



Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
B.Sc Chemistry - I SEMESTER
SEMESTER EXAMINATION: OCTOBER 2021
(Examination conducted in January-March 2021)
CH 121 – CHEMISTRY I

Time- 3hrs

Max Marks-100

NOTE: The question paper contains 29 questions and THREE parts

Write chemical equations and give structures wherever necessary.

[DATA: Atomic mass: Fe = 26, V = 23, Ca = 20, C = 6, O = 8, S = 16]

$h = 6.6 \times 10^{-34}$ Js and $m_e = 9.1 \times 10^{-31}$ kg

Part A

Answer any 10 out of 12 questions. Each question carries 2 marks.

[10 x 2 = 20]

1. How are analytical techniques classified?
2. Suggest two important criteria for the selection of a primary standard for titration?
3. What is molarity of a solution?
4. Among the 3s and 2p orbital, which has higher energy?
5. Draw the shape of d_{xy} orbital.
6. Define normalised wave function.
7. Give the general electronic configuration of *p*- and *f*-block elements.
8. State modern periodic law.
9. Why are the electron affinity values of noble gases very low?
10. What are electrophiles? Give an example.
11. How do you prepare an alkyne from a dihalide?
12. Give an example of: (i) tertiary amine (ii) cyclic nitrile

Part B

Answer any 10 out of 12 questions. Each question carries 6 marks.

[10 x 6 = 60]

13. Differentiate between:
 - (i) Accuracy and Precision
 - (ii) Determinate and indeterminate errors
 - (iii) Absolute error and relative error
14. The normality of a solution is determined by four separate titrations. The results being 0.2041, 0.2049, 0.2039, and 0.2043. Calculate the mean, median and standard deviation.

15. (a) With a suitable titration curve, explain titration between a weak acid and a strong base.
 (b) Mention an application of an acid - base titration. Suggest an indicator that is used for a strong acid strong base titration. What is its colour in a basic solution? (3+3)
16. (a) Define electronegativity. How does it vary across a period and down a group?
 (b) Calculate the electronegativity of fluorine atom from the following data:
 $[E_{H-H} = 104.2 \text{ kcal mol}^{-1}, E_{F-F} = 36.6 \text{ kcal mol}^{-1}, E_{H-F} = 134.6 \text{ kcal mol}^{-1}]$. Electronegativity of Carbon = 2.54. (3+3)
17. (a) Define ionisation energy. Mention any two factors affecting ionisation energy.
 (b) Name the principal oxide of boron. Why are the oxides of boron weakly acidic? (3+3)
18. (a) How and why does the acid strength vary among hydrides of the elements of group 16?
 (b) Define ionic radius. The radius of Cl^- ion is greater than Cl, while that of Na^+ is less than that of Na. Give reason. (3+3)
19. (a) Draw the radial probability function of 2s and 2p orbitals, and indicate the node(s).
 (b) State Pauli's exclusion principle. Write the electronic configuration of Fe^{3+} ion. (3+3)
20. (a) Calculate the effective nuclear charge (Z_{eff}) of the 3d electron of vanadium.
 (b) Write the second differential derivative of Schrodinger wave equation and explain the terms in the equation. (3+3)
21. (a) What does ψ represent? Give the born representation of $|\psi|^2$
 (b) Write any 3 postulates of quantum mechanics. (3+3)
22. (a) Draw and explain the orbital overlap picture of Ethyne.
 (b) Explain the following with one example each:
 (i) substitution reaction (ii) addition reaction (3+3)
23. (a) Define resonance theory. Explain the concept of resonance taking CO_3^{2-} ion as an example
 (b) Give the IUPAC nomenclature of the following organic compounds:
 (i) $(\text{CH}_3)_2\text{CHOH}$ (ii) $\text{CH}_2=\text{CH}-\text{C}\equiv\text{CH}$ (iii) $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_2-\text{OH}$ (3+3)
24. (a) Explain the regioselectivity of the reaction between HBr and 1-propene with the help of the mechanism.
 (b) Draw the potential energy diagrams for the reaction of a chlorine atom with methane and a bromine atom with methane. Give the reason for the difference in activation energies. (3+3)

Part C

Answer any 4 out of 6 questions. Each question carries 5 marks.

[4 x 5 = 20]

25. (a) Which solution is more concentrated? Solution 'A' contains 50.0 g of CaCO_3 in 500 mL of solution. Solution 'B' contains 6.0 moles of H_2SO_4 in 4.0 L of solution.
 (b) Express the following up to three significant digits: The height of a man 5 feet 9 inches in centimetres (1 inch = 2.54 cm) (3+2)

26. In an atom, an electron is moving with a speed of 600 ms^{-1} , with an accuracy of 0.005%. Calculate the certainty with which the position of the electron can be located.
27. (a) Identify the atom with the following ground - state electronic configurations in its outer shells. Which of these would have the lowest ionisation energy?
 (i) $5s^25p^2$ (ii) $3s^23p^63d^64s^2$
 (b) An element in the periodic table has an outer electronic configuration $(n-1) d^7ns^2$, where $n = 5$. Identify the period and the group that the element belongs to. (3+2)
- 28.(a) Rank the following in order of decreasing stability and explain your answer
 trans-3-hexene, hexene, cis-3-hexene
 (b) Which is the stronger acid in the following? Justify.
 (i) CH_2ClCOOH or CHCl_2COOH (ii) CH_2FCOOH or CH_2BrCOOH (2+3)
29. (a) The atomic number of an element is 20. How many electrons have $\ell = 0$ in this?
 (b) Designate the orbital with the following quantum numbers:
 (i) $n=4, \ell =1, m=0$ (ii) $n=3, \ell =0, m=0$ (iii) $n=1, \ell =0$ (2+3)
30. Give the mechanism for the reaction between 2-bromo-3-methylbutane and Sodium ethoxide. Which is the major product that is formed in the reaction.
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