

Total No. of Printed Pages—4

3 SEM TDC PHYH (CBCS) C 6

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(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) If the temperature of the source of the Carnot engine is increased, then its efficiency

(i) increases

(ii) decreases

(iii) remains same

(iv) first increases then decreases

(2)

(b) The thermodynamic process in which there is no heat exchange between system and surroundings is

- (i) isothermal
- (ii) isobaric
- (iii) isochoric
- (iv) adiabatic

(c) If a liquid crystallises into solid, the entropy will

- (i) increase
- (ii) decrease
- (iii) remain same
- (iv) become zero

(d) The relationship between translational kinetic energy (E) of a gas and the temperature (T) is

- (i) $3E = 2NK_B T$
- (ii) $3E = 4NK_B T$
- (iii) $2E = 3NK_B T$
- (iv) $2E = NK_B T$

(e) The SI unit of thermal conductivity is

- (i) $\text{Wm}^{-1}\text{K}^{-1}$
- (ii) $\text{Wm}^{-2}\text{K}^{-1}$
- (iii) $\text{W}^{-1}\text{mK}^{-1}$
- (iv) WmK^{-1}

(3)

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

- (a) Write the expressions for compressibility and expansion coefficients.
- (b) Distinguish between reversible and irreversible processes.
- (c) "The entropy of the universe is always increasing." Justify the statement.
- (d) Calculate the most probable speed for oxygen molecules at 300 K. Given, mass of O_2 molecule is 5.31×10^{-26} kg and $K_B = 1.38 \times 10^{-23} \text{ JK}^{-1}$.
- (e) Find an expression for entropy in an isothermal-isochoric process in terms of Helmholtz free energy.
- (f) Obtain a relation between thermal conductivity and viscosity.

3. Establish a relation between C_p and C_v with the help of first law of thermodynamics. 5

Or

Discuss the concept of temperature in the light of zeroth law of thermodynamics.

4. State and prove the Carnot theorem. 5

5. Write the expression for work done in a Carnot cycle and hence, obtain an expression for efficiency of a Carnot engine. 3

6. Establish the Clausius inequality. 4

Or

Discuss how entropy changes in an irreversible process.

7. Deduce the first and second TdS equations, where the symbols have their usual meanings. 4

8. The van der Waal's constants of hydrogen are

$$a = 2.47 \times 10^{-2} \text{ Nm}^4 \text{ mol}^{-2}$$

$$\text{and } b = 26.5 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$$

Calculate the temperature of inversion. Given $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$. 4

9. Derive an expression for Boyle temperature on the basis of van der Waals' equation. 5

Or

Obtain the law of corresponding states using reduced variables. 5

10. Write short notes on any *two* of the following : 4×2=8

(a) Brownian motion

(b) Adiabatic demagnetization

(c) Thermodynamic scale of temperature
