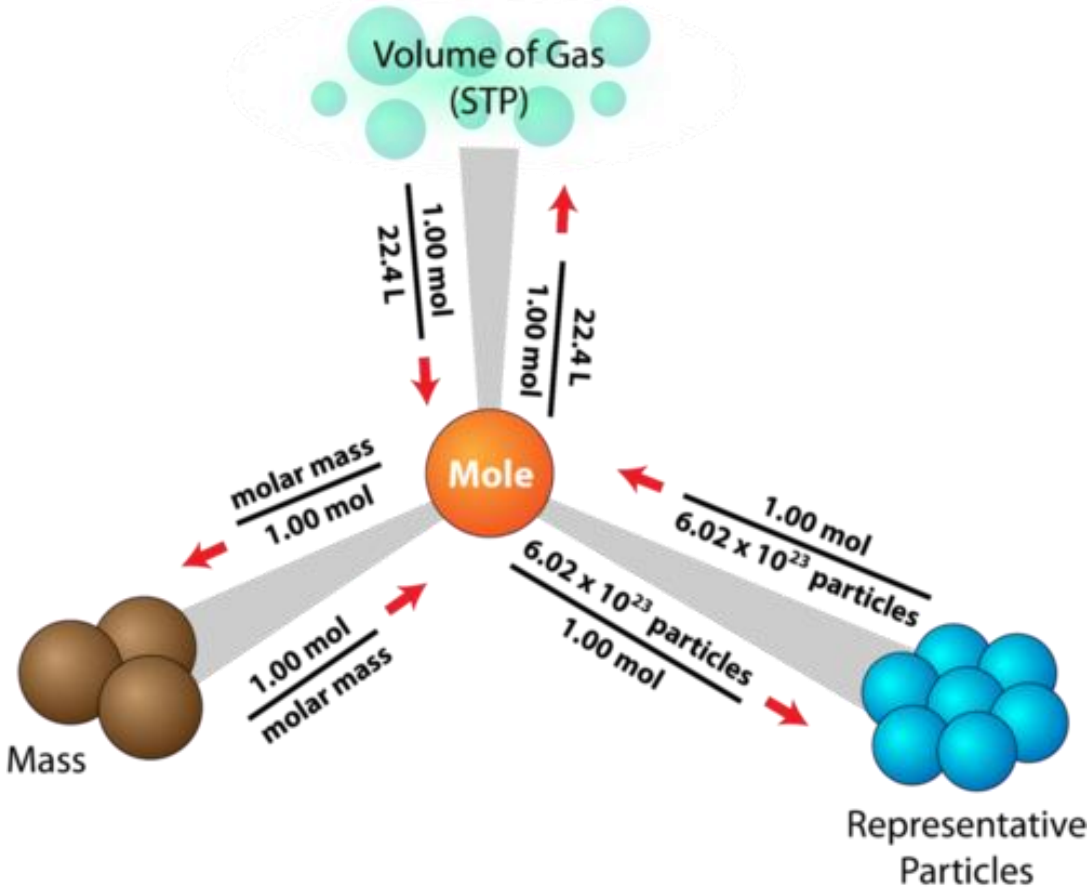
[6.2]
Mole Conversions



6.2 Mole Conversions

There are three mole equalities. They are:

$1 \text{ mol} = 6.02 \times 10^{23} \text{ particles}$

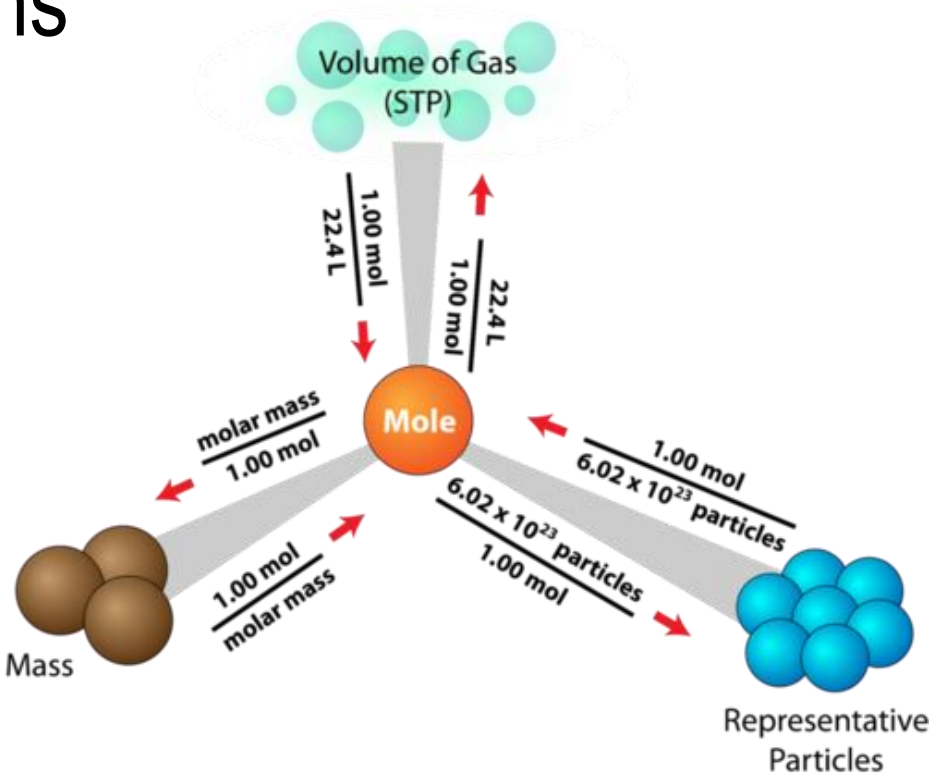
1 mol = molar mass

1 mol = 22.4 L for a gas at STP

STP = Standard Temperature Pressure

Mole Conversions

- As we continue throughout the semester, the mole becomes quite important
- All of the equations will stem from mole conversions



Review of Moles to Molecules

- Remember: 1 mole = 6.02×10^{23} particles
- **Review**: How many moles are there in 7.50×10^{25} molecules of CH_4?

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$$7.50 \times 10^{25}\ \text{molecules} \times \frac{1\ mole}{6.02 \times 10^{23}\ molecules} = 125\ \text{moles}$$

Mole, Molar Mass & Mass

The **mole (n), mass (m), and molar mass (MM)** of a pure substance are related to each other through the following equation:

$$n = \frac{m}{MM}$$

Practice 1: Mass and Moles

Practice: What is the mass of 2.00 moles of $CaCl_2$?

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Molar Mass $CaCl_2$ = 111.0 $\frac{g}{mol}$

We will use the equation: n = $\frac{\mathrm{m}}{\mathrm{MM}}$

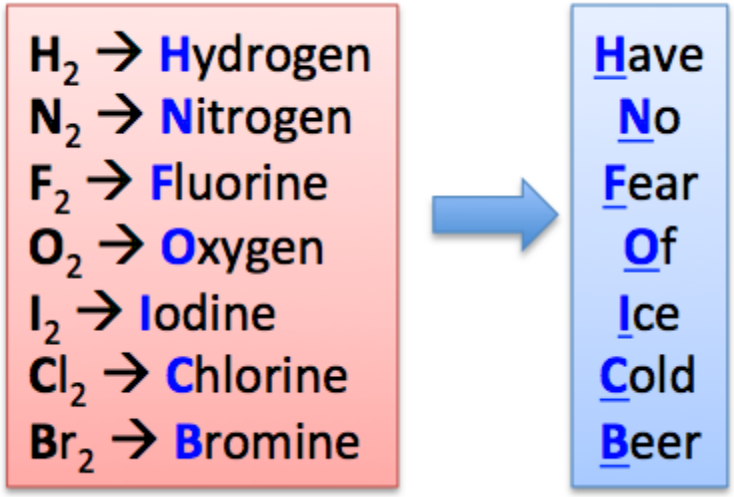
$$n \times MM = m$$

$$2.00\ mol\ \mathrm{CaCl_2} \times 111.0 \frac{g}{mol} = 222.0\ g = 222\ g$$

Don't forget Significant Figures in your answer!

Quick Note

There are some molecules that naturally form **homonuclear diatomic molecules** (a molecule with two of the **same** element).



These molecules are in a gaseous state, and your calculations will take into account their diatomic nature

Calculating Moles to Volume

- Remember:

1 mol = 22.4 L for a gas at STP

- This conversion only works if the particle is a gas
- The conditions **must** be at STP for to use this conversion, otherwise we use the ideal gas law to solve for volume

Practice Problem 2:

1. Calculate the volume occupied by 3.00 moles of H_2 gas at STP.

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$$3.00 \text{ moles } H_2 \times \frac{22.4 \text{ L}}{1 \text{ mole } H_2} = 67.2 \text{ L}$$

Practice Problem 3:

1. If 58.0 liters of F_2 gas at STP occupies a space, how many moles of F_2 gas are present?

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$$58.0\ \text{L}\ F_2 \times \frac{1\ \text{mole}\ F_2}{22.4\ \text{L}} = 2.59\ \text{mole}$$

Extra Practice Problems

1. If Cl_2 gas at STP occupies 0.50 liters of space, how many moles of Cl_2 gas are present?

2. There are 24.0 moles of H_2 gas in Mr. Hudson's room which is at STP. How many liters of H_2 gas are there?

3. If there are 7.50 moles of I_2 gas in a container at STP, how many moles are there?

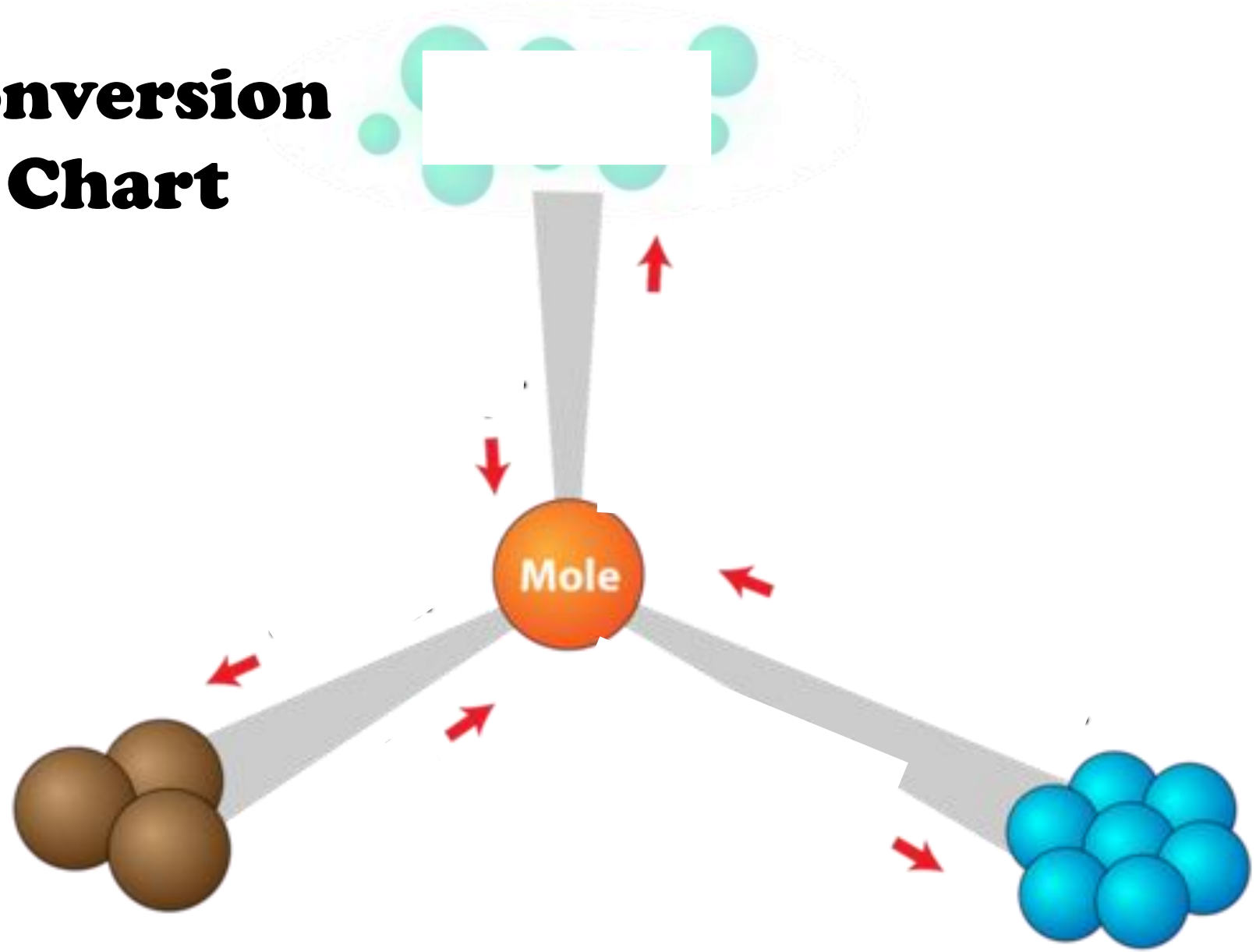
Practice Problems

1. 0.50 liters Cl_2 x $\frac{1 \text{ mole } Cl_2}{22.4 \text{ L } Cl_2}$ = 0.0223 mol Cl_2

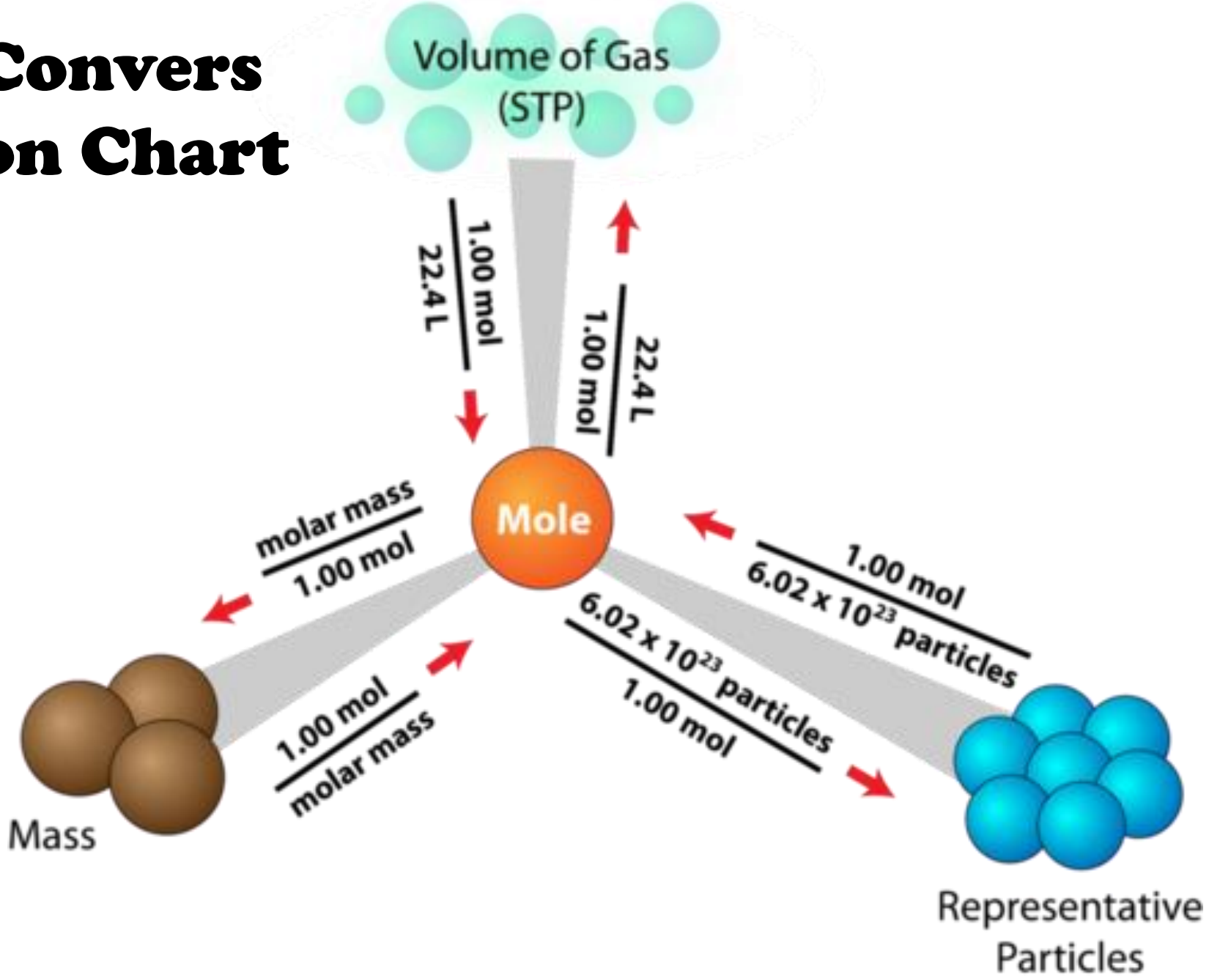
2. 24.0 mole H_2 x $\frac{22.4 \text{ L } H_2}{1 \text{ mole } H_2}$ = 538 L H_2

3. 7.50 moles I_2 x $\frac{22.4 \text{ L } I_2}{1 \text{ mole } I_2}$ = 168 L I_2

Conversion Chart

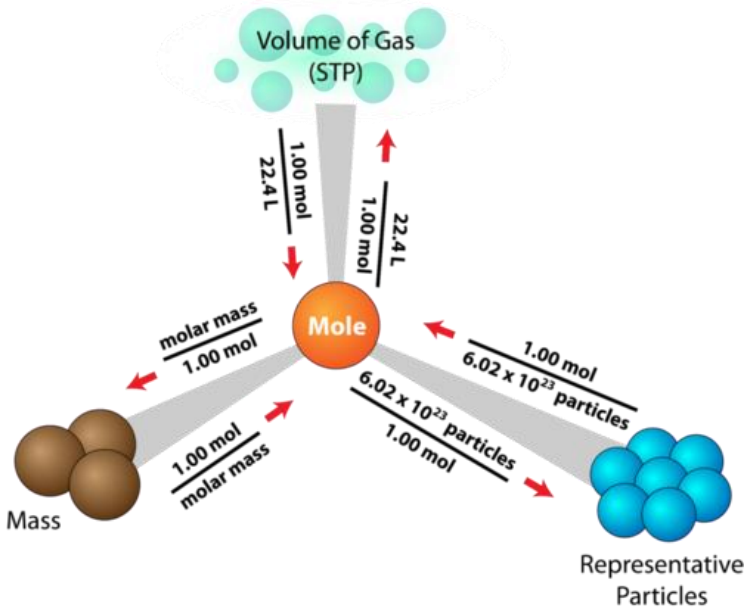


Convers ion Chart



Combining Conversions

- In order to calculate different mole conversions, we need to use **moles** as the main conversion factor
- Looking at the diagram just shown, can we directly go from mass to volume?
- No, we **must** go through moles first



Practice Problem 4:

- **Calculate the volume occupied by 3.00 g of SbH_3(g) at STP**

$$3.00\ g\ SbH_3 \times \frac{1\ mole\ SbH_3}{121.8\ g + (3 \times 1.00\ g)\ SbH_3} \times \frac{22.4\ L\ SbH_3}{1\ mole\ SbH_3} = 0.538\ L\ SbH_3$$

Practice Problem 5:

- **Calculate the mass of 5.60×10^{32} molecules of barium chloride**

$$5.60 \times 10^{32} \text{ molecules } BaCl_2 \times \frac{1 \text{ mole } BaCl_2}{6.02 \times 10^{23} \text{ molecules } BaCl_2} \times \frac{137.3 \text{ g} + (2 \times 35.5) \text{ g}}{1 \text{ mole } BaCl_2} = 1.94 \times 10^{11} \text{ g } BaCl_2$$

Challenge Practice Problem

Al_2O_3 (s) has a density of 3.97 g/mL. How many atoms of Al are in 100 mL of Al_2O_3?

$$100\ mL\ Al_2O_3 \times \frac{3.97\ g}{1\ mL} \times \frac{1\ mol\ Al_2O_3}{102.0\ g\ Al_2O_3} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ Al_2O_3} \times \frac{2\ Al\ atoms}{1\ molecule}$$

$$= 4.69 \times 10^{24}\ atoms\ Al_2O_3$$

HOMEWORK

Pg. 88 #36 B & C

#37 A & B

#38 A &D

Pg 89 #41 A & B

#42 A