

Indian Forest Service Examination - 2013

A-JGPT-M-BGDL-A

CHEMISTRY

PAPER-I

(CONVENTIONAL)

Time Allowed : Three Hours

Maximum Marks : 200

QUESTION PAPER SPECIFIC INSTRUCTIONS

**Please read each of the following instructions carefully
before attempting questions**

There are EIGHT questions in all out of which FIVE are to be attempted.

Question Nos. 1 and 5 are compulsory. Out of the remaining SIX questions, THREE are to be attempted selecting at least ONE question from each of the two Sections A and B.

Attempts of questions shall be counted in chronological order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Answers must be written in ENGLISH only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

SECTION—A

1. Answer **all** the questions : 8×5=40
- (a) Draw the molecular orbital diagram of the following species and comment on their bond energy, bond length and magnetic behaviour : 8
 O_2^{1+} , O_2^{1-} and O_2^{2-}
- (b) Draw the shapes of *d*-orbitals. 8
- (c) What is meant by extinction coefficient in crystallography? How is it useful in distinguishing the various types of cubic lattices? 8
- (d) Describe the critical phenomenon observed in a gas using appropriate example. Explain its applications in liquefaction of gases. 8
- (e) What is hybridization? Discuss the hybridization of xenon in XeF_4 . 8
2. (a) Discuss the significance of each of four quantum numbers. Derive the possible set of four quantum numbers when $n = 2$. 20
- (b) Derive Clausius-Clapeyron equation for a system consisting of liquid in equilibrium with vapour. Give its applications. 20
3. (a) What is first-order reaction? Derive a kinetic expression for the first-order reaction to show that the time required to complete a definite fraction of the reaction is independent of the initial concentration. 20
- (b) In the thermal decomposition of gaseous acetaldehyde, decomposed quantity x is represented by Δp , the pressure increase in a closed vessel. The following results were obtained :
- | | | | |
|---------------------|----|-----|-----|
| <i>Time</i> (sec) : | 42 | 242 | 480 |
| Δp (mm) : | 34 | 134 | 194 |
- The initial pressure of acetaldehyde in this vessel was 363 mm. Show that the reaction is of second order. 10
- (c) Discuss in brief the difference between bonding and anti-bonding molecular orbitals. 10
4. (a) Discuss the phase rule applicable to lead-silver system. Explain the application of this system for desilverization of lead. 20
- (b) Describe the potentiometric determination of pH of a solution using glass electrode. 20

SECTION—B

5. Answer all the questions : 8×5=40
- (a) Why is the chemistry of the lanthanides homogeneous whereas there are erratic and irregular variations in chemical properties in series of *d*-block elements? 8
- (b) What happens when the following substances are treated with liquid NH_3 ? 8
- (i) $\text{Zn}(\text{NO}_3)_2$
- (ii) Hg_2Cl_2
- (iii) KMnO_4
- (iv) TiCl_4
- (c) Describe the preparation of sodium nitroprusside explaining the intermediate substances formed and balance all the chemical reactions. 8
- (d) Explain effective atomic number rule with appropriate example. Show that some complexes are exception to this rule with appropriate example. 8
- (e) Explain why Ce^{3+} ion ($4f^1$) is colourless, whereas Ti^{3+} ($3d^1$) solution is purple in colour. 8
6. Discuss the influence of ionic strength on the rate of ionic reaction utilizing Debye-Hückel limiting law. Show that the rate constant is independent of ionic strength if one of the reactants is neutral molecule. 40
7. (a) Draw the possible structures of $\text{Fe}_2(\text{CO})_9$ with special reference to magnetic and crystallographic studies. Discuss hybridization involved and give the difference between hybridization and resonance. 20
- (b) Explain fluorescence and phosphorescence using the Jablonski diagram. 20
8. (a) Give a succinct account of the transport of molecular/ionic species through a charged semipermeable membrane. 20
- (b) Explain the following terms with suitable example (at least one in each case) : 20
- (i) Complex
- (ii) Chelate
- (iii) Stability
- (iv) Stability constant
- (v) Overall stability of a complex
- (vi) Steric effect
- (vii) Dentate character
- (viii) Chelate effect
