

A needle has a length of 3.2 cm. When placed gently on the surface of the water ( $\sigma = 0.073 \text{ N/m}$ ) in a glass, this needle will float if it is not too heavy. What is the weight of the heaviest needle that can be used in this demonstration?

Applying the fact that the net force acting on the needle is zero we have:

$$\sum \vec{F} = 0$$

$$-W + \sigma L \cos \theta + \sigma L \cos \theta = 0$$

The forces due to the surface tension will balance the largest weight when they point completely vertically and  $\theta = 0^\circ$ . Therefore, the weight of the heaviest needle that can be used in this demonstration is

$$W = 2\sigma L \cos 0^\circ = 2 \times 0.073 \times 0.032 = 4.7 \times 10^{-3} \text{ N}$$

