

(4)

- (b) Derive van der Waals' equation of state for a real gas and discuss the main points of the difference between an ideal gas and a real gas.
- (c) Define 'Boyle temperature' and 'critical temperature'. Also, find the relation between them for a van der Waals' gas. [2+2+(2+4)]

CO4

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Ex/SC/PHY/UG/CORE/TH/06/2024

BACHELOR OF SCIENCE (HONOURS) EXAMINATION, 2024

(2nd Year, 1st Semester)

PHYSICS

PAPER : CORE 06

(Thermal Physics)

Time : Two Hours

Full Marks : 40

Group—A (CO1 & CO2)

Answer any two questions

Marks : 10×2=20

1. (a) Deduce an expression for the most probable velocity of the molecules of a gas. Also, deduce the mean and r.m.s. velocities in terms of the most probable velocity.
- (b) Define 'mean free path' and 'collision frequency'.
- (c) At what temperature, pressure remaining constant? Will the r.m.s. velocity of a gas be half its value at 0 °C.

[(2+4)+2+2]

CO1

2. (a) Find the distribution of free paths among the molecules and establish the survival equation. **CO1**

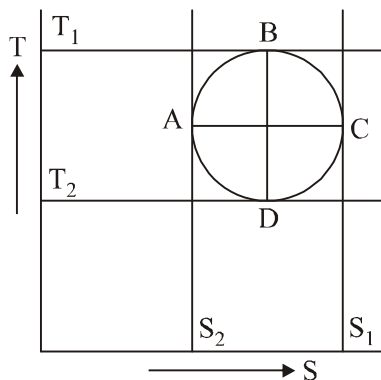
(2)

- (b) State and prove Carnot's theorem. What is its significance? When the sun shines on a glass-roofed greenhouse, the temperature inside becomes higher than outside. Does it violate the second law of thermodynamics?

[(3+2)+(3+2)]

CO2

3. (a) Calculate the efficiency of the cycle ABCDA, as depicted in the T-S diagram in terms of T_1 and T_2 , given $AC = BD$.



- (b) Define entropy. What is its physical significance? How is entropy related to unavailable energy?
- (c) An electric current of 10 amp is maintained for 1S in a resistor of 25 ohm, while its temperature is kept constant at 27 °C. Calculate the change in entropy of the resistor and the universe.

[3+(1+1+2)+3]

CO2

(3)

Group—B (CO3 & CO4)

Answer any two questions

Marks : 10×2=20

4. (a) Deduce Maxwell's four thermodynamic relations.
- (b) Prove the thermodynamic relation for the variation of C_p with pressure at a constant temperature. Hence, calculate the expression for the variations for both perfect gas and real gas.

[4+(2+1+3)]

CO3

5. (a) Prove thermodynamically,

$$\left[\frac{\partial}{\partial V} (C_V) \right]_T = T \left(\frac{\partial^2 p}{\partial T^2} \right)_V$$

Hence, show that C_V for perfect and van der Waals' gas is independent of volume at a constant temperature.

CO3

- (b) What is temperature of inversion? Define J-T coefficient. Find the relationship between 'inversion temperature', 'Boyle temperature' and 'critical temperature'.

[(2+1.5+1.5)+(1+1+3)]

CO4

6. (a) With proper diagram, discuss the results on the experimental study of isothermals of CO_2 by Andrews.