2023

Time - 3 hours

Full Marks - 60

Answer **all groups** as per instructions.

Figures in the right hand margin indicate marks.

GROUP – A

1. Fill in the blanks. (all)   [1 × 8

   (a) Entropy of a system measures _____ of the system.

   (b) In first order phase transition, _____ of the system remains constant.

   (c) Change in entropy in reversible cycle is _____.

   (d) For a process dW is the work done by a gas and dU is change in internal energy. If dU + dW = 0, then the process is _____.

   (e) Ratio of root mean square velocity and mean velocity of the molecules is _____.

   (f) The ratio of RMS velocity of oxygen molecules at 27 degree celsius and 127 degree celsius is _____.

   (g) For a gas, the critical temperature is 40 K, then the temperature of inversion is _____.

   (h) Adiabatic demagnetization results in _____ effect.

GROUP – B

2. Answer <u>any eight</u> of the following questions within two to three sentences each. [1½ × 8

(a) How mean free path varies with the diameter of a molecule ?

(b) Give two examples of extensive parameters.

(c) Write effect of pressure on melting of ice.

(d) State the third law of thermodynamics.

(e) Calculate the change in entropy when 10 gram of ice at 0 degree celsius is converted into water at same temperature. Given the latent heat of fusion of ice is 80 cal/gram.

(f) Define temperature of inversion.

(g) Write degrees of freedom of diatomic molecules at medium temperature.

(h) Determine C_P of monoatomic gas.

(i) Define critical pressure.

(j) What is throttling process ?

GROUP – C

3. Answer <u>any eight</u> of the following questions within 75 words each. [2 × 8

(a) Derive (dT/dP) for ideal gas.

(b) Explain Clausius inequality.

(c) Explain second order phase transition. Give an example.

(d) What is the principle of increase of entropy ?

(e) Write the first TdS equation.

(f) What is magnetic work ?

(g) Write the drawbacks of Van der Waal's equation.

(h) Find the temperature of oxygen molecule at which its RMS speed will be double that of the hydrogen molecule at 227 degree celsius.

(i) Give physical significance of Gibb's function.

(j) Write the limitations of the first law of thermodynamics.

GROUP – D

Answer all questions within 500 words each.

4. State and prove Carnot's theorem. [6

OR

Show the equivalence of Kelvin-Planck's and Clausius statement of the second law of thermodynamics.

5. Derive $C_P - C_V = R\left[1 + \dfrac{2a}{nRT}\right]$ for Van der Waal's gas using Maxwell's thermodynamic relations. [6

OR

Derive Ehrenfest's equations.

6. Write Maxwell-Boltzmann law for the distribution of molecular speed and derive expression for mean velocity from this. [6

OR

Derive expression for coefficient of viscosity of gas. Relate it with the mean free path.

7. Derive expression for the critical constants of the Van der Waal's equation. [6

OR

Derive expression for Joule-Thomson coefficient for real gas.