Name : _____ Date : _____

Limiting Reagent and Percentage Yield

1. Consider the following equation:

$$2\ KBr\ (aq.) + Cl_2\ (aq.) \longrightarrow 2\ KCl\ (aq.) + Br_2\ (l)$$

   a. Suppose 0.855 g of Cl_2 and 3.205 g of KBr are mixed in a solution. Which is the limiting reagent?

   b. How much excess reagent is left?

2. Solid copper (I) oxide reacts with oxygen to form copper (II) oxide. Suppose 4.18 g of copper (I) oxide reacts with 5.77 g of oxygen. Write down the chemical reaction. What is the theoretical yield? If the actual amount of copper (II) oxide produced is 4.28 g, what is the percentage yield?

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Answers

1. Consider the following equation:

$$2\ KBr\ (aq.) + Cl_2\ (aq.) \longrightarrow 2\ KCl\ (aq.) + Br_2\ (l)$$

a. Suppose 0.855 g of Cl_2 and 3.205 g of KBr are mixed in a solution. Which is the limiting reagent?

$$0.855\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{71\ g\ Cl_2} \times \frac{2\ mol\ KCl}{1\ mol\ Cl_2} \times \frac{74.6\ g\ KCl}{1\ mol\ KCl} = 1.8\ g\ KCl$$

$$3.205\ g\ KBr \times \frac{1\ mol\ KBr}{119\ g\ KBr} \times \frac{2\ mol\ KCl}{2\ mol\ KBr} \times \frac{74.6\ g\ KCl}{1\ mol\ KCl} = 2.01\ g\ KCl$$

Cl_2 is the limiting reagent.

b. How much excess reagent is left?

$$0.855\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{71\ g\ Cl_2} \times \frac{1\ mol\ Br_2}{1\ mol\ Cl_2} \times \frac{159.8\ g\ Br_2}{1\ mol\ Br_2} = 1.92\ g\ Br_2$$

2.01 g of KCl and 1.92 g of Br_2 are formed.

2. Solid copper (I) oxide reacts with oxygen to form copper (II) oxide. Suppose 4.18 g of copper (I) oxide reacts with 5.77 g of oxygen. Write down the chemical reaction. What is the theoretical yield? If the actual amount of copper (II) oxide produced is 4.28 g, what is the percentage yield?

$$2\ Cu_2O\ (s) + O_2\ (g) \longrightarrow 4\ CuO\ (s)$$

$$4.18\ g\ Cu_2O \times \frac{1\ mol\ Cu_2O}{143.1\ g\ Cu_2O} \times \frac{4\ mol\ CuO}{2\ mol\ Cu_2O} \times \frac{79.55\ g\ CuO}{1\ mol\ CuO} = 4.65\ g\ CuO$$

$$5.77\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{4\ mol\ CuO}{1\ mol\ O_2} \times \frac{79.55\ g\ CuO}{1\ mol\ CuO} = 57.4\ g\ CuO$$

Since Cu_2O is the limiting reagent, the theoretical yield of CuO is 4.65 g.

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{4.28\ g}{4.65\ g} \times 100 = 92\ \%$$