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 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.		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1		**Attempt any NINE:**		18
	a)	**Define: i)Flux ii)Gangue**		
		i)Flux :-The substance which is used to remove the gangue during the smelting process is known as flux. **OR**	1	2
		It is a substance added during smelting which reacts with gangue to form easily fusible material.		
		ii)Gangue:- The unwanted earthy impurities(like sand particles, dust particles, small rocks etc.) associated with ore are called as gangue.	1	
	b)	**Differentiate between pig iron and cast iron (any 2 points)**		2
		Pig iron / Cast iron 1 The molten iron obtained from the blast furnace is collected in a moulds and on solidification it forms pig iron. / 1. It is obtained by purification of pig iron in cupola furnace in presence of coke and lime. 2. It is the most impure form of iron / 2. It is less impure form of iron 3.It contains 3.5 to 4.5 % of Carbon / 3. It contains 2.1 to 4.0 % of Carbon 4 It is used to produce Wrought iron, Cast iron & Steel / 4 It is used to produce cylinder heads, cylinder boxes, gear box, cooking ranges	1 mark each	
		(Note: As Pig iron & cast iron are nearly similar 2 marks should be given if they write any one of them)		
	c)	**Define heat treatment of steel**		2
		Heat treatment of steel may be defined as the process of heating steel to a certain high temperature and then cooling it at a controlled rate, in order to develop certain desirable physical properties in it without changing its chemical composition	2	
	d)	**Why gold does not corroded in air?**		2
		In case of gold metal the oxide film formed is **Unstable oxide film** So as soon as the film is formed it decomposes back into original metal & oxygen.Therefore corrosion is not possible here.	1	
		2 M + O_2 → 2MO → 2 **M + O_2** Metal Metal oxide	1	

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1.	**e)**	**Write two advantages of metal spraying** **Advantages of metal spraying :-** i) The thickness of coating can be controlled. ii) Large and irregular surfaces can be coated efficiently. iii) Non metallic surfaces like glass, plastic etc. can be coated. iv) Coating can be applied to fabricated structure. v) Warn out machine parts can be reclaimed. vi) In chemical industry coating of metal like Al, Zn, Ni,Sn Pb etc. can be done by metal spraying.	1 mark each	2
	f)	**State the constituents of paint .** **The constituents of paint are:-** 1) Pigments 2) Drying Oil / Medium 3) Thinners 4) Driers 5) Extenders 6) Plasticizers **(Any four constituents)**	½ mark each	2
	g)	**Why galvanized containers are not used to store food stuffs?** 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
	h)	**Define scales and sludges.** **Scales:-** The hard, adherent coating formed on the inner wall of the boiler is called as scale. **Sludges:-** The soft, loose, slimy deposits formed inside the boiler are called as sludges.	1 1	2

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1	i)	**Explain chlorination of water by using chlorine gas.** **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 ⟶ HOCl + HCl** [Hypochlorous acid] **2) HOCl ⟶ HCl + [O]** (Nascent oxygen) **3) Germs + [O] ⟶ Germs are killed**	1 1	2
	j)	**Define sterilization and sedimentation.** **Sterilization**:-The process of destroying diseases causing bacteria and micro-organisms from the water is called as sterilization. **Sedimentation:-**The process of removing suspended impurities from the water by allowing the water to stay undisturbed for some time in a large tank when most of the suspended impurities settle down due to gravitational force is called as sedimentation.	1 1	2
	k)	**List any four constituents of cement.** **Constituents of cement :-** i. Lime ii. Silica iii. Alumina iv. Iron oxide v. Magnesia vi. Sulphur trioxide vii. Soda and Potash viii. Gypsum	½ Mark each	2
	l)	**What is slaking of lime?** The action of water on quick lime is known as slaking of lime. **OR** When 3 parts quick lime & one part of water are mixed together to form slaked lime the process is called slaking of lime. **OR** $CaO + H_2O \longrightarrow Ca(OH)_2$ Quick lime Slaked lime	2	2

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2.		**Attempt any FOUR:**		16
	a)	**Write the chemical reactions occurring during conversion of iron oxide to iron in the reduction zone of blast furnace at various temperature ranges.** 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. $CaCO_3 \longrightarrow CaO + CO_2 \uparrow$ v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4. $2Fe + 3CO \longrightarrow Fe_2O_3 + 3C$ $3Fe + 4CO \longrightarrow Fe_3O_4 + 4C$ **(Note: consider any four reactions)**	1 mark each	4
	b)	**What is the effect of alloying elements Ni and Co on the properties of steel?** **Effect of alloying element Ni:-** **i)** It improves corrosion & heat resistance. **ii)** It also improves hardness, toughness, strength, elasticity & ductility. **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 2	4

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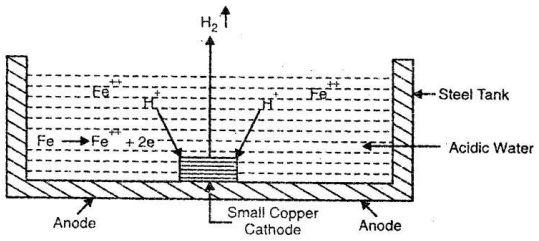
2	c)	**Differentiate between annealing-normalising.**	1Mark each	4

Annealing	**Normalising**
1.It is the process of heating the steel at a temperature (760-925^{0}C) and cooling it slowly in the furnace along with 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 normalising steel becomes homogenous & more soft. The mechanical properties of steel are more improved than annealing.
3.Time required for annealing is more than normalising	3.Time required for normalising is less than annealing
4.Consumption of fuel or electric power is more.	4.Consumption of fuel or electric power is less.

	d)	**Explain the step wise mechanism of electrochemical corrosion with evolution of hydrogen along with neat labeled diagram.**		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:
$Fe \longrightarrow Fe^{++} + 2e^-$ (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

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		At cathode : H^+ ions are eliminated as H_2 gas $2H^+ + 2e^- \longrightarrow H_2 \uparrow$ **(Reduction)** Thus, over all reaction is $Fe + 2H^+ \longrightarrow Fe^{++} + H_2 \uparrow$	1	
	e)	**State and explain the two factors affecting rate of atmospheric corrosion.** **Factors affecting atmospheric corrosion:-** **1) Impurities in the atmosphere:-** Corrosion rate increases in the presence of acidic impurities such as H_2S, SO_2, CO_2, Cl_2, gases along with vapours of HCl & H_2SO_4 etc. Atmospheric air in industrial area contains these impurities so the rate of atmospheric corrosion is fast in industrial area.. **2) Moisture in the atmosphere:-** Atmospheric gases & chemical vapours present in the atmosphere gets dissolved in the moisture . Such dissolved gases reacts faster with the metal than dry gases. Thus moisture acts as conducting medium and enhances the corrosion.	1 1 1 1	4
	f)	**Differentiate between galvanizing - tinning.**		4

Sr.No.	Galvanizing	Tinning
i)	A process of covering iron or steel with a thin coat of **Zinc** to prevent it from rusting.	A process of covering iron or steel with a thin coat of **Tin** to prevent it from corrosion.
ii)	In galvanising, zinc protects the iron as it is more electropositive than iron.It does not allow iron to pass into solution.	Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.
iii)	In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.	In tinning , tin protects the iron, till the coating is perfect.Any break in coating causes rapid corrosion.
iv)	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.	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.

1 Mark each

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3.		**Attempt any FOUR:**		16
	a)	**State any adverse effects of using hard water in (1) paper industry (2) Sugar industry**		4
		Paper industry-(Any two) 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.	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 gets decomposed during storage.	2	
	b)	**Name the types of impurities present in water.Explain sterilization of water using bleaching powder.**		4
		Types of impurities present in water : - i) Suspended impurities ii) Dissolved impurities iii) Colloidal impurities iv) Biological impurities	2	
		Sterilization of water using 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. **$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2$** [Bleaching powder] **$Cl_2 + H_2O \longrightarrow HOCl + HCl$** **HOCl $\longrightarrow$ HCl + [O]** [Hypochlorous acid] [Nascent oxygen] **Germs + [O] $\longrightarrow$ Germs are killed** Thus bleaching powder helps to kill microorganisms.	2	

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3.	**c)**	**Define:** (i) **Hard water** (ii)**Soft water** (iii)**Degree of hardness** (iv)**Filtration** (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 (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 (iii)**Degree of hardness:-** The degree of hardness of water can be measured in 1) degree Clark 2) degree French 3) Parts per million **1) Degree Clark**:-It is defined as number of parts by weight of Calcium carbonate present in 70,000 parts by weight of water. **2) Degree French:-** It is defined as number of parts by weight of Calcium carbonate present in 1,00,000 parts by weight of water. **3) Parts per million :-** It is defined as number of parts by weight of Calcium carbonate present in 10,00,000 (million) parts by weight of water. **(Note: consider any one definition of degree of hardness)** (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 1 1 1	4

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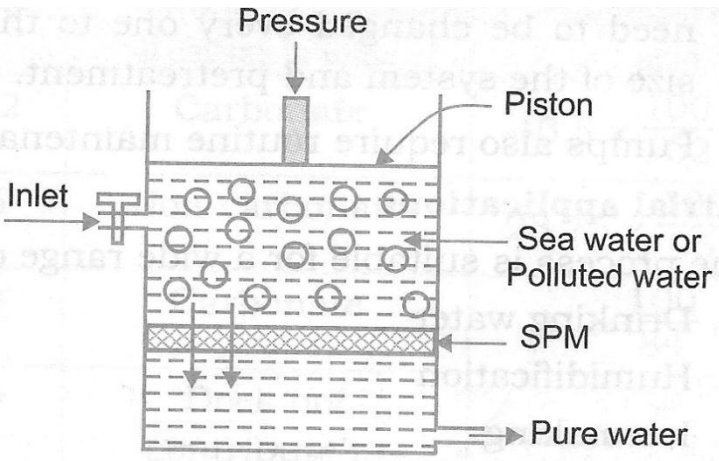
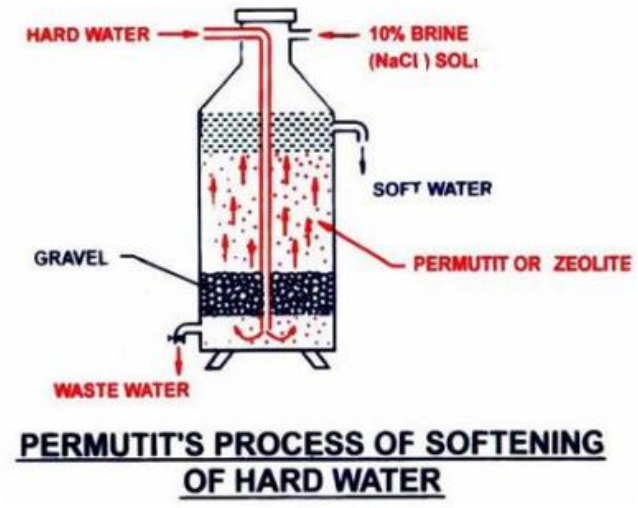
3.	**d)**	**Draw the sketch of reverse osmosis cell and label the parts. Explain the desalination of sea water by reverse osmosis.**  In reverse osmosis the flow of solvent takes place in reverse direction i.e. from higher concentration solution to lower concentration solution through the semi permeable membrane (SPM). Thus in reverse osmosis, we separate water from its contaminants rather than contaminants from water. Sea water is filled in reverse osmosis cell. A pressure of 200-800 psi is applied on it to force the solvent to pass through SPM. SPM has such porosity that it allows only H_2O molecules to pass through & higher sizes ions are prohibited from passing.	2 2	4
	e)	**Explain permutit method for removal of hardness of water with diagram.**  **PERMUTIT'S PROCESS OF SOFTENING OF HARD WATER**	1	4

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3.		Explaination:-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.	1	
		Reaction with temporary hardness causing salts:- $Ca(HCO_3)_2 + Na_2P \longrightarrow Na_2(HCO_3)_2 + CaP\downarrow$ $Mg(HCO_3)_2 + Na_2P \longrightarrow Na_2(HCO_3)_2 + MgP\downarrow$		
		Reaction with permanent hardness causing salts:- $CaCl_2 + Na_2P \longrightarrow 2NaCl + CaP\downarrow$ $MgCl_2 + Na_2P \longrightarrow 2NaCl + MgP\downarrow$ $CaSO_4 + Na_2P \longrightarrow Na_2SO_4 + CaP\downarrow$ $MgSO_4 + Na_2P \longrightarrow Na_2SO_4 + MgP\downarrow$ **(consider any Two reactions)**	2	
	f)	**How does setting and hardening of cement takes 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:** is defined as stiffening of the original plastic mass due to initial gel formation. **Hardening:** is the development of strength due to crystallization. Following chemical reaction taking place during setting and hardening.	2	
		1] Hydrolysis: $C_3S + (x+1)\,H_2O \longrightarrow C_2S.\,xH_2O + C.H_2O.$ $C_4AF + 7\,H_2O \longrightarrow C_3A.\,6H_2O + CF.H_2O.$	1	
		2] Hydration: $C_3S + xH_2O \longrightarrow C_2S\,.x\,H_2O + CaO.$ $C_3A + 6\,H_2O \longrightarrow C_3A.6\,H_2O + Heat.$	1	