3 SEM TDC PHYH (CBCS) C 6

2 0 2 0

(Held in April–May, 2021)

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 and write the correct answer : 1×7=7

   (a) When a gas in a vessel expands, its internal energy decreases. The process involved is

   (i) isothermal

   (ii) isobaric

   (iii) adiabatic

   (iv) isochoric

(*Turn Over*)

(2)

(b) The efficiency of a Carnot engine working between 800 K and 500 K is

   (i) 0·4

   (ii) 0·63

   (iii) 0·38

   (iv) 0·5

(c) In case of a reversible cycle process change in entropy

   (i) is $dS = 0$

   (ii) is $dS > 0$

   (iii) is $dS < 0$

   (iv) may be either $dS > 0$ or $dS < 0$ depending on initial condition

(d) Which of the following phenomena gives evidence of the molecular structure of matter?

   (i) Brownian motion

   (ii) Diffusion

   (iii) Evaporation

   (iv) All of the above

(*Continued*)

(3)

(e) For a gas obeying the Maxwell-Boltzmann distribution law of molecular speeds, the average speed is given by

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

    (ii) $\sqrt{\dfrac{8kT}{\pi m}}$

    (iii) $\sqrt{\dfrac{3kT}{m}}$

    (iv) $\sqrt{\dfrac{m}{3kT}}$

(f) Internal energy of a real gas depends upon

    (i)   both temperature and volume

    (ii)   temperature only

    (iii)   volume only

    (iv)   pressure

(g) The constant a in van der Waals' equation arises due to the

    (i)   attractive forces between the gas molecules

    (ii)   repulsive forces between the gas molecules

    (iii)   finite volume of the gas

    (iv)   None of the above

(4)

2. (a) State and explain the first law of thermodynamics.   1+2=3

   (b) Explain why the temperature of a gas drops in adiabatic expansion.   2

   (c) Define extensive and intensive thermodynamic variables.   2

3. (a) Calculate the change in entropy when 5 kg of water at 100 °C is converted into steam at the same temperature. Given latent heat of steam = 540 cal/g.   3

   (b) State Clausius theorem.   2

4. (a) Describe Carnot's reversible heat engine and calculate its efficiency.   2+3=5

   (b) Write short notes on any *two* of the following :   3×2=6

    (i)   Second law of thermodynamics

    (ii)   Brownian motion

    (iii)   Internal energy

   (c) Deduce the following Maxwell's thermo-dynamical equation :   2+2=4

    (i) $\left(\dfrac{\partial S}{\partial V}\right)_T = \left(\dfrac{\partial P}{\partial T}\right)_V$

    (ii) $\left(\dfrac{\partial S}{\partial P}\right)_T = \left(\dfrac{\partial V}{\partial T}\right)_P$

(d) What is the law of equipartition of energy? Based on this law, show that for a diatomic molecule, the specific heat $C_v = \frac{5}{2}R$ per mole. 2+2=4

5. Show that Clausius-Claperyron equation represents equilibrium between phases. 3

6. What is mean free path of the molecules of a gas? Why is C_p greater than C_v? 1+2=3

7. (a) Discuss about Andrew's experiment on CO_2 gas. 4

(b) What is porous plug experiment? Discuss about Joule-Thompson effect for real and van der Waals' gases. 1+2+2=5

★ ★ ★