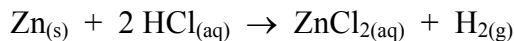


Reaction Stoichiometry I

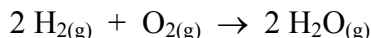
Mass-Mole Relationships and Limiting Reactant

1. According to the equation given on the board, what mass of H₂ can be produced by the reaction of 10.0 g of Zn with the hydrochloric acid?



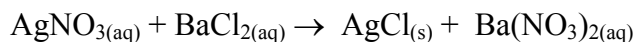
$$m_{\text{H}_2} = 10.0 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{63.59 \text{ g Zn}} \times \frac{1 \text{ mol H}_2}{1 \text{ mol Zn}} \times 2.016 \frac{\text{g H}_2}{\text{mol H}_2} = 0.3083 \text{ g} = 0.308 \text{ g H}_2$$

2. According to the equation of the reaction of H₂ with O₂, what mass of water can be made from the mass of hydrogen from question 1?

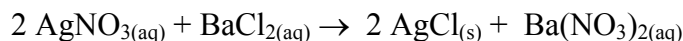


$$m_{\text{H}_2\text{O}} = 0.3083 \text{ g H}_2 \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} \times 18.015 \frac{\text{g H}_2\text{O}}{\text{mol H}_2\text{O}} = 2.76 \text{ g H}_2\text{O}$$

3. For the equation...



- a) Balance the equation



- b) How many moles of silver chloride can be produced starting with 2.0 moles of AgNO₃? ...1.5 moles BaCl₂?

$$n_{\text{AgCl from AgNO}_3} = 2.0 \text{ mol AgNO}_3 \times \frac{2 \text{ mol AgCl}}{2 \text{ mol AgNO}_3} = 2.0 \text{ mol AgCl}$$

$$n_{\text{AgCl from BaCl}_2} = 1.5 \text{ mol BaCl}_2 \times \frac{2 \text{ mol AgCl}}{1 \text{ mol BaCl}_2} = 3.0 \text{ mol AgCl}$$

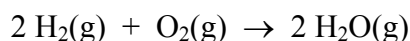
- c) How many mol of AgCl will be produced if 3.00 g of BaCl₂ react with a sufficient amount of AgNO₃?

$$n_{\text{AgCl}} = 3.00 \text{ g BaCl}_2 \times \frac{1 \text{ mol BaCl}_2}{208.24 \text{ g BaCl}_2} \times \frac{2 \text{ mol AgCl}}{1 \text{ mol BaCl}_2} = 0.0288 \text{ mol AgCl}$$

- d. What mass of BaCl_2 is necessary to form 5.15 g of AgCl ? (show the solution using the mass conservation and the “mole-method”).

$$m_{\text{BaCl}_2} = 5.15 \text{ g AgCl} \times \frac{1 \text{ mol AgCl}}{143.3 \text{ g AgCl}} \times \frac{1 \text{ mol BaCl}_2}{2 \text{ mol AgCl}} \times 208.24 \frac{\text{g BaCl}_2}{\text{mol BaCl}_2} = 3.74 \text{ g BaCl}_2$$

4. What mass of water would be formed from the reaction of 5.0 g H_2 , and 30.0 g O_2 ? How much of the excess reagent remains unreacted?



$$n_{\text{H}_2\text{O from H}_2} = \left(5.0 \text{ g H}_2 \div 2.016 \frac{\text{g H}_2}{\text{mol H}_2} \right) \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} = 2.48 \text{ mol H}_2\text{O}$$

$$n_{\text{H}_2\text{O from O}_2} = \left(30.0 \text{ g O}_2 \div 32.00 \frac{\text{g O}_2}{\text{mol O}_2} \right) \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} = 1.875 \text{ mol H}_2\text{O}$$

O_2 is limiting reactant so it determines the mass of H_2O that can be produced:

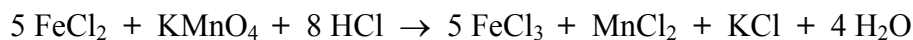
$$m_{\text{H}_2\text{O}} = 1.875 \text{ mol H}_2\text{O} \times 18.015 \frac{\text{g H}_2\text{O}}{\text{mol H}_2\text{O}} = \boxed{34 \text{ g H}_2\text{O}}$$

Determine the mass of H_2 remaining:

$$m_{\text{H}_2 \text{ reacted}} = 1.875 \text{ mol H}_2\text{O} \times \frac{2 \text{ mol H}_2}{2 \text{ mol H}_2\text{O}} \times 2.016 \frac{\text{g H}_2}{\text{mol H}_2} = 3.78 \text{ g H}_2$$

$$m_{\text{H}_2 \text{ remaining}} = 5.0 \text{ g H}_2 - 3.78 \text{ g H}_2 = \boxed{1.2 \text{ g H}_2 \text{ remains unreacted}}$$

5. Calculate the mass of iron(III) chloride produced when 1.05 g iron(II) chloride reacts with 1.10 g of potassium permanganate (KMnO_4) according to the equation...



$$M_{\text{FeCl}_2} = 126.75 \frac{\text{g}}{\text{mol}} \quad M_{\text{FeCl}_3} = 162.21 \frac{\text{g}}{\text{mol}} \quad M_{\text{KMnO}_4} = 158.04 \frac{\text{g}}{\text{mol}}$$

$$n_{\text{FeCl}_3 \text{ from FeCl}_2} = 1.05 \text{ g FeCl}_2 \times \frac{1 \text{ mol FeCl}_2}{126.75 \text{ g FeCl}_2} \times \frac{1 \text{ mol FeCl}_3}{1 \text{ mol FeCl}_2} = 8.284 \times 10^{-3} \text{ mol FeCl}_3$$

$$n_{\text{FeCl}_3 \text{ from KMnO}_4} = 1.10 \text{ g KMnO}_4 \times \frac{1 \text{ mol FeCl}_2}{158.04 \text{ g KMnO}_4} \times \frac{5 \text{ mol FeCl}_3}{1 \text{ mol KMnO}_4} = 3.480 \times 10^{-2} \text{ mol FeCl}_3$$

FeCl_2 is limiting:

$$m_{\text{FeCl}_3} = 8.284 \times 10^{-3} \text{ mol FeCl}_3 \times 162.21 \frac{\text{g FeCl}_3}{\text{mol FeCl}_3} = \boxed{1.34 \text{ g FeCl}_3}$$

Now calculate the mass of KMnO_4 remaining.