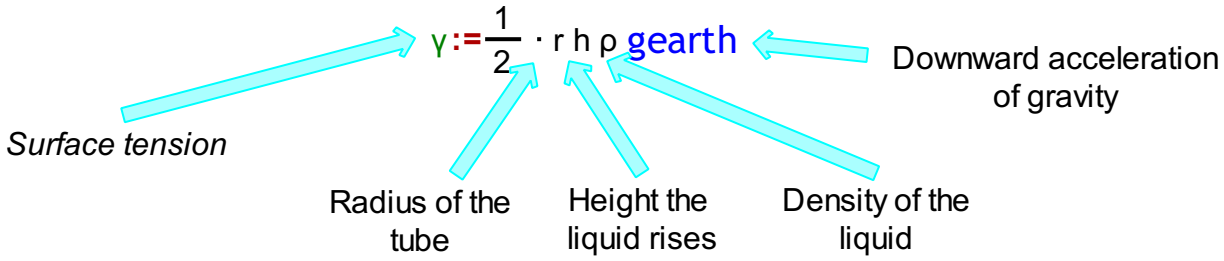
Surface tension

Find the surface tension of a liquid (density 0.876 g/cm^3) which rises 3.2 cm in a capillary where water at 30°C rises 5.6 cm?

Solution:

Surface tension refers specifically to the force within a liquid that acts parallel to the surface and tends to stretch the surface out. The relation between surface tension to the density of a liquid is



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

Because r and g are constants for a given capillary tube and from the standard tables we can find that γ_{H2O} = 72.62 dyn/cm, ρ_{H2O} = 1 g/cm^3.

$$\gamma_{H2O} := 0.7262\ \ dyn/m \qquad \rho_{H2O} := 0.000001\ g/m^3$$

$$h_{H2O} := 0.056\ m \qquad h_{liq} := 0.032\ m \qquad \rho_{liq} := 0.000000876\ g/m^3$$

$$\frac{2\ \gamma_{H2O}}{h_{H2O}\ \rho_{H2O}} == \frac{2\ \gamma_{liq}}{h_{liq}\ \rho_{liq}}$$

$$\gamma_{liq} := \frac{2\ \gamma_{H2O}\ h_{liq}\ \rho_{liq}}{2 \cdot h_{H2O}\ \rho_{H2O}}$$

$$\gamma_{liq} = 0.364\ dyn\ m^{-1}$$

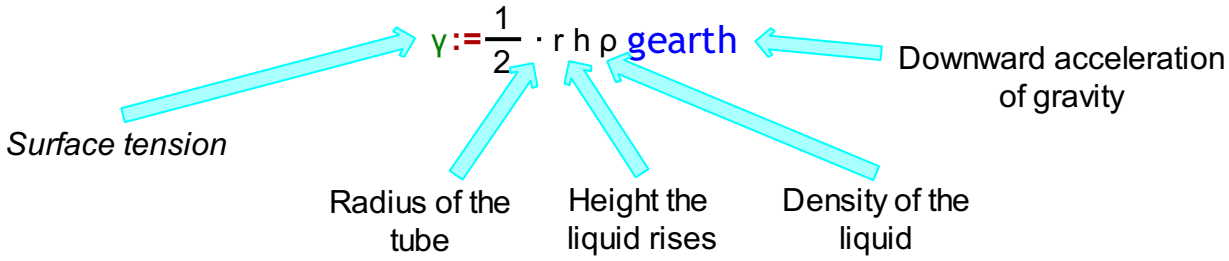
Finally, the surface tension value is γ_{liq} = 36.4 dyn/cm.

Surface tension

If the surface tension of water is 72.62 dyn/cm at 20°C, how high should the water rise in a capillary that is 3 mm in diameter?

Solution:

The equation of surface tension and it's relation to the radius of the capillary tube is:



The density of H_2O is 1 g/cm^3, the force of gravity is 980 cm/s^2 and the surface tension is given as 72.62 dyn/cm. If we divide the diameter of the tube by 2 we will find the radius.

$$cm := m / 100$$

$$\rho := 1\ g / cm^3 \qquad gearth = 9.8067\ s^{-2}\ m \qquad \gamma := 72.62\ dyn / cm \qquad r := \frac{3}{2}\ \frac{cm}{10}$$

$$72.62\ dyn / cm = 72.62\ g / s^2$$

$$\gamma := 72.62\ g / s^2$$

$$\gamma = \frac{1}{2} \cdot r\ h\ \rho\ gearth$$

$$h := \frac{2\ \gamma}{r\ \rho\ gearth}$$

$$h = 0.0098\ m$$