



ST JOSEPH'S UNIVERSITY, BENGALURU - 27
B.Sc. (CHEMISTRY) – III SEMESTER
SEMESTER EXAMINATION: OCTOBER 2023
 (Examination conducted in November/December 2023)
CH 323 – CHEMISTRY III

(For current batch students only)

Time: 2 Hours

Max Marks: 60

This paper contains FOUR printed pages and THREE parts.

NOTE: The periodic table is attached along with this question paper.

PART-A

Answer any SEVEN of the following questions.

[7 x 2 = 14]

1. Draw the Lewis structures of NH_4^+ and NO^+ ions.
2. Write the shape and geometry of ClF_3 using VSEPR theory.
3. Based on band theory distinguish between a conductor and an insulator.
4. List any two advantages of liquid ammonia as a solvent.
5. Mention any two limitations of the first law of thermodynamics.
6. At absolute zero, the entropy of carbon monoxide is not zero. Justify.
7. Identify the extensive properties from the following:
 (i) heat capacity (ii) specific heat (iii) temperature (iv) internal energy
8. What is temperature coefficient of a reaction? Write its expression.
9. Give an example each for catalytic poisons and promoters.

PART-B

Answer any SIX of the following questions.

[6 x 6 = 36]

10. Set up the Born-Haber cycle for the formation of $\text{MgF}_{2(s)}$. Calculate the lattice energy using the following data.
 ΔH sublimation of Mg = 148 kJ mol^{-1} ; ΔH dissociation of F_2 = 159 kJ mol^{-1} ;
 ΔH ionization of Mg (IE_1) = 738 kJ mol^{-1} ; ΔH ionization of Mg^+ (IE_2) = 1450 kJ mol^{-1} ;
 ΔH electron affinity of $\text{F}_{(g)}$ = -328 kJ mol^{-1} ; ΔH_f of $\text{MgF}_{2(s)}$ = $-1123 \text{ kJ mol}^{-1}$
11. Draw the MO energy level diagrams of CO and C_2 molecules. Calculate the bond orders of these molecules.

12. a) Explain the structure of CO_2 using the concept of hybridization.
 b) A strong acid like HNO_3 behaves as a base in hydrogen fluoride. Explain. (3 + 3)
13. a) Thiocyanate (SCN^-) is an ambidentate ligand, it coordinates to Pt^{2+} through S whereas it coordinates through N atom with Cr^{3+} . Give reason.
 b) Give the acid base reaction and autoionization reaction in liquid SO_2 . (3 + 3)
14. a) The hard-hard interactions are generally ionic, while soft-soft interactions are generally covalent. Why?
 b) Explain homogeneous and heterogeneous catalysis, by taking suitable example for each. (3 + 3)
15. What is a Carnot engine? Derive an expression for efficiency in terms of temperature using the concept of entropy.
16. a) Derive an expression for the variation of Gibbs energy with the temperature at constant pressure.
 b) Calculate the free energy change when 1 mole of an ideal gas expands isothermally at 313 K from an initial volume of 10 m^3 to final volume 100 m^3 . (3 + 3)
17. Discuss Lindemann theory of unimolecular reactions and obtain an expression for the reaction rate at high and low pressures.

Part C

Answer any TWO of the following questions.

[2 x 5 = 10]

18. a) Which of the following species has a longer bond? Why?
 (i) B_2 (ii) B_2^+
 b) Pick up the species which are paramagnetic among the following. Give reason.
 (i) C_2^- (ii) N_2^{3-} (iv) O_2^{2-} (2 + 3)
19. a) Which of the following reaction(s) are **not** Lewis acid base reactions? Give reason.
 (i) $\text{BF}_3 + \text{NH}_3 \rightarrow \text{BF}_3 \cdot \text{NH}_3$
 (ii) $\text{Ni}^{2+}_{(\text{aq})} + 6 \text{NH}_3 \rightarrow [\text{Ni}(\text{NH}_3)_6]^{2+}$
 (iii) $\text{HPO}_4^{2-} + \text{H}_2\text{O} \rightarrow \text{H}_2\text{PO}_4^- + \text{OH}^-$
 b) The $t_{1/2}$ of a reaction is doubled as the initial concentration of the reactant is doubled. What is the order of the reaction? (2 + 3)

20. a) From the conditions given below determine whether there is work done by the system, work done on the system, or no work done.

- (i) A balloon expands as a small piece of dry ice (solid CO_2) inside the balloon sublimates (balloon = system).
- (ii) Methane expands freely in vacuum (methane = system).
- (iii) A balloon filled with gaseous helium is compressed in the compressor of an air conditioner to liquefy it. (helium = system).

b) Adsorption of a gas on the surface of solid is generally accompanied by decrease in entropy, still it is a spontaneous process. Explain. (3 + 2)

PERIODIC TABLE OF THE ELEMENTS

1 IA		2 IIA		IUPAC recommendations → Chemical Abstracts Service group notation →										18 VIII A													
Atomic number →	Symbol →	Name (IUPAC) →	Atomic mass →	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII B	9 VIII B	10 VIII B	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIII A								
1	H	Hydrogen	1.0079	21	22	23	24	25	26	27	28	29	30	5	6	7	8	9	10	11	12	13	14	15	16	17	18
3	Li	Lithium	6.941	39	40	41	42	43	44	45	46	47	48	13	14	15	16	17	18	19	20	31	32	33	34	35	36
11	Na	Sodium	22.990	39	40	41	42	43	44	45	46	47	48	13	14	15	16	17	18	19	20	31	32	33	34	35	36
19	K	Potassium	39.098	39	40	41	42	43	44	45	46	47	48	31	32	33	34	35	36	37	38	69	70	71	72	73	74
37	Rb	Rubidium	85.468	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	81	82	83	84	85	86
55	Cs	Caesium	132.91	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	81	82	83	84	85	86
87	Fr	Francium	(223)	89	90	91	92	93	94	95	96	97	98	109	110	111	112	113	114	115	116	151	152	153	154	155	156
				*Lanthanide Series																							
				# Actinide Series																							