PROBLEM 1.19

1. The weight of the tower itself is ignored.
2. Local acceleration of gravity is 32.1 ft/s^2.
3. ρ_{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.

$$F = Weight = mg$$

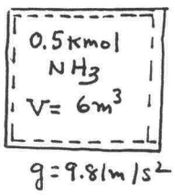
The mass of the water can be determined from its density times the volume the water occupies

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

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

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

PROBLEM 1.20



(a) $F_{grav} = mg$

Using Eq. 1.8, $m = nM = 0.5\ \text{kmol}\left(17.03\frac{\text{kg}}{\text{kmol}}\right) = 8.52\ \text{kg}$ ← Table A-1

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

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

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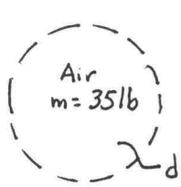
PROBLEM 1.21



(a) $v = \frac{V}{m}$ where $V = \frac{\pi d^3}{6} = \frac{\pi (10)^3\ \text{ft}^3}{6} = 523.6\ \text{ft}^3$

$\therefore\ v = \frac{523.6\ \text{ft}^3}{35\ \text{lb}} = 14.96\frac{\text{ft}^3}{\text{lb}}$ ← v

Using Eq. 1.9, $\bar{v} = Mv = \left(28.97\frac{\text{lb}}{\text{lbmol}}\right)\left(14.96\frac{\text{ft}^3}{\text{lb}}\right)$ ← Table A-1E

$= 433.39\frac{\text{ft}^3}{\text{lbmol}}$ ← $\bar{v}$

(b) $F_{grav} = mg = (35\ \text{lb})\left(31.0\frac{\text{ft}}{\text{s}^2}\right)\left|\frac{1\ \text{lbf}}{32.2\ \text{lb}\cdot\text{ft/s}^2}\right| = 33.7\ \text{lbf}$ ← F_{grav}

(rounded)