

Problem 14-06 Contact angle from capillary elevation

To determine the contact angle between glass and a liquid with surface tension of 18 mN m^{-1} and density $\rho = 1.056 \text{ g cm}^{-3}$, the capillary rise method was used: at the temperature of 25°C the measured liquid exhibited in a capillary of inner diameter 0.05 mm the capillary elevation 93 mm . Calculate the contact angle.

$$[\theta = 48^\circ]$$

Solution:

$$h = 93 \text{ mm} = 0.093 \text{ m}$$

$$\gamma = 18 \text{ mN m}^{-1} = 0.018 \text{ N m}^{-1}$$

$$\rho = 1.056 \text{ g cm}^{-3} = 1056 \text{ kg m}^{-3}$$

$$\mathcal{R} = 0.05/2 \text{ mm} = 2.5 \cdot 10^{-5} \text{ m}$$

$$\cos \theta = \frac{h \rho g \mathcal{R}}{2 \gamma} = \frac{0.093 \cdot 1056 \cdot 9.81 \cdot 2.5 \cdot 10^{-5}}{2 \cdot 0.018} = 0.669042$$

$$\theta = 48.007^\circ$$