SA – 625

II Semester B.Sc. Examination, April/May 2015
(Semester Scheme)
(CBCS – 14 – 15 and Onwards)
PHYSICS – II
Thermal Physics and Statistical Mechanics
(NS-70 Marks – 2011-12 and Onwards)

BHAGAWAN MAHAVEER JAIN COLLEGE
RGF - 563 122

Time : 3 Hours Max. Marks : 70

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

PART – A

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

1. a) Mention any two assumptions of kinetic theory of gases.
   b) Derive an expression for pressure due to an ideal gas enclosed in a cubical vessel on the basis of kinetic theory of gases. **(2+6)**

2. Describe Andrew's experiment on carbon dioxide and discuss the results. **8**

3. a) Distinguish between isothermal and adiabatic processes.
   b) Derive an expression for work done during an isothermal process. **(4+4)**

4. a) State and explain Zeroth law of thermodynamics.
   b) State and explain Carnot's theorem. **(4+4)**

5. a) Write a note on Gibb's free energy.
   b) Write four Maxwell's thermodynamic relations and hence deduce an expression for difference in molar specific heats for a perfect gas. **(2+6)**

6. Obtain the Clausius – Claypeyron latent heat equation. Discuss the elevation of boiling point with pressure. **8**

7. a) Define Joule-Thomson co-efficient and derive an expression for the same.
   b) Write any two difference between adiabatic expansion of a gas and Joule-Kelvin effect. **(6+2)**

8. What is a black body ? Explain black body radiation curves and its spectral energy distribution based on Stefan–Boltzmann law and Wien's displacement law. **8**

P.T.O.

PART – B

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

9. Calculate the mean free path of a gas molecule whose diameter is 4×10^{-10} m and the number of molecules per unit volume is 1.5×10^{25} m^{-3}.
10. Calculate the rms velocity of oxygen molecules at 27°C. Density of oxygen at NTP = 1.43 kg m^{-3}.
11. A definite mass of a perfect gas is compressed adiabatically to half its original volume. Determine the resultant pressure if the initial pressure was one atmosphere. (Given $\gamma = 1.4$).
12. A Carnot engine with the cold body temperature 17°C has 50% efficiency. By how much should the temperature of its hot body be changed to increase the efficiency to 60%.
13. Van der Waals constants for a gas are $a = 0.0245$ Nm^4 $mole^{-2}$; $b = 2.68 \times 10^{-5}$ m^3 $mole^{-1}$ and $R = 8.15$ Jk^{-1} $mole^{-1}$. Calculate the temperature of inversion and critical temperature.
14. Calculate the percentage error in using Stirling's formula $\log_e (n!) = n \log_e n - n$ where $n = 4$.
15. Calculate the change in temperature when helium gas suffers Joule-Thomson expansion at-173°C, the pressure difference on the two sides of the porous plug being 20 atmospheres. Does the gas show a heating effect or a cooling effect in this expansion, given $R = 8.3$ Jk^{-1} $mole^{-1}$ and for helium Van der Waals constants $a = 0.0341$ Nm^4, $b = 2.37 \times 10^{-5}$ m^3 $mole^{-1}$ and $C_p = 20.75$ Jk^{-1} $mole^{-1}$.
16. If the average energy radiated per unit area of the surface of the sun is 7.452×10^4 kW, estimate the surface temperature of the sun, assuming it to be a block body. Stefan's constant is 5.67×10^{-8} W m^{-2} k^{-4}.

PART – C

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

17. a) An ascending balloon filled with hydrogen bursts. Explain.
    b) Can a temperature of OK be attained ? Explain.
    c) Can two isothermals intersect ? Explain.
    d) Can the work done during a cyclic process be zero ? Explain.
    e) Can a Carnot's engine have an efficiency of 100% ? Explain.
    f) Can a room be coded by leaving the door of an electric refrigerator open ? What will happen ?
    g) Why are clear nights colder than cloudy nights ?
    h) What is meant by adiabatic demagnetisation ?
