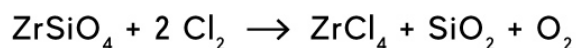


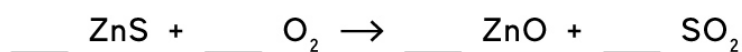
Limiting Reagent and Percentage Yield

- ① Zirconium (IV) orthosilicate reacts with chlorine gas to produce zirconium metal while forming zirconium (IV) chloride.



How much ZrCl_4 can be produced if 862 g of ZrSiO_4 and 950 g of Cl_2 are available? Determine the limiting reagent first.

- ② Heating zinc sulfide in the presence of oxygen gives the following reaction: (balance the equation)



- ① a) Suppose 1.72 mol of ZnS is heated in the presence of 3.04 mol O_2 . Which is the limiting reagent?

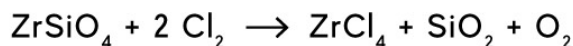
- ① b) How many grams of excess reagent remain?

- ③ When NH_3 is prepared from 28 g N_2 and excess H_2 , the theoretical yield of NH_3 is 34 g. When this reaction is carried out in a given experiment, only 30 g is yielded. What is the percentage yield?

Limiting Reagent and Percentage Yield

Answers

- ① Zirconium (IV) orthosilicate reacts with chlorine gas to produce zirconium metal while forming zirconium (IV) chloride.



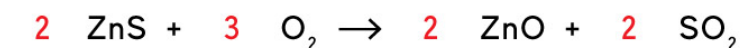
How much ZrCl_4 can be produced if 862 g of ZrSiO_4 and 950 g of Cl_2 are available? Determine the limiting reagent first.

$$862 \text{ g ZrSiO}_4 \times \frac{1 \text{ mol ZrSiO}_4}{183.3 \text{ g ZrSiO}_4} \times \frac{1 \text{ mol ZrCl}_4}{1 \text{ mol ZrSiO}_4} \times \frac{233.2 \text{ g ZrCl}_4}{1 \text{ mol ZrCl}_4} = 1096.67 \text{ g ZrCl}_4$$

$$950 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{71 \text{ g Cl}_2} \times \frac{1 \text{ mol ZrCl}_4}{2 \text{ mol Cl}_2} \times \frac{233.2 \text{ g ZrCl}_4}{1 \text{ mol ZrCl}_4} = 1560.14 \text{ g ZrCl}_4$$

ZrSiO_4 is the limiting reagent. The mass of ZrCl_4 produced is 1096.67 g.

- ② Heating zinc sulfide in the presence of oxygen gives the following reaction: (balance the equation)



- ① Suppose 1.72 mol of ZnS is heated in the presence of 3.04 mol O_2 . Which is the limiting reagent?

$$1.72 \text{ mol ZnS} \times \frac{3 \text{ mol O}_2}{2 \text{ mol ZnS}} = 2.58 \text{ mol O}_2$$

$$3.04 \text{ mol O}_2 \times \frac{2 \text{ mol ZnS}}{3 \text{ mol O}_2} = 2.03 \text{ mol ZnS}$$

ZnS is the limiting reagent.

- ② How many grams of excess reagent remain?

$$3.04 \text{ mol O}_2 - 2.58 \text{ mol O}_2 = 0.46 \text{ mol O}_2$$

$$0.46 \text{ mol O}_2 \times \frac{32 \text{ g O}_2}{1 \text{ mol O}_2} = 14.72 \text{ g O}_2 \text{ remains}$$

- ③ When NH_3 is prepared from 28 g N_2 and excess H_2 , the theoretical yield of NH_3 is 34 g. When this reaction is carried out in a given experiment, only 30 g is yielded. What is the percentage yield?

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{30 \text{ g}}{34 \text{ g}} \times 100 = 88 \%$$