



**FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2026 FOR RECRUITMENT
TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT**

Roll Number

CHEMISTRY, PAPER-I

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II)	MAXIMUM MARKS: 80
NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes.		
(ii) Overwriting/cutting of the options/answers will not be given credit.		
(iii) There is no negative marking. All MCQs must be attempted.		

PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

- For a particle in a one-dimensional infinite square well of width L, the energy difference between the n=2 and n=1 levels is proportional to:**
(A) 1/L (B) 1/L² (C) L (D) None of these
- Which principle states that it is impossible to simultaneously determine the exact position and momentum of an electron?**
(A) Pauli's Exclusion Principle (B) Bohr's model (C) Heisenberg's Uncertainty Principle (D) None of these
- Kohlrausch's law for limiting molar conductivity states that:**
(A) $\Lambda^\circ = \lambda^{\circ+} + \lambda^{\circ-}$ (sum of ionic contributions) (B) Λ° decreases infinitely with dilution
(C) Λ° is independent of ion type (D) None of these
- In a concentration cell without transference, the cell potential is generated by a difference in:**
(A) Temperature (B) Concentration of electrolyte (C) Electrode material (D) None of these
- The Van der Waals equation modifies the ideal gas law to account for:**
(A) The principle of corresponding states (B) Intermolecular forces and finite molecular volume
(C) The critical phenomenon (D) None of these
- The Born-Haber cycle is used to calculate:**
(A) Lattice energy of an ionic solid from measurable quantities (B) Activation energy of a reaction
(C) Standard molar entropy only (D) None of these
- According to collision theory, the rate constant increases because:**
(A) The fraction of collisions with energy $\geq$ activation energy increases with temperature
(B) Molecularity increases with temperature (C) Concentration decreases with temperature (D) None of these
- Which factor typically has the greatest effect on the rate of a chemical reaction?**
(A) Initial pressure (B) Temperature (C) Volume (D) None of these
- In Chemisorption, the forces of attraction between the adsorbate and adsorbent are similar to:**
(A) Van der Waals forces (B) Electrostatic forces (C) Chemical bonds (D) None of these
- A colloidal system stabilized by electrostatic repulsion typically uses:**
(A) Surfactants that provide steric hindrance only (B) Ionic species that develop an electrical double layer
(C) Purely covalent bonding between particles (D) None of these
- ANOVA is primarily used to:**
(A) Compare means across more than two groups to test if at least one differs significantly
(B) Measure central tendency for one group only
(C) Determine molecular weight distributions (D) None of these
- The measure of the spread of a set of data points around their mean is the:**
(A) Arithmetic mean (B) Confidence limit (C) Standard deviation (D) None of these
- Which chromatographic technique is most suitable for preparative separation of large quantities of a substance?**
(A) Paper chromatography (B) Thin layer chromatography (TLC)
(C) Column chromatography (D) None of these
- The process of extracting a solute from a liquid sample by repeatedly mixing it with fresh portions of an immiscible solvent is called:**
(A) Fractional distillation (B) Multiple batch extraction (C) Precipitation (D) None of these
- According to MOT (Molecular Orbital Theory), the bond order of the O₂ molecule is:**
(A) 1 (B) 2 (C) 3 (D) None of these
- According to VSEPR Theory, a molecule with AX₃E (three bonds and one lone pair) has which ideal geometry?**
(A) Tetrahedral electron geometry, trigonal pyramidal molecular shape (B) Trigonal planar geometry
(C) Linear geometry (D) None of these
- According to the SHAB (Soft and Hard Acids and Bases) concept, a hard acid preferentially reacts with a:**
(A) Soft base (B) Neutral base (C) Hard base (D) None of these
- The solubility product K_{sp} decreases when:**
(A) Common ion is added to the solution (B) Temperature always increases
(C) Solid is removed from solution (D) None of these

CHEMISTRY, PAPER-I (2026)

19. Chelate complexes are generally more stable than non-chelate complexes due to the chelate effect, which is primarily a consequence of:
(A) Enthalpy (B) Entropy (C) Energy (D) None of these
20. Werner's Coordination Theory primarily introduced the concept of:
(A) Oxidation states only (B) Primary and secondary valences (coordination number and ligands)
(C) Electron delocalization in metals (D) None of these

PART-II

NOTE: (i) Part-II is to be attempted on the separate Answer Book.
(ii) Attempt **ONLY FOUR** questions from PART-II. ALL questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

- Q. 2. (a) Explain the difference between physisorption and chemisorption in terms of energetics and kinetics. Provide typical experimental evidence to distinguish them. (6)
- (b) Define and explain the concepts of internal energy (E) and enthalpy (H). Show the mathematical relationship between them. (7)
- (c) Discuss the physical meaning of eigenfunctions and eigenvalues, and explain why operators must be Hermitian in quantum mechanics. (7) (20)
- Q. 3. (a) Outline selection criteria for stationary and mobile phases in column chromatography for separating polar organic molecules. (6)
- (b) Propose a corrosion prevention strategy for a steel water pipeline system exposed to chloride-rich environments. (7)
- (c) Derive the integrated rate equation for a second-order reaction where two reactants of equal concentration react ($2A \rightarrow \text{Products}$). (7) (20)
- Q. 4. (a) Given small sample data, compute 95% confidence interval for the mean and interpret the result. (6)
- (b) Predict and justify which complex will undergo a stronger Jahn–Teller distortion: $[Cu(H_2O)_6]^{2+}$ or $[Mn(H_2O)_6]^{3+}$ (7)
Support your reasoning with electronic configurations and degeneracy arguments.
- (c) Explain how transport numbers are determined experimentally and derive their relationship with ionic mobilities. (7) (20)
- Q. 5. (a) Explain the photoelectric effect and how it supports the particle nature of light. Discuss the role of work function and threshold frequency. (6)
- (b) Explain the common ion effect and its application in controlling the solubility of sparingly soluble salts. Use an example to illustrate. (7)
- (c) Explain the mechanism of enzyme catalysis, highlighting the role of the active site and the factors that influence enzyme activity. (7) (20)
- Q. 6. (a) Use VSEPR to predict the shape and bond angles of SF_4 and explain the concept of stereochemically active lone pairs. (6)
- (b) Using the Van der Waals equation, explain qualitatively how critical constants (T_c , P_c , V_c) relate to a , b parameters. (7)
- (c) Explain Debye–Hückel theory and derive the limiting law for the mean ionic activity coefficient. Describe its region of validity. (7) (20)
- Q. 7. (a) Discuss isomerism in coordination complexes (geometric, optical, linkage) with three illustrative examples and draw structures. (6)
- (b) A buffer is to be made at pH 5.00 using sodium phosphate salts. Which pair would you choose and how would you prepare it? Show calculations. (7)
- (c) Explain valence bond theory and hybridization for methane (CH_4), and contrast it with an MO description of bonding in the same molecule. (7) (20)

CHEMISTRY, PAPER-I (2026)

- Q. 8.** (a) Discuss the principle of electrophoresis and its application in the separation and characterization of proteins. (6)
- (b) Describe common statistical tests (t-test, chi-square) and their applications in analytical chemistry. Provide decision criteria. (7)
- (c) Using initial rate data (suppose), determine reaction order and rate constant by method of initial rates. (Provide a short worked example). (7) (20)



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CHEMISTRY, PAPER-II

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PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)
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- Which of the following groups, would have the highest –I effect, relative to hydrogen atom?**
(A) – COOH (B) – CN (C) – NO₂ (D) None of these
- Which molecule would have the highest dipole moment among the given series?**
(A) Aniline (B) 4-Nitroaniline (C) 3-Nitroaniline (D) None of these
- Cyclobutane is an example of which type of hydrocarbons?**
(A) Aromatic (B) Acyclic (C) Alicyclic (D) None of these
- The alpha(α)-elimination in a molecule can be regarded as:**
(A) 1,1-Elimination (B) 1,2-Elimination (C) 1,3-Elimination (D) None of these
- Which one, among the given molecules, would require drastic conditions (highest temperature) for nitration?** (A) Phenol (B) Nitrobenzene (C) Toluene (D) None of these
- The greater percentage of *para*-substituted product would be obtained in which of the electrophilic aromatic substitution reactions on chlorobenzene?**
(A) Methylation (B) Nitration (C) Sulfonation (D) None of these
- When phenol is subjected to a typical Kolbe's reaction, at 125 °C under a pressure of 5 atm, the main product obtained is:**
(A) Salicylic acid (B) Picric acid (C) Carboic acid (D) None of these
- Dow process was introduced by Dow Chemical Company in 1928 to synthesize phenol by hydrolysis of which molecule?**
(A) Cumene (B) Chlorobenzene (C) Sodium benzenesulfonate (D) None of these
- Which of the following items does not affect the mechanism of a nucleophilic substitution reaction in a significant fashion?**
(A) Intensity of light present (B) Reactivity of the nucleophile
(C) Structure of the alkyl halide (D) None of these
- Which rate law describes the unimolecular nucleophilic substitution reactions?**
(A) Rate = k [nucleophile] (B) Rate = k [alkyl halide]²
(C) Rate = k [alkyl halide] (D) None of these
- Which of the following compounds will exhibit the geometrical isomerism?**
(A) (CH₃)₂C=CH-CH₃ (B) CH₃-CH=CH-CH₃ (C) CH₃-CH₂-CH=CH₂ (D) None of these
- In which of the following derivative of cyclohexane carboxylic acid, the plane of symmetry is not present?**
(A) 4-Methyl derivative (B) 2-Methyl derivative (C) 2-Carboxy derivative (D) None of these
- Which of the following bonds shows the stretching absorption in the 3700-2500 cm⁻¹ region in its IR spectrum?** (A) C-C (B) C-O (C) C-N (D) None of these
- The base peak in the molecule of benzoic acid appears by the loss of –OH radical. At which *m/z* it will appear?** (A) 105 (B) 77 (C) 45 (D) None of these
- In a glyceryl tristearate molecule, the fatty acid involved has a chain length of how many carbon atoms?** (A) 10 (B) 12 (C) 06 (D) None of these
- The diploid number of chromosomes contained in the each human cell is:**
(A) 26 (B) 40 (C) 48 (D) None of these
- The coenzyme or metal ion that is covalently bound to the enzyme protein is called a:**
(A) Neighboring group (B) Dummy group (C) Prosthetic group (D) None of these
- The mineral present in urease enzyme is:**
(A) Nickel (B) Zinc (C) Chromium (D) None of these
- Cement's strength is due to:**
(A) Tricalcium aluminate (B) Tricalcium silicate (C) Dicalcium silicate (D) None of these
- The type of glass used in making the lenses and prisms is:**
(A) Flint glass (B) Soft glass (C) Pyrex glass (D) None of these

PART-II

- NOTE:** (i) **Part-II** is to be attempted on the separate **Answer Book**.
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- Q.2.** (a) How the Resonance Effect plays a significant role to conclude the basic and acidic strengths of molecules. Discuss with relevant examples. (12)
 (b) How the Hyperconjugation alters the properties of molecules? Discuss. (8)
- Q.3.** (a) Outline the following reactions of alkenes with suitable examples. (4 each) (16)
 i) Hydrohalogenation ii) Hydration
 iii) Epoxidation iv) Free-radical Polymerization
 (b) Although the halogens are deactivator for electrophillic aromatic substitution but still they are *ortho* and *para* directors. Explain. (4)
- Q.4.** (a) How primary, secondary and tertiary amines can be differentiated by the Hinsberg's method? (9)
 (b) Ethanol is the only primary alcohol which gives a positive iodoform test. Outline the mechanism of this reaction. (6)
 (c) Phenol is converted to salicylaldehyde by the famous Reimer-Tiemann reaction. Draw the mechanism of this reaction. (5)
- Q.5.** (a) Discuss various classes of compounds which do not have any chiral carbon atoms but still they show chirality. (9)
 (b) Why 1,2- and 1-3-methylcyclohexanecarboxylic acid are optically active but 1-4-methylcyclohexanecarboxylic acid is not? Elaborate. (5)
 (c) Allocate the priority to various groups with the help of sequence rules and then assign R or S configuration (whichever is applicable) to the following molecules. (6)
- i)

$$\begin{array}{c} \text{Ph} \\ | \\ \text{H} - \text{C} - \text{Cl} \\ | \\ \text{CH}_2\text{OH} \end{array}$$

ii)

$$\begin{array}{c} \text{Vinyl} \\ | \\ \text{H}_2\text{N} - \text{C} - \text{Et} \\ | \\ \text{CH}_3 \end{array}$$
- Q.6.** (a) Elucidate a structure that is consistent with each set of ^1H -NMR data. (10)
 i) $\text{C}_{11}\text{H}_{12}\text{O}_4$: δ 10.1 (1H, br s), 7.75 (1H, d, $J = 16$ Hz), 7.13 (1H, dd, $J = 2.1$, 8.1 Hz), 7.08 (1H, d, $J = 2.1$ Hz), 6.89 (1H, d, $J = 8.1$ Hz), 6.36 (1H, d, $J = 16$ Hz), 3.92 (3H, s) and 3.87 (3H, s).
 ii) $\text{C}_{10}\text{H}_{10}\text{O}_5$: δ 7.71 (1H, d, $J = 16$ Hz), 6.76 (2H, s), 6.38 (1H, d, $J = 16$ Hz), and 3.78 (3H, s).
 (b) Sketch out the mass fragmentation pattern in $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_2\text{CH}_3$ molecule. (6)
 (c) How can you distinguish between following pairs of compounds with the help of IR spectroscopy? PhCONH_2 and PhCH_2NH_2 (4)
- Q.7.** (a) Discuss the chemistry of fatty acids and glyceryl trialkanoates in detail. (10)
 (b) How the numbering in steroids is carried out? Discuss the reactions and biological functions of cholesterol. (10)
- Q.8.** (a) Draw a flow-sheet diagram and elaborate the manufacturing and processing of paper in the paper industry. (16)
 (b) Elaborate why the fertilizers are necessary for proper plant growth. (4)
