

VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CHEMISTRY

QUESTION BANK



I SEMESTER
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Prepared by

S. No	Unit	Topic	Staff
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2	II	SURFACE CHEMISTRY AND CATALYSIS	Ms. K. Anandhi Dr. N. Jayaprakash
3	III	ALLOYS AND PHASE RULE	Ms. M. Meera Dr. M. Soundarrajan
4	IV	FUELS AND COMBUSTION	Dr. J. Krishnamurthi Ms. R. Kamakshi
5	V	ENERGY SOURCES AND STORAGE DEVICES	Dr. S. G. Gunasekaran Mr. R. Balaji



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DEPARTMENT OF CHEMISTRY

UNIT I - WATER AND ITS TREATMENT			
Q. No	Part-A (2 Marks)	BTL	Competence
1.	What is hardness? How is it classified?	1	Remembering
2.	What are the units of hardness of water?	2	Understanding
3.	Distinguish hard water and soft water?	2	Understanding
4.	How is sodium aluminate used in internal conditioning of water?	3	Applying
5.	Name the salts responsible for scale and sludge.	1	Remembering
6.	Define softening or conditioning of water?	1	Remembering
7.	How is calgon conditioning better than phosphate conditioning?	4	Analyzing
8.	How is the exhausted resin regenerated?	2	Understanding
9.	Calculate the hardness in terms of CaCO_3 equivalent, for a water sample contains 120 mg of MgSO_4 per litre.	5	Evaluating
10.	Create the desalination process for sea water.	6	Creating
11.	Mention any two advantages of zeolite or permutit process.	3	Applying
12.	Define desalination.	1	Remembering
13.	Compare internal conditioning with external conditioning.	4	Analyzing
14.	Name any two salts that cause temporary hardness.	1	Remembering
15.	What is reverse osmosis (RO)?	1	Remembering
16.	Name the salts responsible for scale and sludge.	2	Understanding
17.	How is blow down operation applied to remove hard water?	3	Applying
18.	Why is water softened before using in boilers?	4	Analyzing
19.	A water sample contains 204 mg of CaSO_4 and 73 mg of $\text{Mg}(\text{HCO}_3)_2$ per litre. What is the total hardness in terms of CaCO_3 equivalent?	5	Evaluating
20.	Design the cation exchanger for ion exchange process.	6	Creating

Q. No	Part-B		BTL	Competence
1.	(i)	How do you identify the hard and soft water? Explain the types of hard water.	2	Understanding
	(ii)	What are boiler troubles or Disadvantages of using hard water in the boiler? Suggest steps to minimize the boiler troubles.	1	Remembering
2.	(i)	Differentiate scales and sludges	2	Understanding
	(ii)	Discuss Zeolites? How are they used in softening of water? Use a diagram for your explanation.	4	Analyzing
3.	(i)	0.28 g of CaCO_3 was dissolved in HCl and the solution is made upto one litre with distilled water. 100 mL of the above solution required 28 mL of EDTA solution on titration. 100 mL of hard water sample required 33 mL of same EDTA solution on titration. 100 mL of this water, after boiling, cooling and filtering required 10 mL of EDTA solution on titration. Calculate the total, temporary and permanent hardness of water.	5	Evaluating
	(ii)	15 g of CaCO_3 was dissolved in HCl and the solution is made upto one litre with distilled water. 20 mL of the above standard hard water required 25 mL of EDTA solution on titration. 100 mL of hard water sample required 18 mL of same EDTA solution on titration. 100 mL of this water, after boiling, cooling and filtering required 12 mL of EDTA solution on titration. Find out the permanent, temporary and total hardness of water.	5	Evaluating
4.	(i)	What is boiler feed water? What are its requirements and explain its drawbacks?	1	Remembering
	(ii)	Explain with chemical reaction of the demineralization or ion exchange process.	1	Remembering
5.	(i)	How is hard water converted into soft water using ion exchange process?	3	Applying
	(ii)	Explain the advantages and disadvantages of zeolite process?	2	Understanding
6.	(i)	What is calgon? Explain calgon conditioning briefly.	4	Analyzing
	(ii)	How is internal treatment of boiler water carried out using colloidal, phosphate and sodium aluminate conditioning method?	4	Analyzing
7.	(i)	Compare the external and internal treatment of boilers.	2	Understanding
	(ii)	Write the merits and demerits of external treatment of water.	2	Understanding
8.	(i)	What is desalination? With a neat diagram describe the Reverse Osmosis method for the desalination of brackish water.	1	Remembering
	(ii)	How will you regenerate the exhausted ion exchange resins and zeolites?	3	Applying

9.	(i)	Explain the estimation of hardness by EDTA method	4	Analyzing
	(ii)	Describe Sodium aluminate and calgon conditioning.	1	Remembering
10.	(i)	How is calgon conditioning is superior to phosphate conditioning?	4	Analyzing
	(ii)	Explain the disadvantages of scale formation?	1	Remembering
11.	(i)	What are the essential requirements of boiler feed water?	4	Analyzing
	(ii)	What are the factors which causes boiler corrosion? How can it be minimized?	1	Remembering
12.	(i)	Give an account of Internal treatment of boiler water.	2	Understanding
	(ii)	Draw a suitable diagram and describe the Ion exchange process for the softening of boiler water.	1	Remembering
13.	(i)	Define the term Desalination with a neat diagram describe Desalination by Reverse osmosis method.	3	Applying
	(ii)	Illustrate the determination of hardness of water by EDTA method.	3	Applying
14.	(i)	How is water demineralized? Give reaction wherever necessary.	2	Understanding
	(ii)	Explain the principle behind the estimation of hardness by EDTA method with suitable equations.	3	Applying



UNIT II - SURFACE CHEMISTRY AND CATALYSIS

Q. No	Part-A (2 Marks)	BTL	Competence
1.	Define adsorption.	1	Remembering
2.	Mention a few important characteristics of adsorption.	3	Applying
3.	What is physical adsorption? Give an example.	1	Remembering
4.	What is chemisorption?	2	Understanding
5.	Differentiate adsorption and absorption.	4	Analyzing
6.	What is meant by negative adsorption?	2	Understanding
7.	Define adsorption isotherm.	1	Remembering
8.	Give the conditions in which Freundlich's adsorption isotherm fails.	2	Understanding
9.	Define the terms adsorbent and adsorbate with suitable example.	1	Remembering
10.	Mention the types of catalysis with an example.	3	Applying
11.	Define catalyst. Give general criteria of catalytic reactions.	1	Remembering
12.	What are catalytic promoters?	2	Understanding
13.	What is meant by catalytic poisoning?	2	Understanding
14.	How an acid – base catalysis is carried out?	3	Applying
15.	State the reason why the temperature of human body has to be maintained at 37°C.	5	Evaluating
16.	Explain the role of yeast in the fermentation of cane sugar.	2	Understanding
17.	With an example illustrate homogeneous catalysis.	3	Applying
18.	What are auto catalysis? Give an example.	1	Remembering
19.	How do enzymes act as catalyst?	5	Evaluating
20.	List any four characteristics of enzyme catalysis.	4	Analyzing

Q. No	Part-B		BTL	Competence
1.	(i)	Differentiate physisorption and chemisorptions.	4	Analyzing
	(ii)	Describe the factors that influence adsorption of a gas on a solid.	1	Remembering
2.	(i)	Draw various types of adsorption isotherms and explain them.	4	Analyzing
	(ii)	Derive Freundlich's adsorption isotherm and state its limitations.	3	Applying
3.	(i)	State the postulates and derive Langmuir adsorption isotherm and discuss it with various pressures.	3	Applying
	(ii)	Discuss the adsorption of solutes from solutions.	2	Understanding
4.	(i)	Explain the applications of adsorption in pollution abatement of air and waste water.	2	Understanding
	(ii)	List out the characteristics of catalysis and give four applications of absorption.	1	Remembering
5.	(i)	Explain contact theory of catalysis.	2	Understanding
	(ii)	Explain about positive and negative adsorption.	2	Understanding
6.	(i)	Derive the rate of a unimolecular reaction in a heterogeneous catalysis.	3	Applying
	(ii)	Explain auto catalysis with suitable examples.	2	Understanding
7.	(i)	Derive Michaelis – Menten equation.	3	Applying
	(ii)	Evaluate on catalytic converters.	5	Evaluating
8.	(i)	Explain physical adsorption and chemical adsorption with suitable examples.	2	Understanding
	(ii)	What are adsorption isotherms? Describe its various types.	1	Remembering
9.	(i)	Explain by deriving, when Langmuir adsorption isotherm becomes identical with Freundlich's adsorption isotherm.	3	Applying
	(ii)	Outline the role of activated carbon in pollution abatement of water.	4	Analyzing
10.	(i)	Illustrate the role of adsorbents in ion exchange adsorption. Bring out the applications of activated carbon.	3	Applying
	(ii)	Discuss the factors that influence adsorption of solutes from solution.	1	Remembering
11.	(i)	Describe the heterogeneous catalytic reaction with a suitable example.	1	Remembering
	(ii)	Explain the Freundlich's adsorption isotherm at various pressures.	3	Applying
12.	(i)	With suitable examples explain homogeneous and heterogeneous catalysis.	2	Understanding
	(ii)	Investigate on auto catalysis.	5	Evaluating

13.	(i)	Explain the following (i) Acid base catalysis (ii) Enzyme catalysis.	2	Understanding
	(ii)	Explain the factors affecting the adsorption of a gas on a solid.	2	Understanding
14.	(i)	Discuss the kinetics of enzyme catalyzed reaction.	3	Applying
	(ii)	How does a three way catalytic converter work?	3	Applying



UNIT III - ALLOYS AND PHASE RULE

Q. No	Part-A (2 Marks)	BTL	Competence
1.	Define an alloy.	1	Remembering
2.	Explain 18/8 stainless steel	2	Understanding
3.	Define heat treatment of steel/alloys	1	Remembering
4.	What are the advantages of hardening of steel?	1	Remembering
5.	State the significance of increasing the carbon content in steel.	1	Remembering
6.	Mention any three advantages of alloy making	4	Analyzing
7.	Write the composition of Nichrome and its use	6	Creating
8.	What are stainless steel? How do they resist corrosion?	1	Remembering
9.	Write note on carburizing	1	Remembering
10.	What is meant by nitriding of steel	1	Remembering
11.	Define phase. In what way does it differ from 'state of matter'?	2	Understanding
12.	Define component and construct an example for the same.	4	Analyzing
13.	Define degree of freedom and compose the same with an example.	6	Creating
14.	Calculate the no. of phases of the following i) Sulphur(monoclinic) \rightleftharpoons Sulphur (rhombic) \rightleftharpoons Sulphur (liquid) ii) Water + Alcohol \rightleftharpoons Vapour	3	Applying
15.	Calculate the degree of freedom for i) $2 \text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{H}_2\text{O}(\text{g})$ ii) A saturated solution of NaCl in water.	3	Applying
16.	Calculate the no. of components i) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \rightleftharpoons \text{CuSO}_4 \cdot \text{H}_2\text{O}(\text{s}) + 4\text{H}_2\text{O}(\text{g})$ ii) $\text{PCl}_5(\text{s}) \rightleftharpoons \text{PCl}_3(\text{l}) + \text{Cl}_2(\text{g})$	3	Applying
17.	What is phase rule and list out the uses of phase diagram?	1	Remembering
18.	State the merits and demerits of phase rule.	1	Remembering
19.	What is condensed phase rule? State its significance.	2	Understanding
20.	What is meant by triple point and eutectic point?	4	Analyzing

Q. No	Part-B		BTL	Competence
1.	(i)	Define an alloy. Write its properties.	1	Remembering
	(ii)	Discuss the purpose of making alloys	2	Understanding
2.	(i)	Discuss the effect of Ni, Cr, Mo, W, V and Mn in the alloying of steel.	5	Evaluating
	(ii)	Discuss the effect of alloying.	5	Evaluating
3.	(i)	Write the composition, properties and uses of Nichrome	2	Understanding
	(ii)	Evaluate the composition, properties and uses of Stainless steel (18/8)	4	Analyzing
4.	(i)	Formulate the functions and effect of alloying elements	6	Creating
	(ii)	Explain heat treatment processes a) Carburising b) Nitriding c) Cyaniding	2	Understanding
5.	(i)	Examine the heat treatment of steel with its significance.	4	Analyzing
6.	(i)	Write a note on a) Annealing b) Tempering c) Hardening	2	Understanding
	(ii)	What is stainless steel? Describe its different types.	1	Remembering
7.	(i)	Evaluate the following Nichrome (ii) 18/8 Stainless Steel	5	Evaluating
	(ii)	State phase rule and explain the terms involved in it.	1	Remembering
8.	(i)	How to construct the phase diagram using cooling curve	6	Creating
	(ii)	What is a phase diagram? With the help of phase diagram discuss one component system.	4	Analyzing
9.	(i)	Explain thermal analysis. Mention its use	1	Remembering
	(ii)	What is simple eutectic mixture? Discuss the phase diagram of a simple eutectic system	4	Analyzing
10.	(i)	With two cooling curves for pure substance and mixture, discuss briefly about thermal analysis.	4	Analyzing
	(ii)	Formulate the phase rule and terms involved in it for water system.	6	Creating
11.	(i)	Mention the limitation and uses of phase rule.	1	Remembering
	(ii)	Discuss the various types of plots in phase diagram.	1	Remembering
12.	(i)	Draw and explain the phase diagram of Pb-Ag eutectic system.	4	Analyzing
13.	(i)	Elucidate a neat phase diagram and explain the Pb-Ag system? Briefly write about Pattinson's process	4	Analyzing
	(ii)	Define the following terms a) Phase b) Component C) Degree of freedom d) Condensed phase rule.	3	Applying
14.	(i)	Write condensed phase rule. Why condensed phase rule required?	2	Understanding
	(ii)	Draw and explain the diagram of ice, water, and vapour system. How does the melting point of ice change with variation of pressure?	4	Analyzing



UNIT IV - FUELS AND COMBUSTION			
Q. No	Part-A (2 Marks)	BTL	Competence
1.	Define calorific value of a fuel.	1	Remembering
2.	Differentiate caking coal and coking coal?	4	Analyzing
3.	Justify coke superior to coal.	5	Evaluating
4.	Mention the important difference between Proximate and Ultimate analysis	4	Analyzing
5.	Define octane number and explain the term knocking.	1	Remembering
6.	Give the composition and uses of CNG?	1	Remembering
7.	Illustrate how cetane number is improved?	3	Applying
8.	Explain how coals are classified according to their rank.	5	Understanding
9.	What is metallurgical coke?	1	Remembering
10.	Give the method of conversion of coal to coke.	3	Applying
11.	List out demerits of sulphur in coal?	5	Evaluating
12.	Formulate TEL. Mention its uses?	6	Creating
13.	Distinguish between HCV and LCV.	4	Analyzing
14.	Mention the gas used for domestic purpose with its composition.	3	Applying
15.	Differentiate coke from coal.	4	Analyzing
16.	Is ethanol used as a fuel? Mention its advantages.	5	Evaluating
17.	Formulate the net and gross calorific value if a coal sample has the following composition, C=85%, H=8%, S=1%, N ₂ =2% and ash=4%.	6	Creating
18.	List out any four properties of biodiesel.	2	Understanding
19.	What is a calorie? Give the different units of calorific value.	1	Remembering
20.	State the characteristics of a good fuel.	2	Understanding

Q. No	Part-B		BTL	Competence
1.	(i)	How is ultimate analysis carried out? Bring out its significance. How does it differ from proximate analysis?	2	Understanding
	(ii)	Demonstrate the petroleum refining process in detail with neat sketches.	3	Applying
2.	(i)	Compare the Gross and Net calorific values.	4	Analyzing
	(ii)	Explain how is proximate analysis carried out? Bring out its significance.	2	Understanding
3.	(i)	Formulate a method for analyzing the moisture, volatile matter and ash content in the coal. Give the significance of the method.	5	Evaluating
	(ii)	Illustrate how synthetic petrol is manufactured	3	Applying
4.	(i)	Demonstrate Otto-Hoffman process of conversion of coal to coke and the recovery of byproducts.	3	Applying
	(ii)	Give the classification of fuels.	1	Remembering
5.	(i)	What is power alcohol? How it is obtained? Explain its advantages and disadvantages.	1	Remembering
	(ii)	What is meant by bio-diesel? How is it obtained? Explain its advantages and disadvantages.	2	Understanding
6.	(i)	How the elements are present in the coal analyzed? Give the importance of the analysis.	4	Analyzing
	(ii)	With the help of a neat diagram discuss Bergius process.	1	Remembering
7.	(i)	With neat diagram discuss the analysis of flue gas.	2	Understanding
	(ii)	How is petrol obtained from crude oil? Illustrate the process.	2	Understanding
8.	(i)	How is ethanol used as a fuel? Mention a method for its production with advantages and disadvantages.	4	Analyzing
9.	(i)	List out the difference between petrol and diesel as IC engine fuels	4	Analyzing
	(ii)	When a vegetable oil undergoes trans-esterification, what kind of fuel is obtained? Discuss it in detail.	4	Analyzing
10.	(i)	What is meant by knocking? How it is related to chemical constitution?	1	Understanding
	(ii)	Calculate the GCV and NCV of a coal with carbon 81%, hydrogen 5% oxygen 2% and nitrogen 1.5%.	6	Creating
11.	(i)	Evaluate the followings (a) Ignition temperature (b) Spontaneous Ignition temperature (c) Explosive range of a fuel. (d) LPG	5	Evaluating
12.	(i)	Solve the gross and net calorific values of a coal with the following ultimate analysis: carbon 84%, sulphur 1.5%, nitrogen 0.6%, hydrogen 5.5%, and oxygen 8.4%.	3	Applying

	(ii)	Presence of aromatics or cycloparafins in a fuel is desirable for a petrol engine! Explain.	6	Creating
13	(i)	Evaluate how flue gas is analyzed by Orsat method.	5	Evaluating
14	(i)	Formulate the manufacturing of metallurgical coke by Otto-Hoffman method	6	Creating



UNIT V - ENERGY SOURCES AND STORAGE DEVICES			
Q. No	Part-A (2 Marks)	BTL	Competence
1.	Define nuclear fission with example.	1	Remembering
2.	Mention a few important characteristics of nuclear fission.	1	Remembering
3.	What is nuclear fusion reaction? Give an example.	1	Remembering
4.	Illustrate nuclear chain reaction?	3	Applying
5.	Distinguish nuclear fission and nuclear fusion reaction.	2	Understanding
6.	What is critical mass, super and sub critical mass?	1	Remembering
7.	Give the role of moderators in a nuclear reactor.	1	Remembering
8.	Differentiate fissile and fertile nucleides.	2	Understanding
9.	What are the components of a nuclear reactor?	1	Remembering
10.	Comment on breeder reactor.	3	Applying
11.	Describe the construction of photo galvanic cell.	2	Understanding
12.	Bring out the advantages of wind energy.	4	Analyzing
13.	Formulate primary and secondary batteries with example.	6	Creating
14.	Compose the charging and discharging reaction of lead acid accumulator?	6	Creating
15.	Construct a Lithium ion battery and give its cell reactions.	3	Applying
16.	Justify super capacitors are superior to batteries?	5	Evaluating
17.	List out the advantages of lithium cell.	5	Evaluating
18.	Will the emf of a battery vary with size? Give reasons.	4	Analyzing
19.	Describe the factors that impede the nuclear chain reaction.	2	Understanding
20.	Explain about batteries and its basic requirements.	4	Analyzing

Q. No	Part-B		BTL	Competence
1.	(i)	What is fission reaction? Illustrate the mechanism with example.	4	Analyzing
	(ii)	Write note on a. Fertile nucleide b. Critical mass c. Nuclear energy d. Flow battery	1	Remembering
2.	(i)	Differentiate nuclear fission and nuclear fusion reaction.	2	Understanding
	(ii)	Write in detail about the working of a nuclear reactor.	1	Remembering
3.	(i)	Discuss about primary cell/Leclanche's cell	2	Understanding
	(ii)	Illustrate breeder reactor with an example.	3	Applying
4.	(i)	What is a nuclear chain reaction? Explain its principles and characteristics.	1	Remembering
	(ii)	Investigate the working of Li – S battery	5	Evaluating
5.	(i)	Analyze the components and its functions of a Light water nuclear reactor with a suitable diagram.	4	Analyzing
	(ii)	How fertile nuclei can be converted to fissile nuclei? Explain	4	Analyzing
6.	(i)	Compare and contrast nuclear reactions.	4	Analyzing
	(ii)	What are photovoltaic cell/solar cells? Explain its construction and working with a neat diagram.	1	Remembering
7.	(i)	Discuss how wind energy is converted into electrical energy.	1	Remembering
	(ii)	Demonstrate the principle and applications of photo galvanic cell.	3	Applying
8.	(i)	Describe the principle behind the functioning of solar cell.	2	Understanding
	(ii)	State the merits and demerits of solar energy.	2	Understanding
9.	(i)	State the advantages and limitations of wind energy.	1	Remembering
	(ii)	Construct a dry cell and explain its working.	4	Analyzing
10.	(i)	Describe the construction and working of H ₂ O ₂ fuel cell.	4	Analyzing
	(ii)	Compose Lead acid battery and mention its applications.	6	Creating
11.	(i)	Evaluate how Li – S battery works.	5	Evaluating
	(ii)	What is EDLC? Describe its working and state its applications.	1	Remembering
12.	(i)	Formulate the discharging and recharging process of Li-TiS ₂ battery.	6	Creating
	(ii)	Write in detail about the classification of energy storage devices.	1	Remembering
13.	(i)	Describe the construction of Lead acid accumulator with reactions occurring during discharging and recharging.	3	Applying

	(ii)	How is a solid state Li battery constructed? Describe its functioning.	2	Understanding
14.	(i)	Explain the construction and working of super capacitors.	3	Applying
	(ii)	With a neat diagram discuss the working principle of any one of the flow battery.	2	Understanding