INDIAN INSTITUTE OF TECHNOLOGY MADRAS, CHENNAI-600036.

Advertisement No. IITM/R/4/2024 dated 11.03.2024

Syllabus & Scheme of Examination

Post: Junior Technical Superintendent **Stream: Chemistry**

LEVEL-1 Multiple Choice Question Test **(100 Marks)**

PART – A **(30 Marks)**

1. ***Quantitative aptitude:*** Number systems, simplification, decimals, fractions, LCM, HCF, ratio & proportion, percentage, log and trigonometric functions, solutions of simple equations (linear and quadratic), basic statistics – mean and standard deviation, profit & loss, discount, simple & compound interest, mensuration, time & work, time & distance, tables & graphs.

2. ***Logical reasoning aptitude:*** Analogies, similarities, differences, space visualization, analysis, judgment, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification

3. ***Computer-related aptitude:*** Hardware, software, operating systems, basic operations in MS Office - Word, Excel, PowerPoint

4. ***Language aptitude:*** Comprehension, vocabulary, basic grammar in English.

5. ***General awareness aptitude:*** Current events, general knowledge, Indian history, Indian constitution, basic geography.

PART – B **(70 Marks)**

1. **Solids, liquids, and gases Classification of solids based on different binding forces:**

   Molecular, ionic, covalent and metallic solids. Crystal system — unit cell and voids. Surface tension effect of temperature on surface tension; Viscosity -effect of temperature, effect of pressure; Solutions -concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions; Colligative properties-relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure. Raoult's law-binary liquid mixtures, ideal solutions, deviations from ideal behaviour, vapour pressure, composition and vapour pressure, temperature curves and azeotropic distillation.

   Kinetic theory of molecular gases; transport properties — viscosity, thermal conductivity, diffusion, Maxwell's distribution of molecular velocities

2. **Thermochemistry, chemical kinetics, and electrochemistry**

   Thermodynamics: Bond Energy, Bond dissociation energy, calculation from thermochemical data variation of heat of reaction with temperature Kirchoff's equation.

   Chemical kinetics: Definition of order and molecularity -methods to determine the rate of reactions -derivation of rate constants for I, II, III and Zero order reactions -derivation for time for half change -methods to determine the order of reactions -effect of temperature on the rate of reactions -Arrhenius equation and concept of energy of activation.

Electrochemistry: Redox reactions and their standard electrode potential; Relation between Gibbs energy and emf of the cell; Galvanic cells -standard cell-emf and its measurement; Specific and molar conductivity -variation of conductivity with concentration; Electrorefining of copper and molten aluminium production by smelting.

3. Organic chemistry

Concepts and Characteristic reactions< Hybridisation of carbon; σ and π-bonds; Shapes of simple organic molecules; Structural and geometrical isomerism; Optical isomerism of compounds containing up to two asymmetric centres; IUPAC nomenclature of simple organic compounds (simple hydrocarbons, mono-functional and bi-functional compounds); Conformations of ethane and butane (Newman projections); Resonance and hyperconjugation; Keto-enol tautomerism; Hydrogen bonds: definition and their effects on physical properties of alcohols and carboxylic acids; Inductive and resonance effects on acidity and basicity of organic acids and bases; Polarity and inductive effects in alkyl halides; Reactive intermediates (carbocations, carbanions and free radicals) — formation, structure and stability; Aliphatic nucleophilic substitution reactions — SN1 and SN2; Elimination reactions — E1 and E2 mechanisms; Electrophilic addition reactions of alkenes with X2, HX, HOX and H2O (X = halogen); Addition reactions of alkynes; Aromaticity, Electrophilic substitution reactions Effect of *o*-, *m*-and *p*-directing groups in monosubstituted benzenes; simple functional group interconversions pertaining to alkenes, alkynes, carbonyl compounds, haloalkanes and arenes, hydroxyl compounds, amines.

Laboratory techniques

Separation techniques -chromotography, distillation, extraction; Purification techniques — crystallization, recrystallization, sublimation; Quantitative estimation — acid/base, iodo/iodimetry, potentiometric and conductometric titrations, and gravimetry; Qualitative analysis -detection of nitrogen, sulphur, halogen in organic compounds; determination of anions and cations.

4. Polymers and biomolecules

Free radical, cationic, anionic, addition and condensation polymerization, polymers: natural rubber, nylon, teflon and PVC; Amino acids, peptides, proteins (primary, secondary, tertiary and quaternary structures); DNA and RNA; Carbohydrates (glucose, fructose, sucrose and starch).

5. Chemistry of s-and p-block elements

Alkali and alkaline earth metals –electronic configuration, structure, study of oxides, hydrides, halides, hydroxides, carbonates and sulfates; Electronic configuration, structure, oxidation states, oxides and oxoacids of N, P, S and halogens, their preparation and properties.

6. d-block elements

Electronic configuration, oxidation states; coordination compounds — ligands, coordination number, colour, magnetic properties and shape. Crystal field stabilization theory.

7. Mathematics for chemists

Linear equations; polynomials; logarithmic and exponential relations; calculus (Functions of single variable, limit, continuity and differentiability); first order differential equations; probability and statistics (Definitions of probability and sampling theorems, conditional probability, mean, median, mode and standard deviation, random variables, Poisson, Normal and Binomial distributions, Linear regression analysis).

LEVEL – 2 Trade Test

- **Trade Test -** Syllabus as above under Part-B for Level-1 Multiple Choice Question Test.

Scheme of Examination:

Level	Type of Test	Time	No. of Questions – Max. Marks	Weightage for the final result
Level -1	Multiple Choice Question Test	Time: 120 Minutes	100 Objective Questions – 100 Marks	70 %
Level–2	Trade Test	Time: 90 minutes approximately	Practical Trade Test	30 %

- A minimum of 5X candidates shall be shortlisted (for X number of posts advertised) for the Level-2 Trade Test, based on their performance in the Level-1 Multiple Choice Question Test.

NOTE:

a) The medium of examination will be ENGLISH
b) The questions will generally be on the minimum qualification level i.e. Graduation.
c) There shall be no negative marking for wrong answers.
d) The Level-1 Multiple Choice Question Test is tentatively scheduled to be held on 07th February 2025 at TCS iON Centres in Chennai.