

II Semester B.Sc. Examination, May/June 2010
(Semester Scheme)
PHYSICS – II
Properties of Matter, Heat and Thermodynamics

Time : 3 Hours

Max. Marks : 60

PART – A

Answer **any five** questions. **Each** question carries **six** marks. (5×6=30)

1. a) Define Young's modulus, rigidity modulus and Poisson's ratio. 3
 b) Obtain an expression for work done per unit volume in stretching a wire. 3
2. Derive Poiseuille's formula for the flow of viscous fluid through a horizontal capillary tube of length L and radius r. 6
3. a) Obtain an expression for pressure difference across a curved liquid surface. 4
 b) How does surfactants (surface active agent), temperature affect the surface tension ? 2
4. Obtain Vander Waals' equation of state. 6
5. a) Obtain an expression for the work done during isothermal expansion of an ideal gas. 3
 b) What are reversible and irreversible process ? Give one example each. 3
6. a) Obtain an expression for change in entropy for a perfect gas in terms of pressure and volume. 3
 b) What is a phase diagram ? Explain triple point. 3
7. a) Write a note on Helmholtz free energy. 2
 b) Obtain an expression for the variation of internal energy with volume at constant temperature for a i) perfect gas and for ii) a gas obeying Vander Waals equation. 4
8. a) Derive an expression for Joule-Kelvin coefficient for a perfect gas. 4
 b) What is adiabatic demagnetisation ? 2

PART - B

Answer **any four** questions. **Each** question carries **five** marks.

(4×5=20)

9. The end of cantilever produces a depression of 0.001 m under certain load. Calculate the depression for the same load for another cantilever of the same material, two times in length and 3 times in thickness.
10. A Venturimeter has a pipe diameter of 0.2 m and a throat diameter of 0.15 m. The levels of water column in the two limbs differ by 0.1 m. Calculate the amount of water discharged through the pipe in one hour. Density of water = 10^3 Kg/m^3 , $g = 9.8 \text{ m/s}^2$.
11. At what temperature will Oxygen molecules have the same rms velocity as that of Hydrogen molecules at 100°C ? Mass of Oxygen atom is 16 times that of Hydrogen atom.
12. A Carnot engine with cold body temperature 17°C has 50% efficiency. By how much should the temperature of its hot body be changed to increase the efficiency to 60%.
13. Calculate the increase in entropy of 1 gram of Oxygen gas when its temperature is raised from 0°C to 100°C at constant volume. C_v for Oxygen = $5.035 \times 4.2 \text{ JK}^{-1} \text{ mol}^{-1}$, gm molecular weight of Oxygen = 32 gm.
14. Using the values of $T_c = 5.30 \text{ K}$, $P_c = 2.28 \times 10^5 \text{ N/m}^2$. Calculate the Vander Waal's constant a, b for 1 gm mole of Helium gas, $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$.

PART - C

Answer **any five** questions. **Each** question carries **two** marks.

(5×2=10)

15. a) A hollow shaft is stronger than a solid shaft of same length, mass and material. Justify.
- b) Wings of an aeroplane are made tapering with the upper surface more convex than the lower one.
- c) Average energy per atom in a monatomic substance is kT and not $kT/2$. Why ?

- d) Motion of individual molecules of gas cannot be studied by applying laws of mechanics. Why ?
 - e) For an ideal gas an adiabatic expansion curve is always steeper than the isothermal curve in a p - v diagram for the same change in pressure and volume. Explain.
 - f) The efficiency of a Carnot's engine cannot be greater than or equal to 1. Explain.
 - g) Why Helmholtz function F and Gibbs function G are known as thermodynamic potential.
 - h) Is it possible to attain temperature less than zero degree Kelvin ? Justify your answer.
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