V/ CHEM (vi)

2016

(5th Semester)

CHEMISTRY

SIXTH PAPER (CHEM–352)

(Inorganic Chemistry—II)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* What is meant by hexagonal close packing of spheres? 1

(b) Define lattice energy. Explain why the lattice energy of NaF is less exothermic than that of MgF_2. 1+2=3

(c) How does the solubility of an ionic solid depend upon its lattice energy? 2

(d) The radii of B^{3+} and O^{2-} ions are 0·23 Å and 1·40 Å respectively. Predict the most probable type of geometry exhibited by boron oxide. 1

OR

2. *(a)* When a mole of crystalline LiF is prepared from 1 mole lithium and 0·5 mole of fluorine gas, 605 kJ of energy is liberated. The enthalpy of sublimation of Li metal is 159·5 kJ mol^{-1}. The enthalpy of dissociation of fluorine gas into atoms is 158 kJ mol^{-1}, the ionisation energy of Li is 520 kJ mol^{-1} and the electron affinity of fluorine is 328 kJ mol^{-1}. Calculate the lattice energy of LiF (use appropriate sign for the different energy terms). 3

(b) Point out the differences between Schottky and Frenkel defects. 2

(c) Write a brief note on *p*-type semiconductor. 2

3. *(a)* Write the pictorial representation of atomic orbitals formed by the combinations of (assuming *x*-axis as the molecular axis)—

(i) two p_x orbitals

(ii) two p_y orbitals 1½+1½=3

(b) What do you mean by van der Waals forces? 1

(c) Draw the molecular orbital energy-level diagram of N_2 molecule and calculate the bond order. 2+1=3

OR

4. (a) Write the molecular orbital configurations of NO, NO^+, NO^{2+} and NO^- species and explain their magnetic properties. 2

(b) Mention the differences between bonding and antibonding molecular orbitals. 2

(c) What is meant by dipole-dipole interactions? 3

5. (a) Explain the bonding and structure of IF_5. 2

(b) Complete the following reactions : 1+1=2

(i) $CaC_2 + H_2O \rightarrow ?$

(ii) $H_2S_2O_8 + H_2O \xrightarrow{\text{dil. } H_2SO_4} ?$

(c) Write a short note on methanides. 2

(d) How is boron carbide prepared? 1

OR

6. (a) Write the structure of P_4O_8 and $H_4P_2O_7$. ½+½=1

(b) Discuss the oxidising property of HNO_2. 2

(c) Mention one method of preparation of XeF_4. 1

(d) Describe the physical method of separation of noble gases from liquid air. 3

7. (a) Define a base in terms of solvent system concept and give one example each of substance which behaves as a base in water, liquid ammonia and liquid sulphur dioxide. 1+1½=2½

(b) Explain the behaviour of CH_3COOH in water, liq. NH_3 and liq. HF based on the solvent system concept. 1½

(c) Give appropriate reasons why calcium and magnesium mainly occur in nature as their carbonates while mercury and silver exist as their sulphides. 1½

(d) What are the important characteristics of polar solvents? 1½

OR

8. *(a)* Give an example of—

(i) precipitation reactions shown by ammono bases in liq. NH_3;

(ii) complex formation reactions shown by ammono base in liq. NH_3. 1+1=2

(b) Write two advantages of liquid ammonia as a solvent. 1

(c) Define the following : 2

(i) Plane of symmetry

(ii) Centre of symmetry

(d) Evaluate the symmetry elements and symmetry point group of H_2O. 2

9. *(a)* Discuss the bonding in $[Fe(CN)_6]^{3-}$ on the basis of valence-bond theory. 2

(b) Describe how the *d*-orbitals split in an octahedral field. 3

(c) Explain why Sc^{3+} and Zn^{2+} ions are colourless. 2

OR

10. *(a)* Discuss the stability of the transition metal complexes. 2

(b) Explain why Δ_0 for $[Co^{2+}(H_2O)_6]^{2+}$ is $9300\ cm^{-1}$ while Δ_0 for $[Co^{3+}(H_2O)_6]^{3+}$ is $18200\ cm^{-1}$. 2

(c) Define crystal field stabilisation energy. Calculate CFSE for $[Fe(CN)_6]^{4-}$ ion; given that the mean pairing energy (*P*) and Δ_0 are $14100\ cm^{-1}$ and $33000\ cm^{-1}$ respectively. 1+2=3

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Subject Code : V/ CHEM (vi)

Booklet No. A

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To be filled in by the Candidate

DEGREE 5th Semester
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Subject .....
Paper .....

INSTRUCTIONS TO CANDIDATES

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

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DEGREE 5th Semester
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Roll No. .....
Regn. No. .....

Subject .....
Paper .....

Descriptive Type
Booklet No. B .....

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2016

(5th Semester)

CHEMISTRY

SIXTH PAPER (CHEM–352)

(Inorganic Chemistry—II)

(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—I

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The coordination numbers of spheres in body-centred cubic, hexagonal close packed and cubic close packed lattices are, respectively

(a) 8, 8, 12 ( )

(b) 8, 12, 12 ( )

(c) 8, 12, 8 ( )

(d) 12, 12, 8 ( )

2. In case of metallic bonds, molecular orbital theory is also called

(a) energy theory ( )

(b) valence-bond theory ( )

(c) band theory ( )

(d) metallic theory ( )

3. The stability of +3 oxidation state among the following groups, 13 elements decrease as

(a) $Al^{+3} > Ga^{+3} > In^{+3} > Tl^{+3}$ ( )

(b) $Tl^{+3} > In^{+3} > Ga^{+3} > Al^{+3}$ ( )

(c) $Al^{+3} > In^{+3} > Ga^{+3} > Tl^{+3}$ ( )

(d) $Tl^{+3} > Ga^{+3} > In^{+3} > Al^{+3}$ ( )

4. In the following equilibrium

$$HX + Y^{\ominus} \rightleftharpoons HY + X^{\ominus}$$

the Bronsted-Lowry bases are

(a) $Y^{\ominus}$ and HY ( )

(b) HX and HY ( )

(c) HX and $X^{\ominus}$ ( )

(d) $Y^{\ominus}$ and $X^{\ominus}$ ( )

5. The general electronic configuration of *d*-block elements can be represented as

(a) $nd^{10}ns^2$ ( )

(b) $nd^{10}ns^{0-2}$ ( )

(c) $(n-1)d^{1-10}ns^{0-2}$ ( )

(d) $(n-1)d^{1-10}ns^{1-2}$ ( )

SECTION—II

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What are the consequences of metal excess defects?

2. On the basis of molecular orbital theory, explain why hydrogen forms diatomic molecule while helium remains monoatomic.

3. Comment on the ionic/covalent character of alkaline earth metal hydrides.

4. Explain why tetrahalides of carbon do not behave as Lewis acids while tetrahalides of the other elements of group 14 are Lewis acids.

5. Give reasons why transition metals are not as good reducing agents as the metals of *s*-block.

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