

REVIEW QUESTIONS

Chapter 3

1. What mass of chlorine is present in 12.2 g of PbCl_2 ?

$$12.2 \text{ g } \text{PbCl}_2 \times \frac{1 \text{ mol}}{278.1 \text{ g}} \times \frac{2 \text{ Cl}}{1 \text{ PbCl}_2} \times \frac{35.45 \text{ g}}{1 \text{ mol}} = 3.11 \text{ g}$$

2. How many atoms of oxygen are present in 2.15 g of $\text{Ca}_3(\text{PO}_4)_2$?

$$2.15 \text{ g } \text{Ca}_3(\text{PO}_4)_2 \times \frac{1 \text{ mol}}{310.2 \text{ g}} \times \frac{8 \text{ O}}{1 \text{ Ca}_3(\text{PO}_4)_2} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = 3.34 \times 10^{22} \text{ O atoms}$$

3. What is the percent composition of caffeine ($\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$)?

$$\text{molar mass} = 194.2 \text{ g/mol}$$

$$\% \text{ C} = \frac{8 \times 12.0}{194.2} \times 100 = 49.4\%$$

$$\% \text{ H} = \frac{10 \times 1.01}{194.2} \times 100 = 5.20\%$$

$$\% \text{ N} = \frac{4 \times 14.0}{194.2} \times 100 = 28.8\%$$

$$\% \text{ O} = \frac{2 \times 16.0}{194.2} \times 100 = 16.5\%$$

$$\text{Total} = 99.9\% \cong 100\%$$

4. Determine the empirical formula for a compound with the following composition:

62.1% C

5.21% H

12.1% N

20.7% O

$$\text{mol C} = 62.1 \text{ g} \times \frac{1 \text{ mol}}{12.0 \text{ g}} = 5.175 \quad (6) \xrightarrow{\times 2} (12)$$

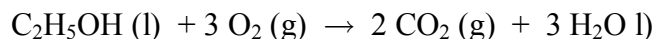
$$\text{mol H} = 5.21 \text{ g} \times \frac{1 \text{ mol}}{1.01 \text{ g}} = 5.158 \quad (6) \xrightarrow{\times 2} (12)$$

$$\text{mol N} = 12.1 \text{ g} \times \frac{1 \text{ mol}}{14.0 \text{ g}} = 0.8643 \quad (1) \xrightarrow{\times 2} (2)$$

$$\text{mol O} = 20.7 \text{ g} \times \frac{1 \text{ mol}}{16.0 \text{ g}} = 1.294 \quad (1.5) \xrightarrow{\times 2} (3)$$

$$\text{Empirical formula} = \text{C}_{12}\text{H}_{12}\text{N}_2\text{O}_3$$

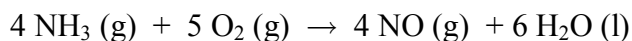
5. The alcohol in “gasohol” burns according to the equation shown below:



How many grams of CO_2 are produced when 3.00 g of $\text{C}_2\text{H}_5\text{OH}$ burns according to this reaction? (Assume excess oxygen)

$$3.00 \text{ g } \text{C}_2\text{H}_5\text{OH} \times \frac{1 \text{ mol}}{46.0 \text{ g}} \times \frac{2 \text{ CO}_2}{1 \text{ C}_2\text{H}_5\text{OH}} \times \frac{44.0 \text{ g}}{1 \text{ mol}} = 5.74 \text{ g CO}_2$$

6. How many grams of NO form when 1.50 g NH_3 react with 1.85 g of O_2 as shown below:



$$1.50 \text{ g } \text{NH}_3 \times \frac{1 \text{ mol}}{17.0 \text{ g}} = 0.08824 \text{ mol}$$

$$1.85 \text{ g } \text{O}_2 \times \frac{1 \text{ mol}}{32.0 \text{ g}} = 0.05781 \text{ mol}$$

$$0.08824 \text{ mol } \text{NH}_3 \times \frac{5 \text{ O}_2}{4 \text{ NH}_3} = 0.1103 \text{ mol O}_2 \text{ needed to completely react with NH}_3$$

0.05781 mol actual < 0.1103 mol needed, therefore O_2 is the Limiting Reactant

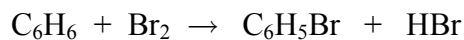
$$0.05781 \text{ mol } \text{O}_2 \times \frac{4 \text{ NO}}{5 \text{ O}_2} \times \frac{30.0 \text{ g}}{1 \text{ mol}} = 1.34 \text{ g NO}$$

Alternate Solution:

$$1.50 \text{ g } \text{NH}_3 \times \frac{1 \text{ mol}}{17.0 \text{ g}} \times \frac{4 \text{ NO}}{4 \text{ NH}_3} \times \frac{30.0 \text{ g}}{1 \text{ mol}} = 2.65 \text{ g NO}$$

$$1.85 \text{ g } \text{O}_2 \times \frac{1 \text{ mol}}{32.0 \text{ g}} \times \frac{4 \text{ NO}}{5 \text{ O}_2} \times \frac{30.0 \text{ g}}{1 \text{ mol}} = 1.34 \text{ g NO} \leftarrow \text{LR (correct answer)}$$

7. When 30.0 g of benzene (C₆H₆) and 65.0 g of bromine are reacted together as shown below, 56.7 g of bromobenzene (C₆H₅Br) is formed. What is the percent yield of this reaction?



$$30.0 \text{ g C}_6\text{H}_6 \times \frac{1 \text{ mol}}{78.1 \text{ g}} = 0.3841 \text{ mol}$$

$$65.0 \text{ g Br}_2 \times \frac{1 \text{ mol}}{159.8 \text{ g}} = 0.4068 \text{ mol}$$

$$0.3841 \text{ mol C}_6\text{H}_6 \times \frac{1 \text{ Br}_2}{1 \text{ C}_6\text{H}_6} = 0.3841 \text{ mol Br}_2 \text{ needed to completely react with C}_6\text{H}_6$$

0.4068 mol actual > 0.3841 mol needed, therefore C₆H₆ is the Limiting Reactant

$$0.3841 \text{ mol C}_6\text{H}_6 \times \frac{1 \text{ C}_6\text{H}_5\text{Br}}{1 \text{ C}_6\text{H}_6} \times \frac{156.95 \text{ g}}{1 \text{ mol}} = 60.3 \text{ g C}_6\text{H}_5\text{Br} \leftarrow \text{Theoretical Yield}$$

$$\% \text{ Yield} = \frac{56.7}{60.3 \text{ g}} \times 100 = 94.0\%$$