



CSS Past Papers

Subject: Chemistry

Year: 2025

CSS/PMS GRAMMAR

— علم بڑی طاقت ہے —



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION – 2025
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

CSS/PMS GRAMMAR



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 attempted **Part-I (MCQS)** on the separate **OMR Answer Book** 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**. ($20 \times 1 = 20$)
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. Which of the following does *not* have the ground-state configuration $1s^2 2s^2 2p^6$?

- (A) Ne
- (B) Na
- (C) Cl
- (D) None of these

2. A reaction is exothermic if:

- (A) $\Delta H > 0$
- (B) $\Delta H < 0$
- (C) $\Delta G > 0$
- (D) $\Delta G < 0$

3. In chemometrics, multivariate calibration involves:

- (A) Using multiple independent variables to predict dependent variables
- (B) Using regression only on X-data
- (C) Performing correlation without regression
- (D) None of these



4. Langmuir isotherm assumes:

- (A) Multilayer adsorption
- (B) Uniform surface without interactions between adsorbed molecules
- (C) Monolayer adsorption with interactions
- (D) None of these

5. A zero-order reaction rate does *not* depend on:

- (A) Temperature
- (B) Pressure
- (C) Reactant concentration
- (D) None of these

6. Enzymes act as catalysts by:

- (A) Increasing activation energy
- (B) Lowering activation energy
- (C) Changing equilibrium position
- (D) None of these

7. In an electrolytic cell:

- (A) Electrons move from cathode to anode
- (B) The anode is negative
- (C) Energy is consumed to drive the reaction
- (D) None of these

8. Silicones are primarily:

- (A) Organic polymers
- (B) Inorganic polymers
- (C) Hybrid organic-inorganic polymers
- (D) None of these

9. The Nernst equation relates electrode potential to:

- (A) Pressure
- (B) Temperature and concentration
- (C) Surface area
- (D) None of these

10. In solvent extraction, distribution coefficient is:

- (A) Ratio of solute concentration in two phases
- (B) Ratio of solvents used
- (C) Ratio of extractant to sample volume
- (D) None of these



11. In gas chromatography, the mobile phase is:

- (A) Liquid
- (B) Gas
- (C) Solid
- (D) None of these

12. Solubility of a salt is decreased in presence of:

- (A) Common ion
- (B) High temperature
- (C) High pH
- (D) None of these

13. The solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid. This is based on:

- (A) Raoult's law
- (B) Henry's law
- (C) Kohlrausch's law
- (D) None of these

14. The heat capacity of a calorimeter is determined using:

- (A) A bomb calorimeter
- (B) A known standard material
- (C) Adiabatic temperature rise
- (D) None of these

15. Fugacity is used to measure:

- (A) Real gas behavior
- (B) Ideal gas compressibility
- (C) Equilibrium constant
- (D) None of these

16. Lattice enthalpy is always:

- (A) Positive and represents energy absorption
- (B) Positive and represents energy release
- (C) Negative and represents energy absorption
- (D) Negative and represents energy release

17. According to Hess's law:

- (A) Enthalpy change depends on reaction pathway



- (B) Enthalpy change is path independent
 (C) Enthalpy depends on final state only
 (D) Enthalpy change includes entropy changes

18. Debye-Hückel theory is used to calculate:

- (A) Solubility of salts
 (B) Ionic strength of solutions
 (C) Gibbs free energy of ions
 (D) None of these

19. Potentiometric titration involves measurement of:

- (A) Current in the reaction
 (B) Volume at equivalence
 (C) Electrode potential as a function of titrant added
 (D) None of these

20. According to molecular orbital theory, the bond order of O_2 is:

- (A) 1.0
 (B) 1.5
 (C) 2.5
 (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.

- Q. 2.** (a) Define adsorption and explain its types. Derive an expression for the Langmuir adsorption isotherm and discuss factors influencing adsorption on solids. **(08)**
- (b) Why are transition metal complexes often colored? Explain using crystal field theory with an example. **(07)**
- (c) Compare and contrast the Lewis concept and the Bronsted-Lowry theory of acids and bases. Include relevant examples and limitations. **(05) (20)**
- Q.3.** (a) What is lanthanide contraction? Analyze its impact on the atomic radii and chemical properties of lanthanides and post-lanthanides. **(08)**

- (b) Analyze the quantum numbers associated with atomic orbitals and describe their importance in explaining electron configurations. (07)
- (c) Describe the catalytic activity of transition metals with reference to their variable oxidation states. Support your explanation with one example. (05) (20)
- Q.4.** (a) Derive the Gibbs free energy equation from the first and second laws of thermodynamics and discuss its importance in predicting the spontaneity of chemical reactions. (10)
- (b) Explain the principle of fractional distillation. Compare it with simple distillation using a diagram and examples of their applications. (05)
- (c) Adsorption isotherms fail at high pressure. Why? Explain with reference to the limitations of the Freundlich isotherm. (05) (20)
- Q.5.** (a) Why are Lewis acids and bases more versatile in their applications than Bronsted-Lowry acids and bases? Provide two examples to support your answer. (10)
- (b) Derive the integrated rate law for a first-order reaction and explain why the half-life of such a reaction is independent of its initial concentration. (05)
- (c) State and explain the Heisenberg Uncertainty Principle. How does it limit our ability to precisely determine the position and momentum of particles? (05) (20)
- Q. 6.** (a) Discuss the Freundlich adsorption isotherm. Derive the equation and highlight its limitations. (07)
- (b) Using a diagram, explain the principle and working of a galvanic cell. Discuss its components with the example of a Zn-Cu system. (07)
- (c) Why does an exothermic reaction sometimes become non-spontaneous at high temperatures? (06) (20)
- Q. 7.** (a) Explain the relationship between entropy, enthalpy, and Gibbs free energy. Derive an expression for equilibrium using these thermodynamic quantities. (08)
- (b) Derive the first law of thermodynamics and explain its connection with internal energy and enthalpy. (07)
- (c) Define the concept of activation energy and illustrate its significance in reaction kinetics using the Arrhenius equation. (05) (20)
- Q. 8.** Define the following: (5 each) (20)
- (a) Difference between Homogenous and Heterogenous Catalysis
- (b) Define Molecular Orbital Theory (MOT)
- (c) Difference between ANOVA and Gaussian Distribution
- (d) Define Chromatography and write key differences between Paper Chromatography and Gas Chromatography