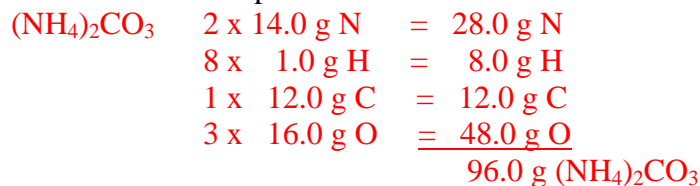


Problem Set for Moles I - **Answers**

1. What is the % composition of ammonium carbonate?



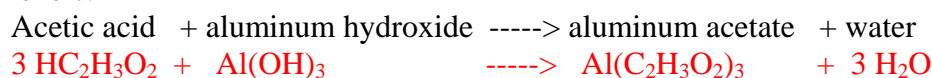
$$\frac{28.0 \text{ g}}{96.0 \text{ g}} \times 100 = 29.2\% \text{ N} \quad \frac{8.0 \text{ g}}{96.0 \text{ g}} \times 100 = 8.3\% \text{ H}$$

$$\frac{12.0 \text{ g}}{96.0 \text{ g}} \times 100 = 12.5\% \text{ C} \quad \frac{48.0 \text{ g}}{96.0 \text{ g}} \times 100 = 50.0\% \text{ O}$$

2. How many molecules of copper (II) nitrate can be formed from 2.2 grams of oxygen?
- $\text{Cu}(\text{NO}_3)_2$

$$2.2 \text{ g O} \times \frac{1 \text{ mol O}}{16.0 \text{ g O}} \times \frac{1 \text{ mol Cu}(\text{NO}_3)_2}{6 \text{ mol O}} \times \frac{6.02 \times 10^{23} \text{ molec Cu}(\text{NO}_3)_2}{1 \text{ mol Cu}(\text{NO}_3)_2} = 1.4 \times 10^{22} \text{ molec Cu}(\text{NO}_3)_2$$

3. How many grams of aluminum acetate can be formed by the reaction of 30.0 g of acetic acid and 30.0 grams of aluminum hydroxide? How much of which reactant is left?



$$30.0 \text{ g HC}_2\text{H}_3\text{O}_2 \times \frac{1 \text{ mol HC}_2\text{H}_3\text{O}_2}{60.0 \text{ g HC}_2\text{H}_3\text{O}_2} \times \frac{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3}{3 \text{ mol HC}_2\text{H}_3\text{O}_2} \times \frac{204.0 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3}{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3} = 34.0 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3$$

$$30.0 \text{ g Al}(\text{OH})_3 \times \frac{1 \text{ mol Al}(\text{OH})_3}{78.0 \text{ g Al}(\text{OH})_3} \times \frac{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3}{1 \text{ mol Al}(\text{OH})_3} \times \frac{204.0 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3}{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3} = 78.5 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3$$

\*\*\*\*The amount that can be made is 34.0 g because when this amount is produced the acetic acid is used up.

Excess.....78.5 g possible – 34.0 g actually made = 44.5 g  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_3$  not formed

$$44.5 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3 \times \frac{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3}{204.0 \text{ g Al}(\text{C}_2\text{H}_3\text{O}_2)_3} \times \frac{1 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}(\text{C}_2\text{H}_3\text{O}_2)_3} \times \frac{78.0 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} = 17.0 \text{ g Al}(\text{OH})_3$$

4. A compound is analyzed and found to contain 1.594 grams of potassium, 0.978 grams of carbon, 0.122 grams of hydrogen, and 1.305 grams of oxygen. Its molar mass is about 97 g/mol. What are the simplest and molecular formulas for the compound?

$$\begin{array}{ll}
 1.594 \text{ g K} \times \frac{1 \text{ mol K}}{39.1 \text{ g K}} = 0.0408 \text{ mol K} & \frac{0.0408}{0.0408} = 1 \\
 0.978 \text{ g C} \times \frac{1 \text{ mol C}}{12.0 \text{ g C}} = 0.0815 \text{ mol C} & \frac{0.0815}{0.0408} \sim 2 \\
 0.122 \text{ g H} \times \frac{1 \text{ mol H}}{1.0 \text{ g H}} = 0.122 \text{ mol H} & \frac{0.122}{0.0408} \sim 3 \\
 1.305 \text{ g O} \times \frac{1 \text{ mol O}}{16.0 \text{ g O}} = 0.0816 \text{ mol O} & \frac{0.0816}{0.0408} \sim 2
 \end{array}$$

The simplest formula is  $\text{K}_1\text{C}_2\text{H}_3\text{O}_2$

Divide the molar mass by the mass of the simplest formula to see how much larger the molecular formula is.  
 $97/98.1 \sim 1$   
 So, the molecular formula is the same as the simplest formula.

5. How many grams of iron (III) sulfate are in 0.0550 moles of the compound?

$$0.0550 \text{ mol Fe}_2(\text{SO}_4)_3 \times \frac{399.9 \text{ g Fe}_2(\text{SO}_4)_3}{1 \text{ mol Fe}_2(\text{SO}_4)_3} = 22.0 \text{ g Fe}_2(\text{SO}_4)_3$$

6. How many moles of nitrogen are in 22 grams of calcium nitrite?

$$22.0 \text{ g Ca}(\text{NO}_2)_2 \times \frac{1 \text{ mol Ca}(\text{NO}_2)_2}{132.1 \text{ g Ca}(\text{NO}_2)_2} \times \frac{2 \text{ mol N}}{1 \text{ mol Ca}(\text{NO}_2)_2} = 0.33 \text{ mol N}$$

7. In the combustion of 10.0 grams of glycerin,  $\text{C}_3\text{H}_8\text{O}$ , a student collects 6.5 grams of water. What is the student's % yield?



$$10.0 \text{ g C}_3\text{H}_8\text{O}_3 \times \frac{1 \text{ mol C}_3\text{H}_8\text{O}_3}{92.0 \text{ g C}_3\text{H}_8\text{O}_3} \times \frac{8 \text{ mol H}_2\text{O}}{2 \text{ mol C}_3\text{H}_8\text{O}_3} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 7.83 \text{ g H}_2\text{O}$$

$$\frac{\text{actual}}{\text{theoretical}} \times 100 = \% \text{ yield} = \frac{6.5 \text{ g}}{7.83 \text{ g}} \times 100 = 83\%$$