

FEDERAL PUBLIC SERVICE COMMISSION



COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2013

Roll Number

CHEMISTRY, PAPER-I

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	30 MINUTES	MAXIMUM MARKS: 20
	(PART-II)	2 HOURS & 30 MINUTES	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) Use of calculator is allowed.

PART-I ((MCQs) (COMPULSORY)

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

- What happens when Al dissolves in aqueous NaOH?
 - Forms soluble NaAl(OH)_4
 - Forms Al_2O_3
 - Precipitates of Al(OH)_3
 - Precipitates $[\text{Al(OH)}_2]_6^{3+}$ forms which then loses H^+
 - None of these
- The magnetic moment of the fluoride complex is expected to be:
 - The same as the magnetic moment of the cyanide complex.
 - Larger than the magnetic moment of the cyanide complex because there are more unpaired electrons in the fluoride complex.
 - Smaller than the magnetic moment of the cyanide complex because there are more unpaired electrons in the fluoride complex.
 - Larger than the magnetic moment of the cyanide complex because there are fewer unpaired electrons in the fluoride complex.
 - None of these
- When solid CoCl_2 is dissolved in water, a pink solution results and the following equilibrium is established:

$$\text{Co(H}_2\text{O)}_6^{2+}(\text{aq}) + 4 \text{Cl}^-(\text{aq}) \rightleftharpoons \text{CoCl}_4^{2-}(\text{aq}) + 6 \text{H}_2\text{O}(\text{l})$$
 Which one of the following best describes what will happen when a concentrated HCl is added to the CoCl_2 solution without changing the volume significantly?
 - Because a solution of HCl is colorless, the color of the CoCl_2 solution will not change.
 - Because HCl is a strong acid, the number of unpaired electrons in $[\text{Co(H}_2\text{O)}_6]^{2+}$, but not $[\text{CoCl}_4]^{2-}$, will change.
 - The concentration of $[\text{Co(H}_2\text{O)}_6]^{2+}$ will decrease and the concentration of $[\text{CoCl}_4]^{2-}$ will increase; the color of the solution will become more blue.
 - The concentration of $[\text{Co(H}_2\text{O)}_6]^{2+}$ will increase and the concentration of $[\text{CoCl}_4]^{2-}$ will decrease; the color of the solution will become more pink.
 - None of these
- Passage of electric current through the metals is due to:
 - Oxidation reaction
 - Reduction reaction
 - Electrolysis
 - Free movement of electrons
 - None of these
- VBT is unable to explain the nature of some of the complexes of:
 - Cobalt
 - Copper
 - Nickel
 - Manganese
 - None of these
- Energy available to do work at constant _____ and _____ is known as Gibb's free energy.
 - Pressure, temperature
 - Pressure, volume
 - Temperature, volume
 - All of these
 - None of these
- A spontaneous reaction is not possible if:
 - ΔH and $\text{T}\Delta\text{S}$ are both negative
 - ΔH and $\text{T}\Delta\text{S}$ are Positive
 - ΔH is positive and $\text{T}\Delta\text{S}$ is negative
 - ΔH is negative and $\text{T}\Delta\text{S}$ is Positive
 - None of these
- Which is not true about thermodynamics?
 - It ignores the internal structure of atoms and molecule.
 - It involves the matter in bulk.
 - It is concerned only with the initial and final states of the system.
 - It is not applicable to macroscopic system.
 - None of these
- The zero point energy of a particle is 1-D box of dimension 6Å is:
 - 10^{-22}J
 - 10^{-2}J
 - $16.22 \times 10^{-20}\text{J}$
 - 10^{22}J
 - None of these
- The salt bridge in the electrochemical cell serves to:
 - Increase the rate at which equilibrium is attained.
 - Increase the voltage of the cell.
 - Maintain electrical neutrality
 - Increase the oxidation/reduction rate.
 - None of these

CHEMISTRY, PAPER-I

11. The equation $\frac{dP}{dT} = \frac{\Delta H}{T(V_2 - V_1)}$ is called:
- (a) Gibbs's Helmholtz equation (b) Kirchoff's equation (c) Clapeyron equation
(d) Clausius Clapeyron equation (e) None of these
12. The hydrogen molecule may be represented by two wave functions, Ψ_{covalent} and Ψ_{ionic} and C_1 and C_2 are coefficient indicating the weight of each function. The real wave function may be written as (N is the normalization constant)
- (a) $\Psi = N [\Psi_{\text{covalent}} + \Psi_{\text{ionic}}]$ (b) $\Psi = N [C_1 \Psi_{\text{covalent}} + C_2 \Psi_{\text{ionic}}]$
(c) $\Psi = N [C_1 \Psi_{\text{covalent}} \times C_2 \Psi_{\text{ionic}}]$ (d) $\Psi = (C_1 + C_2) N [\Psi_{\text{covalent}} \times C_2 \Psi_{\text{ionic}}]$
(e) None of these
13. Copper metal will replace silver ions in solution, resulting in the production of silver metal and copper ions. This indicates that:
- (a) Silver has a higher oxidation potential than copper. (b) A combustion reaction is occurring.
(c) Copper has a higher oxidation potential than silver. (d) Silver is much less soluble than copper.
(e) None of these
14. According to Debye-Huckel theory of strong electrolytes, and ion moving in an atmosphere of oppositely charged ions experiences a drag. This effect is known as the:
- (a) Asymmetric effect (b) Electrophoretic effect (c) Inter-ionic effect
(d) Concentration effect (e) None of these
15. The electrical conductivity of an electrolyte depends upon:
- (a) The number of molecules in the electrolyte. (b) The number of ions present in the electrolyte.
(c) The number of ions present in the solution . (d) The number of molecules of the solvent.
(e) None of these
16. Brass is an alloy of:
- (a) Cu and Zn (b) Cu, Ni, Zn (c) Cu and Ni (d) Cu, Al, Zn (e) None of these
17. Urea is a high quality nitrogenous fertilizer with:
- (a) 76% nitrogen (b) 46% nitrogen (c) 66% nitrogen (d) 26% nitrogen (e) None of these
18. When Zn metal is kept in CuSO_4 solution, copper is precipitated and ZnSO_4 is formed because:
- (a) Atomic number of Zinc is smaller than copper. (b) Atomic number of Zinc is larger than copper.
(c) Standard reduction potential of Zinc is more than that of copper.
(d) Standard reduction potential of Zinc is less than that of copper. (e) None of these
19. The most important ore of aluminium is:
- (a) Bauxite (b) Magnetite (c) Haematite (d) Monazite (e) None of these
20. The inexpensive and commonly used variety of glass is called soda glass. It is called so because:
- (a) Was used initially for making bottles of soda (carbonated drink). (b) Is made using soda (sodium carbonate)
(c) Was initially used for storing sodium carbonate. (d) Is made using soda lime. (e) None of these

PART-II

- NOTE:** (i) **Part-II** is to be attempted on the separate **Answer Book**.
(ii) Candidate must write **Q. No.** in the **Answer Book** in accordance with **Q. No.** in the **Q. Paper**.
(iii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL questions carry EQUAL marks**.
(iv) Extra attempt of any question or any part of the attempted question will not be considered.
(v) **Periodic Table of Elements is available on page-4**.
(vi) **Use of calculator is allowed**.

- Q.2.** (a). What is engineering ceramics? Describe the raw materials used in making classic ceramic products. (08)
(b). How urea is manufactured on commercial scale, support with a schematic diagram. (08)
(c). In what respect does inner orbital complexes differ from an outer orbital complexes? (04)
- Q.3.** (a). Describe the oxyacids of chlorine. (06)
(b). Describe what is meant by *silane* and *silanol*. What is their role in preparation of *Silicons*. (08)
(c). Define the following types of Processes: (06)
(i) Isothermal (ii) Adiabatic (iii) Isochoric (iv) Isobaric

CHEMISTRY, PAPER-I

- Q.4.** (a). How CFT and MOT account for the fact that $[\text{CoF}_6]^{3-}$ is paramagnetic but $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic? (06)
- (b). Discuss crystal field splitting in complexes having different geometries? (08)
- (c). What are the raw materials for the production of calcium superphosphate and cement? (06)
- Q.5.** (a). Derive Schrodinger wave equation and calculate the energy of the particle in one dimensional box having length a . (14)
- (b). What are the hazardous effects of acid rain and global warming on plants? (06)
- Q.6.** (a). How Debye-Huckel theory is applied to determine activity and activity coefficients for strong electrolytes? Derive its mathematical form. (12)
- (b). How standard electrode potential is measured? (06)
- (c). What is de Broglie hypothesis? (02)
- Q.7.** (a). How chlorine is produced on industrial scale? (08)
- (b). How Werner's Theory explains the structure of coordination compounds? (08)
- (c). Why the Ozone Layer exists at a certain altitude in Stratosphere? (04)
- Q.8.** (a). Give the applications of chelates in biological and analytical systems. (04)
- (b). What are the advantages of semiconductive devices? (04)
- (c). Derive mathematical form of Clausius-Clapeyron equation. (12)
