

SEMESTER EXAMINATION-2021
CLASS – III SUBJECT- PHYSICS
PAPER CODE: BPH-C301 THERMAL PHYSICS AND STATISTICAL
MECHANICS

Time: 3 hour

Max. Marks: 70

Min. Pass: 40%

Note: Question Paper is divided into two sections: **A and B**. Attempt both the sections as per given instructions.

SECTION-A (SHORT ANSWER TYPE QUESTIONS)

Instructions: Answer any five questions in about 150 words each. (5 X 6 = 30 Marks)
Each question carries six marks.

Question-1: What is quasi-static process? Derive an expression for the work done during an adiabatic process.

Question-2: State the first law of thermodynamics. Express it mathematically and explain its physical significance.

Question-3: One-gram molecule of a gas expands isothermally to four times of its volume. Calculate the change in its entropy in terms of the gas constant.

Question-4: From the first law of thermodynamics, prove that $C_p - C_v = R$

Question-5: Explain Joule-Thomson effect using the Maxwell's thermodynamic relation.

Question-6: Using Carnot's cycle derive Clausius- Clapeyron's latent heat equation

$$\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$$

Where T is the absolute temperature at which a body changes its state. L the latent heat and V_1 and V_2 the specific volumes in the first and second state respectively.

Question-7: What is the wavelength at which human body radiates maximum energy? Temperature of human body is 37°C. Wein's constant is $2.898 \times 10^{-3} \text{mk}$.

Question-8: Explain the characteristic of radiation in a hollow enclosure at constant temperature.

Question-9: Explain the variation of mean free path(λ) with temperature and pressure.

Question-10: The first excited state of hydrogen atom is 10.2 eV above its ground state. What temperature is needed to excite hydrogen atoms to the first excited level?

SECTION-B (LONG ANSWER TYPE QUESTIONS)

Instructions: Answer any FOUR questions in detail. Each (4 X 10 = 40 Marks) question carries 10 marks.

Question-11: State and prove Carnot's theorem. Show that the temperature below zero kelvin is not possible.

Question-12: Write short any two

- (i) Reversible and irreversible process
- (ii) Concept of energy density
- (iii) Blackbody radiation

Question-13: What is transport phenomena? Explain in brief the viscosity, conductivity and self-diffusion on the basis of kinetic theory of gases.

Question-14: Deduce Maxwell's four thermodynamics relations. Discuss the usefulness and importance of these relations

Question-15: Give Planck's theory of blackbody radiation. Show this reduces to Wien's formula for small wavelength and Rayleigh –Jeans law for large wavelength.

Question-16: What is Carnot's Engine? Explain Carnot's cycle and derive the expression for the efficiency of Carnot's engine.

Question-17: Distinguish between isothermal and adiabatic changes. Show that for an adiabatic change in a perfect gas
 $PV^\gamma = \text{constant}$.

Question-18: Discuss the salient features of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics. Give the comparative pictures of the three statistics.