Sem-I - General Properties of Matter

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Assignment I: Viscosity

Submission due date: 21/08/2019

Q.1) Pressure difference across the two ends of a horizontally placed capillary tube is P. The rate of water flowing through the tube is $Qc.c./second$. If the radius of the tube is doubled and the pressure difference is halved, what will be the amount of water flowing per second?

Q.2) Choice the correct result: the time taken by a spherical object to reach the terminal velocity in a viscous liquid is (i) $\eta R^2/\rho$, (ii) $\eta R/\rho$, (iii) $\rho R/\eta$, (iv) $\rho R^2/\eta$.

Q.3) To what height should a cylindrical vessel be filled with a homogeneous liquid to make the force with which the liquid exerts pressure on the sides of the vessel equals to the force exerted by the liquid on the bottom of the vessel?

Q.4) A metal plate of $100cm^2$ area rests on a layer of castor oil $2mm$ thick whose coefficient of viscosity is 15.5Poise. Calculate the horizontal force required to move the plate with a speed of $0.03m/s$.

Q.5) (a) What is a Decapoise? (b) In the Poiseuille's experiment the following observations were made: Volume of water collected in 5 minutes is $40c.c.$, Head of water is $0.4m$, length and radius of capillary tube is $0.602m$ and $5.2 \times 10^{-4}m$. Calculate the coefficient of viscosity of water, given, density of water is $10^3kg/m^3$ or $1gm/cc$.

Q.6) A capillary tube of radius a and length l is filled horizontally at the bottom of a cylindrical flask of cross-sectional area A. Initially there is water in the flask upto a height h. What time would be required for half the liquid to flow out, if the coefficient of viscosity of the liquid is η?

Q.7) Two spherical raindrops of the same size are falling through air with terminal velocity of $1m/s$. If both of them combine to form a large single drop, calculate its terminal velocity.

Q.8) A steel ball of radius $2 \times 10^{-3}m$ falls in a vertical column of Castor oil. The coefficient of viscosity of Castor oil is $0.7N/m^2$ and density is $9.8 \times 10^2kg/m^3$, while the density of steel is $7.8 \times 10^3kg/m^3$ and gravitational acceleration $g = 9.8m/s^2$. Find the terminal velocity of the ball.

Q.9) The volume of an air bubble is doubled in rising from a depth of h meters in sea to the surface. If the barometric height be $750mm$ and the relative densities of sea water and mercury be 1.05 and 13.58 gm/cc respectively, using Boyle's law, calculate h.

Q.10) The combined frictional and air resistance on a bicyclist has the force $F = av$, where v is cyclists velocity and $a = 4$ Newton-sec/m. At maximum effort, the cyclist can generate $600Watts$ of propulsive power. What is cyclists maximum speed on ground level with no wind?