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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

(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

2. Answer any *five* of the following : 2×5=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 $T_1 = 600$ K and $T_2 = 300$ 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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