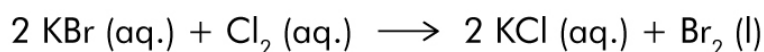


LIMITING REAGENT AND PERCENTAGE YIELD

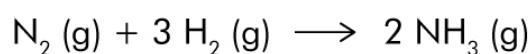
1 Consider the following equation:



a Suppose 1.855 g of Cl_2 and 3.205 g of KBr are mixed in a solution. Which is the limiting reagent?

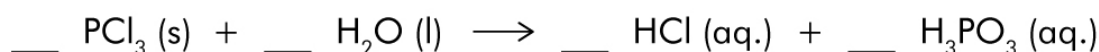
b How many grams of each product are formed?

2 Suppose 25 L of nitrogen reacts with 25 L of hydrogen at STP to produce ammonia.



a Identify the limiting and excess reagents. How many liters of ammonia gas are formed?

3 What is the percentage yield of a reaction in which 201 g of solid phosphorous trichloride reacts with excess water to form 128 g of aqueous hydrogen chloride and aqueous phosphorous acid? First, balance the chemical reaction.



LIMITING REAGENT AND PERCENTAGE YIELD

Answers

- 1 Consider the following equation:



- a) Suppose 1.855 g of Cl_2 and 3.205 g of KBr are mixed in a solution. Which is the limiting reagent?

$$1.855 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \times \frac{2 \text{ mol KCl}}{1 \text{ mol Cl}_2} \times \frac{74.6 \text{ g KCl}}{1 \text{ mol KCl}} = 3.90 \text{ g KCl}$$

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

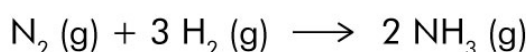
KBr is the limiting reagent.

- b) How many grams of each product are formed?

$$3.205 \text{ g KBr} \times \frac{1 \text{ mol KBr}}{119 \text{ g KBr}} \times \frac{1 \text{ mol Br}_2}{2 \text{ mol KBr}} \times \frac{159.8 \text{ g Br}_2}{1 \text{ mol Br}_2} = 2.15 \text{ g Br}_2$$

2.01 g of KCl and 2.15 g of Br_2 are formed.

- 2 Suppose 25 L of nitrogen reacts with 25 L of hydrogen at STP to produce ammonia.



- a) Identify the limiting and excess reagents. How many liters of ammonia gas are formed?

$$25 \text{ L N}_2 \times \frac{1 \text{ mol N}_2}{22.4 \text{ L N}_2} \times \frac{2 \text{ mol NH}_3}{1 \text{ mol N}_2} \times \frac{22.4 \text{ L NH}_3}{1 \text{ mol NH}_3} = 50 \text{ L NH}_3$$

$$25 \text{ L H}_2 \times \frac{1 \text{ mol H}_2}{22.4 \text{ L H}_2} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol H}_2} \times \frac{22.4 \text{ L NH}_3}{1 \text{ mol NH}_3} = 16.7 \text{ L NH}_3$$

H_2 is the limiting reagent, and N_2 is the excess reagent. 16.7 g of NH_3 is formed from this reaction.

- 3 What is the percentage yield of a reaction in which 201 g of solid phosphorous trichloride reacts with excess water to form 128 g of aqueous hydrogen chloride and aqueous phosphorous acid? First, balance the chemical reaction.



$$201 \text{ g PCl}_3 \times \frac{1 \text{ mol PCl}_3}{137.32 \text{ g PCl}_3} \times \frac{3 \text{ mol HCl}}{1 \text{ mol PCl}_3} \times \frac{36.46 \text{ g HCl}}{1 \text{ mol HCl}} = 160 \text{ g HCl}$$

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{128 \text{ g}}{160 \text{ g}} \times 100 = 80 \%$$