

Limiting Reactant and Percentage Yield

- 1 Calcium hydroxide reacts with hydrochloric acid according to the following reaction:



- a) Suppose 6.3 mol of HCl reacts with 2.8 mol Ca(OH)_2 . Which substance is the limiting reactant?
- b) How many moles of the excess reactant remain?
- 2 Aluminum oxidizes according to the following unbalanced reaction: (First, balance it)



- a) 0.048 mol of powdered Al is placed in a container containing 0.030 mol of O_2 . What is the limiting reactant?
- b) How many moles of excess reactant remain?
- 3 In the reaction between CO and Fe_3O_4 , the theoretical yield in an experiment is calculated to be 47.2 g Fe. When a careless chemistry student experiments, the actual yield is 42.9 g Fe. Calculate the percentage yield.

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Answers

- 1 Calcium hydroxide reacts with hydrochloric acid according to the following reaction:



- a) Suppose 6.3 mol of HCl reacts with 2.8 mol Ca(OH)_2 . Which substance is the limiting reactant?

$$2.8 \text{ mol Ca(OH)}_2 \times \frac{1 \text{ mol CaCl}_2}{1 \text{ mol Ca(OH)}_2} = 2.8 \text{ mol CaCl}_2$$

$$6.3 \text{ mol HCl} \times \frac{1 \text{ mol CaCl}_2}{2 \text{ mol HCl}} = 3.2 \text{ mol CaCl}_2$$

Ca(OH)_2 is the limiting reactant.

- b) How many moles of the excess reactant remain?

$$2.8 \text{ mol Ca(OH)}_2 \times \frac{2 \text{ mol HCl}}{1 \text{ mol Ca(OH)}_2} = 5.6 \text{ mol HCl used}$$

$$6.3 \text{ mol HCl} - 5.6 \text{ mol HCl} = 0.7 \text{ mol HCl remain.}$$

- 2 Aluminum oxidizes according to the following unbalanced reaction: (First, balance it)



- a) 0.048 mol of powdered Al is placed in a container containing 0.030 mol of O_2 . What is the limiting reactant?

$$0.048 \text{ mol Al} \times \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} = 0.024 \text{ mol Al}_2\text{O}_3$$

$$0.030 \text{ mol O}_2 \times \frac{2 \text{ mol Al}_2\text{O}_3}{3 \text{ mol O}_2} = 0.020 \text{ mol Al}_2\text{O}_3$$

O_2 is the limiting reactant.

- b) How many moles of excess reactant remain?

$$0.030 \text{ mol O}_2 \times \frac{4 \text{ mol Al}}{3 \text{ mol O}_2} = 0.040 \text{ mol Al used}$$

$$0.048 \text{ mol Al} - 0.040 \text{ mol Al} = 0.008 \text{ mol Al remain.}$$

- 3 In the reaction between CO and Fe_3O_4 , the theoretical yield in an experiment is calculated to be 47.2 g Fe. When a careless chemistry student experiments, the actual yield is 42.9 g Fe. Calculate the percentage yield.

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{42.9 \text{ g}}{47.2 \text{ g}} \times 100 = 90.9\%$$