: -** 1) **Effect of pH**: -Acidic media are more corrosive than alkaline and neutral media. e.g. corrosion of Zn can be minimized by increasing the pH to 11 **2) Differential aeration**: Corrosion occurs where oxygen access is least. eg :- When pipeline passes through moist soil as well as dry soil the part passing through moist soil having restricted oxygen access becomes anodic while the part passing through dry soil having more access of air becomes cathodic. This causes corrosion of pipe embedded in moist soil. **3) Presence of impurities in the atmosphere**: - Corrosion of metals is more in industrial areas because corrosive gases like H_2S, SO_2, CO_2 and fumes of H_2SO_4 and HCl in industrial areas increases conductivity of the liquid layer in contact with the metal surface thereby increases the rate of corrosion. **4) Humidity: -** The greater the humidity greater is the rate and extent of corrosion. Moisture dissolves the atmospheric gases or chemical vapors and the reaction between such dissolved gases with metallic surface becomes faster. Hence water can act as a conducting medium and promotes corrosion. e.g:- Rusting of Fe is promoted in humid atmosphere. **(Note: consider any other related factor)**	1 mark each

WINTER – 2017 EXAMINATION

17208

Model Answer

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	(f)	**Describe the sacrificial anodic protection method with the help of diagram. Write its applications.**	4
			1
		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
		Applications:	
		1.This method is applicable to protect buried pipelines, buried cables, hot water tank, ship hull etc.	1
		2. Mg or Zn rods are bolted along the sides of ship, hot water tank or inserted into boiler to prevent corrosion	
3		**Attempt any four of the following:**	**16**
	(a)	**What are boiler scales? Explain the causes of the formation of boiler scales.**	**4**
		Boiler Scale: Hard, adherent coating on the inner surface of the boiler is known as boiler scale.	1
		Causes of formation of boiler scales: -	
		1) Chemical Decomposition-Calcium bicarbonate & Magnesium bicarbonate decomposes at higher temperature to form insoluble carbonates which precipitates to form scale.	1 ½ each
		$Ca(HCO_3)_2 \longrightarrow \underset{\text{Scale}}{CaCO_3\downarrow} + H_2O + CO_2\uparrow$	

WINTER – 2017 EXAMINATION

Model Answer

Subject Code: 17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
3		$Mg(HCO_3)_2 \rightarrow \underset{\text{Scale}}{MgCO_3\downarrow} + H_2O + CO_2\uparrow$ **2) Decrease in solubility of salts –** Some salts present in hard water becomes insoluble at higher temperature e.g. $CaSO_4$, $CaSiO_3$, $MgSiO_3$ These salts form hard scale at high temperature. **3) Presence of silica**-The presence of silica in water deposits as magnesium silicate ($MgSiO_3$) and calcium silicate ($CaSiO_3$). These deposits stick very firmly on the inner side of boiler. **(consider any two causes)**	
	(b)	**Write two disadvantages each of using hardware in paper and sugar industries?**	**4**
		Paper industry- (Any two) 1) 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. 2) Iron & manganese impurities in hard water affect whiteness of colours.	2
		Sugar industry - (Any two) 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.	2
	(c)	**Calculate carbonate and non-carbonate hardness of a sample of water containing $MgCl_2$=9.5 PPM, $MgSO_4$=48 PPM, $Ca(HCO_3)_2$=16.2 PPM, KCl=12 PPM, $Mg(HCO_3)_2$=14.6 PPM.**	**4**
		Step I: Conversion of the quantities of all the chemicals in terms of $CaCO_3$ equivalents in ppm	

WINTER – 2017 EXAMINATION

Model Answer

Subject Code: 17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
3			

Sr. No.	Salt/Chemical	Quantity in PPM	Mol. Wt.	Type of hardness	$CaCO_3$ equivalents in PPM
1	$MgCl_2$	9.5	95	Non-carbonate	9.5 x 100/95=10
2	$MgSO_4$	48	120	Non-carbonate	48 x 100/120=40
3	$Ca(HCO_3)_2$	16.2	162	carbonate	16.2 x 100/162=10
4	KCl	12	75	Does not cause harness	
5	$Mg(HCO_3)_2$	14.6	146	carbonate	14.6 x 100/146=10

2

Step II: Calculation of Carbonate hardness (temporary):

= [$CaCO_3$ equivalent in PPM of $Ca(HCO_3)_2$ + $Mg(HCO_3)_2$]

= [10 + 10]

= **20 PPM**

1

Step II: Calculation of Non-carbonate hardness (permanent):

= [$CaCO_3$ equivalent in PPM of $MgCl_2$ + $MgSO_4$]

= [10 + 40]

= **50 PPM**

1

(d)

Describe ion exchange process of softening of hardwater with neat and labeled diagram and chemical reactions.

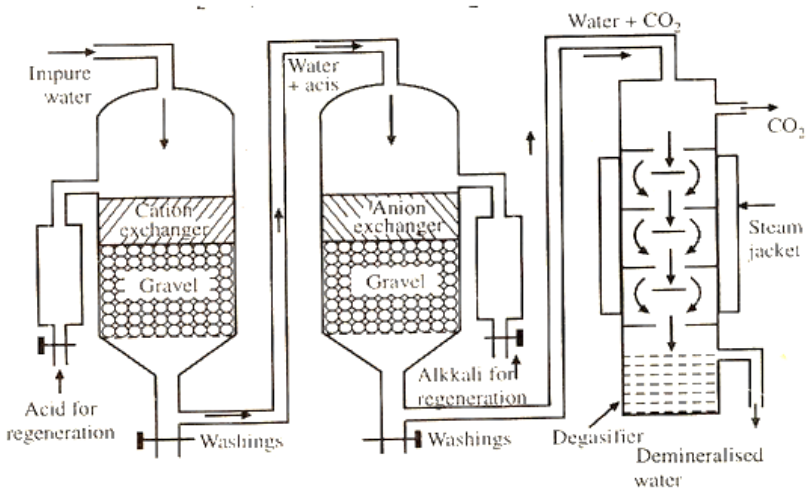
4

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.

WINTER – 2017 EXAMINATION

Model Answer

Subject Code: 17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
3		**Process :-** It consist of three cylindrical towers, the first tower contains cation exchange resin ($R-H_2$) and the other contains anion exchange resin ($R'-OH_2$). 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. **Working :-** $RH_2 + CaCl_2 \rightarrow RCa + 2HCl$ $RH_2 + MgSO_4 \rightarrow RMg + H_2SO_4$ **[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. $R'(OH)_2 + 2HCl \rightarrow R'Cl_2 + 2H_2O$ $R'(OH)_2 + H_2SO_4 \rightarrow R'SO_4 + 2H_2O$ **[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 2 1

WINTER – 2017 EXAMINATION

Model Answer

Subject Code: 17208

Q. No.	Sub Q. N.	Answer	Marking Scheme
3	(e)	**Describe chlorination process with Chemical reactions by using chlorine gas. Write it's two disadvantages.**	4
		Chlorination of water by using chlorine gas: - Cl_2 reacts with water to produce hypochlorous acid & nascent oxygen. Both are powerful germicides. Thus, kills germs & microorganisms. **1) $Cl_2 + H_2O \longrightarrow$ HOCl + HCl** [Hypochlorous acid] **2) HOCl $\longrightarrow$ HCl + [O]** (Nascent oxygen) **3) Germs + [O] $\longrightarrow$ Germs are killed**	1 2
		Disadvantages: 1) Excess Cl_2 produces unpleasant taste. 2) It also produces odour. 3) Irritation on mucous membrane.	1
	(f)	**Describe setting and hardening of cement. Write chemical reactions taking place.**	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.	2
		Following chemical reaction taking place during setting and hardening. **1] Hydrolysis:** $C_3S + (x+1)\ H_2O \rightarrow C_2S.\ xH_2O + C.H_2O$ $C_4AF + 7\ H_2O \rightarrow C_3A.\ 6H_2O + CF.H_2O$	1
		2] Hydration: $C_3S + xH_2O \rightarrow C_2S\ .x\ H_2O + CaO$ $C_3A + 6\ H_2O \rightarrow C_3A.6\ H_2O$	1