Registration Number:

Date & Session:



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

Time: 2 Hours

(For current batch students only)

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 CIF_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.

- 10. Set up the Born-Haber cycle for the formation of $MgF_{2(s)}$. Calculate the lattice energy using the following data.
 - Δ H sublimation of Mg = 148 kJ mol⁻¹; Δ H dissociation of F₂ = 159 kJ mol⁻¹;
 - Δ H ionization of Mg (IE₁) = 738 kJ mol⁻¹; Δ H ionization of Mg⁺ (IE₂) = 1450 kJ mol⁻¹;
 - Δ H electron affinity of $F_{(g)} = -328 \text{ kJ mol}^{-1}$; Δ H_f of MgF_{2(s)} = -1123 kJ mol}^{-1}
- 11. Draw the MO energy level diagrams of CO and C₂ molecules. Calculate the bond orders of these molecules.

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 $[6 \times 6 = 36]$

- 12. a) Explain the structure of CO₂ using the concept of hybridization.
 - b) A strong acid like HNO_3 behaves as a base in hydrogen fluoride. Explain. (3 + 3)
- a) Thiocyanate (SCN⁻) is an ambidentate ligand, it coordinates to Pt²⁺ through S whereas it coordinates through N atom with Cr³⁺. 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 m³ to final volume 100 m³. (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) $BF_3 + NH_3 \rightarrow BF_3.NH_3$
 - (ii) $Ni^{2+}_{(aq)} + 6 NH_3 \rightarrow [Ni(NH_3)_6]^{2+}$
 - (iii) $HPO_4^2 + H_2O \rightarrow H_2PO_4 + OH$

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)

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- 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.
 - A balloon expands as a small piece of dry ice (solid CO₂) inside the balloon sublimes (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)

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PERIODIC TABLE OF THE ELEMENTS

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