$25\bar{0}0$ L of chlorine gas at 25.0 C and 1.00 atm are used to make hydrochloric acid. How many kilograms of hydrochloric acid could be produced if all the chlorine reacts?

$$H_2 + Cl_2 \rightarrow 2\,HCl$$

1 - Convert volume of chlorine gas to moles using ideal gas equation
2 - Convert moles of chlorine gas to moles of HCl using the chemical equation
3 - Convert moles of HCl to mass using the formula weight of HCl

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

$P = 1.00$ atm $\quad V = 25\bar{0}0$ L $\quad R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$

$T = 25.0°C = 298.2$ K

$n = ???$

$$① \; n = \frac{PV}{RT} = \frac{(1.00\text{ atm})(25\bar{0}0\text{ L})}{\left(0.08206 \frac{L \cdot atm}{mol \cdot K}\right)(298.2\text{ K})} = 102.1647 \text{ mol } Cl_2$$

mol Cl_2 = 2 mol HCl | 36.458 g HCl = mol HCl | kg = 10^3 g

$$102.1647 \text{ mol } Cl_2 \times \frac{2 \text{ mol HCl}}{\text{mol } Cl_2} \times \frac{36.458 \text{ g HCl}}{\text{mol HCl}} \times \frac{\text{kg}}{10^3 \text{ g}} = \boxed{7.45 \text{ kg HCl}}$$

② (mol Cl_2 → mol HCl) ③ (mol HCl → kg HCl)

Calculate the mass of 22650 L of oxygen gas at 25.0 C and 1.18 atm pressure.

O_2

* Volume of a 10'x10'x8' room

1 - Convert the volume of oxygen gas to moles using the ideal gas law
2 - Convert the moles of oxygen gas to mass using formula weight.

$PV = nRT$

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

$P = 1.18\ atm$ $V = 22650\ L$ $R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$

$T = 25.0°C = 298.2\ K$

(1) $$n = \frac{(1.18\ atm)(22650\ L)}{(0.08206\ \frac{L \cdot atm}{mol \cdot K})(298.2\ K)} = 1092.222\ mol\ O_2$$

$32.00\ g\ O_2 = mol\ O_2$

$$1092.222\ mol\ O_2 \times \frac{32.00\ g\ O_2}{mol\ O_2} = 35000\ g\ O_2$$

35.0 kg

(about 77 lb)

$$2\,HCl + Na_2CO_3 \rightarrow CO_2 + H_2O + 2\,NaCl$$

If 48.90 mL of hydrochloric acid solution react with sodium carbonate to produce 125.0 mL of carbon dioxide gas at 0.950 atm and 290.2 K. What is the molar concentration of the acid?

We need to find: $\underline{M} \text{ of } HCl = \dfrac{\text{moles } HCl}{\text{L solution}}$ ← 0.04890 L

1 - Convert volume of carbon dioxide gas to moles using ideal gas equation
2 - Convert moles of carbon dioxide gas to moles HCl using chemical equation
3 - Divide moles HCl / 0.04890 L to get concentration

$n = \dfrac{PV}{RT}$ | $P = 0.950$ atm $V = 125.0\text{ mL} = 0.1250\text{ L}$ $R = 0.08206 \dfrac{L \cdot atm}{mol \cdot K}$

$T = 290.2\text{ K}$

① $$n_{CO_2} = \frac{(0.950\text{ atm})(0.1250\text{ L})}{\left(0.08206 \frac{L \cdot atm}{mol \cdot K}\right)(290.2\text{ K})} = 0.0049866 \text{ mol } CO_2$$

$2 \text{ mol } HCl = \text{mol } CO_2$

② $$0.0049866 \text{ mol } CO_2 \times \frac{2 \text{ mol } HCl}{\text{mol } CO_2} = 0.0099732 \text{ mol } HCl$$

③ $$\underline{M}_{HCl} = \frac{\text{moles } HCl}{\text{L solution}} = \frac{0.0099732 \text{ mol } HCl}{0.04890\text{ L}} = \boxed{0.204\ \underline{M}\ HCl}$$