

2011

**280045****CHEMISTRY (Optional)  
Paper – I**

Standard : Degree

Total Marks : 200

Nature : Conventional (Essay) Type

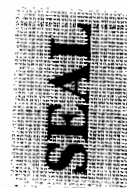
Duration : 3 Hours

**N.B. :**

- 1) Answers must be written in *English*.
- 2) Question No. 1 is **compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each** section.
- 3) Figures to the **RIGHT** indicate marks of the respective question.
- 4) Use of log table, Non-programmable calculator is permitted, but any other Table/ Code/ Reference book are not permitted.
- 5) Make suitable assumptions, wherever be necessary and state the same.
- 6) 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.
- 7) Credit will be given for orderly, concise and effective writing.
- 8) 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.

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

- |   |    |
|---|----|
| (a) What do you mean by "isomers" ? List different types of isomerism possible for co-ordination compounds, giving an example of each.  | 10 |
| (b) What are carbonyl complexes ? Discuss bonding in such complexes.  | 10 |
| (c) Discuss the biochemical processes which require (i) iron (ii) zinc.   | 10 |
| (d) What are the major air pollutants and their sources ? Suggest how the pollutants can be controlled.   | 10 |
| (e) What is colloid ? How does it differ from a true solution ? Give types of colloids (with an example of each) on the basis of physical state of dispersed phase and dispersing medium. | 10 |

**P.T.O.**

## SECTION – A

2. Answer the following sub-questions :

- (a) (i) For an element M having atomic number 24, give the electronic configuration, block, group and period. Write the formula for its oxide in (+ VI) state and calculate its formula weight. [Given : Atomic mass : M : 52.00 ; O 16.00] 5
- (ii) What is diagonal relationship ? Explain it with reference to group 1 of the periodic table. 5
- (b) Using the MO theory explain the difference in bond strength and magnetic properties of dioxygen, dioxygen cation, superoxide anion and peroxide anion respectively. 10
- (c) What is allotropism ? Explain it with suitable examples of p-Block elements. 10
- (d) Why do the second and third rows of transition elements resemble each other much more closely than they resemble the first row ? 10

3. Answer the following sub-questions :

- (a) (i) Give the significance of quantum numbers and Pauli's exclusion principle in the study of atomic structure. 5
- (ii) What are the alkaline earths ? Comment on their close similarities. 5
- (b) Discuss the structure and bonding in diborane. 10
- (c) Compare and contrast the chemistry of carbon and silicon. 10
- (d) Give the characteristics of the transition metals. 10

## SECTION – B

4. Answer the following sub-questions :

- (a) Write in brief about magnetic behaviour of transition metal complexes. 10
- (b) Illustrate  $d^8$  arrangement in nickel in weak octahedral, strong octahedral and tetrahedral fields, with suitable examples and indicate the magnetic behaviour in these cases. 10
- (c) (i) Describe the processes which can lead to absorption of light by a transition metal complex. 5
- (ii) Why is it difficult to separate compounds of the lanthanide elements ? What methods have been used, and which of these is still used ? 5
- (d) Compare the electronic structures of actinides with those of lanthanides and comment on their bonding. 10

5. Answer the following sub-questions :

- (a) Write a note on "Jahn-Teller effect". 10
- (b) In octahedral complexes the  $d^5$  systems should be exceptionally stable in their high-spin states while the  $d^6$  systems should be exceptionally stable in their low-spin states. The reverse is valid for tetrahedral complexes. Elucidate. 10

## Marks

- (c) (i) Using the 10 Dq value below, estimated from spectroscopic measurements, calculate the crystal field stabilization energy of  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  in  $\text{kJ mol}^{-1}$ . [Given : Atomic number for Co : 27 ;  $10 Dq = 13000 \text{ cm}^{-1}$ ; assume a pairing energy of  $19000 \text{ cm}^{-1}$  and that  $1 \text{ kJ mol}^{-1} = 83 \text{ cm}^{-1}$ ]. 5
- (ii) Comment on : Lanthanide contraction and its significance. 5
- (d) Write in short about different oxidation states found in the actinides. 10

## SECTION – C

6. Answer the following sub-questions :

- (a) (i) Explain Lux-Flood theory of acids and bases with suitable examples. 5
- (ii) Write a note on liquid ammonia and liquid sulphur dioxide as solvents. 5
- (b) Write in brief about following :  
Ideal gas equation, Van der Waals equation, units of pressure as Pascal, Torr and Atmosphere. 10
- (c) Give the characteristics which differ in gases, liquids and solids. Write in brief about the characteristics as viscosity, surface tension, capillary action and vapour pressure of liquid state. 10
- (d) Gold crystals are face-centered cubic, with a cell edge of 410 pm. What is the distance between centers of the two closest Au atoms ? How many nearest neighbours does each atom have ? 10

7. Answer the following sub-questions :

- (a) (i) Briefly describe and give an example of Bronsted-Lowry acid, conjugate acid of a Bronsted-Lowry base, neutralization in terms of the Bronsted-Lowry concept, amphoteric solvent, amphoteric solute and autoprotolysis. 5
- (ii) What is the influence of nonaqueous solvents on the behaviour of acids and bases ? 5
- (b) The bottle of compressed oxygen carried by a mountain climber has an internal volume of 5.9 L. Such a bottle was filled with  $\text{O}_2$  to a pressure of 2000 psi at  $25^\circ \text{C}$ . How many moles of  $\text{O}_2$  are in the bottle ? What is the mass of  $\text{O}_2$  in bottle in grams ? [Given :  $1 \text{ atm} = 14.7 \text{ psi}$  ; molar mass of dioxygen =  $32.00 \text{ g mol}^{-1}$  ; Assume that  $\text{O}_2$  behaves as an ideal gas ; gas constant =  $0.08206 \text{ L. atm/mol. K}$ ] 10
- (c) What are liquid crystals ? Write in brief about lyotropic liquid crystals. 10
- (d) What do you mean by crystalline solids and amorphous solids ? What is XRD ? Why can't XRD be used to determine the structures of amorphous compounds or compounds in solution ? 10

P.T.O.

## SECTION – D

8. Answer the following sub-questions :

- (a) Define the terms : Catalysis, catalyst, catalytic cycle, catalytic support and turnover frequency. Write in brief about homogenous and heterogeneous catalysis. 15
- (b) What is thermodynamics ? Give in brief the three laws of thermodynamics. Write about Gibb's free energy. 15
- (c) What is Le Chatelier's principle ? Describe the factors related to it. 10

9. Answer the following sub-questions :

- (a) Explain the following terms : Molecularity, reaction order, half-life of a reaction, rate-determining step and rate constant. 15
- (b) Write in short about : Calorimetry, thermochemistry, heat capacity, molar heat capacity, fuel value, standard state, state function and internal energy. 15
- (c) How does the rate constant of a chemical reaction vary with temperature ? The order of a reaction is independent of temperature, but the value of the rate constant varies with temperature. Why ? 10

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