CHM 1010 **Gage**

PROBLEMS INVOLVING MOLES III - Answers

1. What is the mass of one molecule of potassium chromate in grams? K_2CrO_4

$$\frac{194.2 \text{ g/mol}}{6.02 \times 10^{23} \text{ molecules/mole}} = 3.23 \times 10^{-22} \text{ g/molecule}$$

2. How many grams of sodium acetate can be formed from 3.4×10^{22} atoms of oxygen?

$$3.4 \times 10^{22} \text{ atoms O} \times \frac{1 \text{ mol O}}{6.02 \times 10^{23} \text{ atoms O}} \times \frac{1 \text{ mol } NaC_2H_3O_2}{2 \text{ mol O}} \times \frac{82.0 \text{ g } NaC_2H_3O_2}{1 \text{ mol } NaC_2H_3O_2} = 2.3 \text{ g } NaC_2H_3O_2$$

3. How many moles of sulfur are in 32.0 grams of aluminum sulfate?

$$32.0 \text{ g } Al_2(SO_4)_3 \times \frac{1 \text{ mol } Al_2(SO_4)_3}{342.3 \text{ g } Al_2(SO_4)_3} \times \frac{3 \text{ mol S}}{1 \text{ mol } Al_2(SO_4)_3} = 0.280 \text{ mol S}$$

Use the following equation to answer questions 4-8.

$$2\ C_4H_8O + 11\ O_2 \text{ ----------> } 8\ CO_2 + 8\ H_2O \quad \text{(balanced)}$$

4. How many moles of CO_2 are formed from 0.762 moles of oxygen?

$$0.762 \text{ mol } O_2 \times \frac{8 \text{ mol } CO_2}{11 \text{ mol } O_2} = 0.554 \text{ mol } CO_2$$

5. How many grams of oxygen are required to completely react with 2.34 moles of C_4H_8O?

$$2.34 \text{ mol } C_4H_8O \times \frac{11 \text{ mol } O_2}{2 \text{ mol } C_4H_8O} \times \frac{32.0 \text{ g } O_2}{1 \text{ mol } O_2} = 412 \text{ g } O_2$$

6. What mass of carbon dioxide is produced from the combustion of 36.7 grams of C_4H_8O?

$$36.7 \text{ g } C_4H_8O \times \frac{1 \text{ mol } C_4H_8O}{72.0 \text{ g } C_4H_8O} \times \frac{8 \text{ mol } CO_2}{2 \text{ mol } C_4H_8O} \times \frac{44.0 \text{ g } CO_2}{1 \text{ mol } CO_2} = 89.7 \text{ g } CO_2$$

7. a. How many grams of water are formed when 25.0 grams of C_4H_8O react with 25.0 grams of oxygen?

$$25.0 \text{ g } C_4H_8O \times \frac{1 \text{ mol } C_4H_8O}{72.0 \text{ g } C_4H_8O} \times \frac{8 \text{ mol } H_2O}{2 \text{ mol } C_4H_8O} \times \frac{18.0 \text{ g } H_2O}{1 \text{ mol } H_2O} = 25.0 \text{ g } H_2O$$

$$25.0 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32.0 \text{ g } O_2} \times \frac{8 \text{ mol } H_2O}{11 \text{ mol } O_2} \times \frac{18.0 \text{ g } H_2O}{1 \text{ mol } H_2O} = 10.2 \text{ g } H_2O \quad \triangleleft\triangleleft\triangleleft$$

b. How much of which reactant is in excess and by how much?

25.0 g water possible – 10.2 g made = 14.8 g water not made

$$14.8 \text{ g } H_2O \times \frac{1 \text{ mol } H_2O}{18.0 \text{ g } H_2O} \times \frac{2 \text{ mol } C_4H_8O}{8 \text{ mol } H_2O} \times \frac{72.0 \text{ g } C_4H_8O}{1 \text{ mol } C_4H_8O} = 14.8 \text{ g } C_4H_8O$$

8. Starting with 68 grams of oxygen a student produces 20.0 grams of water. What is the student's % yield?

$$68 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32.0 \text{ g } O_2} \times \frac{8 \text{ mol } H_2O}{11 \text{ mol } O_2} \times \frac{18.0 \text{ g } H_2O}{1 \text{ mol } H_2O} = 28 \text{ g } H_2O$$

$$\frac{\text{actual}}{\text{theor}} \times 100 = \%\text{ yield} = \frac{20.0}{28} \times 100 = 71\%$$

9. A compound a molar mass of 143± 2 g/mol and the following composition: 50.7% C, 7.04% H, 19.7% N, and 22.5% O. What are the simplest and molecular formulas for the compound?

$50.7\text{ g C} \times \frac{1\text{ mol C}}{12.0\text{ g C}} = 4.23\text{ mol C}$ $\frac{4.23}{1.41} \approx 3$

$7.04\text{ g H} \times \frac{1\text{ mol H}}{1.0\text{ g C}} = 7.04\text{ mol H}$ $\frac{7.04}{1.41} \approx 5$

$19.7\text{ g N} \times \frac{1\text{ mol N}}{14.0\text{ g N}} = 1.41\text{ mol N}$ $\frac{1.41}{1.41} = 1$

$22.5\text{ g O} \times \frac{1\text{ mol O}}{16.0\text{ g O}} = 1.41\text{ mol O}$ $\frac{1.41}{1.41} = 1$

The simplest formula is $C_3H_5N_1O_1$.

Find the molecular formula by dividing the molar mass by the molar mass of the simplest formula and multiplying the subscripts by that factor.

143/71 ~ 2

So the molecular formula is $C_6H_{10}N_2O_2$.