CALCULATING MOLES TO GRAMS

QUICK INTRO TO MOLES, GRAMS, AND CHEMICAL REACTIONS

WHAT'S A MOLE???

- In chemistry, the mole is the standard measurement of amount.
  - 1 mole = 6.02×10^{23} atoms (Avogadro's number)

When substances react, they do so in simple ratios of moles. However, balances give readings in grams. Balances DO NOT give readings in moles.

So the problem is that, when we compare amounts of one substance to another using moles, we must convert from grams, since this is the information we get from balances.

CONVERTING GRAMS TO MOLES

There are three steps to converting grams of a substance to moles:

- Step 1: Determine how many grams of a substance are in the problem.

  → 0.2 g Al

- Step 2: Find the amount of grams in 1 mole of the substance
  - Use the periodic table to check the atomic mass, this is the number of grams per mole

    → 1 mole of Aluminum is 26.982 g
  - Written as a fraction this is …

    $$\frac{1\ mol\ Al}{26.982\ g\ Al}$$

- Step 3: Multiply step one by step two.
  - → 0.2 g Al X $\frac{1\ mol\ Al}{26.982\ g\ Al}$ = 0.0074 moles of Aluminum

Practice:

How many moles are in 0.2 g of…

Cu?

Mg?

Zn?

CONVERTING MOLES TO GRAMS GIVEN THIS BALANCED REACTION:

$2AL + 3CUCL_2 \rightarrow 2ALCL_3 + 3CU$

- Step 1: Calculate the number of moles in a substance from the amount of mass measured.

$$0.2 \, g \, Al \quad X \quad \frac{1 \, mol \, Al}{26.982 \, g \, Al}$$

- Step 2: Calculate the number of moles produced in a reaction
  - Use the coefficients in the chemical reaction as a ratio of moles to calculate the number of moles present in the other substance
  - From the reaction, 2 moles of Aluminum produce 3 moles of Copper

$$0.2 \, g \, Al \quad X \quad \frac{1 \, mol \, Al}{26.982 \, g \, Al} \quad X \quad \frac{3 \, mol \, Cu}{2 \, mol \, Al}$$

- Step 3: Multiply the result by the number of grams per mole of the substance you wish to measure
  - Use the grams per mole ratio for the desired substance

$$0.2 \, g \, Al \quad X \quad \frac{1 \, mol \, Al}{26.982 \, g \, Al} \quad X \quad \frac{3 \, mol \, Cu}{2 \, mol \, Al} \quad X \quad \frac{63.546 \, g \, Cu}{1 \, mol \, Cu} = \quad grams \, of \, Copper!$$

Important! Units count, so make sure to write the fractions correctly to cancel out the unwanted units so that only the desired units are left.

WHAT HAPPENS WHEN THERE AREN'T ANY COEFFICIENTS?

Here's an example: How many grams of copper are produced if 0.5 g of calcium reacts with copper chloride in the following:

$$Ca \ + \ CuCl_2 \ \rightarrow \ Cu + CaCl_2$$
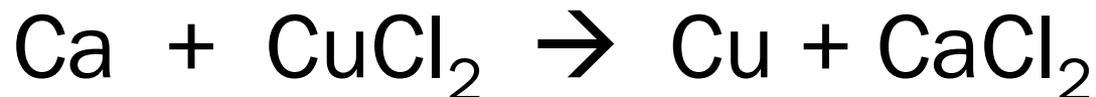
Step 1: $0.5 \, g \, Ca \ \times \ \dfrac{1 \, mol \, Ca}{40.078 \, g \, Ca}$

Step 2: $0.5 \, g \, Ca \ \times \ \dfrac{1 \, mol \, Ca}{40.078 \, g \, Ca} \ \times \ \dfrac{1 \, mol \, Cu}{1 \, mol \, Ca}$

Step 3: $0.5 \, g \, Ca \ \times \ \dfrac{1 \, mol \, Ca}{26.982 \, g \, Ca} \ \times \ \dfrac{1 \, mol \, Cu}{1 \, mol \, Ca} \ \times \ \dfrac{63.546 \, g \, Cu}{1 \, mol \, Cu}$
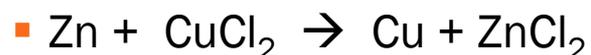
$= \textit{grams of Copper!}$

PRACTICE!

How many grams of copper are produced if 0.5 g of magnesium reacts with copper chloride in the following:

- $Mg + CuCl_2 \rightarrow Cu + MgCl_2$
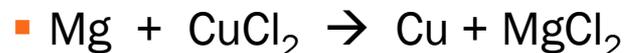
How many grams of copper are produced if 0.5 g of zinc reacts with copper chloride in the following:

- $Zn + CuCl_2 \rightarrow Cu + ZnCl_2$

How many grams of water are produced if 0.5g of hydrogen reacts with oxygen in the following:

- $2 H2 + O2 \rightarrow 2 H2O$

How many grams of nitrogen are produced if 0.5g of ammonia decompose in the following:

$2NH_3 \rightarrow N_2 + 3H_2$