Name : _____   Date : _____

Limiting Reagent and Percentage Yield

1 Consider the following reaction:
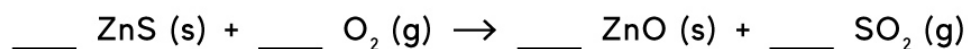
$$P_4O_{10} + 6\,H_2O \longrightarrow 4\,H_3PO_4$$

   ⓐ Suppose 3 moles of P_4O_{10} and 9 moles of H_2O react. What is the limiting reactant?

   ⓑ How many grams of H_3PO_4 form?

   ⓒ Suppose 575 grams of H_3PO_4 actually forms. What is the percentage yield?

2 A vastamount of sulfur dioxide is formed from zinc sulfide from the following unbalanced reaction. First, balance the reaction.

   ____ ZnS (s) + ____ O_2 (g) $\longrightarrow$ ____ ZnO (s) + ____ SO_2 (g)

Suppose the typical yield is 86 %. How much SO_2 should be expected if 4897 g of ZnS are used?

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① Consider the following reaction:

$$P_4O_{10} + 6\ H_2O \longrightarrow 4\ H_3PO_4$$

ⓐ Suppose 3 moles of P_4O_{10} and 9 moles of H_2O react. What is the limiting reactant?

$$3\ \text{mol}\ P_4O_{10}\ \times\ \frac{4\ \text{mol}\ H_3PO_4}{1\ \text{mol}\ P_4O_{10}}\ =\ 12\ \text{mol}\ H_3PO_4$$

$$9\ \text{mol}\ H_2O\ \times\ \frac{4\ \text{mol}\ H_3PO_4}{6\ \text{mol}\ H_2O}\ =\ 6\ \text{mol}\ H_3PO_4$$

H_2O is the limiting reagent.

ⓑ How many grams of H_3PO_4 form?

$$6\ \text{mol}\ H_2O\ \times\ \frac{98\ \text{g}\ H_3PO_4}{1\ \text{mol}\ H_3PO_4}\ =\ 588\ \text{g}\ H_3PO_4$$

ⓒ Suppose 575 grams of H_3PO_4 actually forms. What is the percentage yield?

$$\text{Percentage yield} = \frac{575\ \text{g}}{588\ \text{g}}\ \times\ 100\ =\ 97.8\ \%$$

② A vastamount of sulfur dioxide is formed from zinc sulfide from the following unbalanced reaction. First, balance the reaction.

$$\underline{\ 2\ }\ ZnS\ (s)\ +\ \underline{\ 3\ }\ O_2\ (g)\ \longrightarrow\ \underline{\ 2\ }\ ZnO\ (s)\ +\ \underline{\ 2\ }\ SO_2\ (g)$$
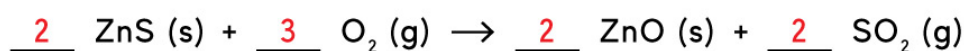
Suppose the typical yield is 86 %. How much SO_2 should be expected if 4897 g of ZnS are used?

$$4897\ \text{g}\ ZnS\ \times\ \frac{1\ \text{mol}\ ZnS}{97.48\ \text{g}\ ZnS}\ \times\ \frac{2\ \text{mol}\ SO_2}{2\ \text{mol}\ ZnS}\ \times\ \frac{64.07\ \text{g}\ SO_2}{1\ \text{mol}\ SO_2}\ =\ 3219\ \text{g}\ SO_2\ \text{(theoretical)}$$

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}}\ \times\ 100$$

$$\Rightarrow\ 0.86\ =\ \frac{\text{actual yield}}{3219\ \text{g}}$$

$$\Rightarrow\ \text{actual yield} = 0.86\ \times 3219\ \text{g} = 2793\ \text{g}$$