Stoichiometry Limiting Reactant

1. How many grams of calcium phosphate can be produced from the reaction between 2.50 L of 0.250 M calcium chloride with an excess of phosphoric acid?

2. How many milliliters of 1.50 M nitric acid is required to react with 100.0 g of cuprous oxide?

3. Consider the following unbalanced reaction:

$$\_\_\_\ NH_3 + \_\_\_\ O_2 \rightarrow \_\_\_\ NO + \_\_\_\ H_2O$$

Balance the reaction. 3.25 g of NH_3 is allowed to react with 3.5 g of O_2.

a. Which reactant is the limiting reagent?

b. How many grams of NO are formed?

c. How much excess reagent remains after the reaction?

Stoichiometry Limiting Reactant

Answers

(1) How many grams of calcium phosphate can be produced from the reaction between 2.50 L of 0.250 M calcium chloride with an excess of phosphoric acid?

$$3\ CaCl_2 + 2\ H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6\ HCl$$

$$2.50\ L\ CaCl_2 \times \frac{0.250\ mol\ CaCl_2}{1\ L\ CaCl_2} \times \frac{1\ mol\ Ca_3(PO_4)_2}{3\ mol\ CaCl_2} \times \frac{310\ g\ Ca_3(PO_4)_2}{1\ mol\ Ca_3(PO_4)_2} \quad 64.6\ g\ Ca_3(PO)_2$$

(2) How many milliliters of 1.50 M nitric acid is required to react with 100.0 g of cuprous oxide?

$$14\ HNO_3 + 3Cu_2O \longrightarrow 6\ Cu(NO_3)_2 + 2\ NO + 7H_2O$$

$$100\ g\ Cu_2O \times \frac{1\ mol\ Cu_2O}{143\ g\ Cu_2O} \times \frac{14\ mol\ HNO_3}{3\ mol\ Cu_2O} \times \frac{1000\ ml\ HNO_3}{1.5\ mol\ HNO_3} = 2180\ ml\ HNO_3$$

(3) Consider the following unbalanced reaction:

$$\underline{4}\ NH_3 + \underline{5}\ O_2 \longrightarrow \underline{4}\ NO + \underline{6}\ H_2O$$

Balance the reaction. 3.25 g of NH_3 is allowed to react with 3.5 g of O_2.

(a) Which reactant is the limiting reagent?

$$3.25\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.03\ g\ NH_3} \times \frac{4\ mol\ NO}{4\ mol\ NH_3} \times \frac{30.01\ g\ NO}{1\ mol\ NO} = 5.73\ g\ NO$$

$$3.5\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{4\ mol\ NO}{5\ mol\ O_2} \times \frac{30.01\ g\ NO}{1\ mol\ NO} = 2.63\ g\ NO$$

O_2 is the limiting reagent.

(b) How many grams of NO are formed?

2.63 g of NO are formed.

(c) How much excess reagent remains after the reaction?

$$3.5\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{4\ mol\ NH_3}{5\ mol\ O_2} \times \frac{17.03\ g\ NH_3}{1\ mol\ NH_3} = 1{,}49\ g\ NH_3\ used$$

$3.25\ g\ NH_3 - 1.49\ g\ NH_3 = 1.76\ g\ NH3\ remains.$