CHEM/V/CC/09

Student's Copy

2024 (CBCS) (5th Semester)

CHEMISTRY

FIFTH PAPER

(Inorganic Chemistry-II)

Full Marks: 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A-OBJECTIVE)

(Marks: 10)

Tick (1) the correct answer in the brackets provided :

1×10=10

1. Which one of the following is not the characteristic of ionic solids?

(a) High melting and boiling points ()

(b) High electrical conductivity in solid state ()

(c) Low vapour pressure at ordinary temperature ()

(d) High heat of vaporization ()

- 2. If N is the total number of spheres in a closed-packed arrangement, the number of tetrahedral holes will be
 - (a) N/2 ()
 - (b) N ()
 - (c) 2N ()
 - (d) N^2 ()
- 3. London force is attributed to
 - (a) dipole-dipole interaction ()
 - (b) dipole-induced dipole interaction ()
 - (c) instantaneous dipole-induced dipole interaction ()
 - (d) ion-dipole interaction ()
- 4. What is the bond order of N₂ molecule?



Contd.

- 5. Marshall's acid is
 - (a) $H_2S_2O_8$ ()
 - (b) $H_2S_2O_6$ ()
 - (c) $H_2S_4O_8$ ()
 - (d) $H_2S_3O_8$ ()
 - 6. Hydrolysis of CaC₂ yields
 - (a) methane ()
 - (b) ethane ()
 - (c) acetylene ()
 - (d) allylene ()

7. Lewis acids are

- (a) proton donors ()
- (b) proton acceptors ()
- (c) electron pair donors ()
- (d) electron pair acceptors ()

- 8. The principal axis in BF_3 molecule is
 - (a) C_2 ()
 - (b) C₃ ()
 - (c) C₄ ()
 - $(d) C_5 ()$
- 9. Most of the transition metals are coloured due to
 - (a) d-d electronic transition ()
 - (b) the charge transfer transition ()
 - (c) pi-pi electronic transition ()
 - (d) fully filled d orbitals ()

10. The complex $[Fe(H_2O)_6]^{3+}$ is a

- (a) low-spin complex ()
- (b) high-spin complex ()
- (c) diamagnetic complex ()
- (d) ferromagnetic complex ()

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(SECTION : B-SHORT ANSWERS)

(Marks: 15)

swer the following :

3×5=15

Unit—I

1. What do you mean by the hexagonal close packing of spheres?

OR

2. The ionic radii of K⁺ and Cl⁻ ions are 1.33 Å and 1.81 Å respectively. Predict the coordination number of K⁺ ion and the site occupied by K⁺ ion in the KCl crystal.

Unit—II

3. Explain the concept of dipole-dipole interaction.

OR

 Explain why hydrogen forms H₂ molecule while He₂ molecule does not exist.

UNIT-III

 Explain what is meant by inert pair effect. Explain the relative stability of different oxidation states of group 14 elements based on inert pair effect.

OR

6. Differentiate between ionic and covalent hydrides.

UNIT-IV

7. Illustrate the solvolysis reactions in liquid NH₃.

OR

8. Evaluate the symmetry elements and symmetry point group of H_2O .

UNIT-V

 Transition metals are less reactive than alkali and alkaline earth metals Explain.

OR

 What are inner sphere and outer sphere complexes? Explain with examples.

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer the following :

UNIT-I

- (a) How is a trigonal site formed? The radii of B³⁺ and O²⁻ ions are 0.23 Å and 1.40 Å respectively. Predict the most probable type of geometry exhibited by boron oxide.
 - (b) Calculate the limiting radius ratio (r_c / r_a) for the tetrahedral coordination of a cation in an ionic lattice.
 - (c) Explain Schottky defect. Point out the differences between Schottky and Frenkel defects. 2+2⁼⁴

OR

- 2. (a) Write a short note on n-type semiconductor. 3
 - (b) Write a brief note on metal excess defects.
 - (c) Define lattice energy. Discuss Born-Haber cycle taking the example of NaCl. 1+3^{#4}

10×5=

3

UNIT-II

• (a)	Draw MO diagram of O_2 molecule and calculate the bond order.	3
(b)	Discuss the conditions under which atomic orbitals combine to form molecular orbitals.	3
(c)	What do you mean by van der Waals' forces? Explain dipole-induced dipole interactions.	=4
	OR	
4. (a)	Explain how molecular orbitals are formed by the combination of two p_z orbitals (taking z-axis as the molecular axis).	3
(b)) Explain why the MO energy-level diagrams of O_2 and N_2 are different.	3
(c,) Using the molecular orbital theory, discuss the bond order and the magnetic property of NO molecule.	4
	Unit—III	
5. (a) Explain how helium and neon are separated from the first fraction in the fractionation of noble gases from liquid air. 	3
	(b) Discuss the hybridization and structure of XeF ₄ .	3
	(c) How is nitrous acid prepared? Give one example each where it acts as an oxidizing agent and as a reducing agent, respectively. 1+3	3=4
	OR	
6.	(a) What is catenation? Why does sulphur show more catenation property than nitrogen? 1+	2=3
	(b) What are noble gas clathrates? Give examples.	3

(c) What are the different types of interhalogen compounds? Discuss with suitable examples of each type. 4

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Unit—IV

(a)	What are conjugate acids and bases? 3	
<i>(</i> b)	Explain how the trihalides of boron behave as Lewis acids. 3	
(c)	What is an ammono base? Explain the complex formation reactions shown by ammono base in liquid ammonia. $1+3\approx4$	
	OR	
(a)	Write a brief note on the alkali metal-ammonia solution explaining the colour, magnetic properties and electrical properties. 3	0
(Ь)	Describe the neutralization reactions in liquid ammonia solvent. 3	1
(c)	Define axis of symmetry and plane of symmetry. Evaluate the symmetry elements and point group of NH_3 . $2+2=4$	•
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Unit-V

9.	(a)	Describe the reactions that occur in liquid ammonia involving neutralization and complex formation.	3	
	(Ь)	Explain why d -block elements are called transition elements.	3	
	(c)	Draw and explain the crystal field splitting pattern in octahedral geometry.	4	
		OR		
10.	(a)	Describe the bonding in [Ni(CO) ₄] on the basis of VBT.	3	9
10.	(a) (b)	Describe the bonding in $[Ni(CO)_4]$ on the basis of VBT. Explain the factors influencing the magnitude of crystal field splitting in transition metal complexes.	3 3	0

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(5th Semester)

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- (a) 1 (
- (b) 2 ()
- (c) 2·5 (
- (d) 3 ()

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Contd.

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(d) electron pair acceptors

<u></u> electron pair donors

(b) proton acceptors

(a) proton donors

7. Lewis acids are

Marshall's acid is

(a) H₂S₂O₈

(b) H₂S₂O₆

(c) H₂S₄O₈

(d) H₂S₃O₈

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Hydrolysis of CaC₂ yields

(a) methane

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(b) ethane

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(c)

acetylene

(d) allylene

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8. The principal axis in BF3 molecule is

(4) C₂ () (b) C₃ () (c) C₄ ()

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SECTION : B-SHORT ANSWERS |

(Marks : 15)

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UNIT-V

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<u>5</u> What examples. are inner sphere and outer sphere complexes? Explain with

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UNIT-IV

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6 elements and point group of NH3. Define axis of symmetry and plane of symmetry. Evaluate the symmetry 2+2=4

UNIT-V

- 9 a) neutralization and Describe the reactions complex formation. that occur 3 liquid ammonia involving ω
- 6 Explain why d-block elements are called transition elements

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10. (a) Describe the bonding in [Ni (CO)₄] on the basis of VBT.

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- 6 in transition metal complexes. Explain the factors influencing the magnitude of crystal field splitting ω
- 0 Compare the CFSE of [FeF6]3and [Fe(CN)₆]³⁻ ions.

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