

Problem 1.44

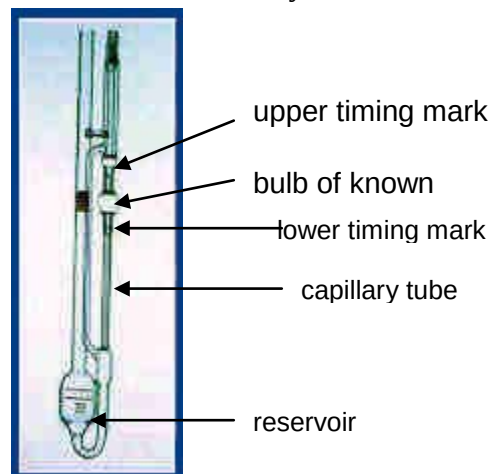
One type of viscometer is simply a long capillary tube. A commercial device is shown in Prob. C1.10. One measures the volume flow rate Q and the pressure drop Δp and, of course, the radius and length of the tube. The theoretical formula, which will be discussed in Chap. 6, is $\Delta p \approx 8\mu QL / (\pi R^4)$. For a capillary of diameter 4 mm and length 10 inches, the test fluid flows at $0.9 \text{ m}^3/\text{h}$ when the pressure drop is 58 lbf/in^2 . Find the predicted viscosity in $\text{kg/m}\cdot\text{s}$.

Problem C1.10

A popular gravity-driven instrument is the Cannon-Ubbelohde viscometer, shown in Fig. C1.10. The test liquid is drawn up above the bulb on the right side and allowed to drain by gravity through the capillary tube below the bulb. The time t for the meniscus to pass from upper to lower timing marks is recorded. The kinematic viscosity is computed by the simple formula $\nu = Ct$, where C is a calibration constant. For ν in the range of $100\text{--}500 \text{ mm}^2/\text{s}$, the recommended constant is $C = 0.50 \text{ mm}^2/\text{s}^2$, with an accuracy less than 0.5%.

Fig. C1.10

The Cannon-
Ubbelohde



- (a) What liquids from Table A.3 are in this viscosity range? (b) Is the calibration formula dimensionally consistent? (c) What system properties might the constant C depend upon? (d) What problem in this chapter hints at a formula for estimating the viscosity?