

2007

CHEMISTRY - I (Optional)

100058

Standard : Degree

Total Marks : 200

Nature : Conventional

Duration : 3 Hours

Note :

- (i) Answers must be written in **English** only.
- (ii) Question No. 1 is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each** section.
- (iii) Figures to the **RIGHT** indicate marks of the respective question.
- (iv) Use of log table, Non-Programmable calculator is permitted, but any other Table / Code / Reference book are not permitted.
- (v) Make suitable assumptions, wherever be necessary and state the same.
- (vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.
- (vii) Credit will be given for orderly, concise and effective writing.
- (viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.
- (ix) For each slab of 10 and 15 marks, the examinee is expected to write answers in 125 and 200 words respectively.

1. Answer **any four** of the following :

- (a) What are postulates of Werner's theory of coordination compounds ? Give **10** experimental evidences to support it.
- (b) What are olefin complexes ? Discuss bonding in such complexes. **10**
- (c) What are colloids ? Give classification of colloids (with examples) on the basis of **10** physical state of dispersed phase and dispersion medium.
- (d) Draw labelled phase diagram of water system and discuss the importance of **10** various points, lines and areas in it.
- (e) What is green house effect ? Which gases are responsible for it ? What are its **10** consequences ?

P.T.O.

SECTION - A

2. Answer the following sub-questions :
- (a) (i) Calculate the wave length associated with an electron ($m=9.1 \times 10^{-31}\text{kg}$) travelling with one third speed of light ($h=6.624 \times 10^{-34}\text{ Js}$ and $C=2.998 \times 10^8\text{ms}^{-1}$) 5
- (ii) Describe the mechanism of colours imparted to the flame by alkali metals and some alkaline earth metals. 5
- (b) What is VSEPR theory ? Explain hybridisation and shapes of ClF_3 and ICl_2^- on the basis of it. 10
- (c) What are interhalogen compounds ? How do they differ from halogens ? Give preparation of each type of interhalogen compound. 10
- (d) What are transition elements ? Explain the trends in atomic and ionic radii of these elements. 10
3. Answer the following sub-questions :
- (a) (i) Draw radial Probability distribution curves for 1s, 2s, 3s and 4s orbitals. 5
- (ii) Explain the mobilities of alkali metal ions in aqueous solution. 5
- (b) What is lattice energy ? Explain Born-Haber cycle to calculate the lattice energy of NaCl crystal. 10
- (c) Explain structure and bonding in diborane and tetrasulphur tetranitride. 10
- (d) Discuss magnetic properties of transition elements. 10

SECTION - B

4. Answer the following sub-questions :
- (a) Explain diagrammatically how d orbitals lose their degeneracy in octahedral and square planar field. 10
- (b) For a tetrahedral Co (II) Complex, $\mu_{\text{eff}}=4.87\text{ B.M.}$ The crystal field splitting parameter, D_2 for the Complex is 294 cm^{-1} . Calculate spin-orbit coupling constant, λ , of Co (II) in this complex. 10

- (c) (i) Give the spectroscopic symbol for ground state term in the following complexes. **5**
 (1) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ (Cr = 24) (2) $[\text{Co}(\text{NH}_3)_6]^{2+}$ (Co = 27)
- (ii) Give electronic configuration of lanthanide elements. **5**
- (d) What are actinides ? Give a method of separation of Np, Pu and Am from U. **10**
5. Answer the following sub-questions :
- (a) Explain with suitable examples, different factors affecting crystal field splitting parameter. **10**
- (b) Which of the following complexes show orbital contribution to their magnetic moments ? Justify your answer. **10**
 (i) $\text{Na}_4 [\text{Co}(\text{NO}_2)_6]$ (ii) $\text{K}_3 [\text{Fe}(\text{CN})_6]$, (Fe = 26)
- (c) (i) Explain Laporte Selection rule in d-d transitions. State under which conditions it is relaxed ? **5**
 (ii) What is lanthanide contraction ? What are its consequences ? **5**
- (d) Give points of similarities between lanthanides and later actinides. **10**

SECTION - C

6. Answer the following sub-questions :
- (a) (i) Explain Lewis concept of acids and bases with suitable examples. What are drawbacks of the concept. **5**
 (ii) What are nonaqueous solvents ? Explain in short acid-base reactions in liquid NH_3 as a solvent. **5**
- (b) Derive the reduced equation of state and state the law of corresponding state. **10**
- (c) What are liquid crystals ? Describe in short classification of thermotropic liquid crystals. **10**
- (d) Derive Bragg's equation $n\lambda = 2d \sin\theta$. **10**

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7. Answer the following sub-questions :
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| (a) (i) | What are limitations of Arrhenius theory of acids and bases. | 5 |
| (ii) | What is dipole moment of a solvent ? Explain it with respect to different solvents. | 5 |
| (b) | Derive van der Waal's Equation for real gases. | 10 |
| (c) | What is isotropy and anisotropy ? Describe following properties of liquid crystals. Viscosity, optical properties, electrical properties and magnetic properties. | 10 |
| (d) | What is Tyndall effect in colloids ? Explain it in short. | 10 |

SECTION - D

8. Answer the following sub-questions :
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| (a) | What is first order reaction ? Derive an expression for the rate constant of first order reaction. | 15 |
| (b) | Derive an expression for work done in isothermal reversible expansion of a gas. | 15 |
| (c) | State and explain law of mass action. Deduce the law of Chemical equilibrium. What is meant by equilibrium constant ? | 10 |
9. Answer the following sub-questions :
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| (a) | How will you determine order of a reaction using differential rate equation ? The half-life period of a substance is 50 min. at a certain concentration. When the concentration is reduced to one half of the initial concentration the half life period is 25 min. Calculate the order of the reaction. | 15 |
| (b) | State and explain Carnot theorem. What is Carnot cycle ? Calculate the efficiency of a Carnot engine. | 15 |
| (c) | Discuss the equilibrium of the reaction | 10 |
- $$\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$$
- Show that for above reaction $K_p = K_e$.

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