Ref. No.: EX/UG/SC/PHY/TH/02/18

1ST B. SC. 1ST SEMESTER, 2018
Physics (Honours)
Paper: CORE- 2

Time: Two Hours

Full Marks: 50
(25 marks for each group)

Use separate answer scripts for each group

GROUP A

Answer question no. 1 and any three from the rest

1.(a) State, with reasons, the type of temperature measuring device which you consider most suitable for use at temperatures of (a) -50^0 C and (b) 900^0 C.

(b) Write down the Maxwell's law of distribution of molecular speed in three dimension. Find out expressions for the most probable speed.

(c) Depict the nature of speed distribution for two different temperatures T and 4T on the same graph.

(d) Consider an ideal gas of diatomic molecules where each molecule is like two mass points connected by a massless spring. The spring can only have longitudinal vibration. The gas is at absolute temperature T. Utilize the law of equipartition of energy to obtain an expression for the total energy per mole.

[2+4+2+2)]

2. Define mean free path of a gas molecule. Derive Clausius expression for the mean free path.

[1+4]

3. What do you mean by coefficient of self –diffusion 'D'. Write down expression of 'D' in transport phenomena. Show that $D \propto P^{-1}T^{1.5}$, where P and T are the pressure and temperature of the gas.

[2+1+2]

4.(a) 'Brownian motion may be considered as analogous to the heat motion of the molecules but on a much reduced scale' – Explain the significance of the statement.

(b) In an experiment on water suspension of gambose at 20^0 C, Perrin observed an average of 49 particles per sq. cm in a layer at a certain level, and 14 particles per sq. cm in another layer 60 microns higher. Find the Avogadro number, given density of gambose is 1.1949 gm/cc and radius of each particle is 0.212 micron.

[2+3]

5.(a) What is the significance of Boyle temperature and critical temperature in case of real gases ?

(b) Deduce the expression for Boyle temperature in case of Van-der-Waal's gas.

[2+3]

6.(a) Define thermal conductivity and thermometric conductivity of a material.

(b) Show theoretically that the thermal conductivities of the different bars with their ends fixed at certain high temperature vary as the square of the lengths along which the wax has melted in Ingen Hausz's experiment.

[2+3]

BACHELOR OF SCIENCE EXAMINATION, 2018
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Group-B

Answer **Q. No. 1** and any **two** from the rest.

1. Write short note (any one): 3
   a) Gravitational self-energy.
   b) Stokes law and terminal velocity.

2. a) Prove that the potential of a circular disc of uniform surface density σ and radius a at a point on its circumference is $-4G\sigma a$.
   b) Describe a compound pendulum and show the centres of oscillation and suspension for a given compound pendulum are interchangeable.
   c) Distinguish between stream-line motion and turbulent motion of a fluid.

4+5+2=11

3. a) A straight beam of rectangular cross-section, rigidly clamped at one end, is loaded at the free end with a weight W. Obtain an expression for the depression at the middle of the beam, if the weight of the beam is negligible.
   b) A cylindrical rod of length l and radius a is stretched such that the volume of the rod is not changed. Show that the Poisson's ratio is $\frac{1}{2}$.
   c) Explain the reciprocal theorem for a cantilever having negligible mass.

5+3+3=11

4. a) Show that the excess pressure acting on the curved surface of a membrane is given by

$$p = 2S\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

   Where r_1 and r_2 are the radii of curvature and S the surface tension of the membrane.
   b) Calculate the force to pull a horizontal plate upwards from a liquid surface.
   c) A cylindrical vessel of mass 500 gms and outer radius 10 cm is floating in water. It has a circular hole of radius 0.2 mm at the bottom surface. Calculate the maximum weight that can be placed in the vessel without submerging it. Surface tension of water is 73 dynes/cm.

(5+3+3)=11