

Problem 14-03 Capillary elevation

The surface tension of a certain liquid was determined by the capillary rise measurement. At the temperature of 25°C the liquid level in the capillary of inner diameter 0.2 mm climbed up to the height of 9 cm above the planar liquid level in the wide vessel. The measured liquid completely wets the material of the capillary and its density is 1.076 g cm^{-3} . Calculate the surface tension of the liquid.

$$[\gamma = 47.5 \text{ mN m}^{-1}]$$

Solution:

$$\gamma = ?$$

$$\rho = 1.076 \text{ g cm}^{-3} = 1076 \text{ kg m}^{-3}$$

$$h = 9 \text{ cm} = 0.09 \text{ m}$$

$$D = 0.2 \text{ mm}$$

$$R = 0.1 \text{ mm} = 1 \cdot 10^{-4} \text{ m}$$

$$h \cdot \rho \cdot g \cdot \pi R^2 = \gamma \cdot 2 \pi R \quad (\theta = 0)$$

$$\gamma = \frac{h \rho g R}{2} = \frac{9 \cdot 10^{-2} \cdot 1076 \cdot 9.81 \cdot 1 \cdot 10^{-4}}{2} = 47.5 \text{ mN m}^{-1}$$