

**PUNJAB PUBLIC SERVICE COMMISSION**  
**COMBINED COMPETITIVE EXAMINATION FOR**  
**RECRUITMENT TO THE POSTS OF**  
**PROVINCIAL MANAGEMENT SERVICE-2019**

**SUBJECT: CHEMISTRY (PAPER-I)**

**TIME ALLOWED: THREE HOURS**

**MAXIMUM MARKS: 100**

**NOTE: Attempt Five Questions in All. Attempt in Urdu or English.**

- Q No. 1:**
- a) What is meant by corrosion? How it can be explained electrochemically? Also list methods to avoid them.  
(10 Marks)
- b) Define Gibbs free energy. How it can be related to equilibrium constant? Derive the relationship.  
(10 Marks)
- Q No. 2:**
- a) Define the following: (5X2=10 Marks)
- i. Millimole                      ii. Equivalent                      iii. Tunneling effect  
iv. Potential                      v. Entropy
- b) Derive the equation of wave function for a particle moving in one dimension.  
(10 Marks)
- Q No. 3:**
- a) Differentiate between  $K_4[Fe(CN)_6]$  and  $[Fe(H_2O)_6]SO_4$  on the basis of CFT. Also explain the distortion present in copper complexes.  
(4+6=10 Marks)
- b) Write down postulates of VBT in case of transition metal compounds. Also comment, why  $ClO_4^{-1}$  and  $H_2SO_4$  has the same geometry,  
(7+3=10 Marks)
- Q No. 4:**
- a) Define pollutant. How it produces adverse effect on living organisms and imbalance in the environment?  
(10 Marks)
- b) Explain briefly the advantage and disadvantage of supplying sewage and sludge to the agriculture soil.  
(10 Marks)
- Q No. 5:**
- a) How will you prove " $H\psi = E\psi$ " by the Schrodinger wave equation?  
(10 Marks)
- b) Briefly, explain the followings: (5 + 5=10 Marks)
- (i) Principal Quantum Number      (ii) Azimuthal Quantum Number
- Q No. 6:**
- a) Define thermodynamics and enthalpy. Prove First law of thermodynamics by mathematical formulation.  
(10 Marks)
- b) Explain the followings, (5 + 5=10 Marks)
- (i) Gibbs free energy and its applications in different process  
(ii) Change in enthalpy ( $\Delta H$ ) and relationship with change in energy ( $\Delta E$ )

**P.T.O**

- Q No. 7:**
- a)** Define hybridization and give examples. Write down the rules of hybridization and explain SP hybridization and  $SP^3$  hybridization. **(10 Marks)**
  - b)** Describe the main postulates of Molecular Orbital Theory. Give its application in heteronuclear diatomic molecules with two examples. **(10 Marks)**
- Q No. 8:**
- a)** Discuss the nature of Alpha ( $\alpha$ ) rays and Gamma rays ( $\gamma$ ). Describe the kinetic study of radioactive decay. Give example. **(10 Marks)**
  - b)** Define pollution, pollutants and contaminants. Describe the source, effects and control of carbon monoxide as pollutant. **(10 Marks)**

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**SUBJECT: CHEMISTRY (PAPER-II)**

**TIME ALLOWED: THREE HOURS**

**MAXIMUM MARKS: 100**

**NOTE: Attempt Five Questions in All. Attempt in Urdu or English.**

**Q No. 1: (i) Draw the structures of the following compounds: (5 Marks)**

- a) Spiro [2.4]heptane                      b) Bicyclo [2.2.2] cyclo octane  
c) Hexane dioic acid                      d) 4-oxobutanoic acid  
e) Ethanoic anhydride

**(ii) Justify the following statement: (2x5=10 Marks)**

- a) Dimethyl amine is stronger base than methyl amine which is stronger than ammonia                      b) Phenol is stronger than ethanol  
c) *m*-chloro-benzoic acid is a stronger acid than *p*-chloro-benzoic acid  
d) Pyrrole is a weaker base than Pyridine

**iii) Draw the resonance structures of the following compounds: (5 Marks)**

- (a) CH<sub>2</sub>=CH-CH<sub>3</sub>    (b) CH<sub>3</sub>=CH-O-CH<sub>3</sub>                      (c) CH<sub>3</sub>-N=N=N  
(d) CH<sub>2</sub>=CH-C=N    (e) CH<sub>3</sub>-C-CH<sub>2</sub>-C-OC<sub>2</sub>H<sub>5</sub>

- Q No. 2:**
- (i) Methanol is a good solvent for UV but not for IR Spectroscopy. Explain the fact. **(5 Marks)**
- (ii) Briefly describe the basic difference between Beer's and Lambert's laws of absorption of light. **(5 Marks)**
- (iii) Explain the working of double beam IR instrument with special discussion on the formation of a solution and recording of absorbance. **(10 Marks)**

- Q No. 3:**
- (a) **Illustrate the difference between the following with examples: (3 + 5 + 4+5=17)**
- Conjugation and Hyperconjugation.
  - Mesomeric Effect and Inductive Effect.
  - Chromophore and Auxochrome.
  - Electromeric Effect and Resonance Effect.
- (b) Why esters have low boiling points than their corresponding acids? **(3 Marks)**

- Q No. 4:**
- (a) Explain the principle of UV and IR Spectroscopy. **(3.5+3.5=7 Marks)**
- (b) How would you distinguish between ethane ethylene and acetylene by IR spectroscopy? **(6 Marks)**
- (c) Differentiate between Bathochromic Shift and Hypsochromic Shift. **(5 Marks)**
- (d) What is the formula for absorbance of a substance in Electronic Spectroscopy? **(2 Marks)**

**P.T.O**

- Q No. 5:** (i) Explain the steps involved in the phenomenon of "Walden Inversion". **(5 Marks)**  
(ii) Discuss the role of Nicol Prism for plane of polarized light. **(5 Marks)**  
(iii) Sketch the energy profile diagram and shapes of boat, twist boat, half chair and chair conformations of cyclohexane. **(10 Marks)**
- Q No. 6:** (i) Differentiate between the following terms with the help of appropriate examples.  
(a) Fats and oils (b) Soap and detergents (c) Lipids and wax  
(d) Iso-electronic point and flash- point. **(2x4=8 Marks)**  
(ii) Proteins exhibit a variety of coloured reactions, describe any four of these. **(8 Marks)**  
(iii) Hydrogen bonding plays an important role in protein structure, prove it. **(4 Marks)**
- Q No. 7:** (a) **What are Carbohydrates? Discuss their classification.** **(2+6=8 Marks)**  
(b) How do you differentiate between paper partition and adsorption paper chromatography? **(6 Marks)**  
(c) Define Detergent. What are its types and how it is different from soap? **(2+2+2=6 Marks)**
- Q No. 8:** (a) Explain the difference between chain growth and step growth polymerization? **(6 Marks)**  
(b) **Write a brief note on the following:** **(3.5x4=14 Marks)**  
i. TLC  
ii. Functions of Lipids  
iii. PTFE and its applications  
iv. P-type and N-type Semiconductors