A 30.0 L container of propane used with a barbeque grill contains 6115 grams of liquefied propane, C_3H_8. If, on a hot summer day, the temperature of the air is 31°C, and the pressure of the oxygen in the air is 29 kPa, what volume of oxygen gas at these conditions would be needed to completely burn all the propane in the container? Start by writing a balanced equation.

$$\underset{6115\,g}{C_3H_8} + \underset{?\,L}{5\,O_2} \longrightarrow 4\,H_2O + 3\,CO_2$$

$$6{,}115\,\cancel{g}\,\cancel{C_3H_8} \times \frac{1\ \cancel{mol}}{44.11\ \cancel{g}} \times \frac{5\ mol\ O_2}{1\ \cancel{mol\ C_3H_8}} = 693.15\ mol\ O_2$$

$$V = \frac{nRT}{P} = \frac{(693.15\ mol)\left(8.314\ \frac{kPa\cdot L}{mol\cdot K}\right)(304\ K)}{29\ kPa} = \boxed{60{,}410\ L\ O_2}$$

If the products of the combustion were collected and placed in a 250 L container kept at 500 K, what would be the pressure of the carbon dioxide produced, in mm Hg?

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$$P = \frac{nRT}{V} = \frac{(415.89\ mol)\left(62.4\ \frac{mm\,Hg\cdot L}{mol\cdot K}\right)(500\ K)}{250\ L}$$

$$\boxed{P = 51{,}903\ mm\ Hg}$$

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A 1.00 L container of hydrogen chloride gas kept 21°C at 345 kPa is bubbled through water, making 500 mL of a solution of hydrochloric acid. What is the molarity of the acid solution formed?

$$n = \frac{PV}{RT} = \frac{(345\,kPa)(1.0\,L)}{(8.314\,\frac{kPa \cdot L}{mol \cdot K})(294\,K)}$$

$n = 0.14$ mol HCl

$$M = \frac{mol}{L}$$

$$M = \frac{0.14\,mol}{0.5\,L} = 0.28\,M\ HCl$$

500 mL

If 5.00 g of solid Al is added to the solution, what volume of hydrogen gas at 21°C and 0.94 atm is produced? Start with a balanced equation.

$$2\,Al_{(s)} + 6\,HCl_{(aq)} \longrightarrow 3\,H_{2(g)} + 2\,Al^{3+}Cl^{-1}_3$$

5.00 g   500 mL 0.28 M   ? L

$$5.00\,g\,Al \times \frac{1\,mol}{26.98\,g} \times \frac{3\,mol\,H_2}{2\,mol\,Al} = 0.28\,mol\,H_2$$

$$0.14\,mol\,HCl \times \frac{3\,mol\,H_2}{6\,mol\,HCl} = 0.07\,mol\,H_2$$

$$V = \frac{nRT}{P} = \frac{(0.07\,mol)(0.0821\,\frac{atm \cdot L}{mol \cdot K})(294\,K)}{0.94\,atm} = 1.80\,L\ H_2$$

How many grams of Al are left over?

$$\begin{array}{r} 0.28\,mol\,H_2 \\ -\ 0.07\,mol\,H_2 \\ \hline \end{array}$$

$$0.21\,\cancel{mol\,H_2} \times \frac{2\,mol\,Al}{3\,\cancel{mol\,H_2}} \times \frac{26.98\,g}{1\,mol\,Al} = \boxed{3.78\,g\,Al}$$