

3 SEM TDC PHYH (CBCS) C 6

2021

(Held in January/February, 2022)

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 option : 1×5=5

(a) The zeroth law of thermodynamics introduces the concept of

- (i) heat (ii) temperature
(iii) entropy (iv) internal energy

(b) Which of the following is a correct expression for the first law of thermodynamics?

- (i) $dQ = dU + PdV$ (ii) $dU = dQ + PdV$
(iii) $dQ = dU - PdV$ (iv) None of the above

(c) Which of the following is the largest unit of heat?

- (i) Electron volt (ii) Joule
(iii) Calorie (iv) Erg

(d) Which of the following thermodynamic laws gives the concept of enthalpy?

- (i) First law of thermodynamics
(ii) Zeroth law of thermodynamics
(iii) Second law of thermodynamics
(iv) Third law of thermodynamics

(e) Mean free path of a gas

- (i) increases with increase in pressure
(ii) decreases with increase in pressure
(iii) is independent of pressure
(iv) has no linear relation with pressure

2. (a) State and explain the zeroth law of thermodynamics. 2

(b) Applying the first law of thermodynamics, obtain a relationship between the specific heats of an ideal gas. 4

(c) A Carnot's engine running between 1000 K and 500 K has the same efficiency as that running between x K and 1000 K (temperature of the sink in this case). Calculate x . 3

Or

Write down the working principle of heat engines. Obtain the coefficient of performance of a refrigerator.

3. (a) Deduce the following Maxwell's thermodynamical relations : 3×2=6

$$(i) \left(\frac{\partial T}{\partial P} \right)_S = \left(\frac{\partial V}{\partial S} \right)_P$$

$$(ii) \left(\frac{\partial T}{\partial V} \right)_S = - \left(\frac{\partial P}{\partial S} \right)_V$$

- (b) What are the conditions of reversibility of a thermodynamic process? State the second law of thermodynamics. 1+2=3
4. What is entropy? Show that entropy remains constant in reversible processes but increases in irreversible processes. 1+2+2=5
5. (a) What do you understand by first and second order phase transitions? Discuss with examples. 2+2=4
- (b) Write the equation for second order phase transition. 2

Or

Explain the third law of thermodynamics in brief.

6. (a) Write the expression for Maxwell's velocity distribution function and from it, determine the most probable speeds. 1+3=4
- (b) Using the law of equipartition of energy, show that the specific heat per mole is $C_v = \frac{5}{2}R$. 2
7. On the basis of kinetic theory of gases, deduce an expression for the viscosity of a gas in terms of mean free path of its molecules. Show that it is independent of pressure and depends upon the temperature of the gas. 4
8. (a) Derive the van der Waals equation of state. Calculate the critical constant of a gas in terms of the van der Waals equation. 5
- (b) Discuss about Joule-Thomson effect of real and van der Waals gases. Distinguish between Boyle's temperature and temperature of inversion. 2+2=4
