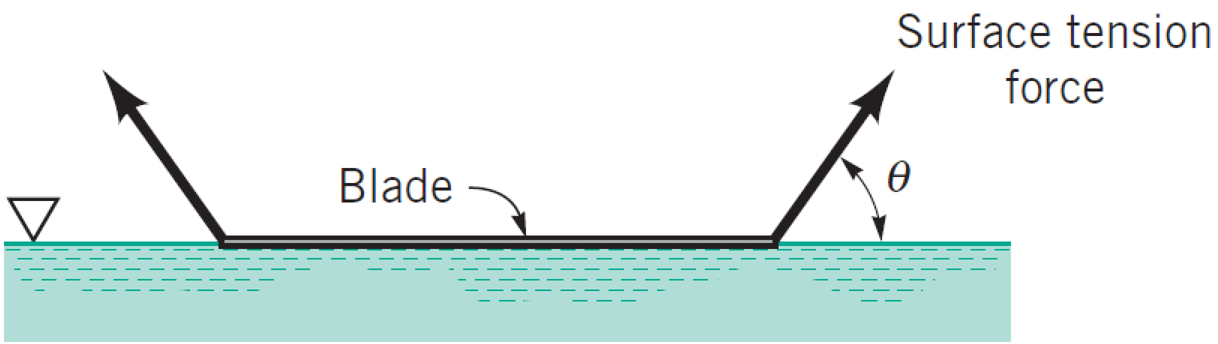
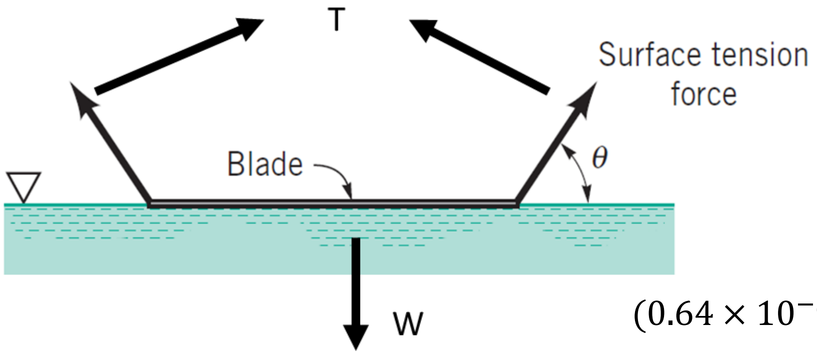
1-72: Assume that the surface tension forces act at an angle Θ relative to the water surface.

a) The mass of the double edge blade is 0.64×10^{-3} kg, and the total length of its sides is 206 mm. Determine the value of Θ required to maintain equilibrium between the blade weight and the resultant surface tension force.

b) The mass of the single-edge blade is 2.61×10^{-3} kg, and the total length of its sides is 154 mm. Does this blade sink?

$$\sigma = 7.34 \times 10^{-2}\ N/m$$





a) $\Sigma F_{vertical} = 0$ $\quad W = T \times \sin\theta$

$W = m_{blade} \times g$ $\quad T = \sigma \times length\ of\ sides$

$$(0.64 \times 10^{-3} kg) \times (9.81\ m/s^2) = (7.34 \times 10^{-2}\ N/m) \times (0.206\ m) \times \sin\theta$$

$$\sin\theta = 0.415 \qquad \theta = 24.5°$$

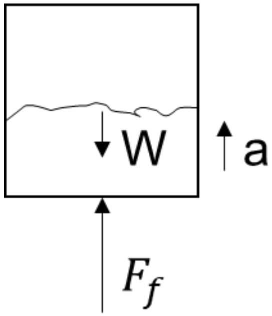
b) $W = m_{blade} \times g = (2.61 \times 10^{-3} kg) \times (9.81\ m/s^2) = 0.0256N$

$$T \times \sin\theta = (\sigma \times length\ of\ blade) \times \sin\theta = (7.34 \times 10^{-2}\ N/m) \times (0.154\ m) \times \sin\theta = 0.0113 \times \sin\theta$$

In order for blade to float $W < T \times \sin\theta$. Since max value for $\sin\theta$ is 1, the blade will sink.

1-2: A tank of liquid having a total mass of 36 kg rests on a support in the equipment bay of the Space Shuttle. Determine the force that the tank exerts on the support shortly after lift off when the shuttle is accelerating upwards at 4.5 m/s^2.

1-2: A tank of liquid having a total mass of 36 kg rests on a support in the equipment bay of the Space Shuttle. Determine the force that the tank exerts on the support shortly after lift off when the shuttle is accelerating upwards at 4.5 m/s^2.



W: weight of the tank and liquid
F_f: the reaction of the floor on the tank

Newton's second law of motion:
$\Sigma F = ma \qquad F_f - W = ma \qquad (W = mg)$

$$F_f = m(g+a) = 36\,[kg]\left(9.81\left[\frac{m}{s^2}\right] + 4.5\left[\frac{m}{s^2}\right]\right) = 515[kgm/s^2]$$

1-22: The information on a can of pop indicates that the can contains 355 mL. The mass of a full can of pop is 0.369 kg while an empty can weighs 0.153 N. Determine the specific weight, density and specific gravity of the pop.

Calculate the weight of fluid in Newton unit.

1-22: The information on a can of pop indicates that the can contains 355 mL. The mass of a full can of pop is 0.369 kg while an empty can weighs 0.153 N. Determine the specific weight, density and specific gravity of the pop.

$$\gamma = \frac{weight\ of\ fluid}{volume\ of\ fluid} \qquad total\ weight = mass \times g = (0.369\ kg)\left(9.81\,\frac{m}{s^2}\right) = 3.62\ N$$

$$weight\ of\ can = 0.153\ N$$

$$volume\ of\ fluid = (355 \times 10^{-3}\ \mathrm{L})(10^{-3}\ m^3/L) = 355 \times 10^{-6} m^3$$

$$\gamma = \frac{(3.62 - 0.153)N}{355 \times 10^{-6} m^3} = 9770\ N/m^3 \qquad \rho = \frac{\gamma}{g} = \frac{9770\ N/m^3}{9.81\,\frac{m}{s^2}} = 996\,\frac{Ns^2}{m^4} = 996 kg/m^3$$

$$SG = \frac{\rho}{\rho_{ref}} = \frac{996\ kg/m^3}{1000\ kg/m^3} = 0.996$$

1.59: A sound wave is observed to travel through a liquid with a speed of 1500 m/s. The specific gravity of the liquid is 1.5. Determine the bulk modulus for this fluid.

1.59: A sound wave is observed to travel through a liquid with a speed of 1500 m/s. The specific gravity of the liquid is 1.5. Determine the bulk modulus for this fluid.

$$c = \sqrt{\frac{E_v}{\rho}}$$

E_v → Bulk modulus (N/m^3)

ρ → kg/m^3

$$\rho = SG \times \rho_{H_2O} \qquad SG = 1.5$$

$$E_v = c^2 \times \rho = c^2 \times SG \times \rho_{H_2O} = (1500\, m/s)^2 \times (1.5) \times (999\, kg/m^3) = 3.37 \times 10^9\, kg/s^2 m \quad (N/m^2)$$

1-70: An open, clean glass tube $(\theta = 0°)$ is inserted vertically into a pan of water. What tube diameter is needed if the water level in the tube is to rise one tube diameter (due to surface tension)?

1-70: An open, clean glass tube ($\theta = 0°$) is inserted vertically into a pan of water. What tube diameter is needed if the water level in the tube is to rise one tube diameter (due to surface tension)?

$$h = \frac{2\sigma \cos\theta}{\gamma R} \qquad For\ h = 2R\ and\ \theta = 0° \qquad 2R = \frac{2\sigma(1)}{\gamma R}$$

$$R^2 = \frac{\sigma}{\gamma} = \frac{5.03 \times 10^{-3}\ N/m}{62.4\ N/m^3} \qquad R = 8.98 \times 10^{-3}\ m \qquad diameter = 2R = 1.8 \times 10^{-2}\ m$$