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3 SEM TDC PHYH (CBCS) C 6

2025

(Nov/Dec)

PHYSICS

(Core)

Paper : C-6

(Thermal Physics)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer : 1×5=5

(a) Maxwell-Boltzmann distribution law is applicable to

(i) ideal gas only

(ii) real gas only

(iii) both ideal gas and real gas

(iv) solids at low temperature

(2)

- (b) Which of the following represents the most probable speed v_p of gas molecules?

(i) $\sqrt{\frac{2kT}{m}}$

(ii) $\sqrt{\frac{3kT}{m}}$

(iii) $\sqrt{\frac{8kT}{m}}$

(iv) $\sqrt{\frac{kT}{m}}$

- (c) The transport phenomenon in gases does not include

(i) viscosity

(ii) thermal conductivity

(iii) diffusion

(iv) radiation pressure

- (d) The van der Waals' equation of state introduces correction for

(i) molecular attraction and molecular volume

(ii) temperature and pressure

(iii) entropy and enthalpy

(iv) adiabatic and isothermal process

- (e) Entropy of universe in any real process

(i) remains constant

(ii) decreases

(iii) increases

(iv) becomes zero

(3)

2. Answer any *five* of the following : $2 \times 5 = 10$

(a) State the zeroth law of thermodynamics.

(b) Write the expression for the most probable speed of gas molecules.

(c) Define mean free path.

(d) What is Joule-Thomson effect?

(e) Define Gibbs' free energy. Derive the condition for spontaneity of a process using Gibbs' free energy.

(f) Write the principle of increase of entropy.

3. (a) Write the expression for different thermodynamic potentials and state their natural variables. 3

(b) Show that Helmholtz free energy $F = U - TS$ is a minimum for a system in equilibrium at constant temperature and volume. 3

4. Derive Clausius inequality and explain the concept of entropy with examples. 5

5. (a) Derive the work done during an isothermal process for an ideal gas using the first law of thermodynamics. 3

- (b) Explain the concept of internal energy. How is it related to heat and work? 3

Or

- (c) Derive the expression for work done during an isobaric process.
6. (a) State and explain the second law of thermodynamics. (Kelvin-Planck and Clausius statement) 4
- (b) Explain with reason why the efficiency of heat engine is always less than that of a Carnot engine. 3
- (c) A Carnot engine operates between $T_1 = 600 \text{ K}$ and $T_2 = 300 \text{ K}$. Calculate its efficiency. 3
7. (a) Write three Maxwell's thermodynamic relations. Write their physical significances in brief. 3
- (b) Show that
- $$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$
- using appropriate thermodynamic potential. 3
- (c) Derive the relation between mean, RMS and most probable speed of gas molecules. 5

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