Student Practice for Proficiency
Ideal Gas Law Calculations

$37+273 = 310$
$20+273 = 293$

1. Anesthetic gas is normally given to a patient when the room temperature is 20.0°C and the patient's body temperature is 37.0°C. how would the volume change as a result of this temperature change if the initial volume is 1.60L and the pressure is constant.

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad \frac{V_1T_2}{T_1} = V_2$ $\quad \frac{1.6L \cdot 310}{293} = 1.69L$

2. Calcium carbonate, $CaCO_{3(s)}$ decomposes upon heating to give $CaO_{(s)}$ and $CO_{2(g)}$. A sample of $CaCO_3$ is decomposed, and the carbon dioxide is collected in a 250mL flask. After the decomposition is compete, the gas has a pressure of 1.3atm at a temperature of 31°c. How many moles of CO_2 gas were generated?

$CaCO_3 \longrightarrow CaO_s + CO_2$ $\quad 304K$

$PV = nRT$

$\frac{PV}{RT} = n$ $\quad \frac{1.3 \cdot .250}{.0821 \cdot 304} = 0.013$ mol $\quad 1.3$ atm

3. The safety air bags in automobiles are inflated by nitrogen gas generated by the rapid decomposition of sodium azide, NaN_3. $2NaN_{3(s)} \rightarrow 2Na_{(s)} + 3N_{2(g)}$ If the air bag has a volume of 36L and is to be filled with nitrogen gas at a pressure of 1.15 atm at a temperature of 26.0°C, how many grams of NaN_3 must be decomposed?

299K

$PV = nRT$

$\frac{PV}{RT} = n$ $\quad \frac{1.15 \cdot 36}{.0821 \cdot 299} = 1.68L$

4. The gas pressure in an aerosol can is 1.5atm at 25°C. Assuming that the gas inside obeys the ideal-gas equation, what would the pressure be if the can were heated to 450°C.

$\frac{PV}{T} = \frac{PV}{T}$ $\quad \frac{P_1T_2}{T_1} = P_2$ $\quad \frac{1.5 \cdot 723}{298} = 3.6$ atm

5. An inflated balloon has a volume of 6.0L at lea level (1atm) and is allowed to ascend in altitude until the pressure is 0.45 atm. During the temperature of the gas falls from 22°C to -21°C. Calculate the volume of the balloon at its final altitude.

295 252

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad \frac{P_1V_1T_2}{T_1P_2} = V_2$ $\quad \frac{1 \cdot 6 \cdot 252}{295 \cdot .45} = 11.3L$

$35+273 = 308$

6. A sample of argon is trapped in a glass bulb at a pressure of 760torr when the volume is 100mL and the temperature is 35.0°C. The pressure is altered to 720torr;
   a. On a kinetic molecular level, why is the pressure increasing? – more collisions w/ inside wall container.
   b. What is the new temperature causing this change?

$\frac{PV}{T} = \frac{PV}{T}$ $\quad V$ = Constant

$T_2 = \frac{T_1P_2V_2}{P_1V_1}$ $\quad \frac{308 \cdot 720 \cdot V_2}{760 \quad V_2} = 291K\ (18°C)$