2024

(CBCS)

(6th Semester)

CHEMISTRY

NINTH PAPER

(Inorganic Chemistry—I)

Full Marks: 75

Time: 3 hours

The figures in the margin indicate full marks for the questions

( SECTION : A-OBJECTIVE )

( Marks: 10 )

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

1×10=10

- 1. The hybridization of carbon in the bridging carbonyl group is
  - (a) sp ( )
  - (b)  $sp^2$  ( )
  - (c)  $dsp^2$  ( )
  - $(d) sp^3$  ()

2.	Wha	at is the mis	ssing reactant in the reaction given below?
		SnX	$X_4 + \underline{\hspace{1cm}} \longrightarrow SnR_4 + MgX_2$
	(a)	RMgX	( )
	(b)	MgR <sub>2</sub>	
r.,	(c)	Mg + R	( )
	(d)	RX (	)
3.	The	coordination	n number of iron in oxymyoglobin is
	(a)	4 (	)
	(b)	5 (	)
	(c)	6 (	)
	(d)	7 (	)
4.		w is the zind nydrase?	c ion coordinated with the apoenzyme of the carbonic
	(a)	Three imida	zole nitrogens of three histidine groups ( )
	(b)	Two imidaz acid (	zole nitrogens of two histidine groups and glutamic
	(c)	One imida acids (	zole nitrogen of histidine group and two glutamic
	(d)	Two imidaz acids (	ole nitrogens of two histidine groups and two glutamic )

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5.	The electronic configuration of gadolinium is	
	(a) $[Xe]4f^75d^26s^1$ ( )	
	(b) $[Xe]4f^85d^06s^2$ ( )	
	(c) $[Xe]4f^65d^26s^2$ ( )	
	(d) $[Xe]4f^75d^16s^2$ ( )	
6.	The +4 oxidation state is exhibited by which elements among the actinides?	
	(a) The first 8 elements (Ac to Cm) ( )	
	(b) The first 5 elements (Th to Pu) ( )	
	(c) The last 4 elements (Pa to Pu) ( )	
	(d) All actinide elements ( )	
7.	The magnetic susceptibility of antiferromagnetic substance is	
	(a) small and negative ( )	
	(b) large and positive ( )	
	(c) small and positive ( )	

(d) zero ( )

8.	Whi elec	ich one trons i	of t	he fol octal	lowing nedral	ions	s will plex?	have	the	highes	t nur	nber	of	unpair
	(a)	a high	-spir	ı d <sup>5</sup> i	on	(	)							
	(b)	a low-	spin	d <sup>5</sup> io	n	(	)							
	(c)	a high	-spir	d <sup>6</sup> i	on	(	)							
	(d)	a low-	spin	d <sup>4</sup> io	n	(	)							
9.	The	numbe	er of	norm	al mo	des o	of vib	ration	for	SO <sub>2</sub> m	olecu	ıle is		
	(a)	2	(	)										
	(b)	3	(	)										
	(c)	4	(	)										
	(d)	5	(	)										
		ich one uency?		ne foll	owing	is ex	pecte	d to s	how	the lov	vest l	M-X s	stre	etching
	(a)	[AlF <sub>4</sub> ]	-	(	)							15		
	(b)	[A1C1 <sub>4</sub> ]	-	(	)									
	(c)	[GaCl4	]-	(	)									
	(d)	[GaBr4	1-	(	)									

# ( SECTION : B—SHORT ANSWERS )

( Marks: 15)

Answer the following:

3×5=15

### UNIT-I

1. What are  $\pi$ -acid ligands? Explain how CO acts as a  $\pi$ -acid ligand.

## OR

2. What are the characteristics of ionic organometallic compounds?

# UNIT-II

3. Point out the basic differences between inorganic polymers and organic polymers.

## OR

4. What are condensation polymers and addition polymers? Give examples.

## UNIT-III

5. Give reasons, why the separation of lanthanides is difficult.

# OR

**6.** Explain how the lanthanide contraction affects the atomic size of transition elements.

# UNIT-IV

 Compare the magnetic properties of Ni<sup>2+</sup> ion in tetrahedral and square planar complexes.

# OR

8. Discuss the origin of the spin magnetic moment.

# UNIT-V

 Give at least three differences of Raman spectroscopy and Infrared spectroscopy.

OR

10. Differentiate between Rayleigh scattering and Raman scattering.

( SECTION : C-DESCRIPTIVE )

( Marks : 50 )

Answer the following:

10×5=50

# UNIT-I

- (a) Discuss how carbonyl to metal coordinate bond is formed in metallic carbonyls.
  - (b) How will you prepare the following compounds?

 $1 \times 3 = 3$ 

- (i) Ni (CO)4
- (ii) BR<sub>3</sub>
- (iii) Co<sub>2</sub>(CO)<sub>8</sub>
- (c) What is meant by  $\pi$ -metal alkene complexes? Citing suitable example, explain the bonding in the metal-alkene complex. 1+3=4

OR

- 2. (a) Explain how back bonding stabilized the metal carbonyls.
  - (b) Give one method of preparation of Grignard reagent and also write two uses of this reagent in the preparation of alcohol. 1+2=3
  - (c) How will you obtain Fe2(CO)9? Discuss its bonding and structure.

1+3=4

3

# UNIT-II

3.	(a)	Write one method of preparation of (NPCl <sub>2</sub> ) <sub>3</sub> and explain its structure.	
		1+	2=3
	(b)	What are the roles of sodium and potassium ions in biological systems?	3
	(c)	Draw the structure of the heme group present in hemoglobin and discuss the cooperativity effect in hemoglobin.	3=4
		OR	
4.	(a)	Discuss the functioning of carboxypeptidase.	3
	(b)	Explain how oxyhemoglobin passes on its oxygen to myoglobin.	3
	(c)	What are silicones? Discuss the method of preparation of a linear	
		tatromer dilicone	3=4
		Unit—III	
_	(a)		
Э.		Why do lanthanides show lower oxidation number than actinides?	3
	(b)	Comment on the colour of tripositive (M <sup>3+</sup> ) actinide ions.	3
	(c)	What is lanthanide contraction? What are its causes?	+3=4
		OR	
6	. (a)	Give reasons why the magnetic moments of lanthanides cannot be obtained from the spin-only formula.	e 3
	(b)	Compare the complexation tendency of lanthanides and actinides.	3
	(c)	Discuss how lanthanides are separated by ion exchange method.	4
		Unit—IV	
7	. (a	What are the important properties of paramagnetic substances?	3
	(b	Deministration of the state of	×3=3
¥		(i) Magnetic induction	
		(ii) Bohr magneton	
		(iii) Curie temperature	

(c) What is meant by magnetic susceptibility? Explain the temperature dependence of the magnetic susceptibilities of paramagnetic and antiferromagnetic substances.

# OR

- 8. (a) Write a short note on ferromagnetism.
  - (b) How was the Curie's law corrected in Curie-Weiss law and why?
  - (c) Under strong field ligands, Co(III) forms diamagnetic complexes wherein weak field ligands it forms paramagnetic complexes. Explain.

# UNIT-V

- 9. (a) Differentiate between Stokes' lines and anti-Stokes' lines. Which one has greater intensity and why?
  - (b) Give reasons why the N-H stretching frequencies of ammine complexes are lower than those of the free NH<sub>3</sub> molecule.
  - (c) Give reasons for the difference in the observed Ni-X stretching frequencies of the given species :

NiCl <sub>2</sub>	Ni(PPh <sub>3</sub> ) <sub>2</sub> Cl <sub>2</sub>	trans-Ni (py) <sub>4</sub> Cl <sub>2</sub>
521	341	207
NiBr <sub>2</sub>	Ni(PPh <sub>3</sub> ) <sub>2</sub> Br <sub>2</sub>	trans-Ni (py) <sub>4</sub> Br <sub>2</sub>
414	265	140

## OR

- 10. (a) What are the fundamental vibrations of CO<sub>2</sub> molecules? Indicate whether they are IR and Raman active or not.
  - (b) Arrange the given species in the increasing order of their Fe-X stretching frequency and give reasons to support your answer:

(c) What is mutual exclusion principle? Explain how it can be used for the structural elucidation of N<sub>2</sub>O molecules.
1+3=4

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2. What is the missing reactant in the reaction given below?  $\operatorname{SnX_4} + \underline{\hspace{1cm}} \operatorname{SnR_4} + \operatorname{MgX_2}$ (a) RMgX ( ) (b) MgR<sub>2</sub> ( ) (c) Mg + R ( ) (d) RX ( ) 3. The coordination number of iron in oxymyoglobin is (a) 4 ( ) **(b)** 5 ( ) (c) 6 () ( ) (d) 7 4. How is the zinc ion coordinated with the apoenzyme of the carbonic anhydrase? (a) Three imidazole nitrogens of three histidine groups (b) Two imidazole nitrogens of two histidine groups and glutamic acid ( ) (c) One imidazole nitrogen of histidine group and two glutamic

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acids

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# 6. The +4 oxidation state is exhibited by which elements among the actinides?

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(a)		a)	0
ø.			

# UNIT—IV

`.	. (a) What are the important properties of paramagnetic substances?	of paramagnetic substances?	က
_	(b) Explain the following terms:		$1\times3=3$
	(i) Magnetic induction		

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Bohr magneton Curie temperature

(ii)

[ Contd.

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- How was the Curie's law corrected in Curie-Weiss law and why? (g)
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UNIT-V

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[FeCl $_4$ ] $^-$ , [FeBr $_4$ ] $^-$  and [FeBr $_4$ ] $^{2-}$ 

What is mutual exclusion principle? Explain how it can be used for the structural elucidation of N2O molecules. 0

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