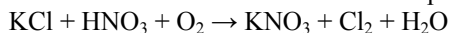


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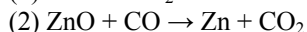
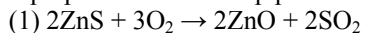
### Stoichiometry for Experts

(1) Potassium nitrate is used in fertilizers and is prepared according to the following unbalanced equation:



- Balance the chemical equation.
- Calculate the mass of each reactant that must be available to produce 5.67 kg of potassium nitrate.
- What mass of  $\text{Cl}_2$  and  $\text{H}_2\text{O}$  will be produced?

(2) Zinc is prepared in a two-step process according to the two reactions below:



(a) If 300 g of zinc sulphide are combined with 250 g of oxygen, determine the mass of zinc oxide that will be produced if the reaction has a 90.0% yield. What mass of sulphur dioxide will be obtained?

(b) The zinc oxide produced is then reacted with 100 g of CO. If 110 g of zinc are produced, what is the percent yield for the reaction? What mass of carbon dioxide will be obtained?

(3) Tetrasilane ( $\text{Si}_4\text{H}_{10}$ ) is a liquid with a density of 0.825 g/mL. Tetrasilane reacts with oxygen to produce silica ( $\text{SiO}_2$ ) and water.

- Write a balanced chemical equation for this reaction.
- Calculate the mass of silica that would form if 25.0 mL of tetrasilane is reacted with excess oxygen.
- What volume of water would be obtained? How many molecules of water are produced?

(4) Methane ( $\text{CH}_4$ ) is reacted with ammonia ( $\text{NH}_3$ ) to produce hydrocyanic acid and hydrogen gas.

- Write a balanced chemical equation for this reaction.
- If 500.0 g of methane are combined with 200.0 g of ammonia, determine the mass of each product.
- What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?
- If the reaction has a percent yield of 75.0%, what mass of each product would actually be obtained?

(5) In an experiment, 46.19 g of an unknown metal (with a charge of positive two) is reacted with copper (II) sulphate. The reaction produces 50.00 g of copper. Determine the molar mass of the unknown metal. Identify the metal.

Answers:

(1)  $4.18 \times 10^3$  g KCl,  $3.53 \times 10^3$  g  $\text{HNO}_3$ , 449 g  $\text{O}_2$ ,  $1.99 \times 10^3$  g  $\text{Cl}_2$ , and 505 g  $\text{H}_2\text{O}$

(2) 226 g ZnO and 176 g  $\text{SO}_2$  60.4% and 73.7 g  $\text{CO}_2$

(3) 40.5 g  $\text{SiO}_2$  15.2 mL  $\text{H}_2\text{O}$   $5.07 \times 10^{23}$  molecules  $\text{H}_2\text{O}$

(4) theoretical yield: 317.3 g HCN and 71.01 g  $\text{H}_2$ , 188.4 g  $\text{CH}_4$  used and 311.6 g  $\text{CH}_4$  remaining,  
actual yield: 238.0 g HCN and 53.26 g  $\text{H}_2$

(5) 58.71 g/mol Nickel