



ST. ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)

(An ISO 9001 : 2015 Certified Institution)

ANGUCHETTYPALAYAM, PANRUTI – 607 106.

ENGINEERING CHEMISTRY

UNIT – I

WATER AND ITS TREATMENT

PART A (2 MARKS)

1. Define hardness of water.
2. What are the salts responsible for carbonate and non-carbonate hardness of water?
3. Distinguish between carbonate (temporary) hardness (CH) and non-carbonate (permanent) hardness (NCH)
4. Distinguish between hard and soft water.
5. Why is water softened before using in boiler?
6. What are scales and sludges?
7. Why is demineralization process used for softening of water for use in boilers?
8. Mention any two compounds that cause caustic embrittlement in boilers.
9. Distinguish between soft water and demineralised water.
10. What is meant by priming and foaming? How can they be prevented?
11. What is meant by caustic embrittlement? How is it prevented?
12. What is calgon conditioning? How is it functioning to water treatment?
13. What are boiler compounds? Mention two different boiler compounds and their actions.
14. What is colloidal conditioning?
15. Why can caustic embrittlement be controlled by adding sodium sulphate to boiler – feed water?
16. Why is boiled water not always 100% safe for drinking purposes?
17. What are ion-exchange resins?
18. How is water demineralized by using an ion- exchanger?
19. Phosphate conditioning is suitable at all-operating pressures? Give reasons to support this statement.
20. Differentiate between drinking water and boiler feed water.
21. What is meant by reverse osmosis?
22. What are the advantages of reverse osmosis method?
23. What is the purpose of the internal treatment of boiler feed water?
24. Write any two disadvantages of hardwater in boilers?
25. Mention any two disadvantages of formation of deposits in stream boilers

PART B

1. How is internal treatment of boiler feed water carried out using phosphate and calgon conditioning? (8marks)
2. What are boiler troubles? How are they caused? Suggest steps for minimizing the boiler troubles (or) Explain the boiler troubles, “scales and sludge” in detail. (8marks)
3. Describe the process of demineralization of hard water using ion exchange resin. (16 marks)
4. (16 marks)
5. How is the exhausted resin regenerated in an ion – exchange method? What are the merits and demerits of ion – exchange method? (16 marks)
6. Explain the disadvantages of scale formation. (8 marks)
7. Explain briefly about boiler feed water and its requirements. (8 marks)
8. Write short notes on: a) Boiler compounds b) Caustic embrittlement(8marks)
9. What are soft and hard scales? How they are removed? (8marks)

10. Explain internal conditioning of boiler feed water. (8marks)
11. Define desalination. Explain the reverse osmosis process of desalination of water. (or) What is reverse osmosis? How is it useful for desalination of brackish water? Explain with a diagram. (16 marks)
12. Discuss in detail the problems caused due to the usage of hard water in boilers. How are they minimized by carbonate conditioning, phosphate conditioning and calgon conditioning? (8marks)
13. Distinguish between demineralized water and soft water. How is demineralized water prepared? (or) How is water softened by Ion exchange method? Explain in detail with a neat diagram. (16 marks)

UNIT – II
SURFACE CHEMISTRY AND CATALYSIS
PART A (2MARKS)

1. Define adsorption.
2. What are adsorbent and adsorbate?
3. Distinguish between adsorption and absorption?
4. What are sorption and desorption?
5. what is physical adsorption? Give examples.
6. what is chemisorption? Give examples.
7. what is chemisorption differ from physisorption.
8. Write any four characteristics of adsorption?
9. Mention the factors which influence the adsorption of gases on solids.
10. What is the effect of temperature and pressure on the adsorption of hydrogen gas on charcoal?
11. What is adsorption isotherm?
12. What is Freundlich's adsorption isotherm?
13. Explain the limitations of Freundlich's adsorption isotherm.
14. What is Langmuir adsorption isotherm? Write its mathematical form.
12. Write the demerits of Langmuir's adsorption isotherm.
13. How arsenic poisoning is removed from the body?
14. Define catalyst.
15. What are the types of catalysis?
16. What is a homogeneous catalysis? Give example.
17. What is heterogeneous catalysis? Give example.
18. Write any few criteria of catalysis? Give example.
19. Define auto catalysis. Give example
20. What is catalytic promoter? Give an example.
21. What is catalytic poison? Give an example.
22. What is an acid base catalysis? Give examples.
23. What is catalytic converter? Mention its type.
24. What is an enzyme catalysis?
25. Write Michaelis – Menton equation and explain the terms
26. Define K_m .
27. Define turn over number.

PART B

1. Distinguish between physical adsorption and chemisorptions. (8marks)
2. Derive an expression for Langmuir unimolecular adsorption isotherm. What are its limitations? (8marks)
3. Explain adsorption theory or contact theory with examples (or) Explain the role of adsorption in catalytic reactions. (8 marks)

4. Define the term adsorption and list its application. (8marks)
5. (i) Give any three factors on which adsorption depends.
 (ii) Derive Freundlich's adsorption isotherm. Give the conditions in which it fails.
 (iii) (16 marks)
6. Enumerate the factors influencing the adsorption of gases on solids. Derive the Langmuir adsorption isotherm and interpret the results at 1. Low pressure and at 2. high pressure. (16 marks)
7. Define adsorption isotherm. Explain the various types of adsorption isotherm. (8marks)
8. Explain the role of adsorbents in pollution abatement or Discuss the role of activated carbon in the abatement of air pollution and waste water treatment.(8 marks)
9. Applying Michaelis and Menten equation discuss the kinetics of enzyme catalysed reaction. (16 marks)
10. Mention important characteristic features of enzyme catalysis. (8marks)
11. Give the mechanism for enzyme catalyzed reaction as proposed by Michaelis and Menten. Write the rate equation for enzyme catalyzed reaction and what do the various terms in it stand for. What happens to the rate if 1. $[S] < k_m$ 2. $[S] > k_m$? (16 marks)
12. Explain the following with suitable examples Heterogeneous catalysis and Acid –base catalysis. (8marks)

UNIT – III
ALLOYS AND PHASE RULE
PART A (2 MARKS)

1. Define an alloy (or) what are alloys? (Jan 2014)
2. Mention the purpose of alloy making. (Dec 2014)
3. What are the objectives of heat treatment?
4. Mention some important properties of ferrous alloy.
5. What is nichrome? Give its composition and uses. (June 2014)
6. What is meant by 18/8 stainless steel?
7. What are stainless steels?
8. What is annealing? Explain its types.
9. What is meant by quenching in heat treatment of metals?
10. What is tempering?
11. State phase rule and explain the terms involved.
12. Define phase (p) with suitable example.
13. Define component with suitable examples. (Dec 2015 & Jan 2016)
14. What is meant by degree of freedom? (June 2016)
15. How many phases and components are present in the following system?
 (i) $\text{CaCO}_3(\text{s}) \xrightarrow{\quad} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ & (ii) $\text{PCl}_5(\text{s}) \xrightarrow{\quad} \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ at 50°C
 $\text{C} \quad \quad \quad \longleftarrow \quad \quad \quad \longleftarrow$
16. Write the number of phases and components in the following heterogeneous system.
17. What is condensed phase rule (or) State reduced phase rule (Jan 2016)
18. $\text{NH}_4\text{Cl}(\text{s}) \rightleftharpoons \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$. Write the values of P, F and C for this system?
19. What is triple point?
20. State the conditions under which two substances can form a simple eutectic.
21. What is a metastable equilibrium in water system?
22. Differentiate melting point, eutectic point and triple point?
23. What are the types of phase diagrams?
24. What is phase diagram? What is the use of studying such diagrams?
25. Mention the merits of phase rule. (or) Mention the applications of phase rule.
26. What are the limitations of phase rule?

PART B

1. Define alloy and discuss the functions and effect of alloying of metals with examples.(8marks)

2. What are the purposes of alloy making? Illustrate with suitable examples. (8marks)
3. How are the properties of metals improve by alloy formation? (May 2015, Dec 2015 & Jan 2016) (8marks)
4. Discuss the heat treatment of steel in detail. (or) Write note on heat treatment of steel. (June 2014 & June 2016) (8marks)
5. Explain about Ferrous alloys (or) Discuss the composition, characteristics and uses of ferrous alloy such as Nichrome . (Dec 2014 & Jan 2015) (8marks)
6. What is stainless steel and explain its types? (8marks)
7. State phase rule and explain the terms involved in it. (June 2014) (8marks)
8. Explain the one-component water system in detail with neat diagram. (or) Draw and explain the phase diagram of water system. (Jan 2014, Dec 201, June 2016 & Jan 2016) (16 marks)
9. Discuss in detail the Lead -Silver system. Briefly write about Pattinson's process. (or)
10. Draw a neat phase diagram and explain the lead-silver system? Briefly write about Pattinson's process. (May 2013, June 2014, Dec 2015, June 2016, Jan 2016).
11. What is condensed phase rule? What is the number of degrees of freedom at eutectic point for a two-component system? (16 marks)
12. What is thermal analysis. Draw the cooling curves of a pure substance and a mixture and discuss. (16 marks)

UNIT – IV
FUELS AND COMBUSTION
PART A (2 MARKS)

1. What is coal? How is it classified?
2. Define caking coals and coking coals.
3. What is meant by carbonization of coal?
4. What is metallurgical coke? Give the characteristics of metallurgical coke.
5. Distinguish between coal and coke
6. Define octane number. How can it be improved?
7. Define cetane number. How can it be improved?
8. Why should leaded petrol not to be used?
9. What is compressed natural gas, CNG? Give the composition. Write its CV.
10. Mention the properties of CNG
11. How is CNG superior to LPG?
12. What is power alcohol?
13. What is bio-diesel?
14. What are the advantages of bio-diesel?
15. Define calorific values of a fuel.
16. What is 'gross calorific value'?
17. What is meant by 'net calorific value'?
18. Distinguish between proximate and ultimate analysis of coal.
19. What is refining of petroleum ?
20. Distinguish between petrol and Diesel
21. What are the characteristics of a good fuel?
22. How will you improve the antiknock properties?
23. What is diesel index number?
24. Define ignition temperature.
25. Define explosive range. Give examples.
26. Define spontaneous ignition temperature.

PART-B

1. Describe the proximate and ultimate analysis of coal. Mention its significance. (8marks)
2. How is metallurgical coke manufactured? What are their special properties and uses? (16 marks)

3. What is meant by crude petroleum? Discuss steps involved in refining of crude petroleum. (16 marks)
4. What is knocking of petrol? What are the factors governing it? How is it measured? (8 marks)
5. What is synthetic petrol? How is it manufactured by Bergius process? (16 marks)
6. Define the terms: Octane number and Cetane number. How are they related to chemical composition and molecular structure of fuel? (8 marks)
7. Explain the calculation of minimum quantity of air required for the complete combustion of a fuel. (8 marks)
8. Write a note on the production, composition and applications of LPG. (8 marks)
9. What are flue gases? How does Orsat's apparatus analyze them? (16 marks)
10. Explain explosive range of a fuel. (8 marks)
11. What is power alcohol? Explain its manufacture, properties of power alcohol. (8 marks)
12. What are the advantages of compressed natural gas? (8 marks)
13. What is leaded and unleaded petrol? Discuss the advantages and disadvantages of leaded petrol? (8 marks)
14. What is meant by diesel-knocking? How is it found? How can it be avoided? (8 marks)
15. Define the terms: Octane number and Cetane number. How are they related to chemical composition and molecular structure of fuel? (8 marks)
16. Explain the calculation of minimum quantity of air required for the complete combustion of a fuel. (8 marks)
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25. Explain explosive range of a fuel. (8 marks)
26. What is power alcohol? Explain its manufacture, properties of power alcohol. (8 marks)
27. What are the advantages of compressed natural gas? (8 marks)
28. What is leaded and unleaded petrol? Discuss the advantages and disadvantages of leaded petrol? (8 marks)

UNIT- V
ENERGY SOURCES AND STORAGE DEVICES
PART-A (2 MARKS)

1. Define nuclear fission.
2. What is a moderator? Give example.
3. Mention few important characteristics of nuclear fission.
4. Define nuclear fusion.
5. What is lead-acid accumulator?
6. Give any two differences between nuclear fission and fusion.
7. What is super critical mass and sub-critical mass?
8. What is nuclear energy? Give example.
9. What are the drawbacks of nuclear energy?
10. Give the important requirements for the nuclear chain reaction to occur.
11. What is a nuclear reactor?
12. What is nuclear chain reaction?
13. What is fissile nucleides and fertile nucleides?
14. What is Breeder reactor?
15. Mention any two differences of a nuclear reaction and chemical reaction.
16. What is photo galvanic cell (or) Solar cell?
17. Explain the applications of Solar cells.
18. What are fuel cells?

19. What are the applications of H₂-O₂ fuel cell?
20. What is wind energy? How is it obtained?
21. What are the drawbacks of wind energy?
22. Furnish the sequence of reactions in proton cycle nuclear fusion.
23. What is the important requirement of a battery?
24. What are the advantages of alkaline battery over dry battery?
25. Will the EMF of battery vary with size? Give reasons for your answer.
26. What are secondary cells? Give an example.
27. What are the applications of lithium batteries?
28. Lithium battery is the cell of future, Why?
29. What are non-conventional energy sources? Give examples.
30. What are the advantages of super capacitors?
31. Define light water nuclear power plant.

PART-B

1. Distinguish between nuclear fission and fusion reactions. (8marks)
2. Write a short note on nuclear fission and fusion (or) With a neat sketch explain the functioning of nuclear fission and fusion. (8marks)
3. Describe briefly controlled nuclear fission as source of useful energy. (8marks)
4. What is a nuclear reactor? Describe the components of a light water nuclear power plant with a suitable block diagram. (16 marks)
5. What is breeder reactor? Explain with an example. (16 marks)
6. What is primary battery? Write a note on dry cell. (8marks)
7. Write a brief note on lithium battery. (16 marks)
8. What are lead accumulators? Explain the construction and functioning of a lead accumulator? (16 marks)
9. What are solar cells? Explain with an example. (or) State the principle and application of solar batteries. (8marks)
10. Describe the construction and working of H₂-O₂ fuel cell (or) What are fuel cells? Explain the construction and working of fuel cells. (16 marks)
11. What is a photovoltaic cell? Explain the construction and working of a photovoltaic cell with a diagram.(16 marks)
12. How is wind energy harnessed? What are its advantages and limitations? (8marks)
13. How are super capacitors constructed? Explain the working and applications of super capacitors. (8marks)