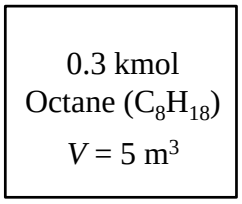
1.17 A closed system consists of 0.3 kmol of octane occupying a volume of 5 m^3. Determine (a) the weight of the system, in N, and (b) the molar- and mass-based specific volumes, in m^3/kmol and m^3/kg, respectively. Let g = 9.81 m/s^2.

KNOWN: A specified number moles of octane occupies a known volume.

FIND: Determine (a) the weight of the system, and (b) the specific volumes on molar and mass bases.

SCHEMATIC AND GIVEN DATA:

g = 9.81 m/s^2
M_{octane} = 114.22 kg/kmol (Table A-1)



ENGINEERING MODEL:
1. Octane is a closed system.
2. The acceleration of gravity is constant at 9.81 m/s^2.

ANALYSIS:
(a) Weight of the octane is the mass of octane times the local acceleration of gravity.

$$F_{grav} = mg_{local}$$

Using Eq. 1.8 to determine the mass of the octane

$$m = nM = (0.3\,\text{kmol})\left(114.22\,\frac{\text{kg}}{\text{kmol}}\right) = 34.266\ \text{kg}$$

Solving for the octane weight,

$$F_{grav} = (34.266\,\text{kg})\left(9.81\,\frac{\text{m}}{\text{s}^2}\right)\left|\frac{1\,\text{N}}{1\,\text{kg}\cdot\text{m/s}^2}\right| = \underline{\mathbf{336.1\ N}}$$

(b) Specific volume on a molar basis is

$$\overline{v} = \frac{V}{n} = \frac{5\,\text{m}^3}{0.3\,\text{kmol}} = \underline{\mathbf{16.67\ m^3/kmol}}$$

Specific volume on a mass basis is

$$v = \frac{V}{m} = \frac{5\,\text{m}^3}{34.266\,\text{kg}} = \underline{\mathbf{0.146\ m^3/kg}}$$