Ref. No. *Ex/IP/II/6/2018*

BACHELOR OF SCIENCE EXAMINATION, 2018

(1st Year, 1st Semester)

PHYSICS (Honours)

Paper : HO-02

Time: Two hours. **Full Mark: 50**

(25 marks for each group)

Use separate answer script 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) -70^0 C and (b) 800^0 C.

(b) What is meant by speed distribution law? Deduce Maxwell's law of distribution of molecular speed in three dimension considering the probability of a molecule may have speed lying between u and $u+du$ in a definite direction is $f(u)du = ae^{-bu^2}du$, where a and b are constants for the system.

(c) Assuming Maxwell's law of distribution of molecular speed, find the fraction of molecules having speed in the range C_m to 2 C_m, where C_m is the most probable velocity.

[2+(2+4)+2)]

2. Define mean free path of a gas molecule. Write down the expression for mean free path. Comment on its dependence on pressure. The mean free path of molecules in a certain gas is 4.0 cm. Consider 10,000 free paths. i) how many are longer than 4.0 cm ? ii) how many are between 3.9 cm and 4.0 cm?

[1+1+1+2]

3. Explain the origin of viscosity and thermal conduction in an ideal gas on the basis of kinetic theory. Write down the expressions for the coefficient of viscosity and thermal conductivity. Comment on their dependence on pressure and temperature.

[2+1+2]

4. Using Einstein's theory of translational Brownian motion find the temperature dependence of the mean squared displacement per unit time of colloidal particles suspended in a liquid.

[5]

5. What are the critical constants of a real gas? Obtain their values in terms of the constants of Van-der-Waal's equation. [5]

6. When steam is passed through a circular tube of length l having external and internal diameters a and b respectively, show by solving Fourier equation that the radial flow of heat per sec. outward is given by:

$$\dot{Q} = \frac{2\pi Kl(\theta_1 - \theta_2)}{\ln\left(\frac{b}{a}\right)}$$

Where θ_1, θ_2 being the temperatures of the inner and outer surface respectively.

[5]

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Group-B

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

1. Write short note (any one): 3
   a) Surface tension and vapour pressure.
   b) Gravitational self-energy.

2. a) State and prove Gauss theorem in gravitation.
   b) Find an expression for the potential due to a thin uniform straight rod and comment on its equipotential surface.

5+6=11

3. a) Obtain an expression for the height h through which a liquid of surface tension S will rise in a capillary tube of radius r.

   What will happen if the length of the tube is smaller than the height of liquid ascent h?

   b) A U-tube is supported with its limbs vertical and is partly filled with water. If the internal diameters of the limbs are respectively equal to 1cm and 1mm, what will be the difference in heights at which the water stands in the two limbs? Surface tension of water = 70 dynes/cm.

(5+2)+4=11

4. a) Define co-efficient of viscosity of a fluid.
   b) Derive Poiseuille's formula for the steady flow of an incompressible viscous liquid through a horizontal capillary of uniform cross section.
   c) Show that for a homogeneous isotropic medium

   $2n(1+\sigma)=3k(1-2\sigma)$

   where n is the rigidity modulus
   k is the bulk modulus
   and σ is the poisson's ratio.

1+5+5=11