

- (a) List the name of colligative properties of dilute solutions. Why are these called colligative properties? 2.0
- (b) 18.2 g of urea is dissolved in 100 g of water at 50 °C. The lowering of vapour pressure produced is 5 mm Hg. Calculate the molecular mass of urea. The vapour pressure of water at 50 °C is 92 mm Hg. 2.5
- (c) Define exothermic and endothermic reactions. Draw enthalpy diagrams for exothermic and endothermic reactions. 2.5
- (d) State and illustrate the Hess's law with suitable example. 3.0
- (e) The combustion enthalpy of CH₄(g) is -890 KJ mol⁻¹ and formation enthalpies of CO₂(g) and H₂O(l) are -406.1 KJ mol⁻¹ and -285.85 KJ mol⁻¹, respectively. Calculate the formation enthalpy of CH₄(g). 2.0
7. (a) A 5.0 L vessel contained 0.0185 mole of phosphorous trichloride, 0.0158 mole of phosphorous pentachloride and 0.0870 mole of chlorine at 230°C in an equilibrium mixture. Calculate the value of K_c and K_p for the reaction: 2.5
- $$\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$$
- (b) Explain with the help of *Le Chatelier's principle*, the effect of temperature and pressure on the reaction: 3.0
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}); \Delta H = -192.5 \text{ KJ/mol} \quad \text{Exothermic}$$
- (c) A catalyst cannot change the equilibrium position, explain the statement with suitable diagram. 1.5
- (d) Derive the integrated rate equations of any second order reaction. 3.0
- (e) Half-life of a certain first order reaction is 100 seconds. How long will it take for the reaction to be completed 75%? 2.0
8. (a) Differentiate between electrolytic and electrochemical cells with appropriate example. 4.0
- (b) What is the function of a salt-bridge? What kind of electrolyte should be used in a salt-bridge? 4.0
- (c) A cell expresses as follows: $\text{Sn}/\text{Sn}^{2+} (0.1\text{M}) \parallel \text{Fe}^{3+} (0.03\text{M})/\text{Fe}$ 4.0
- (i) Write down the half-cell reactions
- (ii) Calculate the *e.m.f.* of the reaction [Where, $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ V}$ and $E^\circ_{\text{Fe}^{3+}/\text{Fe}} = -0.04 \text{ V}$]

Good Luck!!!

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
UNIVERSITY OF BARISHAL

1st Year 1st Semester B.Sc. (Hons.) Final Examination-2025

Session: 2024-25 (Admission Session: 2024-25)

Course Code: **CHEM-1107**

Course Title: **CHEMISTRY**

Time: 3:00 hours

Full marks: 60

Answer any five (5) questions from. Part of each question should be answered consecutively.

1. (a) Calculate the number of protons, neutrons, and electrons of the following atoms or ions: 2.0
 (i) $^{23}_{11}\text{Na}^+$ (ii) $^{32}_{16}\text{S}$ (iii) $^{35}_{17}\text{Cl}^-$ (iv) $^{56}_{26}\text{Fe}^{3+}$
 (b) Define quantum numbers. Briefly discuss the types of quantum numbers. 5.0
 (c) Find the minimum wavelength of spectral lines of Paschen series in Hydrogen atom. Given 2.5
 that, Rydberg constant is 109679 cm^{-1} . λ_{min}
 (d) Write a short note "Heisenberg uncertainty principle". 2.5

$$\frac{\Delta x \Delta p}{h} \geq \frac{1}{4} \left(\frac{1}{n_1} - \frac{1}{n_2} \right)$$

$$\frac{\Delta x \Delta p}{h} \geq \frac{1}{4} \left(\frac{1}{n_1} - \frac{1}{n_2} \right) \approx 8.2 \times 10^{-8} \text{ nm}$$
2. (a) Zinc is a *d* block element, but not a transition metal- explain why? 2.5
 (b) Draw the shape of five *d* orbitals. 2.0
 (c) The ion Na^+ occurs in chemical compounds, but the ions Na^{2+} does not. Explain why? 2.0
 (d) Arrange with explanation the order of following elements according to their electron 2.5
 affinity: Br, F, Cl and I. $\text{Cl} > \text{F} > \text{Br} > \text{I}$
 (e) Write down the electronic configuration and predict the position (group no. and period 3.0
 no.) in periodic table of following elements: P, Sc, and Fe.
3. (a) Discuss the types of chemical bonds. Indicate different types of bonds, which are present 4.0
 in NH_4Cl compound.
 (b) Explain the hybridization of carbon in ethane, ethene, and ethyne. 4.5
 (c) Use VSEPR theory, predict the geometry of the following molecule: H_2O , ClF_3 , and PCl_5 . 1.5
 (d) Briefly discuss the metallic bond. 2.0
4. (a) Define ionization energy. Explain - why the 1st ionization energy tends to increase as one 4.0
 proceeds from left to right across a period in periodic table.
 (b) Briefly explain, which of the following species is larger? 3.0
 (i) F^- and O^{2-} and (ii) Fe^{2+} and Fe^{3+} .
 (c) Determine the position of *Si* (14) and *Ar* (18) element in periodic table according to their 2.0
 electronic configuration.
 (d) Differentiate between electronegativity and electron affinity. 3.0
5. (a) 4.5 g of NaCl is dissolved in 1000 g of water. If the density of the resulting solution is 4.0
 0.997 g mL^{-1} , calculate the molality, molarity, and normality of the solution and mole
 fraction of the solute.
 (b) Determine the number of phases, components and number of degrees of freedom for the 3.0
 following systems:
 (i) mixture of O_2 and N_2 .
 (ii) mixture of monoclinic and rhombic Sulphur.
 (c) Briefly discuss the typical phase diagram of water with suitable figure. 5.0