

B.Sc. S.Y. (CBCS Pattern) Semester-III  
**USPHT05 - Physics Paper-I : Thermal Physics**

P. Pages : 3

Time : Three Hours



**GUG/W/24/11616**

Max. Marks : 50

- Notes : 1. All questions are compulsory.  
2. Draw well labelled diagram wherever necessary.

**Either:**

1. A) i) Define Mean Free Path and Obtain an expression for it. 3  
ii) Derive an expression of Maxwell's distribution law of velocities for gas molecules. 5  
iii) Calculate the mean free path of molecule the molecular diameter is  $2 \times 10^{-8}$  cm and 2  
the number of molecules per CC is  $3 \times 10^{19}$ .

**OR**

- B) a) What are transport phenomena in gases for energy, momentum and mass? 2½  
b) Find an expression for the coefficient of thermal conducting of the gas. 2½  
c) Discuss the effect of temperature on the viscosity of gas and thermal conductive of 2½  
gas.  
d) Find the coefficient of viscosity of nitrogen at N.T.P. if  $C = 454.4$  m/s, 2½  
 $\lambda = 9.44 \times 10^{-8}$  m and  $\rho = 1.25$  kg / m<sup>3</sup>.

**Either:**

2. A) i) State and explain zeroth law of Thermodynamics. 3  
ii) What is Isothermal process? Obtain an expression for the work done during an 4  
Isothermal process.  
iii) A certain mass of an ideal gas at 27°C and pressure of 8 atm is expanded suddenly to 3  
four times of its volume. Find the final pressure and final temperature ( $\gamma = 1.5$ ).

**OR**

- B) a) Explain intensive and extensive thermodynamic variables with examples. 2½  
b) State and explain first law of thermodynamics give its limitations. 2½  
c) Derive relation between  $C_p$  and  $C_v$ . 2½

- d) Calculate the work done when 1 gram molecule of an ideal gas expands isothermally at 27°C to double its original volume. 2½  
 (R = 8.3 J/deg mole and  $\log_{10} 2 = 0.3010$ ).

**Either:**

3. A) i) What is a Heat Engine? Explain 2  
 ii) Describe Carnot's cycle and deduce an expression for the efficiency of an ideal heat engine working between two temperatures  $T_1$  &  $T_2$ . 6  
 iii) A Carnot's engine is operated between two reservoirs at temperature 450K and 350K. If the engine receives 1000 calories of heat in each cycle, calculate the amount of heat rejected to the sink in each cycle. 2  
 (1 Cal = 4.2J)

**OR**

- B) a) Define entropy and give its physical significance. 2½  
 b) Show that external work done in the Carnot's cycle is equal to area of rectangle on the T-S diagram. 2½  
 c) Show that during reversible adiabatic process the entropy of the system remains constant. 2½  
 d) Prove that in a T-S diagram the slope of Isochoric curve is  $T/C_v$  and that of Isobaric curve is  $T/C_p$ . 2½

**Either:**

4. A) i) Derive Clausius – Clapeyron Latent Heat equation  $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$ . What is the effect of change of pressure on boiling point of a liquid and melting point of solid. 4  
 ii) Explain Helmholtz function (F). 2  
 iii) Describe the Joule-Thomson porous plug experiment with experimental diagram. 4

**OR**

- B) a) What do you understand by Thermodynamic potential? State the importance of these functions. 2½  
 b) Derive Maxwell's first Thermodynamic Relation  $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$  2½  
 c) Explain Gibb's function. 2½

- d) Calculate the change in temperature of boiling point of water when the pressure is increased by 1 atmosphere. 2½  
 Given Boiling point of water = 373K,  
 Specific volume of steam =  $1.671 \text{ m}^3 / \text{kg}$   
 Latent heat of steam =  $2.268 \times 10^6 \text{ J / kg}$

5. Solve **any ten** of the following.

- |   |   |
|---|---|
| a) State any two assumptions of kinetic theory of gases.                      | 1 |
| b) What is meant by Degree of Freedom for gas molecules?                      | 1 |
| c) What is the unit of viscosity ( $\eta$ )?                                  | 1 |
| d) Define thermal expansion.  | 1 |
| e) What is an adiabatic process?  | 1 |
| f) What is compressibility?   | 1 |
| g) Which is more effective way to increase the efficiency of Carnot's engine? | 1 |
| h) State the principle of increase in entropy.                                | 1 |
| i) State the third law of thermodynamics.                                     | 1 |
| j) What is latent heat?   | 1 |
| k) Define enthalpy function.  | 1 |
| l) State the first TdS equation.  | 1 |

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