Example Stoichiometry Problems

Example 1) How many Au atoms are contained in 5.0 g of Au?

Thought Process/Objective: To count Au atoms (i.e. to determine "how many"), we need to FIND MOLES Au

Step 1: $\frac{5.0\ \text{g Au}}{196.97\ \text{g/mol}} = 0.025\ \text{mol Au}$ OR $5.0\ \text{g Au} \times \frac{1\ \text{mol Au}}{196.97\ \text{g Au}} = 0.025\ \text{mol Au}$

Step 2: Since we want to count Au atoms and we already have moles of Au, no need for a conversion here

Step 3: $0.025\ \text{mol Au} \times \frac{6.022\times10^{23}\ \text{Au atoms}}{\text{mol Au}} =$ 1.5 x 10^{22} Au atoms

Example 2) What mass of Au contains 2500 Au atoms?

Thought Process/Objective: FIND MOLES of Au, then convert moles to mass

Step 1: $\frac{2500\ \text{Au atoms}}{6.022\times10^{23}\ \text{Au atoms/mol}} =$ 4.2 x 10^{-21} mol Au OR $2500\ \text{Au atoms} \times \frac{1\ \text{mol Au}}{6.022\times10^{23}\ \text{Au atoms}} =$ 4.2 x 10^{-21} mol Au

Step 2: Since we want mass of Au and we already have moles of Au, no need for a conversion here

Step 3: $4.2\times10^{-21}\ \text{mol Au} \times \frac{196.97\ \text{g Au}}{\text{mol Au}} =$ 8.2 x 10^{-19} g Au

Example 3) How many O atoms are contained in 100.0 g $Al_2(SO_3)_3$?

Thought Process/Objective: To count O atoms, we need to FIND MOLES O. But we're given mass of $Al_2(SO_3)_3$, so we have to find moles of $Al_2(SO_3)_3$ first and then convert to moles O

$$\frac{100.0\ \text{g Al}_2(\text{SO}_3)_3}{294.17\ \text{g/mol}} = 0.3399\ \text{mol Al}_2(\text{SO}_3)_3 \times \frac{9\ \text{mol O}}{1\ \text{mol Al}_2(\text{SO}_3)_3} \times \frac{6.022\times10^{23}\ \text{O atoms}}{\text{mol O}} =$$ 1.842 x 10^{24} O atoms

Step 1 | Step 2 | Step 3

Example 4) What mass of $Al_2(SO_3)_3$ contains 2500 sulfur atoms?

Thought Process/Objective: To get the mass of $Al_2(SO_3)_3$, we need to FIND MOLES of $Al_2(SO_3)_3$. But we're given a number of S atoms, so we have to find moles S first and then convert to moles $Al_2(SO_3)_3$.

$$\frac{2500\ \text{S atoms}}{6.022\times10^{23}\ \text{S atoms/mol}} = 4.2\times10^{-21}\ \text{mol S} \times \frac{1\ \text{mol Al}_2(\text{SO}_3)_3}{3\ \text{mol S}} \times \frac{294.17\ \text{g Al}_2(\text{SO}_3)_3}{\text{mol Al}_2(\text{SO}_3)_3} =$$ 4.1 x 10^{-19} g $Al_2(SO_3)_3$

Step1 | Step 2 | Step 3

Try these on your own:

Example 5) What mass of CCl_4 contains 100.0 g of Cl total?

Example 6) A 0.500 g sample of an unknown element contains 1.07 x 10^{22} atoms. What is the element? (Hint: think about the units on molar mass; from the given info, you can find the element's molar mass.)