2500 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 chlorine to moles chlorine using ideal gas equation.
2 - Convert moles chlorine to moles HCl using chemical equation
3 - Convert moles HCl to mass using formula weight.

① $PV = nRT$ | $n = \frac{PV}{RT}$

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

$V = 2500\ L$ $\quad T = 25.0°C = 298.2\ K$

$$n_{Cl_2} = \frac{(1.00\ atm)(2500\ L)}{\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(298.2\ K)} = 102.1646983\ mol\ Cl_2$$

$mol\ Cl_2 = 2\ mol\ HCl$ (②)

$HCl: H: 1.008 \times 1$

$Cl: 35.45 \times 1$

$36.458\ g\ HCl = mol\ HCl$ (③)

$Kg = 10^3\ g$

$$102.1646983\ mol\ Cl_2 \times \frac{2\ mol\ HCl}{mol\ Cl_2} \times \frac{36.458\ g\ HCl}{mol\ HCl} \times \frac{Kg}{10^3\ g} = 7.45\ kg\ HCl$$

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 22650L of oxygen gas to moles using ideal gas equation.
2 - Convert moles oxygen gas to mass using formula weight.

① $PV = nRT$

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

$P = 1.18\ atm$

$V = 22650\ L$

$R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$

$T = 25.0°C = 298.2\ K$

$$n_{O_2} = \frac{(1.18\ atm)(22650\ L)}{\left(0.08206 \frac{L \cdot atm}{mol \cdot K}\right)(298.2\ K)} = 1092.222357\ mol\ O_2$$

$32.00\ g\ O_2 = mol\ O_2$

$$1092.222357\ mol\ O_2 \times \frac{32.00\ g\ O_2}{mol\ O_2} = \boxed{35000\ g\ O_2}$$

35.0 kg

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 want $M_{HCl} = \frac{\text{mol HCl}}{\text{L solution}}$ ← 48.90 mL = 0.04890 L

1 - Convert volume carbon dioxide gas to moles using ideal gas equation.
2 - Convert moles carbon dioxide to moles HCl using chemical equation
3 - Calculate molarity of HCl by dividing moles hCl and volume of solution.

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① $n = \frac{PV}{RT}$ | $P = 0.950$ atm $\quad R = 0.06206 \frac{L \cdot atm}{mol \cdot K}$

$V = 125.0$ mL $= 0.1250$ L $\quad T = 290.2$ K

$$n_{CO_2} = \frac{(0.950\text{ atm})(0.1250\text{ L})}{\left(0.06206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(290.2\text{ K})} = 0.004986619\text{ mol } CO_2$$

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

$$0.004986619\text{ mol } CO_2 \times \frac{2\text{ mol HCl}}{\text{mol } CO_2} = 0.009973238\text{ mol HCl}$$

$$M_{HCl} = \frac{\text{mol HCl}}{\text{L solution}} = \frac{0.009973238\text{ mol HCl}}{0.04890\text{ L}} = \boxed{0.204\ \underline{M}\ HCl}$$

③