# Problem 58

Estimate the mass of air in a classroom.

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**Solution**

Start by finding the molar mass of air. Assume for simplicity that it's made of 80% nitrogen gas ($N_2$) and 20% oxygen gas ($O_2$). The average molar mass is then

$$0.8 \left( 14.0 \times 2 \; \frac{\text{g}}{\text{mol}} \right) + 0.2 \left( 16.0 \times 2 \; \frac{\text{g}}{\text{mol}} \right) = 28.8 \; \frac{\text{g}}{\text{mol}}.$$

The aim now is to find how many moles of air are in this classroom. Assume the air is an ideal gas so that the ideal gas law applies.

$$PV = nRT$$

Solve for $n$, the number of moles.

$$n = \frac{PV}{RT}$$

Suppose this classroom has a pressure of 1 atmosphere and room temperature, or about 300 K. Assume the volume is about 1000 liters.

$$n = \frac{(1 \; \cancel{\text{atm}})(1000 \; \cancel{L})}{\left( 0.0821 \; \frac{\cancel{L} \cdot \cancel{\text{atm}}}{\text{mol} \cdot \cancel{K}} \right) (300 \; \cancel{K})} \approx 40.6 \; \text{mol}$$

The mass of air in this hypothetical classroom is

$$40.6 \; \cancel{\text{mol}} \times 28.8 \; \frac{\text{g}}{\cancel{\text{mol}}} \approx 1000 \; \text{g},$$

or about 1 kilogram.