Stoichiometry Limiting Reagent

1. Consider the following reaction:

$$\_\_\_ \ AgNO_3 + \_\_\_ \ Na_3PO_4 \longrightarrow \_\_\_ \ Ag_3PO_4 + \_\_\_ \ NaNO_3$$

Balance the reaction.

a. 200 grams of each reactant react. How many grams of silver phosphate are formed?

b. How much excess reagent is left?

2. Consider the following reaction:

$$\_\_\_ \ N_2 + \_\_\_ \ H_2 \longrightarrow \_\_\_ \ NH_3$$

Balance the reaction.

How many grams of NH_3 are produced when 28 g of N_2 reacts with 25 g of H_2? What is the limiting reagent? What is the excess reagent? How many grams of excess reagent remain?

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Answers

(1) Consider the following reaction:

$$\underline{3}\ AgNO_3 + \underline{\quad}\ Na_3PO_4 \longrightarrow \underline{\quad}\ Ag_3PO_4 + \underline{3}\ NaNO_3$$

Balance the reaction.

[a] 200 grams of each reactant react. How many grams of silver phosphate are formed?

$$200\ g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{170\ g\ AgNO_3} \times \frac{1\ mol\ Ag_3PO_4}{3\ mol\ AgNO_3} \times \frac{419\ g\ Ag_3PO_4}{1\ mol\ Ag_3PO_4} = 164\ g\ Ag_3PO_4$$

$$200\ g\ Na_3PO_4 \times \frac{1\ mol\ Na_3PO_4}{164\ g\ Na_3PO_4} \times \frac{1\ mol\ Ag_3PO_4}{1\ mol\ Na_3PO_4} \times \frac{419\ g\ Ag_3PO_4}{1\ mol\ Ag_3PO_4} = 511\ g\ Ag_3PO_4$$

164 g of Ag_3PO_4 are produced.

[b] How much excess reagent is left?

$$200\ g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{170\ g\ AgNO_3} \times \frac{1\ mol\ Na_3PO_4}{3\ mol\ AgNO_3} \times \frac{164\ g\ Na_3PO_4}{1\ mol\ Na_3PO_4} = 64.3\ g\ Na_3PO_4\ used$$

$200\ g\ Na_3PO_4 - 64.3\ g\ Na_3PO_4 = 135.7\ g\ Na_3PO_4$ remains

(2) Consider the following reaction:

$$\underline{\quad}\ N_2 + \underline{3}\ H_2 \longrightarrow \underline{2}\ NH_3$$

Balance the reaction.

How many grams of NH_3 are produced when 28 g of N_2 reacts with 25 g of H_2? What is the limiting reagent? What is the excess reagent? How many grams of excess reagent remain?

$$28\ g\ N_2 \times \frac{1\ mol\ N_2}{28\ g\ N_2} \times \frac{2\ mol\ NH_3}{1\ mol\ N_2} \times \frac{17\ g\ NH_3}{1\ mol\ NH_3} = 34\ g\ NH_3$$

$$25\ g\ H_2 \times \frac{1\ mol\ H_2}{2\ g\ H_2} \times \frac{2\ mol\ NH_3}{3\ mol\ H_2} \times \frac{17\ g\ NH_3}{1\ mol\ NH_3} = 142\ g\ NH_3$$

N_2 is the limiting reagent, and H_2 is the excess reagent. 34 g of NH_3 can be produced. Let us calculate how much excess reagent remains.

$$28\ g\ N_2 \times \frac{1\ mol\ N_2}{28\ g\ N_2} \times \frac{3\ mol\ H_2}{1\ mol\ N_2} \times \frac{2\ g\ H_2}{1\ mol\ H_2} = 6\ g\ H_2\ used$$

$25\ g\ H_2 - 6\ g\ H_2 = 19\ g\ H_2$ remains