LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

SECOND SEMESTER – **APRIL 2015**

PH 2505 - MECHNAICS & STATISTICAL PHYSICS

Date : 15/04/2015 Dept. No. Max. : 100 Marks

Time : 01:00-04:00

PART-A

Answer All Questions **(10x2=20 marks)**

1. What is a compound pendulum? Give the condition for its minimum time period of oscillation.
2. State Fick's law of diffusion in liquids. Write it in the form of differential equation.
3. Define generalized coordinates?
4. Define phase space.
5. Find the coefficient of viscosity of Nitrogen from the following data $\rho = 1.25$ kg/m^3, $\bar{C} = 454.4$ m/sec, $\lambda = 9.44 \times 10^{-8}$ m.
6. Define the coefficient of diffusion.
7. Show that $T.dS = C_P\, dT - T\left(\partial V/\partial T\right)_p\, dP$.
8. State the differences in the internal energy of ideal and real gases.
9. Calculate the thermodynamic probability for a macro state (2,2).
10. Mention any two limitations of Maxwell's Boltzmann statistics.

PART-B

Answer ANY FOUR Questions **(4X7.5=30 marks)**

11. Obtain the expression for the time period of oscillation of a bifilar pendulum with parallel threads.
12. Derive Hamilton's Canonical equation of motion.
13. Derive an expression for thermal conductivity of a gas on the basis of kinetic theory of gases and discuss the effect of temperature and pressure on it.
14. Explain in detail about the Clausius inequality with a neat diagram..
15. Derive the Gibb's-Helmholtz equation for E.M.F of a reversible cell.
16. Discuss briefly about entropy and probability and obtain Boltzmann's entropy relation.
17. Using Maxwell's distributive law of molecular speeds show that:

    i) $V_{r.m.s} = \sqrt{3KT/m}$ (4 marks)

    ii) $V_{m.p} = \sqrt{2KT/m}$ (3.5 marks)

PART–C

Answer ANY FOUR Questions : **(4x12.5 = 50marks)**

17. i) State and prove Bernoulli's theorem and mention any two of its applications. (7.5 marks)

ii) Water is flowing through a horizontal Venturimeter, with a bore of 360 mm at the entrance and of 120 mm at the throat. If the pressure differences across the two be equivalent to 450 mm head of water.
Calculate the mass flow of water through the meter. (5 marks)

19. i) Derive Lagrange's equation using D'Alembert's principle. (7.5 marks)

ii) Discuss the application of Lagrange's equation to Atwoods machine. (5 marks)

20. i) Derive Maxwell's equation for mean free path on the basis of kinetic theory of gases and explain the variation of it with temperature and pressure. (7.5 marks)

ii) The diameter of the molecule of a gas is $2X10^{-8}$cm and Boltzmann's constant $1.38x10^{-23}$ J/K. Calculate the mean free path at N.T.P. (5 marks)

21. i) Obtain Maxwell's thermodynamic equations using thermodynamic potentials. (7.5 marks)

ii) Show that for a Vander wall's gas $C_P-C_V=R(1+2a/VRT)$. (5 marks)

22. Discuss the second order phase transitions and derive the Ehrenfest's equations.

23. Derive Maxwell's Boltzmannn law of distribution of speeds of molecules in a gas.

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