**CHM 1010** **Gage**

# Problem Set for Moles I - Answers

1. What is the % composition of ammonium carbonate?

$(NH_4)_2CO_3$ 2 x 14.0 g N = 28.0 g N
8 x 1.0 g H = 8.0 g H
1 x 12.0 g C = 12.0 g C
3 x 16.0 g O = 48.0 g O
96.0 g $(NH_4)_2CO_3$

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

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

2. How many molecules of copper (II) nitrate can be formed from 2.2 grams of oxygen? $Cu(NO_3)_2$

$$2.2\ gO \times \frac{1\ mol\ O}{16.0\ g\ O} \times \frac{1\ mol\ Cu(NO_3)_2}{6\ mol\ O} \times \frac{6.02 \times 10^{23} molec\ Cu(NO_3)_2}{1\ mol\ Cu(NO_3)_2} = 1.4 \times 10^{22} molec\ Cu(NO_3)_2$$

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?

Acetic acid + aluminum hydroxide -----> aluminum acetate + water

$3\ HC_2H_3O_2 + Al(OH)_3 \text{ -----> } Al(C_2H_3O_2)_3 + 3\ H_2O$

$$30.0\ g\ HC_2H_3O_2 \times \frac{1\ mol\ HC_2H_3O_2}{60.0g\ HC_2H_3O_2} \times \frac{1\ mol\ Al(C_2H_3O_2)_3}{3\ mol\ HC_2H_3O_2} \times \frac{204.0\ g\ Al(C_2H_3O_2)_3}{1\ mol\ Al(C_2H_3O_2)_3} = 34.0\ g\ Al(C_2H_3O_2)_3$$

$$30.0g\ Al(OH)_3 \times \frac{1\ mol\ Al(OH)_3}{78.0\ g\ Al(OH)_3} \times \frac{1\ mol\ Al(C_2H_3O_2)_3}{1\ mol\ Al(OH)_3} \times \frac{204.0\ g\ Al(C_2H_3O_2)_3}{1\ mol\ Al(C_2H_3O_2)_3} = 78.5\ g\ Al(C_2H_3O_2)_3$$

****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 $Al(C_2H_3O_2)_3$ not formed

$$44.5\ g\ Al(C_2H_2O_3)_3 \times \frac{1\ mol\ Al(C_2H_2O_3)_3}{204.0\ g\ Al(C_2H_2O_3)_3} \times \frac{1\ mol\ Al(OH)_3}{1\ mol\ Al(C_2H_2O_3)_3} \times \frac{78.0\ g\ Al(OH)_3}{1\ mol\ Al(OH)_3} = 17.0\ g\ Al(OH)_3$$

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?

$1.594\ g\ K \times \frac{1\ mol\ K}{39.1\ g\ K} = 0.0408\ mol\ K$ $\quad \frac{0.0408}{0.0408} = 1$

$0.978\ g\ C \times \frac{1\ mol\ C}{12.0\ g\ C} = 0.0815\ mol\ C$ $\quad \frac{0.0815}{0.0408} \sim 2$

$0.122\ g\ H \times \frac{1\ mol\ H}{1.0\ g\ H} = 0.122\ mol\ H$ $\quad \frac{0.122}{0.0408} \sim 3$

$1.305\ g\ O \times \frac{1\ mol\ O}{16.0\ g\ O} = 0.0816\ mol\ O$ $\quad \frac{0.0816}{0.0408} \sim 2$

The simplest formula is $K_1C_2H_3O_2$

Divide the molar mass by the mass of the simplest formula to see how much larger the molecular formula is.

97/98.1 ~ 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?

$$0.0550\ mol\ Fe_2(SO_4)_3 \times \frac{399.9\ g\ Fe_2(SO_4)_3}{1\ mol\ Fe_2(SO_4)_3} = 22.0\ g\ Fe_2(SO_4)_3$$

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

$$22.0\ g\ Ca(NO_2)_2 \times \frac{1\ mol\ Ca(NO_2)_2}{132.1\ g\ Ca(NO_2)_2} \times \frac{2\ mol\ N}{1\ mol\ Ca(NO_2)_2} = 0.33\ mol\ N$$

7. In the combustion of 10.0 grams of glycerin, $C_3H_8O$, a student collects 6.5 grams of water. What is the student's % yield?

$$2\ C_3H_8O + 7\ O_2 \text{ ---------> } 6\ CO_2 + 8\ H_2O$$

$$10.0\ g\ C_3H_8O_3 \times \frac{1\ mol\ C_3H_8O_3}{92.0\ g\ C_3H_8O_3} \times \frac{8\ mol\ H_2O}{2\ mol\ C_3H_8O_3} \times \frac{18.0\ g\ H_2O}{1\ mol\ H_2O} = 7.83\ g\ H_2O$$

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