3.3 - Viscosity and Turbulent Flow

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- (1998) Two equal drops of water are falling through air with a steady velocity of 0.15 ms^{-1} , If the drops coalesce, find their new terminal velocity.
- (1999) With the help of a well labelled diagram briefly explain how you will determine the coefficient of viscosity of a liquid by a constant pressure head apparatus in the laboratory.
- (2010) In the form of Millikans experiment, an oil drop was observe fall with a constant velocity of $2.5 \times 10^{-4} m/s$ in the absence of an electric field. When a p.d of 1000 V was applied between the plates 10 mm apart, the drop remained stationary between them. i the density of oil is 9×10^2 kg/m^3 , density of air is 1.2 kg/m^3 and viscosity of air is 1.8×10^{-5} Ns/m^2 , Calculate the radius of the oil drop and the number of electric charges it carries.
- (2013) Write down the Poiscuilles equation for a viscous fluid flowing through a tube defining all the symbols.
  - What assumptions are used to develop the equation above.
- (2015) A sphere is dropped under gravity through a fluid of viscosity, η . Taking average acceleration as half of the initial acceleration, show that the time taken to attain terminal velocity is independent of fluid density.
- (2015) The flow rate of water from a tap of diameter 1.25 cm is 3 litres per minute. The coefficient of viscosity of water is 10^{-3} Ns/m^2 . Determine the Reynolds number and then state the type of flow of water.
- (2016) State Newtons law of viscosity and hence deduce the dimensions of the coefficient of viscosity.
- (2016) In an experiment to determine the coefficient of viscosity of motor oil, the following measurements are made:
  - Mass of glass sphere = 1.2×10^{-4} kg.
  - Diameter of sphere = 4.0×10^{-3} m.
  - Terminal velocity of sphere = 5.4×10^{-5} m/s.
  - Density of oil = 860 kg/m^3
  - Calculate the coefficient of viscosity of the oil.
- (2016) Give reasons for the following observations as applied in fluid dynamics.
  - A flag flutter when strong winds are blowing on a certain day.

  - A parachute is used while jumping from an airplane.
  - Hotter liquids flow faster than cold ones.

- (2017) Derive an expression for the terminal velocity of a spherical body falling from rest through a viscous fluid.

- (2019) Give the meaning of the terms velocity gradient, tangential stress and coefficient of viscosity as used in fluid dynamics.

- (2019) Write Stokes equation defining clearly the meaning of all symbols used.

  - State two assumptions used to develop the equation above

- (2019) Calculate the terminal velocity of the rain drops falling in air assuming that the flow is laminar, the rain drops are spheres of diameter 1 mm and the coefficient of viscosity, $\eta = 1.8 \times 10^{-5}$ Ns/m^2 .

- (2019) Water flows past a horizontal plate of area 1.2 m^2 . If its velocity gradient and coefficient of viscosity adjacent to the plate are 10 s^{-1} and 1.3×10^{-5} Ns/m^2 respectively, calculate the force acting on the plate.