

Time : 3 hours

Full Marks : 200

Instructions :

(1) Answer any **twenty-five** questions following the directions.

(2) All questions carry **eight** marks each.

1. What is meant by nuclear fission? What are isotopes? Describe the common methods used for separation of radioactive isotopes.
2. What is meant by radioactive disintegration? Derive an expression for the rate of disintegration of a radioactive material.
3. Define order and molecularity of a simple reaction by giving example. How do you determine the order of a reaction by the use of differential rate expressions?
4. Integrate the rate expression for a first-order reaction. What is meant by half-life time of a reaction?
5. Differentiate between Freundlich and Langmuir isotherms.
6. Show the difference between conductometric titration of strong acid-strong base and weak acid-weak base graphically.
7. Define the following terms used in electrochemistry : specific conductance, equivalent conductance, transport number and Nernst equation.
8. Determine the number of phases present in the following systems :
 - (a) A gaseous mixture of N_2 , H_2 and NH_3 in equilibrium
 - (b) A solution of two miscible liquids
 - (c) A solution of two immiscible liquids
 - (d) An emulsion of oil in water

9. State the phase rule and express it mathematically. Explain the terms involved in it.
10. Discuss the stability and structures of the following :
- (a) Carbanions
 - (b) Carbocations
 - (c) Free radicals
11. What is the number of optically active isomers possible for a compound with unlike chiral center where $n = 3$? What do you understand by racemic mixture? Comment on their optical activity.
12. Draw the energy level diagram for O_2 , and calculate the bond orders of O_2^{2-} , O_2^{2+} and O_2^+ .
13. Derive the Kirchhoff's equation and show its application in deducing the heat of reactions.
14. Explain the second law of thermodynamics in terms of entropy. Show that entropy is a state function.
15. What is Grignard reagent? How will you obtain the following compounds from a Grignard reagent?
- (a) Propane
 - (b) Ethanol
 - (c) Ethanoic acid
16. Write short notes on :
- (a) Chromophores
 - (b) Auxochromes
 - (c) Bathochromic shift
 - (d) Hypsochromic shift

17. Explain the Beer-Lambert law for absorption of light. Write down its significance in quantitative analysis.
18. List out the differences between IR and Raman spectroscopy. What do you mean by overtones and combination vibrations?
19. Describe the extraction of cast iron from its ore. What are the important properties of wrought iron?
20. What is the difference between starch and cellulose? Draw their structures and explain their individual properties.
21. Write the mechanism of open chain to cyclic form of D-glucose by showing all intermediate steps.
22. Define the following terms used in the study of fats and oils :
- (a) Saponification
 - (b) Hardening
 - (c) Rancidity
 - (d) Hydrolysis
23. Write short notes on the following :
- (a) Linkage isomerism
 - (b) Ionization isomerism
 - (c) Water of crystallization
 - (d) Effective atomic number
24. Explain the crystal field theory by considering the splitting of metal *d*-orbitals.
25. Draw the structures of any two natural coordination compounds and mention their significances.
26. Describe conjugate pairs by mentioning proper example. What are amphoteric substances?

27. What is meant by acid-base indicator? Write the theory of acid-base indicators taking phenolphthalein as an example.
28. How are osmotic pressure measurements utilized for determining molar mass of a non-volatile solute? What are isotonic solutions?
29. Define the terms solubility and solubility product of a substance. Explain the use of this concept by giving example for qualitative analysis.
30. What do you mean by gold number? How is it calculated?
31. Define critical constants of a gas. Draw and explain the P - V isotherms of carbon dioxide.
32. State Le Chatelier's principle and discuss the effects of change of concentration, temperature and pressure in a reaction equilibrium in the light of this principle.

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