**D 131444** **(Pages : 2)** **Name.....**

**Reg. No.....**

**THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION**
**NOVEMBER 2025**

Chemistry, Industrial Chemistry, Polymer Chemistry

CHE 3B 03—PHYSICAL CHEMISTRY I

(2020—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

**Section A (Short Answer)**

*Answer questions upto* 20 *marks.*
*Each question carries* 2 *marks.*

1. Define collision frequency.
2. Define Boyle temperature. Give an expression for Boyle temperature in terms of van der Waals constant.
3. What is the mean free path of hydrogen gas at 25°C and a pressure of 1 atm. Given $d$ = 2.86 Å, collision cross section of the molecules, $\sigma = \pi d^2$, 1 atm = $1.01325 \times 10^5$ N/m$^2$, $k$, Boltzmann constant = $1.3806 \times 10^{-23}$ J/K.
4. Differentiate inversion temperature from critical temperature.
5. What is compressibility factor, Z and how it relates to ideal and non-ideal behaviour of a gas and molecular interactions. What is meant by virial equation of state ?
6. Write the Gibb's Duhem equation for a mixture containing three components.
7. Write the equation connecting Kp and Kc. How free energy of a reaction relates to the equilibrium constant.
8. What is meant by reaction quotient ? Explain its relation with equilibrium constant.
9. What is Stirling's approximation ?
10. Account for the correction to pressure in Vander Waals equation.
11. What are the different symmetry elements and Shoenflies notation ?
12. Why work done in an isothermal reversible expansion is maximum ?

(Ceiling of marks : 20)

**Turn over**

**Section B (Paragraph)**

*Answer questions up to* 30 *marks.*
*Each question carries* 5 *marks.*

13. What is meant by "continuity of state" and "critical constants" ?

14. Derive an expression for entropy change in an isothermal expansion of an ideal gas.

15. Describe Carnot's cycle and deduce the expression for the efficiency of heat engine.

16. A certain volume of dry air at NTP is expanded reversibly to three times its volume adiabatically. Calculate the final pressure and temperature in each case assuming ideal behaviour. ($C_p/C_v$ for air is 1.4).

17. Describe temperature dependence of Gibb's free energy.

18. What is meant by partial molar properties ? Explain chemical potential.

19. What is point group ? Give one example each for molecules belonging to $C_{2v}$ and $C_{2h}$ point group.

[Ceiling of marks : 30]

**Section C (Essay)**

*Answer any* **one** *question.*
*Each question carries* 10 *marks.*

20. a) Derive the expressions for i) entropy change for an ideal gas with temperature, pressure and volume ; and ii) work done for an isothermal reversible expansion of ideal gas. b) Five moles of an ideal gas expand reversibly from a volume of 8 $dm^3$ to 80 $dm^3$ at a temperature of 27°C. Calculate the change in entropy and work done during the process.

21. State Le-Chatlier principle. Using the principle explain Haber process for the large scale production of ammonia.

(1 × 10 = 10 marks)