MS – 266

II Semester B.Sc. Examination, May/June 2014
(NS) (2011-12 and Onwards)
PHYSICS – II
Thermal Physics and Statistical Mechanics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

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

1. Derive an expression for pressure due to an ideal gas enclosed in a cubical vessel on the basis of kinetic theory of gases.

2. a) Derive an expression for 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) What are isothermal and adiabatic processes ? Mention one example for each.
   b) Derive an expression for work done during an isothermal process. **(4+4)**

4. Explain the working of Carnot's ideal heat engine and derive an expression for its efficiency in terms of temperatures of source and sink. **8**

5. a) Write expressions for enthalpy and Gibb's potential.
   b) Write four Maxwell's thermodynamic equations and hence deduce an expression for difference in molar specific heats of a gas. **(2+6)**

6. a) What is first order phase transition ? What is triple point ?
   b) Derive Clausius – Clayperon equation. **(6+2)**

7. Derive an expression for Joule-Thomson coefficient. **8**

8. a) State and explain Kirchhoff's law of radiation.
   b) Deduce Wien's displacement law and Rayleigh – Jeans law from Planck's radiation formula. **(2+6)**

PART – B

Answer **any five** of the following questions. **Each** question carries **four** marks. **(5×4=20)**

9. The number of molecules (n) per m^3 of a gas is 2.76×10^{25} m^3 and mean free path is 2.2×10^{-10} m. Calculate diameter of the molecule of a gas.

10. Calculate Van der Waal's constants for a gas which has
    $T_c = 132$ K and $P_c = 38.31\times10^5$ Nm^{-2}
    $R = 8.31$ J mol^{-1} K^{-1}.

P.T.O.

11. Dry gas enclosed at 300 K is adiabatically compressed to one third of its original volume. Calculate final temperature of the gas. $\gamma = 1.4$.

12. Calculate the change in entropy when 0.03 kg. of ice at 0°C is converted into water at the same temperature.
Latent heat of fusion of ice = 3.36×10^5 Jkg^{-1}.

13. Calculate the change in boiling point of water when the pressure changes by 1.332×10^3 Nm^{-2} at 373 K.
Specific Volume of water = 10^{-3} m^3
Specific volume of steam = 1.674 m^3
Latent heat of steam = 22.68×10^5 Jkg^{-1}.

14. Calculate the probability that in tossing a coin 10 times, we get :
a) all heads
b) 5 heads, 5 tails.

15. Van der Waal's constants for hydrogen are
$a = 0.0247$ Nm^4 mol^{-2}, $b = 2.65 \times 10^{-5}$ m^3 mol^{-1}
Calculate the Joule-Thomson cooling for 2×10^5 fall in pressure, the initial temperature being 100 K.
$R = 8.31$ J mol^{-1} K^{-1}, $C_p = 28.7$ J mol^{-1} K^{-1}.

16. A body at 1500 K emits maximum energy of wavelength 2000 nm. If the sun emits maximum energy at wavelength 550 nm, what would be the surface temperature of the sun ?

PART – C

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

17. a) Does molecular motion cease at absolute zero temperature. Justify your answer.
b) Does coefficient of viscosity increase with increase in temperature. Explain.
c) Can the work done during reversible cyclic process be zero ? Explain.
d) Can room be cooled by leaving the door of an electric refrigerator open ? Justify your answer.
e) Helmholtz free energy is called thermodynamic potential at constant volume. Explain why ?
f) What is the significance of – ve slope of fusion line for water ?
g) Which quantities remain constant in isothermal and adiabatic changes ?
h) Why are clear nights colder than cloudy nights ?