

### Problem 14-02 Capillary elevation

The stems of roses growing in the garden are about 50 cm in length. The cell walls are interwoven by a network of small canals (capillaries) enabling the water transport in plants. You can assume that water completely wets the walls of these capillaries and the average *diameter* of capillaries is 80  $\mu\text{m}$ . Estimate if due to the capillary elevation can water climb up to the bloom. Surface tension of water is 72.6  $\text{mN m}^{-1}$  and its density 0.998  $\text{g cm}^{-3}$ .



[ $h = 0.37 \text{ m}$  – water does not climb up to the blossom]

Solution:

$$\frac{2\gamma}{r} = h \rho g$$

Complete wetting :  $\theta = 0$

$$\gamma = 72.6 \text{ mN m}^{-1} = 0.0726 \text{ N m}^{-1}$$

$$\rho = 0.998 \text{ g cm}^{-3} = 998 \text{ kg m}^{-3}$$

$$d = 80 \mu\text{m} = 80 \cdot 10^{-6} \text{ m}$$

$$r = d/2 = 40 \cdot 10^{-6} \text{ m}$$

$$h = \frac{2\gamma}{r \rho g} = \frac{2 \cdot 0.0726}{40 \cdot 10^{-6} \cdot 998 \cdot 9.81} = 0.3708 \text{ m} < \text{lenght of the stem}$$