WINTER–15 EXAMINATION

Subject Code: 17208 **Model Answer**

Applied Chemistry

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may tryto 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 thefigure. 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 constantvalues 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.		

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1		**Attempt any NINE:**		18
	a)	**Write the products of blast furnace.** i) Pig Iron ii) Slag iii) Flue Gases **(any two)**	1mark each	2
	b)	**Write two applications of cast iron.** a) It is used for casting metal objects such as stoves, lamp posts, drainage covers, pipes, fire gates etc. b) It is also used in toys, cooking ranges, agricultural implements etc. where cheapness is more important than strength. c) Mostly, used in manufacturing of wrought iron & steel. d) It is also used in making electric poles, Bunsen – burners bases etc.	1 mark each	2
	c)	**Define : i) Hardening ii) Normalizing** **Hardening:** It is defined as heating the steel to a high temperature (800 – 900^0C) & then suddenly cooled by dipping or quenching in some suitable medium is called hardening. **Normalizing:** It is defined as heating the steel to a definite temperature about 50^0C above the critical temperature. Then it is allowed to cool freely in air. The cooling rate is generally about 5^0C per second is called Normalizing.	1 1	2
	d)	**Write different types of oxide films formed due to oxygen. Which type of oxide film is protective?** **Oxide films: (any two)** 1) Stable film a) Porous film b) Non – Porous film 2) Unstable film 3) Volatile film **Protective film: (any one)** 1. Stable non – Porous oxide film is protective. 2. Unstable oxide film is protective.	1 1	2

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answer</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>1.</td><td>e)</td><td>Name the different constituents of oil paint.

The constituents of oil paint are:- (any four)
1) Pigments 2) Drying Oil / Medium 3) Thinners 4) Driers
5) Extenders 6) Plasticizers</td><td>½ mark each</td><td>2</td></tr>
<tr><td></td><td>f)</td><td>Write two applications of metal cladding.

1) Al clad sheets used in aircraft industry in which a plate of duralumin is sandwiched between two layers of 99.5% pure Al.
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.
3) Al cladded steel sheets are also used in industry.</td><td>1mark each</td><td>2</td></tr>
<tr><td></td><td>g)</td><td>Distinguish with two points between Galvanizing and tinning.
<table>
<tr><th>Sr.No.</th><th>Galvanizing</th><th>Tinning</th></tr>
<tr><td>i)</td><td>A process of covering iron or steel with a thin coat of Zinc to prevent it from rusting.</td><td>A process of covering iron or steel with a thin coat of Tin to prevent it from corrosion.</td></tr>
<tr><td>ii)</td><td>In galvanising, zinc protects the iron as it is more electropositive than iron.It does not allow iron to pass into solution.</td><td>Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.</td></tr>
<tr><td>iii)</td><td>In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.</td><td>In tinning , tin protects the iron, till the coating is perfect.Any break in coating causes rapid corrosion.</td></tr>
<tr><td>iv)</td><td>Galvanized containers can not be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.</td><td>Tin coated containers and utensils can be used for storing any food stuff since Tin is non toxic and protects the metal from corrosion and does not causes food poisoning.</td></tr>
</table></td><td>1mark each</td><td>2</td></tr>
</table>

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1	h)	**Write two causes of hardness of water.** **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 acidified 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 and gives hardness to water. $H_2CO_3 + CaCO_3 \longrightarrow Ca(HCO_3)_2$ $H_2CO_3 + MgCO_3 \longrightarrow Mg(HCO_3)_2$ 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.	1mark each	2
	i)	**Write two disadvantages of chlorination method.** **Disadvantages:** 1) Excess of Cl_2 produces unpleasant taste, 2) It also produces unpleasant odour. 3) Irritation on mucous membrane.	1Mark each	2

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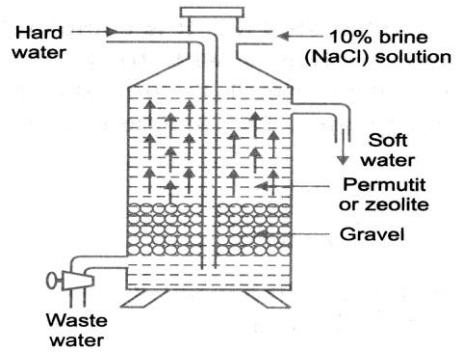
	j)	**Draw a neat labelled diagram of zeolite process.** 	2	2
	k)	**Write two properties of water proofing cement.** 1. Ingredients in it act as pore blocking agents. 2. These acts as water repelling agents. 3. They increase the resistance to the penetration of moisture.	1mark each	2
	l)	**Write chemical composition of fat lime and lean lime.** **Composition of Fat lime:** 1.CaO = 90 – 95% 2. Silica, Alumina, Iron oxide = less than 2% 3. Remaining consists of MgO, H_2O & CO_2 **Composition of Lean lime:** 1.CaO→ 75% 2. Clay → 25%	1 1	2
2.		**Attempt any FOUR of the following:**		16
	a)	**Write the chemical reactions in the reduction zone of blast furnace.** The reduction of iron oxide is done in the following stages:- $Fe_2O_3 \longrightarrow Fe_3O_4 \longrightarrow FeO \longrightarrow Fe$ i) In between 300 – 500^{0}C $3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2 \uparrow$ ii) In between 650 – 700^{0}C $Fe_3O_4 + CO \longrightarrow 3FeO + CO_2 \uparrow$ iii) At temperature between 700 – 800^{0}C $FeO + CO \longrightarrow Fe + CO_2 \uparrow$ iv) Simultaneously, the limestone present in the charge is also decomposed to produce lime. $CaCO_3 \longrightarrow CaO + CO_2 \uparrow$	1 mark each	4

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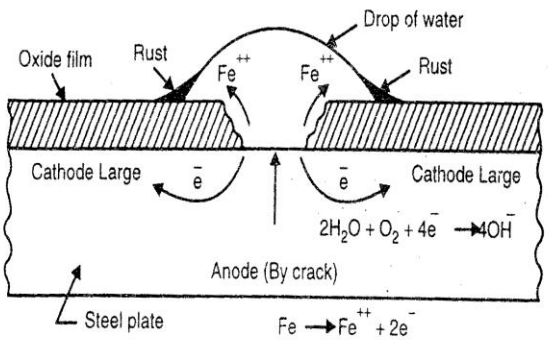
2.		v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4. $2Fe + 3CO \longrightarrow Fe_2O_3 + 3C$ $3Fe + 4CO \longrightarrow Fe_3O_4 + 4C$		
	b)	**(Note: consider any four reactions)** **Define annealing. Write three properties of Annealing.** **Annealing:** It is defined as heating the steel to certain high temperature & then cooling slowly at controlled rate in furnace is called annealing. **Properties:** i)It improves machinability ii) It softens the steel. iii) It increases ductility & shock resistance. iv) It removes internal stress caused due to uneven contraction during casting.	1 1 Mark each	4
	c)	**Write four properties and four applications of high carbon steel.** **Properties:** 1. High carbon steel is quite hard than mild and medium carbon steel. 2. It is unwealdable. 3. Highest desired hardness can be imparted by heat treatment. 4. It has highest tensile Strength. **Uses:** 1. High carbon steel used in wooden working tools. 2. It is used in chisels, saws, drills. 3. It is used in metal cutting tools for lathe. 4. It is used for cutters, knives, blades, and razors.	½ Mark each ½ Mark each	4
	d)	**Describe mechanism of electrochemical corrosion by absorption of oxygen gas.**  	2	4

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		Mechanism: The surface of iron is usually coated with a thin film of iron oxide however if this iron oxide film develops some, cracks anodic area are created on the surface while the coated metal part acts as cathode. i) In this example anodic areas are small surface parts while nearly rest of the surface of the metal forms large cathodes. At anode: - Iron dissolves with the liberation of electrons $Fe \longrightarrow Fe^{++} + 2e^{-}$ ii) The liberated electrons flow from anodic to cathodic areas, through iron metal where electrons are intercepted by the dissolved O_2.These in presence of water drop form OH^{-} ions. $2 H_2O + O_2 + 4e^{-} \longrightarrow 4(OH)^{-}$ The Fe^{++} ions at anode and OH^{-} ions at cathode diffuse towards each other and when they meet $Fe(OH)_2$ is precipitated. $Fe^{++} + 2(OH)^{-} \longrightarrow Fe(OH)_2\downarrow$ a) If enough O_2 is present ferrous hydroxide is easily oxidies to ferric hydroxide. $4Fe(OH)_2 + O_2 + 2H_2O \longrightarrow 4 Fe(OH)_3\downarrow$	2	
	e)	**Describe four factors affecting rate of electrochemical corrosion.** **A) Nature of matel:** **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. **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.	1 Mark each	4

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2.	**e)**	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 minimised by increasing the pH to 11 2) **Differeatial aeration**: Corrosion occures 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 vapours and the reaction between such dissolved gases with metallic surface becomes faster. Hence water can acts as a conducting medium and promotes corrosion. e.g:- Rusting of Fe is promoted in humid atmosphere. **(Note: write any four factors)**		
	f)	**Define paint. Write all characteristics of good paint.** **Paint: -**It is defined as a mechanical dispersion mixture of one or more pigments in vehicles. **Characteristics of a good paint:-** 1) It should be able to resist the atmospheric conditions. 2) Paint should have desired consistency. 3) It should have high hiding power. 4) Its film should be washable. 5) Its film should not crack or shrink on drying. 6) It should form uniform, nonporous, adherent, durable and glossy film. 7) When paint is applied on a metal it should resist corrosion. **(Note: write any three points)**	1 1 mark each	4

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3.		**Attempt any FOUR of the following:**		16
	a)	**Write four distinguishing points between temporary hardness and permanent hardness of water.**		4
		Temporary hardness / **Permanent hardness** **1.** Water containing bicarbonates of Ca and Mg and can be made free from these salts by boiling is known as temporary hard water. / **1.** Water containing Chlorides and Sulphates of Calcium and Magnesium and can not be made free from these salts by boiling is known as permanent hard water. **2** Temporary hardness is due to $Ca(HCO_3)_2$ & $Mg(HCO_3)_2$. / **2.** Permanent hardness is due to $CaCl_2$, $MgCl_2$, $CaSO_4$, and $MgSO_4$. **3.** This hardness can be removed by boiling water. / **3.** This hardness cannot be removed by boiling water. 4. It is due to carbonates hence it is known as carbonate hardness. / 4. It is due to other salts hence it is known as non-carbonate hardness.	1 mark each	
	b)	**Write two causes of scale and sludge formation and write its four disadvantages.**		4
		1) Chemical Decomposition-Calcium bicarbonate & Magnesium bicarbonate present in water 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 $Mg(HCO_3)_2 \longrightarrow MgCO_3 + H_2O + CO_2$	1	
		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.	1	

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3.	**b)**	**Disadvantages of scale formation : (any four)** 1. Wastage of fuel. 2. Lowering safety of boiler. 3. Danger of explosion. 4. Decrease in efficiency. 5. Shortening the life of boiler.	½ mark each	4
	c)	**What is the carbonate and non-carbonate hardness of a sample of water in ppm containing $Ca(HCO_3)_2$ = 16.2mg/lit, $Mg(HCO_3)_2$ = 7.3mg/lit, $MgCl_2$ = 9.5mg/lit, and $CaSO_4$ = 13.6mg/lit?**		
		Salt | Quantity in mg/lit | Mol. wt. | Types of hardness | $CaCO_3$ equivalent in ppm $Ca(HCO_3)_2$ | 16.2 | 162 | Carbonate | 16.2x(100/162) = 10 $Mg(HCO_3)_2$ | 7.3 | 146 | Carbonate | 7.3x(100/146) = 05 $MgCl_2$ | 9.5 | 95 | Non-carbonate | 9.5x(100/95) = 10 $CaSO_4$ | 13.6 | 136 | Non-carbonate | 13.6x(100/136) = 10	2	
		1. Calculation of carbonate or temporary hardness in ppm of $CaCO_3$ $CaCO_3$ equivalent in ppm of $Ca(HCO_3)_2$ + $Mg(HCO_3)_2$ equivalent in ppm of $CaCO_3$ 10 + 05 = 15 ppm.	1	
		2. Calculation of Non- carbonate or permanent hardness in ppm of $CaCO_3$ $CaCO_3$ equivalent in ppm of $MgCl_2$+ $CaSO_4$ 10 + 10 20 ppm.	1	

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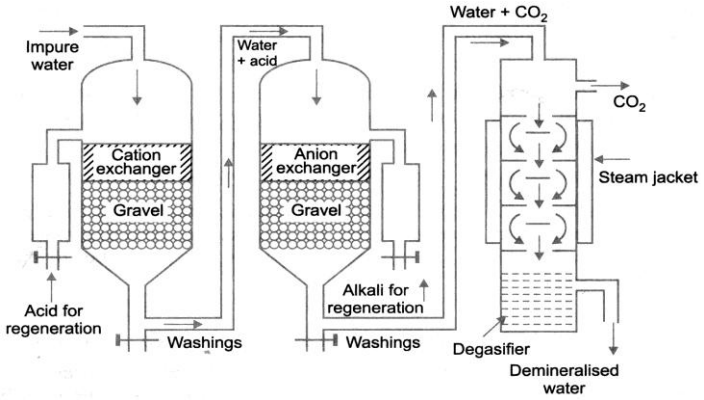
3.	**d)**	**Describe the coagulation process for purification of water.**		4
		Coagulation: Coagulation is the process of removing colloidal or fine sized particles from water by the addition of certain chemicals is known as Coagulation.	1	
		Process of coagulation: Fine sized particles present in water do not settle easily at bottom. In order to have a quick settling of these particles coagulants are added. Commonly used coagulants are Alum and Ferrous sulphate. These coagulants reacts with bicarbonates present in water and form bulky gelatinous PPT. It is called as flock. As these flock descend through water, they catches more fine impurity particles of water and forms bigger flocks. It settles down quickly. Coagulant also removes colour, odour and improves taste. Coagulant forms the flock because they neutralize the charge present on fine particles.	3	
	e)	**Describe ion-exchange process of water softening with neat labelled diagram and chemical reactions.**		4
			2	
		Process: It consists of two cylindrical towers. The first tower consists of cations exchanger (RH_2) & another one consists of anion exchanger $R(OH)_2$. Hard water is first allowed to pass through a tower containing cation exchanger which removes all the cations like Ca^{2+}, Mg^{2+} etc. $RH_2 + CaCl_2 \longrightarrow RCa + 2HCl$ $RH_2 + MgSO_4 \longrightarrow RMg + H_2SO_4$ This acidified water is then passed through tank containing anion exchange resins. Here all the anions are replaced by OH^- ions. $R(OH)_2 + 2HCl \longrightarrow RCl_2 + 2H_2O$ $R(OH)_2 + H_2SO_4 \longrightarrow R(SO_4)_2 + 2H_2O$ Thus water becomes free from all ions. This water is then passed through a degasifier to remove gases like CO_2.	2	

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3.	**f)**	**Define concrete. Write the properties and applications of it.** **Concrete**: It is the building & structural material obtained by mixing of binding materials like lime or cement, aggregates, like sand, crushed stones, gravel, broken bricks, slag & water in a suitable proportion (1:2:4) which can be easily molded into any desired shape. **Properties: (any two)** It is compact. It is rigid. It is strong. Durable. It can be molded into any desired shape. **Uses : (any two)** 1) It is used for construction of roads, building, floors, columns, roofs, arches, tanks, foundations. 2) Abutments, piers, reinforce works, water – proof structures etc.	2 1 1	4