

#### WINTER – 2012 EXAMINATION

Subject Code: 12020 Page No: 1/10 **Model Answer** 

Section-II (Applied chemistry)

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Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
4.	a)	<b>pH</b> : pH of a solution is defined as the negative logarithm to the base ten of hydrogen ion concentration expressed in mole / liter. PH value of extremely acidic solution is Zero (0) pH value of extremely alkaline solution is Fourteen (14)	1 ½ Each	2
	b)	Limitations of permutit process. (any 2 points)  1) If water is turbid, it can not be softened by this process as turbidity clogs / chokes the pores of permutit and flow of water is restricted.  2) If water contains mineral acid, it can not be softened by this process since acid may destroy the permutit material.  3) If water contains manganese ions (Mn <sup>++</sup> ) and ferrous (Fe <sup>++</sup> ) ions, sodium permutit is converted into manganese permutit and ferrous permutit which cannot be regenerated easily.  4) Permutit process replaces cations Ca <sup>++</sup> or Mg <sup>++</sup> by Na <sup>+</sup> ions but leaves acidic ions like HCO <sub>3</sub> <sup>-</sup> , CO <sub>3</sub> <sup></sup> , Cl <sup>-</sup> and SO <sub>4</sub> <sup></sup> in the softened water.	1 mark each	2
	c)	Function of lime in cement:  1) A high content of lime increases the setting time but gives early. strength and make the cement 'unsound' and liable to expand and crack.  2) A very less content of lime reduces the strength of cement and may set quickly that is hardens before the mason has a change to place it in the forms.  Hence lime content should be moderate.	1	2
	d)	Uses of mortar:- (any two points)  1) It is used as a matrix for concrete.  2) It is used for blending and bonding masonry units such as bricks, stones and tiles etc.  3) It is used for plastering and pointing walls to protect joints and exterior surfaces of masonry work from deteriorating effect of water.	1 mark each	2
	e)	Four characteristics of good paint. (any 4 points)  1) It should have high covering power.  2) It should form tough, uniform and adherent film.  3) It should have brushing characteristics.  4) It produces glossy film.  5) It should have high hiding power.  6) Its film should be fluid enough to be spread easily over the surface to be protected.	<sup>1</sup> / <sub>2</sub> mark each	2



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Que. No.	Sub.	Model Answer	Marks	Total Marks
4.	Que.	Enamels: Enamel is a pigmented varnish i.e. it is an intimate dispersion of pigment in varnish.  Constituents of enamels:1)Pigment 2)Vehicle 3) Driers 4) Thinner	1	2
	g)	Two functions of pigment. (any 2 points)  1) It protects the paint film by reflecting ultraviolet light, hence prevents the destructive oxidation of painted surface.  2) It gives color to the paint film.  3) It gives aesthetic look to the painted surface.  4) It increases weather resistance of paint film.	1 mark each	2
	h)	Corrosion: - It is a process of chemical or electrochemical destruction of a metal due to action surrounding medium.  Types of corrosion:  i) Atmospheric or Chemical or Dry corrosion ii) Immersed or Electrochemical or Wet corrosion.	1 1/2 +1/2	2
	i)	Galvanizing means coating of Zinc. Zinc coating get dissolved in acidic foodstuff, to produce poisonous matter which will poison the foodstuff, hence galvanized container are not used for storing food stuff.	2	2
	j)	Stable non- porous oxide film is more protective against corrosion. Example: Aluminium, Copper, Lead and Tin forms stable non-porous oxide film.	1	2
	k)	Factors affecting rate of electrochemical Corrosion.  1) pH value of surrounding solution.  2) Position of metal in electrochemical series.  3) Solubility of corrosion product.  4) Physical difference of the metal surface.	1/ <sub>2</sub> 1/ <sub>2</sub> 1/ <sub>2</sub> 1/ <sub>2</sub> 1/ <sub>2</sub>	2

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Que.	Sub.	Model Answer	Marks	Total
No.	Que.		17101103	Marks
5.	a)	Disadvantages of hard water in boiler due to scale formation.  1) Wastage of fuel: - The scales are hard and bad conductor of heat. When it is deposited on the inner walls of boilers, overheating of boiler is necessary for steady supply of steam. Hence large amount of heat is wasted in heating the scale which results in wastage 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. The over heating of boiler makes the boiler material softer and weaker which causes distortion of boiler tube results in bending of boiler tube and make the boiler unsafe to bear pressure of steam.	1	4
		3) <b>Danger of explosion</b> :-When thick scales crack due to uneven expansion of scale and boiler material, the water comes suddenly in contact with over heated iron plates of boiler. This causes the formation of a large amount of steam suddenly inside the boiler. So sudden high pressure is developed which may cause explosion of the boiler.  4) <b>Decrease in efficiency of boiler:-</b> Scales are deposited in the valves and condensers of the boiler and choke them partially. This results in decrease in efficiency of boilers.	1	
	b)	Ion Exchange Process:  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 <sup>+</sup> and anion exchange resins have exchangeable OH ions.  Process:-  It consist of three cylindrical towers, the first tower contains cation exchange resin (R-H₂) and the other contains anion exchange resin (R'-OH₂).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:-  i) Hard water is first passed through the cation exchange resin. It removes all the cations like Ca <sup>++</sup> , Mg <sup>++</sup> and releases H <sup>+</sup> ions.  R-H₂ + CaCl₂ → R-Ca + 2HCl R-H₂ + MgSO₄ → R-Mg + H₂SO₄  Thus water is free from cations but it is acidic.  ii) The acidic water is then passed through anion exchange resin where acid is converted into water  R' -(OH)₂ + 2HCl → R' SO₄ + 2 H₂O  Thus water is free from all cations and anions  iii) Finally water is made free from dissolved gases like CO₂ , O₂ etc. by passing it through third tower of degasifier	1	4



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Que.	Sub.	Model Answer	Marks	Total
No. 5.	Que.	Diagram :-		Marks
		Impure water + CO <sub>2</sub> Water + CO <sub>2</sub> Anion exchanger  Gravel  Alkkali for regeneration  Washings  Degasifier  Demineralised water	1	
	c)	Sterilisation: The process of destroying disease causing bacteria and microorganism from water is known as sterilization.  Sterilization can be carried out by following methods of chlorination.  (any one method is for 3 marks)  i) By using chlorine gas  ii) By using bleaching powder  iii) By using chloramine  i) By using chlorine gas:  Chlorine in the form of chlorine gas or chlorine water form can be used for sterilization of municipal water supply. It reacts with water to form	1 1 1	4
		hypochlorus acid and nascent oxygen, which are powerful germicides. $Cl_2 + H_2O \longrightarrow HOCl + [O]$ Hypochlorus acid nascent oxygen $HOCl \longrightarrow HCl + [O]$	1	
		hypochlorus acid nascent oxygen		
		ii) By using bleaching powder: 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. $ \text{CaOCl}_2 + \text{ H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{ Cl}_2 $		
		$Cl_2 + H_2O \longrightarrow HOCI + [O]$		
		hypochlorus acid nascent oxygen		



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Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
5.	Que.	HOCI + [O]		IVIAINS
		hypochlorus acid nascent oxygen iii)By using chloramines:		
		Chloramine reacts with water to form hypochlorus acid and nascent oxygen, which are powerful germicides.		
		$CINH_2 + H_2O \longrightarrow HOCI + NH_3$ hypochlorus acid		
		HOCI		
		hypochlorus acid nascent oxygen		
	d)	Given: pH = 4.1 [OH ] = ? Solution:		4
		Part I: pH + pOH = 14 4.1 + pOH = 14	1	
		pOH = 14 - 4.1 pOH = 9.9	1	
		Part II : $pOH = -log_{10}[OH^{-1}]$ $9.9 = -log_{10}[OH^{-1}]$ $log_{10}[OH^{-1}] = -9.9$	1	
		$[OH^{-}] = 10^{(-9.9)}$ $[OH^{-}] = 1.259 \times 10^{-10} \text{ moles/ lit.}$	1	
	e)	Causes of Hardness of water:  1) Rain water combines with CO <sub>2</sub> from air or from decaying plants on soil and forms carbonic acid.  CO <sub>2</sub> + H <sub>2</sub> O		4
		When such acidic rain water flows over rocks containing calcium or magnesium carbonate forms soluble calcium or magnesium bicarbonate and makes the water hard.  H <sub>2</sub> CO <sub>3</sub> + CaCO <sub>3</sub> Ca(HCO <sub>3</sub> ) <sub>2</sub>	1	
		H <sub>2</sub> CO <sub>3</sub> +MgCO <sub>3</sub> — Mg(HCO <sub>3</sub> ) <sub>2</sub> ( Soluble)  2) On the surface of soil, there are also chloride and sulphate of calcium		
		and magnesium. These salts are water soluble making it hard.	1	



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Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
5.	Que.	Sr.No. Temporary Hard Water Permanent Hard Water		WILLIKS
		1 It contains only calcium It contains chlorides and bicarbonate and magnesium sulphates of calcium and magnesium.	1	
		It can be converted into soft just by boiling.  It can not be converted into soft just by boiling but by any softening method such as permutit or ion exchange etc.	1	
	f)	Setting and Hardening of cement:  When water is added to cement, it forms 'cement paste'. This cement paste looses its plasticity and becomes quite rigid in short time is called initial set.  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.	1	4
		Setting and Hardening involves chemical as well as physical change. Following chemical reaction taking place during setting and hardening. i) Hydrolysis: $C_3S + (x+1) H_2O \longrightarrow C_2S.xH_2O + C.H_2O $ (gel) (crystals) $C_4AF + 7 H_2O \longrightarrow C_3A.6 H_2O + CF.H_2O $ (crystals) (gel) ii) Hydration: $a) C_3S + x H_2O \longrightarrow C_2S.xH_2O + CaO $ (gel) (lime) $b) C_3A + 6 H_2O \longrightarrow C_3A.6 H_2O + heat $ (crystals)	2	
		Gel is bonding material and gives strength to cement. Finally these crystals and gel interlock the inert particles of aggregates like sand, stone, to form compact cement –rock like material Thus setting is due to initial gel formation and hardening is the development of strength due to crystallization.	1	



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Que. No.	Sub. Que.	Model Answer					Total Marks
6.	a)	Chemical composition of Portland cement:					4
		Sr. No.	Compound	Formula	Present		
		1	Lime	CaO	60-69		
		2	Silica	SiO <sub>2</sub>	17-25		
		3	Alumina	Al <sub>2</sub> O <sub>3</sub>	3-8		
		4	Iron oxide	Fe <sub>2</sub> O <sub>3</sub>	0.5-6		
		5	Magnesium oxide	MgO	0.1-4		
		6	Sulphur trioxide	SO <sub>3</sub>	1-2		
		7	Soda and potash	$Na_2O + K_2O$	0.5-1.3		
	b)	Properties of 1. Quality: It Silica modular Alumina modular Setting the setting or had crystallization. The initial setting of the setting of	ıal	4			
		3. <b>Shrinkage</b> drying periothe	id crystallization of C <sub>3</sub> S e: The volume shrinkag d and temperature flu eriod the smaller is the ess: If the cement is so volume or indicate and dreenish grey colour of iron in it. If this iron is l, even white cement c	ge depends upon uctuation of the seshrinkage.  Dund, it will not make a service of the seshrinkage.  Dund, it will not make a service of the seshrinkage.  If ordinary Portlam prevented by sor an be obtained.	water/cement rati surroundings, long undergo apprecial or drastic weath and cement is due me suitable choice	ole er to of	
		6. <b>Corrosion</b> acids.	<b>n by acid</b> : Cement co	nstructions are a	ttacked by types	of	



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Que. No.	Sub. Que.		Model An	swer	Marks	Total Marks
6.		affected lime pre 8. <b>Sulp</b> balance	d by water containing dissolved esent in the cement to form calcinate corrosion: Sulphate like of free lime, silica and aluminat	MgSO <sub>4</sub> & Na <sub>2</sub> SO <sub>4</sub> disturbs the		
	c)	Differer	nce between Paints and Varnis	shes (any four points)		
		Sr.	Paints	Varnishes		
		No.			1	4
		1	Paint is mechanical dispersion mixture of one or more pigments in medium or vehicle	Varnish is a homogeneous colloidal dispersion solution of resins in oil or thinner or both	mark each	
		2	Paint contains pigments	Varnish do not contain pigments		
		3	Paint hide the surface on which it is applied	Varnish do not hide the surface on which it is applied		
		4	Paint produces non – transparent film	Varnish produces transparent film		
		5	In paint ,instead of oil ,the resin cannot be used	In vanish ,instead of oil ,the resin can be used		
		6	Painted surface reflects heat and light.	Varnished surfaces do not reflect heat and light.		



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Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
6.	d)	Ingredients of Distempers:  1. Whitening or chalk powder 2. Glue or casein(binder) 3. Coloring pigment 4. Water(solvent or thinner)  Advantages of Distemper: (any two) 1. Distempers are cheaper than paints and varnishes 2. They can be applied easily on plasters, cement concrete or wall surfaces in the interior of buildings. 3. They are durable. 4. They have good covering power. 5. They give smooth and pleasing finish to walls  Uses: Distempers are used as finishing coat on (any two) 1. White wash surfaces of interior walls. 2. Plastered surfaces of interior walls 3. External surfaces of brick works, concrete etc. after adding a weather resisting compound at the time of mixing.	1	4
	e)	Atmospheric corrosion: Atmospheric corrosion is defined as the decay or destruction of metal due to the gases like hydrogen, oxygen, and sulphur- di-oxide etc. present in the atmosphere.  Mechanism of Atmospheric corrosion:- During oxidation metal forms metal oxide.  Metal + O₂ → Metal oxide  In the mechanism of atmospheric corrosion metal has a tendency to lose electrons while the oxygen has the tendency to accept these electrons, with formation of ions. These ions combine to form a metal oxide film is over the metal surface. The mechanism is,	2	4
		$M \rightarrow M^{++} + 2e$ , loss of electrons ${}^{1/2}O_2 + 2e^- \rightarrow O^{}$ gain of electrons $\cdots \cdots $		



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Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
6.	2	Metal Oxide (MO) Layer  Metal-Metal Oxide Interface  Metal  Metal Oxide Oxide Interface	1	
	f)	<b>Metal Cladding:</b> Metal cladding involves bonding firmly and permanently, a dense, homogeneous layer of a metal to the base metal on one or both sides.	1	4
		<b>Process</b> : In this method the base metal to be protected from corrosion is sandwiched or cladded between the two sheets of coating metal. Then it is passed through two heavy rollers at high temperature. The coated metal is catholic with respect to base metal so that electrolytic protection is provided. Metals used for cladding are like copper, nickel, silver, platinum, and alloys like stainless steel, nickel alloy, lead alloy. The base metals are aluminium, copper, nickel etc.	1	
		Claded sheet  Rollers  ALUMINIUM Base metal  ALUMINIUM ALUMINIUM	1	
		Disadvantages:  1. By metal cladding only plain surfaces can be protected.  2. Cladding not perfect for irregular surfaces.	1	