



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2024 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.

- When we consider a proton (p^+) instead of an electron (e^-) in a one dimensional (1D) box of 0.1 nm, then the energy levels:**
(A) Become less widely spaced (B) Become more widely spaced (C) Cannot be recognized (D) None of these
- Which of the following statements concerning the quantum numbers (l , m , and s) is false?**
(A) If the value of azimuthal quantum number (l) is zero, the electronic distribution has spherical symmetry
(B) The spin quantum number (s) indicates the orientation of the spin of the nucleus with respect to a magnetic field
(C) The magnetic quantum number (m) indicates the possible orientations of orbital in a magnetic field
(D) None of these
- A characteristic of an oxidizing agent is that it is always:**
(A) A non-metal (B) Oxidized in a redox reaction (C) Gaining electrons (D) None of these
- During electrolysis, the oxidation takes place at the:**
(A) Anode (B) Cathode (C) Both (A) & (B) (D) None of these
- The process of chemical adsorption which is a surface phenomena:**
(A) Is exothermic (B) Takes place at high temperature (C) Is reversible (D) None of these
- The most commonly used adsorbent for chromatographic separations of organic compounds is:**
(A) Activated charcoal (B) Aluminium (C) Silica gel (D) None of these
- If x/m is the amount of adsorbate per unit mass of the adsorbent and P is the pressure, then according to the Langmuir adsorption isotherm, which one of the followings is correct?**
(A) $x/m > P$ (B) $x/m = 1/P$ (C) $x/m \propto P$ (D) None of these
- Inversion of the cane sugar in the presence of a mineral acid is the best example of:**
(A) Heterogeneous catalyst (B) Homogeneous catalysis (C) Extremely fast reaction (D) None of these
- At standard conditions of temperature and pressure the order of mean square velocity of molecules N_2 , H_2 , O_2 and HCl is:** (A) $H_2 > N_2 > O_2 > HCl$ (B) $N_2 > O_2 > H_2 > HCl$ (C) $HCl > O_2 > N_2 > H_2$ (D) None of these
- The density of an ideal gas under the given conditions:**
(A) Is proportional to its molecular mass (B) Increases with increasing pressure, keeping temperature constant
(C) Decreases with increasing temperature, keeping pressure constant (D) None of these
- According to the third law of thermodynamics, the entropy of a pure and perfect crystalline substance is:**
(A) Zero at $0^\circ C$ (B) Zero at $0 K$ (C) Zero at $0^\circ F$ (D) None of these
- Which one of the followings is a factor which does not influence the rate of a chemical reaction?**
(A) Molecularity of the reaction (B) Order of the reaction (C) Temperature of the reaction (D) None of these
- According to transition state theory, the rate constant of a chemical reaction**
(A) Depends upon inverse of temperature (B) Is directly proportional to temperature
(C) Is inversely proportional to negative free energy change (ΔG) (D) None of these
- During steady state of a unimolecular gaseous phase reaction:**
(A) The concentration of activated molecules goes on decreasing
(B) The concentration of activated molecules goes on increasing
(C) The concentration of activated molecules remains constant (D) None of these
- Viscosity of a liquid at a given temperature is:**
(A) Frictional resistance between adjacent layers (B) Exportability to flow on the walls of tube
(C) Independent of the sizes of molecules and their shape (D) None of these
- The critical angle of refraction of a liquid as compared to air is:**
(A) Greater than 90° (B) Less than 180° but greater than 120° (C) Always less than 90° (D) None of these
- Which of the followings has the highest oxidation state of the central atom?**
(A) $K_3[Fe(CN)_6]$ (B) $Na[Co(CO)_4]$ (C) $Fe(CO)_5$ (D) None of these
- A compound has the empirical formula $CoCl_3 \cdot 4NH_3$. One mole of it gives one mole of $AgCl$ on treatment with $AgNO_3$ solution. NH_3 is not removed with conc. H_2SO_4 . It has structure:**
(A) $Co(NH_3)_4 Cl_3$ (B) $[Co(NH_3)_4 Cl_2]Cl$ (C) $[Co(NH_3)_3 Cl_3]NH_3$ (D) None of these
- There are two scales of energy to measure the crystal field splitting. Which is true from the following?**
(A) $\Delta_{Oh} = 10D_q$ (B) $0.4 \Delta_{Oh} = 6D_q$ (C) $0.6 \Delta_{Oh} = 4D_q$ (D) None of these
- The value of one Bohr Magneton is:**
(A) $9.27 \times 10^{-21} \text{ erg} \cdot G^{-1}$ (B) $92.7 \times 10^{-21} \text{ erg} \cdot G^{-1}$ (C) $5.28 \times 10^{-20} \text{ erg} \cdot G^{-1}$ (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** by selecting **TWO** questions from **EACH SECTION**. **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) What is the de Broglie hypothesis and how was this proved experimentally? (10)
Explain in detail.
- (b) How do you compare the Gibb's and Helmholtz free energies? (05)
- (c) Explain occurrence and oxidation states of Lanthanides. (05) (20)
- Q. 3.** (a) Explain in detail the Nernst equation. (10)
- (b) Justify that half life period of third order reaction is inversely proportional to square of the initial concentration of reactants. (05)
- (c) What are Eigen function and Eigen values? Explain with examples. (05) (20)
- Q. 4.** (a) Discuss in detail the Hess's law with the help of suitable examples. (10)
- (b) Discuss the Hamiltonian operator in detail. (05)
- (c) Explain the phase diagram by applying the Gibb's phase rule for a two component system with the help of a suitable example. (05) (20)
- Q. 5.** (a) Derive the equation for rate constant of a third order reaction with same initial concentrations. Give its half life and examples as well. (10)
- (b) What is solvent extraction? Discuss its theory and uses for the extraction of metals. (05)
- (c) What is theory of buffer solutions? Explain. (05) (20)
- Q. 6.** (a) Explain the kinetics of the enzymes catalysis (10)
- (b) Give postulates of Werner's theory of co-ordination compounds. How does it justify the formulae of $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$, and $\text{CoCl}_3 \cdot 3\text{NH}_3$? (05)
- (c) How the electrochemical series will help us, that whether a particular metal will react with an acid or not? (05) (20)
- Q. 7.** (a) Discuss in detail the soft and hard acid and base (SHAB) concept with suitable examples. (10)
- (b) Derive relationship between equilibrium constant and Gibb's free energy. (05)
- (c) What are different statistical tests in chemical analysis? Explain. (05) (20)
- Q. 8.** (a) Discuss the nomenclature and structure of coordination complexes with coordination number 2-10. (10)
- (b) How do you calculate the degree of dissociation (α) of a weak electrolyte by Kohlrausch law? (05)
- (c) The hydrolysis of $\text{CH}_3\text{COOH}_2\text{H}_5$ with NaOH is a second order reaction. How do you follow the progress of this reaction in the laboratory? (05) (20)
