SE – 154

II Semester B.Sc. Examination, September 2020
(CBCS 14-15 and Onwards/Prior to 2016-17)
PHYSICS – II (Repeaters)
Thermal Physics and Statistical Mechanics

Time : 3 Hours Max. Marks : 70

Instruction : ***Use*** *of Non-programmable, scientific calculator is* ***permitted.***

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Write the basic assumptions of Kinetic theory of gases.

   b) Deduce Boyle's law from $PV = \frac{1}{3} Mc^2$. **(6+2)**

2. a) Derive the relation for the coefficient of viscosity of a gas on the basis of Kinetic Theory of gases.

   b) Derive the relation between the coefficient of viscosity and coefficient of thermal conductivity of a gas. **(6+2)**

3. a) State and explain zeroth law of thermodynamics.

   b) Derive an expression for work done during isothermal process. **(4+4)**

4. a) State and explain first law of thermodynamics.

   b) Using first law of thermodynamics explain :

      i) Isothermal process

      ii) Adiabatic process

      iii) Isochoric process. **(2+6)**

5. a) What are the basic postulates of statistical mechanics ?

   b) Distinguish between distinguishable and indistinguishable particles.

   c) Distinguish between microscopic and macroscopic states of a system. **(4+2+2)**

P.T.O.

6. Derive Clausius-Clapeyron's latent heat equation and discuss the effect of Pressure on boiling point of a liquid and melting point of a solid. **8**

7. a) What is Joule-Thomson effect ?

   b) Derive an expression for Joule-Thomson coefficient. **(2+6)**

8. a) Define Solar constant.

   b) Describe an experiment to determine the surface temperature of the sun. **(2+6)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. If the rms velocity of hydrogen molecule at NTP is 1.84 Kms^{-1}, calculate the rms velocity of oxygen molecule. Molecular weights of oxygen and hydrogen molecules are 32 and 2 respectively.

10. The mean free path of a gas molecule is 6×10^{-8} m and the diameter of the molecule is 5×10^{-10} m. Determine the number of molecules per unit volume of the gas.

11. A heat engine operating on a reversible cycle absorbs 42×10^{4} J of heat from the source, rejects 24.8×10^{4} J of heat to the sink and converts the difference into work. Calculate the efficiency of the engine.

12. The volume of the given mass of gas at NTP is compressed adiabatically to $\frac{1}{4}^{th}$ of its original volume. What is the new Pressure ? Given $\gamma = 1.4$.

13. The pressure of 5 g of water at 20°C is increased from 0 to 400 atmospheres reversibly and adiabatically. Calculate the change in temperature. Specific heat of water = 4200 J Kg^{-1} K^{-1}, coefficient of volume expansion is 15×10^{-6} K^{-1}, Cp = 4198 JKg^{-1} K^{-1} and 1 atmosphere = 10^{5} Nm^{-2}.

14. Using stirling's formula calculate the Percentage error finding $\log_e 6!$.

15. Calculate the inversion temperature of helium from the following data.

    $a = 3.41\times10^{-3}$ Nm^4 mol^{-2}, $b = 2.37\times10^{-5}$ m^3 mol^{-1} and $R = 8.3$ Jk^{-1} mol^{-1}.

16. Calculate the energy radiated in one minute by a black body of surface area 200×10^{-4} m^2 maintained at 227°C. Stefan's constant = 5.67×10^{-8} wm^{-2} k^{-4}.

PART – C

17. Answer **any five** of the following. **Each** question carries **two** marks. **(5×2=10)**

a) Does the Pressure increase when a gas is compressed isothermally ? Explain.

b) Is melting of ice an isothermal change ? Explain.

c) Can we increase the efficiency of Carnot's engine by decreasing source temperature ? Explain.

d) Does greater disorder correspond to higher entropy ? Explain.

e) Does enthalpy change during isobaric process ? Explain.

f) Does the latent heat of a substance change its temperature ? Explain.

g) Does the adiabatic demagnetization produce cooling ? Explain.

h) If the temperature of a black body is raised from 300 K to 600 K by what factor does the rate of emission incrase ?