

Physics 151 Class Exercise: Ideal Gas Law - KEY

1. The Goodyear blimp *Spirit of Akron* is 62.6 m long and contains 7023 m³ of helium. When the temperature of the helium is 12 °C, its gauge pressure is 11 kPa. Find the mass of the helium in the blimp and estimate the number of helium atoms.



$$n = \frac{PV}{RT} = \frac{(112 \times 10^3 \text{ Pa})(7023 \text{ m}^3)}{\left(8.31 \frac{\text{J}}{\text{mol} \cdot \text{K}}\right)(285 \text{ K})} = 332000 \text{ moles}$$

$$m_{\text{total}} = nM = (332000 \text{ moles}) \left(4.00260 \frac{\text{g}}{\text{mol}}\right) = 1.33 \times 10^6 \text{ g} = 1.33 \times 10^3 \text{ kg}$$

$$N = nN_A = (332000 \text{ moles}) \left(6.022 \times 10^{23} \frac{\text{atoms}}{\text{mole}}\right) = 2.00 \times 10^{29} \text{ atoms}$$

2. A balloon contains 3.0 liters of nitrogen gas at a temperature of 87 K and a pressure of 101 kPa. If the temperature of the gas is allowed to increase to 23 °C and the pressure remains constant, what volume will the gas occupy?

$$\begin{aligned} \frac{V_i}{T_i} &= \frac{V_f}{T_f} \\ V_f &= \frac{T_f V_i}{T_i} \\ &= \frac{(273.15 + 23) \text{ K} (3.0 \text{ L})}{87 \text{ K}} \\ &= \boxed{10 \text{ L}} \end{aligned}$$