



Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27  
B.Sc. CHEMISTRY - VI SEMESTER  
SEMESTER EXAMINATION: APRIL 2022  
(Examination conducted in July 2022)

**CH 6118 – INORGANIC CHEMISTRY**

Time- 2 ½ hrs

Max Marks-70

This question paper contains **four** printed pages, **three** parts and **twenty one** questions.  
The periodic table is provided at the end.

**Part A**

Answer any six of the following questions.

[6 × 2 = 12]

1. What are d-block elements?
2. Many transition metals and their compounds show catalytic properties. Give reason.
3. State Jahn-Teller theorem.
4. Mention any two reasons for the anomalous behavior of fluorine.
5. Draw the structure of  $[\text{Fe}(\text{CO})_5]$ .
6. Sketch the structure of haem.
7. Give an example each for a bulk metal and a trace metal that are present in human body.
8. Write the equation for the reaction between Xe and  $\text{PtF}_6$ .

**Part B**

Answer any six of the following questions.

[8 × 6 = 48]

9. a) A complex of a transition metal ion with a  $d^6$  configuration is diamagnetic. Is it an octahedral or a tetrahedral one? Give reason for your answer.  
b) Sketch the structures for  $[\text{Fe}(\text{C}_2\text{O}_4)]^{3-}$  and  $\text{trans-}[\text{Co}(\text{en})_2(\text{NH}_3)_2]$ . (3+3)
10.  $[\text{Ni}(\text{CN})_4]^{2-}$  is diamagnetic whereas  $[\text{NiCl}_4]^{2-}$  is paramagnetic. Explain the formation of the complexes using valence bond theory (VBT). Draw the structures of both the complexes.
11. a) Write the IUPAC names of the following complexes.  
i)  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$                       ii)  $\text{cis-}[\text{PtCl}_2(\text{NH}_3)_2]$                       iii)  $[\text{CoCl}_2(\text{en})_2]\text{Cl}$   
b) Write the coordination sphere/formula for the following complexes.  
i) Tetraamminechloridonitrito- $\kappa$ -Nplatinum(IV) sulphate  
ii) Tris(ethylenediamine)cobalt(III) ion  
iii) di- $\mu$ -hydroxidoctaquadiairon(III) (3+3)
12. a) State any three postulates of Werner's theory of coordination compounds.  
b) Which of the following in each of the pairs have greater 10 Dq value and why?  
i)  $[\text{Fe}(\text{CN})_6]^{3-}$  and  $[\text{Fe}(\text{CN})_6]^{4-}$   
ii)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Ir}(\text{NH}_3)_6]^{3+}$  (3+3)

13. a) Calculate the EAN of Cr in  $K_3[Cr(Br)_2(Cl)_4]$  and Pt in  $[Pt(NH_3)_6]^{4+}$ .  
 b) Show  $Ti^{3+}$  is paramagnetic. Calculate its magnetic moment. (3+3)
14. a) Draw the facial and meridional structures of  $Ma_3b_3$  complex.  
 b) Write an expression for stepwise stability constant ( $K_1$  and  $K_2$ ) and overall stability constant ( $\beta$ ) for the below expression. (M = metal, L= monodentate ligand, ML and  $ML_2$  are complexes formed)
- $$M + L \xrightleftharpoons{K_1} ML$$
- $$ML + L \xrightleftharpoons{K_2} ML_2$$
- (3+3)
15. a) Draw the Born-Haber cycle for the dissociation of hydric acid in aqueous solution and obtain the expression for enthalpy of the same.  
 b) Between  $HClO_4$  and  $HClO$ , which is a stronger acid. Give reason. (3+3)
16. a) Elucidate the structure of  $ClF_3$  using VSEPR theory.  
 b) Explain cooperativity effect in haemoglobin using stepwise binding constants. (3+3)
17. a) Draw the orbital overlap diagram to show bonding in metal carbonyls.  
 b) i) What is Wilkinson's catalyst? Mention one of its application.  
 ii) Give an application of Ziegler-Natta catalyst. (3+3)
18. a) Describe the method of separation of lighter and heavier lanthanides from monazite.  
 b) What is lanthanide contraction? Give any one of its consequences. (3+3)

### Part C

Answer any two of the following questions.

[5 × 2 = 10]

19. On the basis of the following observations made in the aqueous solution of the complexes, write the formula and assign the secondary valency of the metal.

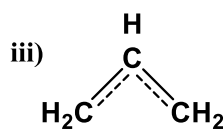
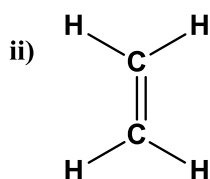
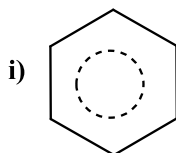
Serial number	Formula	Moles of AgCl precipitated per mole of compound on reacting with excess of $AgNO_3$
i)	$CoCl_3.4NH_3$	1
ii)	$NiCl_2.6H_2O$	2
iii)	$PtCl_2.2NH_3$	0

20. a) The polyhalide ion  $ICl_2^-$  is linear in shape. Justify your answer.  
 b) A compound of xenon is square planar and has two lone pairs of electron. What is the hybridization of xenon?

21. a) Among the following ions, identify the ion which gets eluted first in the cation exchange method. Give reason.

$\text{Yb}^{3+}$ ,  $\text{Lu}^{3+}$ ,  $\text{Dy}^{3+}$ ,  $\text{Er}^{3+}$

b) Identify the hapticity of the following ligands.



(2+3)

-----End of the question paper -----

1	<b>H</b> Hydrogen 1.008	2	<b>He</b> Helium 4.003
3	<b>Li</b> Lithium 6.941	4	<b>Be</b> Beryllium 9.012
5	<b>B</b> Boron 10.811	6	<b>C</b> Carbon 12.011
7	<b>N</b> Nitrogen 14.007	8	<b>O</b> Oxygen 15.999
9	<b>F</b> Fluorine 18.998	10	<b>Ne</b> Neon 20.180
11	<b>Na</b> Sodium 22.990	12	<b>Mg</b> Magnesium 24.305
13	<b>Al</b> Aluminum 26.982	14	<b>Si</b> Silicon 28.086
15	<b>P</b> Phosphorus 30.974	16	<b>S</b> Sulfur 32.066
17	<b>Cl</b> Chlorine 35.453	18	<b>Ar</b> Argon 39.948
19	<b>K</b> Potassium 39.098	20	<b>Ca</b> Calcium 40.078
21	<b>Sc</b> Scandium 44.956	22	<b>Ti</b> Titanium 47.867
23	<b>V</b> Vanadium 50.942	24	<b>Cr</b> Chromium 51.996
25	<b>Mn</b> Manganese 54.938	26	<b>Fe</b> Iron 55.845
27	<b>Co</b> Cobalt 58.933	28	<b>Ni</b> Nickel 58.693
29	<b>Cu</b> Copper 63.546	30	<b>Zn</b> Zinc 65.38
31	<b>Ga</b> Gallium 69.723	32	<b>Ge</b> Germanium 72.631
33	<b>As</b> Arsenic 74.922	34	<b>Se</b> Selenium 78.972
35	<b>Br</b> Bromine 79.904	36	<b>Kr</b> Krypton 83.798
37	<b>Rb</b> Rubidium 85.468	38	<b>Sr</b> Strontium 87.62
39	<b>Y</b> Yttrium 88.906	40	<b>Zr</b> Zirconium 91.224
41	<b>Nb</b> Niobium 92.906	42	<b>Mo</b> Molybdenum 95.95
43	<b>Tc</b> Technetium 98.907	44	<b>Ru</b> Ruthenium 101.07
45	<b>Rh</b> Rhodium 102.906	46	<b>Pd</b> Palladium 106.42
47	<b>Ag</b> Silver 107.868	48	<b>Cd</b> Cadmium 112.411
49	<b>In</b> Indium 114.818	50	<b>Sn</b> Tin 118.711
51	<b>Sb</b> Antimony 121.760	52	<b>Te</b> Tellurium 127.6
53	<b>I</b> Iodine 126.904	54	<b>Xe</b> Xenon 131.294
55	<b>Cs</b> Cesium 132.905	56	<b>Ba</b> Barium 137.328
57-71		72	<b>Hf</b> Hafnium 178.49
73	<b>Ta</b> Tantalum 180.948	74	<b>W</b> Tungsten 183.84
75	<b>Re</b> Rhenium 186.207	76	<b>Os</b> Osmium 190.23
77	<b>Ir</b> Iridium 192.217	78	<b>Pt</b> Platinum 195.085
79	<b>Au</b> Gold 196.967	80	<b>Hg</b> Mercury 200.592
81	<b>Tl</b> Thallium 204.383	82	<b>Pb</b> Lead 207.2
83	<b>Bi</b> Bismuth 208.980	84	<b>Po</b> Polonium [208.982]
85	<b>At</b> Astatine 209.987	86	<b>Rn</b> Radon 222.018
87	<b>Fr</b> Francium 223.020	88	<b>Ra</b> Radium 226.025
89	<b>Ac</b> Actinium 227.028	90	<b>Th</b> Thorium 232.038
91	<b>Pa</b> Protactinium 231.036	92	<b>U</b> Uranium 238.029
93	<b>Np</b> Neptunium 237.048	94	<b>Pu</b> Plutonium 244.064
95	<b>Am</b> Americium 243.061	96	<b>Cm</b> Curium 247.070
97	<b>Bk</b> Berkelium 247.070	98	<b>Cf</b> Californium 251.080
99	<b>Es</b> Einsteinium [254]	100	<b>Fm</b> Fermium 257.095
101	<b>Md</b> Mendelevium 258.1	102	<b>No</b> Nobelium 259.101
103	<b>Lr</b> Lawrencium [262]	104	
105		106	
107		108	
109	<b>Mt</b> Meitnerium [278]	110	<b>Ds</b> Darmstadtium [281]
111	<b>Rg</b> Roentgenium [280]	112	<b>Cn</b> Copernicium [285]
113	<b>Nh</b> Nihonium [286]	114	<b>Fl</b> Flerovium [289]
115	<b>Mc</b> Moscovium [289]	116	<b>Lv</b> Livermorium [293]
117	<b>Ts</b> Tennessine [294]	118	<b>Og</b> Oganesson [294]

Atomic Number	Symbol
Name	
Atomic Mass	

57	<b>La</b> Lanthanum 138.905	58	<b>Ce</b> Cerium 140.116	59	<b>Pr</b> Praseodymium 140.908	60	<b>Nd</b> Neodymium 144.242	61	<b>Pm</b> Promethium 144.913	62	<b>Sm</b> Samarium 150.36	63	<b>Eu</b> Europium 151.964	64	<b>Gd</b> Gadolinium 157.25	65	<b>Tb</b> Terbium 158.925	66	<b>Dy</b> Dysprosium 162.500	67	<b>Ho</b> Holmium 164.930	68	<b>Er</b> Erbium 167.259	69	<b>Tm</b> Thulium 168.934	70	<b>Yb</b> Ytterbium 173.055	71	<b>Lu</b> Lutetium 174.967
89	<b>Ac</b> Actinium 227.028	90	<b>Th</b> Thorium 232.038	91	<b>Pa</b> Protactinium 231.036	92	<b>U</b> Uranium 238.029	93	<b>Np</b> Neptunium 237.048	94	<b>Pu</b> Plutonium 244.064	95	<b>Am</b> Americium 243.061	96	<b>Cm</b> Curium 247.070	97	<b>Bk</b> Berkelium 247.070	98	<b>Cf</b> Californium 251.080	99	<b>Es</b> Einsteinium [254]	100	<b>Fm</b> Fermium 257.095	101	<b>Md</b> Mendelevium 258.1	102	<b>No</b> Nobelium 259.101	103	<b>Lr</b> Lawrencium [262]

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Semimetal
- Nonmetal
- Halogen
- Noble Gas
- Lanthanide
- Actinide