LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SECOND SEMESTER – **APRIL 2016**

PH 2505 – MECHANICS & STATISTICAL PHYSICS

Date: 21-04-2016 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART-A

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

1. Show that in a compound pendulum the centres of suspension and oscillation are interchangeable.
2. State the law of velocity of efflux of a fluid flow.
3. Distinguish between holonomic and non-holonomic constraints. Give examples.
4. Give the physical significance of the Hamiltonian function.
5. Define the term i) mean free path ii) mean free time of a gas molecule.
6. Explain the effect of temperature on thermal conductivity of a gas.
7. Show that there is no Joule-Thompson effect for a perfect gas.
8. What are second order phase transitions? Give examples.
9. Define the term most probable state.
10. Mention any two limitations of Maxwell's Boltzmann statistics.

PART-B

Answer ANY FOUR Questions **(4x7.5=30 marks)**

11. Obtain an expression for the time period of oscillation of a bifilar pendulum with non-parallel threads.
12. Apply Hamilton's Canonical equations to determine the motion of a particle in a central force field.
13. i) Explain the term sphere of influence and collision cross section. (3+2 marks)
    ii) Calculate the mean free path of a gas molecule, given that the molecular diameter is $2x10^{-8}$cm and the number of molecules per cc is $3x10^{19}$. (2.5 marks)
14. Explain in detail the Clausius inequality with a neat diagram.
15. Discuss how the Maxwell's Boltzmann distribution law can be used to find the total energy and specific heat at constant volume for an ideal gas.
16. What do you mean by Doppler broadening of spectral lines? Obtain an expression for the wavelength shift.

PART–C

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

17. i) A pitot tube is fixed in a main of diameter 15 cm, and the difference of pressure indicated by the gauge is 4 cm of water column. Find the volume of water passing through the main in a minute. (5 marks)
    ii) State and prove Bernoulli's theorem and mention any two of its applications. (7.5 marks)

18. 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)

19. What are transport phenomena? Explain in detail, viscosity and self diffusion on the basis of kinetic theory of gases.

20. i) What do you mean by first order phase transition? Prove that $\frac{dP}{dT} = \frac{(S_2 - S_1)}{(V_2 - V_1)}$. (7.5 marks)
    ii) Show that for a perfect gas C_P-C_V=R. (5 marks)

21. Obtain Maxwell's thermodynamic equations using thermodynamic potentials and use it to derive any two T.ds equations. (7.5+5marks)

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 distributive law of molecular speeds show that
    a) Vr.m.s=$\sqrt{3KT/m}$ (3 marks)
    b) Vm.p =$\sqrt{2KT/m}$ (3 marks)

$$$$$$$