PROBLEM 1.19

1. The weight of the tower itself is ignored.
2. Local acceleration of gravity is 32.1 ft/s^2.
3. $\rho_{water} = 62.4$ lb/ft^3

The structure must exert a minimum force equivalent to the weight of the water, which can be expressed as the mass (m) of the water times acceleration of gravity, g.

$$F = Weight = mg$$

The mass of the water can be determined from its density times the volume the water occupies

$$m = \rho V = \left(62.4\frac{\text{lb}}{\text{ft}^3}\right)(1{,}000{,}000\text{ gal})\left|\frac{0.13368\text{ ft}^3}{1\text{ gal}}\right| = 8{,}341{,}632\text{ lb}$$

Substituting for mass and acceleration of gravity and applying the appropriate conversion factor yield

$$F = mg = (8{,}341{,}632\text{ lb})\left(32.1\frac{\text{ft}}{\text{s}^2}\right)\left|\frac{1\text{ lbf}}{32.174\frac{\text{lb}\cdot\text{ft}}{\text{s}^2}}\right| = \underline{\mathbf{8{,}322{,}446\ lbf}} \longleftarrow$$

PROBLEM 1.20

$\boxed{\begin{array}{c} 0.5\text{ kmol} \\ NH_3 \\ V = 6\text{ m}^3 \end{array}}$

$g = 9.81\text{ m/s}^2$

(a) $F_{grav} = m\,g$

Table A-1

Using Eq. 1.8, $m = n\,M = 0.5\text{ kmol}\left(17.03\frac{\text{kg}}{\text{kmol}}\right) = 8.52\text{ kg}$

$\therefore\ F_{grav} = (8.52\text{ kg})(9.81\frac{\text{m}}{\text{s}^2})\left|\frac{1\text{ N}}{1\text{ kg}\cdot\text{m/s}^2}\right| = 83.58\text{ N} \longleftarrow F_{grav}$

(b) $\bar{v} = \frac{V}{n} = \frac{6\text{ m}^3}{0.5\text{ kmol}} = 12\frac{\text{m}^3}{\text{kmol}}$, $v = \frac{V}{m} = \frac{6\text{ m}^3}{8.52\text{ kg}} = 0.704\frac{\text{m}^3}{\text{kg}} \longleftarrow \bar{v}, v$