

2018

( CBCS )

( 5th Semester )

**CHEMISTRY**

FIFTH PAPER

**( Inorganic Chemistry—II )***Full Marks : 75**Time : 3 hours***( PART : A—OBJECTIVE )***( Marks : 25 )**The figures in the margin indicate full marks for the questions*

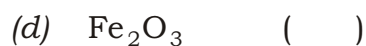
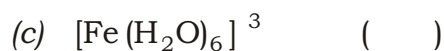
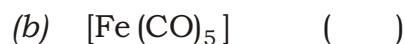
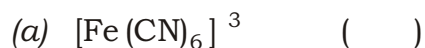
## SECTION—A

*( Marks : 10 )*

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. Which of the following has the metal in the lowest oxidation state?



2. Which of the following alkali metal hydrides is thermally most stable?

(a) LiH ( )

(b) NaH ( )

(c) KH ( )

(d) RbH ( )

3. Caro's acid is

(a)  $\text{H}_2\text{SO}_5$  ( )

(b)  $\text{H}_2\text{SO}_8$  ( )

(c)  $\text{H}_2\text{SO}_4$  ( )

(d)  $\text{H}_2\text{SO}_7$  ( )

4. A centre of symmetry is present in

(a) *cis*-1,2-dichloroethylene ( )

(b) *trans*-1,2-dichloroethylene ( )

(c) HCl ( )

(d) HCN ( )

5. Square planar complexes are usually

(a) low-spin complex ( )

(b) high-spin complex ( )

(c) Both (a) and (b) ( )

(d) None of the above ( )

6. The ratio between the number of close-packed atoms and the number of tetrahedral holes in cubic close-packing is

(a) 1:1 ( ) (b) 1:2 ( )

(c) 1:3 ( ) (d) 1:4 ( )

7. In corundum, oxide ions are arranged in hexagonal close-packing and  $\text{Al}^{3+}$  ions occupy two-third of the octahedral voids. Then the formula of corundum is

(a)  $\text{Al}_2\text{O}_3$  ( ) (b)  $\text{Al}_2\text{O}$  ( )

(c)  $\text{AlO}$  ( ) (d)  $\text{AlO}_3$  ( )

8. The number of antibonding electron pairs in  $\text{O}_2^2-$  ion on the basis of MO theory is

(a) 4 ( ) (b) 3 ( )

(c) 2 ( ) (d) 5 ( )

9.  $\mu_{\text{oct}}$  is

(a) greater than  $\mu_{\text{tet}}$  ( ) (b) lesser than  $\mu_{\text{tet}}$  ( )

(c) equal to  $\mu_{\text{tet}}$  ( ) (d) None of the above ( )

10. Dipole-dipole interactions are also called as

(a) London forces ( )

(b) Debye forces ( )

(c) Keesom forces ( )

(d) ion-dipole interactions ( )

SECTION—B

( Marks : 15 )

Answer the following questions :

3×5=15

1. Give a brief account of hexagonal close-packed (hcp) structure of crystals.

**OR**

Explain non-stoichiometric defects in crystals and its consequence.

2. Using molecular orbital energy level diagram, explain the paramagnetism of  $O_2$  molecule.

**OR**

Explain instantaneous dipole-induced dipole interactions (London forces).

3.  $HNO_3$  only can act as an oxidizing agent but  $HNO_2$  can act both as an oxidizing agent and a reducing agent. Explain.

**OR**

How do calcium carbide ( $CaC_2$ ), magnesium carbide ( $Mg_2C_3$ ) and silicon carbide (SiC) react with water?

4. What are the necessary conditions for a set to form a group?

**OR**

Compare the self-ionization of water and liq.  $NH_3$ .

5. Compare valence bond theory (VBT) and crystal field theory (CFT).

**OR**

What are the factors on which the magnitude of crystal field stabilization energy (CFSE) depend?

( PART : B—DESCRIPTIVE )

( Marks : 50 )

*The figures in the margin indicate full marks for the questions*

1. (a) Define the term 'lattice energy' of an ionic solid. How is lattice energy of sodium chloride calculated with the help of Born-Haber cycle? Describe. 1+4=5
- (b) Calculate the limiting radius ratio ( $r_+/r_-$ ) for the tetrahedral coordination of a cation in an ionic lattice. 3
- (c) Explain giving reason why LiI is soluble in H<sub>2</sub>O while LiF is not. 2

**OR**

2. (a) What are *n*-type and *p*-type semiconductors? Discuss giving examples. 4
- (b) Explain 'Li<sup>+</sup> ion is most extensively hydrated among the alkali metal cations'. 2
- (c) What are the three types of cubic crystals? Calculate the number of atoms per unit cell in each case. 1+3=4
3. (a) What are sigma- and pi-molecular orbitals? Give their characteristics. 1+2=3
- (b) How can you deduce bond order from molecular orbital theory? 2
- (c) Why is hydrogen diatomic but helium monoatomic? 2
- (d) Arrange O<sub>2</sub>, O<sub>2</sub><sup>+</sup> and O<sub>2</sub><sup>-</sup> in increasing order of their stability and bond length. 3

**OR**

4. (a) Write a note on 'bonding and antibonding molecular orbitals'. 2

- (b) Draw molecular orbital energy level diagram of NO. Find its bond order and magnetic properties. 3+2=5
- (c) How does MOT explain the difference in the reactivity of  $N_2$ ,  $O_2$  and  $F_2$ ? 3
5. (a) Ge(II) is strong reducing agent and Ge(IV) is not, Pb(IV) is an oxidizing agent and Pb(II) is not. Explain. 2
- (b) Discuss the structure and geometry of  $XeF_4$  and  $XeF_6$ .  $1\frac{1}{2}+1\frac{1}{2}=3$
- (c) What is catenation? Discuss with reference to nitrogen group elements. 2
- (d) Discuss the structure and bonding in diborane ( $B_2H_6$ ) molecule. 3

**OR**

6. (a) What are carbides? How are they classified? Specify the placement of the different elements from the different groups of the periodic table in different classes of the carbides. 1+1+2=4
- (b) Write the structure of Marshall's acid and mention the oxidation state of sulphur atom in it. 2+1=3
- (c) What are pseudohalogens? Give three examples of it.  $1\frac{1}{2}+1\frac{1}{2}=3$
7. (a) Discuss solvent system of acids and bases with suitable examples. 3
- (b) What are conjugate acids and bases? Discuss with examples. 2
- (c) Discuss the following reactions in liquid ammonia : 4
- (i) Precipitation reactions
- (ii) Redox reactions
- (d) Define symmetry point group. 1

**OR**

8. (a) Find out all the symmetry elements present in  $H_2O$  and  $NH_3$  and then specify their point groups. 3
- (b) Discuss the action of liq. ammonia on alkali metals. 3

- (c) Compare Lewis concept and Brönsted-Lowry concept of acids and bases. 2
- (d) Define the following : 2
- (i) A subgroup
- (ii) Order of a group
9. (a) Discuss the splitting of  $d$ -orbitals in weak and strong field with reference to octahedral complexes. 2
- (b) Discuss the properties of  $3d$  series elements with respect to—
- (i) oxidation states;
- (ii) electronic configurations. 3
- (c) Third and second rows of transition series elements resemble each other much more than they resemble first row transition elements. Explain. 3
- (d) Discuss ‘ $[\text{Fe}(\text{CN})_6]^{4-}$  is diamagnetic but  $[\text{Fe}(\text{CN})_6]^{3-}$  is paramagnetic’. 2

**OR**

10. (a) How can the magnetic properties of transition metal complexes be explained on the basis of CFT? Discuss with at least two examples. 3
- (b)  $\text{Sc}^{3+}$  is colourless but  $\text{Ti}^{3+}$  is coloured. Explain. 2
- (c) Define ‘crystal field stabilization energy’. For  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$  ion the mean pairing energy  $P$  is found to be  $23500 \text{ cm}^{-1}$ . The magnitude of  $\Delta_0$  is  $13900 \text{ cm}^{-1}$ . Calculate the CFSE for this complex ion corresponding to high-spin and low-spin states. 1+4=5

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