Molar Volume

The individual particles of a gas are very small in volume compared to the total volume of a gas. The particles also have great distances between them and rarely interact with each other. For these reasons all gas volumes can be thought to be equal at STP...

The molar volume is the volume occupied by one mole of ideal gas at STP. Its value is:

$$\frac{22.414\ \text{L}}{1\ \text{mole}}$$

ex. What is the volume of 3 moles of CO_2 gas at STP?

$1\ \text{mole}_{(g)} = 22.4\ \text{L}$ (c.f. from Standard Molar Volume)

$$3\ \text{mol}\ CO_{2(g)} \times \frac{22.4\ \text{L}}{1\ \text{mol}} = 67.2\ \text{L}\ CO_{2(g)}$$

ex. How many grams of $NH_{3(g)}$ are in 15.5 L of the gas at STP?
First we have to find how many moles of the gas there are and then we can derive the mass from the molar mass of the gas...

$1\ \text{mole}_{(g)} = 22.4\ \text{L}$ (c.f. from Standard Molar Volume)

$$15.5\ \text{L}\ NH_{3(g)} \times \frac{1\ \text{mol}}{22.4\ \text{L}} = 0.692\ \text{mol}\ NH_{3(g)}$$

$$M_{NH_3} = 14.01g/mol + 3(1.01g/mol)$$
$$= 17.04g/mol$$

1 mole $NH_{3(g)}$ = 17.4g (c.f. derived from molar mass of $NH_{3(g)}$)

$$0.692 \text{ mol } NH_{3(g)} \times \frac{1 \text{ mol } NH_{3(g)}}{17.04g} = 11.8g \text{ } NH_{3(g)}$$

$\therefore$ there are 11.8g of $NH_3(g)$ in 15.5 L of the gas at STP