B.Sc. S.Y. (CBCS Pattern) Semester - III

USPHT05 - Physics Paper-I : Thermal Physics

P. Pages : 3 **GUG/S/23/11616**

Time : Three Hours * 1 7 4 7 * Max. Marks : 50

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

Either:

1. a) i) State and explain the Maxwell's law of distribution of molecular velocities. **3**

ii) Define degree of freedom. Hence explain the degree of freedom for monoatomic, diatomic and polyatomic gas. **3**

iii) State and prove law of equipartition of energy. **2**

iv) At the absolute temperature 400 K, calculate the most probable speed of molecules of hydrogen gas. Given mass of hydrogen gas is 3.2×10^{-27} kg and $K = 1.38\times10^{-23}$ J / K. **2**

OR

b) a) Obtain an expression for mean free path of a gas molecule. **2½**

b) Explain transport phenomena in gases for Momentum, Energy and Mass. **2½**

c) State the equation for the coefficient of viscosity of a gas. What is the effect of pressure and temperature on it? **2½**

d) Calculate the coefficient of viscosity of oxygen at N.T.P. from the following data: **2½**
$\rho = 1.429\,\text{kg/m}^3$; $\bar{C} = 425\,\text{m/s}$ and
$\lambda = 9.95\times10^{-8}\,\text{m}$

Either:

2. a) i) Define Thermodynamic system and Thermodynamic equilibrium. **2**

ii) State the first law of thermodynamics. State its importance and limitations. **3**

iii) Obtain an expression for work done in isothermal process. **2**

iv) A certain mass of an ideal gas at 27ºC and at a pressure of 8 atm. is expanded suddenly to four times its volume. **3**
Find:
a) the final pressure
b) final temperature (γ = 1.5)

OR

b) a) Distinguish between extensive and intensive variables with examples. **2½**

b) Prove that $C_P - C_V = R$ using two specific heats. **2½**

c) For an adiabatic change of an ideal gas prove that PV^{γ} = constant where the symbols have their usual meaning. **2½**

d) Calculate the work done when a gram molecule of an ideal gas expands isothermally at 27ºC to double its original volume (Given – R = 8.3 J/deg.mol) **2½**

Either:

3. a) i) Define heat engine. **1**

ii) Explain the construction and working of Carnot's ideal heat engine. **7**

iii) How the efficiency of a Carnot's engine is increased effectively. **2**

OR

b) a) Explain the entropy – temperature diagram. **2½**

b) Distinguish between reversible and irreversible process. **2½**

c) Show that in any irreversible process entropy of the universe increases. **2½**

d) A Carnot's engine whose lower temperature heat – sink is at 27ºC has its efficiency 40%. What is the temperature of the heat source? **2½**

Either:

4. a) i) Derive the Thermodynamic relation **4**

a) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$

b) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

ii) Give the experimental set – up for Porus – Plug experiment and explain the experimental result. **6**

OR

b) a) Derive the first latent heat equation $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$. **2½**

b) Derive the second latent heat equation $C_2 - C_1 = \frac{dL}{dT} - \frac{L}{T}$. **2½**

c) Explain Gibb's function (G) and Helmholtz function (F). **2½**

d) Calculate the specific heat capacity of saturated steam at 100ºC. **2½**
[Given: For steam L = 539.3 cal/g. dL/dT = -0.64 cal/g.k and $C_1 = 1.01 cal/g.k$]

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

a) State any two assumptions of kinetic theory of gases. **1**

b) Define Thermal conductivity of gas. **1**

c) Define r.m.s. velocity. **1**

d) Define Isobaric and Isochoric process. **1**

e) What is internal energy of system. **1**

f) State Zeroth law of thermodynamics. **1**

g) State second law of thermodynamics. **1**

h) State Carnot's theorem. **1**

i) State third law of thermodynamics. **1**

j) Write the first T-ds equation. **1**

k) Define Latent heat. **1**

l) What is Joule – Thomson effect. **1**

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