

Quiz 8.2 – Gas Laws

Name: Kerry

Question 1

A weather balloon starts in Cedar City with with $P = 0.82 \text{ atm}$, $T = 21.5^\circ\text{C}$, and $V = 18.75 \text{ L}$

- Find the number of moles of gas inside the balloon

$$n = \frac{PV}{RT} = \frac{0.82 \text{ atm} \cdot 18.75 \text{ L}}{0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \cdot 294.5 \text{ K}} = 0.64 \text{ moles}$$

- If the balloon is filled with He gas, find the mass of the gas inside the balloon

$$\frac{0.636 \text{ moles}}{1 \text{ mol He}} \cdot 4.003 \text{ g He} = 2.5 \text{ g}$$

- Find the density of the He-filled balloon (assume the instruments and balloon itself have no mass)

$$d = \frac{\text{mass}}{\text{volume}} = \frac{2.55 \text{ g}}{18.75 \text{ L}} = 0.14 \text{ g/L} \rightarrow 1.4 \cdot 10^{-4} \text{ g/mL}$$

- Find the density of the surrounding air (assume it is 100% N_2 gas)

$$\frac{0.636 \text{ moles}}{1 \text{ mol N}_2} \cdot 28.01 \text{ g N}_2 = 17.81 \text{ g}$$

$$\frac{17.81 \text{ g}}{18.75 \text{ L}} = 0.95 \text{ g/L} \rightarrow 9.5 \cdot 10^{-4} \text{ g/mL}$$

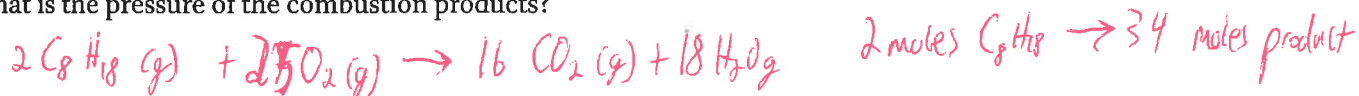
Question 2

The weather balloon is released into the upper atmosphere and the instruments on-board indicate a pressure of 0.45 atm and a temperature of $-32.4^\circ\text{C} \rightarrow 240.6 \text{ K}$

What will the new volume of the balloon be?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \frac{0.82 \text{ atm} \cdot 18.75 \text{ L}}{294.5 \text{ K}} = \frac{0.45 \text{ atm} \cdot V_2}{240.6 \text{ K}} \rightarrow V_2 = 28 \text{ L}$$

Question 3

A car engine burns about 0.1 g of gasoline (C_8H_{18}) for each engine cycle. A car engine may have a cylinder volume of 1.25 L , and operate at a temperature of 80.0°C . If the gasoline combusts completely inside the 1.25 L piston, what is the pressure of the combustion products?

$$\frac{0.1 \text{ g C}_8\text{H}_{18}}{114.23 \text{ g C}_8\text{H}_{18}} \cdot \frac{34 \text{ moles product}}{2 \text{ mol C}_8\text{H}_{18}} = 0.0149 \text{ moles product}$$

$$80.0^\circ\text{C} \rightarrow 353 \text{ K}$$

$$P = \frac{nRT}{V} = \frac{0.0149 \text{ moles} \cdot 0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \cdot 353 \text{ K}}{1.25 \text{ L}} = 0.34 \text{ atm}$$