LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SECOND SEMESTER – **APRIL 2019**

PH 2505– MECHANICS & STATISTICAL PHYSICS

Date: 02-04-2019 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART-A

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

1. Define centre of suspension and centre of oscillation.
2. State the law of conservation of angular momentum. Give one example of its application.
3. Distinguish clearly between holonomic and non-holonomic constraints.
4. Define phase space.
5. Calculate the mean free path of a gas molecule, given that the molecular diameter is 2×10^{-8} cm and the number of molecule per cc is 3×10^{19}.
6. What is the effect of temperature and pressure on thermal conductivity of a gas?
7. Define intensive variable. Give examples.
8. How does the internal energy of an ideal gas differ from a real gas?
9. What is meant by most probable state?
10. The average K.E of a gas molecule at a certain temperature is 6.21×10^{-21} joule. Find the temperature. (Boltzmann's constant $K=1.38 \times 10^{-23}$ J/K).

PART-B

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

11. State and prove Bernoulli's theorem and mention any two of its applications.
12. Apply Hamilton's Canonical equations to determine the motion of a particle in a central force field.
13. Derive the Clausius expression for mean free path on the basis of kinetic theory of gases.
14. Derive the Gibb's-Helmholtz equation for E.M.F of a reversible cell.
15. Obtain Maxwell's thermodynamic equations using thermodynamic potentials.
16. What do you mean by Doppler broadening of spectral lines? Derive the relation for the wavelength shift.

PART–C

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

17. Obtain an expression for the time period of oscillation of a bifilar pendulum with parallel threads.

18. i)State Fick's law of diffusion in liquids. Obtain the relation between time of diffusion and length of column. **(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 difference across the two be equivalent to 450 mm head of water. Calculate the mass flow ofwater through the meter. **(5 marks)**

19. i) Derive Lagrange's equation using D'Alembert's principle**.** **(7.5 marks)**
    ii) Apply Lagrange's equation to determine the motion of a bead sliding on a uniformly rotating wire in a force free space. **(5 marks)**

20. i) What are transport phenomena? Derive an expression for the viscosity of gas in terms of mean free path of its molecules. Show that it is independent of pressure but depends upon the temperature of the gas. (10.5 marks)
    ii) In an experiment, the viscosity of the gas was found to be 2.25×10^{-4} CGS units. The r.m.s. velocity of the molecules is 4.5×10^{4} cm/s. The density of the gas is 1 gram per litre. Calculate the mean free path of the molecules. **(2 marks)**

21. Explain second order phase transition and hence derive the Ehrenfest's equations.

22. i) What is meant by the term "thermodynamic probability of macrostates"? How it is related to the probability of occurrence of that state. **(6.5 marks)**
    ii) Using Maxwell's velocity distribution law show that
    a) $V_{r.m.s} = \sqrt{3KT/m}$ **(3 marks)**
    b) $V_{m.p} = \sqrt{2KT/m}$ **(3 marks)**