FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION-2026
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

CSS Chemistry Paper-I 2026

Roll Number

TIME ALLOWED: THREE HOURS	**PART-I MCQS MAXIMUM MARKS = 20**
PART-I (MCQS): MAXIMUM 30 MINUTES	**PART-II MCQS MAXIMUM MARKS = 80**

NOTE:

1. First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes.
2. Overwriting/cutting of the options/answers will not be given credit.
3. There is no negative marking. All MCQs must be attempted.

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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.

1. **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) $1/L^2$ (C) L (D) None of these
2. **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
3. **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
4. **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
5. **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
6. **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
7. **According to collision theory, the rate constant increases because:**
(A) The fraction of collisions with energy ≥ activation energy increases with temperature
(B) Molecularity increases with temperature (C) Concentration decreases with temperature (D) None of these
8. **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
9. **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
10. **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
11. **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
12. **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
13. **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
14. **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
15. **According to MOT (Molecular Orbital Theory), the bond order of the O_2 molecule is:**
(A) 1 (B) 2 (C) 3 (D) None of these
16. **According to VSEPR Theory, a molecule with AX_3E (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
17. **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
18. **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

NOTE:

i. **Part-II** is to be attempted on the separate **Answer Book.**

ii. Attempt **ALL** questions from **Part-II.**

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 according 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 calculates is not allowed.**

Question No. 2.

(a) Explain the difference between physisorption and chemisorption in terms of energetics and kinetics. Provide typical experimental evidence to distinguish them.

(b) Define and explain the concepts of internal energy (E) and enthalpy (H). Show the mathematical relationship between them.

(c) Discuss the physical meaning of eigenfunctions and eigenvalues, and explain why operators must be Hermitian in quantum mechanics.

Question No. 3.

(a) Outline selection criteria for stationary and mobile phases in column chromatography for separating polar organic molecules.

(b) Propose a corrosion prevention strategy for a steel water pipeline system exposed to chloride-rich environments.

(c) Derive the integrated rate equation for a second-order reaction where two reactants of equal concentration react (2A \rightarrow Products).

Question No. 4.

(a) Given small sample data, compute 95% confidence interval for the mean and interpret the result.

(b) Predict and justify which complex will undergo a stronger Jahn-Teller distortion: $[Cu(H_2O)_6]^{2+}$ or $[Mn(H_2O)_6]^{3+}. Support your reasoning with electronic configurations and degeneracy arguments.

(c) Explain how transport numbers are determined experimentally and derive their relationship with ionic mobilities.

Question No. 5.

(a) Explain the photoelectric effect and how it supports the particle nature of light. Discuss the role of work function and threshold frequency.

(b) Explain the common ion effect and its application in controlling the solubility of sparingly soluble salts. Use an example to illustrate.

(c) Explain the mechanism of enzyme catalysis, highlighting the role of the active site and the factors that influence enzyme activity.

Question No. 6.

(a) Use VSEPR to predict the shape and bond angles of SF_4 and explain the concept of stereochemically active lone pairs.

(b) Using the Van der Waals equation, explain qualitatively how critical constants (Tc, Pc, Vc) relate to a, b parameters.

(c) Explain Debye-Hückel theory and derive the limiting law for the mean ionic activity coefficient. Describe its region of validity.

Question No. 7.

(a) Discuss isomerism in coordination complexes (geometric, optical, linkage) with three illustrative examples and draw structures.

(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.

(c) Explain valence bond theory and hybridization for methane (CH_4), and contrast it with an MO description of bonding in the same molecule.

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 → 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: **(7)**
$[Cu(H_2O)_6]^{2+}$ or $[Mn(H_2O)_6]^{3+}$
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 (Tc, Pc, Vc) 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)**