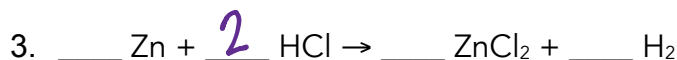
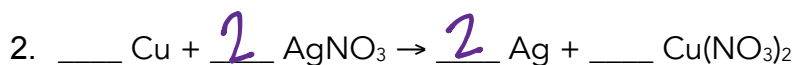
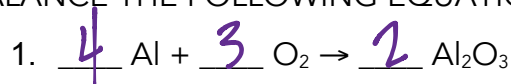


# Stoichiometry Review

**\*\*YOU MUST SHOW ALL WORK AND YOUR ANSWERS MUST INCLUDE THE PROPER NUMBER OF SIG FIGS AND COMPLETE UNITS IN ORDER TO RECEIVE CREDIT FOR THE PROBLEM.\*\***

BALANCE THE FOLLOWING EQUATIONS TO USE IN QUESTIONS 5 – 14:



PERFORM THE FOLLOWING STOICHIOMETRIC CALCULATIONS:

5. Zinc reacts with hydrochloric acid to produce zinc chloride and hydrogen. How many moles of HCl are required to produce 7.50 moles of ZnCl<sub>2</sub>?

$$\frac{7.50 \text{ mol ZnCl}_2}{1 \text{ mol ZnCl}_2} \times \frac{2 \text{ mol HCl}}{1 \text{ mol ZnCl}_2} = 15.0 \text{ mol HCl}$$

6. Copper metal reacts with silver nitrate to form silver and copper(II) nitrate. How many grams of copper are required to form 250 g of silver?

$$\frac{250 \text{ g Ag}}{107.868 \text{ g Ag}} \times \frac{1 \text{ mol Ag}}{1 \text{ mol Ag}} \times \frac{1 \text{ mol Cu}}{2 \text{ mol Ag}} \times \frac{63.546 \text{ g Cu}}{1 \text{ mol Cu}} = 74 \text{ g Cu}$$

7. When aluminum is burned in excess oxygen, aluminum oxide is produced. How many grams of oxygen are required to produce 0.75 moles of Al<sub>2</sub>O<sub>3</sub>?

$$\frac{0.75 \text{ mol Al}_2\text{O}_3}{1 \text{ mol Al}_2\text{O}_3} \times \frac{3 \text{ mol O}_2}{2 \text{ mol Al}_2\text{O}_3} \times \frac{31.998 \text{ g O}_2}{1 \text{ mol O}_2} = 36 \text{ g O}_2$$

8. How many grams of iron(III) chloride are produced when 15.3 g of iron react with excess chlorine gas?

$$\frac{15.3 \text{ g Fe}}{55.845 \text{ g Fe}} \times \frac{1 \text{ mol Fe}}{1 \text{ mol Fe}} \times \frac{2 \text{ mol FeCl}_3}{2 \text{ mol Fe}} \times \frac{162.204 \text{ g FeCl}_3}{1 \text{ mol FeCl}_3} = 44.4 \text{ g FeCl}_3$$

9. Copper metal reacts with silver nitrate to form silver and copper(II) nitrate. How many moles of silver will be produced from 3.65 moles of silver nitrate?

$$\frac{3.65 \text{ mol AgNO}_3}{2 \text{ mol AgNO}_3} \times \frac{2 \text{ mol Ag}}{2 \text{ mol AgNO}_3} = 3.65 \text{ mol Ag}$$

10. How many grams of iron are needed to react with 31.0 L of chlorine gas at STP to produce iron(III) chloride?

$$\frac{31.0 \text{ L Cl}_2}{22.4 \text{ L Cl}_2} \times \frac{1 \text{ mol Cl}_2}{3 \text{ mol Cl}_2} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}} \times \frac{55.845 \text{ g Fe}}{1 \text{ mol Fe}} = 51.5 \text{ g Fe}$$

11. When 9.34 g of zinc react with excess hydrochloric acid how many grams of zinc chloride will be produced?

$$\frac{9.34 \text{ g Zn}}{65.38 \text{ g Zn}} \times \frac{1 \text{ mol Zn}}{1 \text{ mol Zn}} \times \frac{1 \text{ mol ZnCl}_2}{1 \text{ mol Zn}} \times \frac{136.286 \text{ g ZnCl}_2}{1 \text{ mol ZnCl}_2} = 19.5 \text{ g ZnCl}_2$$

12. How many liters of oxygen gas at STP are required to react with 65.3 g of aluminum in the production of aluminum oxide?

$$\frac{65.3 \text{ g Al}}{26.982 \text{ g Al}} \times \frac{1 \text{ mol Al}}{4 \text{ mol Al}} \times \frac{3 \text{ mol O}_2}{1 \text{ mol O}_2} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = 40.7 \text{ L O}_2$$

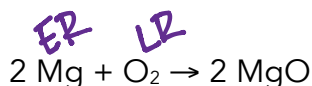
13. Zinc metal reacts with chromium(III) nitrate in a single replacement reaction. How many grams of zinc are required to react with 42.5 g  $\text{Cr}(\text{NO}_3)_3$ ? First, write a balanced equation.

$$\frac{42.5 \text{ g Cr}(\text{NO}_3)_3}{238.008 \text{ g Cr}(\text{NO}_3)_3} \times \frac{1 \text{ mol Cr}(\text{NO}_3)_3}{2 \text{ mol Cr}(\text{NO}_3)_3} \times \frac{3 \text{ mol Zn}}{1 \text{ mol Zn}} \times \frac{65.38 \text{ g Zn}}{1 \text{ mol Zn}} = 65.38 \text{ g Zn}$$

$$2\text{Cr}(\text{NO}_3)_3(\text{aq}) + 3\text{Zn}(\text{s}) \rightarrow 3\text{Zn}(\text{NO}_3)_2(\text{aq}) + 2\text{Cr}(\text{s})$$

PERFORM THE FOLLOWING LIMITING REACTANT PROBLEMS:

14. When 16.3 g of magnesium and 4.52 g of oxygen gas react, how many grams of magnesium oxide will be formed? Identify the limiting and excess reactants. Determine how much excess remains.



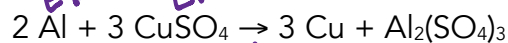
$$\frac{16.3 \text{ g Mg}}{24.305 \text{ g Mg}} \times \frac{1 \text{ mol Mg}}{2 \text{ mol Mg}} \times \frac{2 \text{ mol MgO}}{1 \text{ mol MgO}} \times \frac{40.304 \text{ g MgO}}{1 \text{ mol MgO}} = 27.0 \text{ g MgO}$$

$$\frac{4.52 \text{ g O}_2}{31.998 \text{ g O}_2} \times \frac{1 \text{ mol O}_2}{1 \text{ mol O}_2} \times \frac{2 \text{ mol MgO}}{1 \text{ mol MgO}} \times \frac{40.304 \text{ g MgO}}{1 \text{ mol MgO}} = 11.4 \text{ g MgO}$$

$$\begin{array}{|l|l|l|l|}
 \hline
 11.4 \text{ g MgO} & 1 \text{ mol MgO} & 2 \text{ mol Mg} & 24.305 \text{ g Mg} = 6.87 \text{ g Mg} \\
 \hline
 40.304 \text{ g MgO} & 2 \text{ mol MgO} & 1 \text{ mol Mg} & \text{used} \\
 \hline
 \end{array}$$

$16.3 \text{ g} - 6.87 \text{ g} = 19.43 \text{ g}$

15. If 25.3 g of aluminum reacts with 25.3 g of copper(II) sulfate, how many grams of copper are formed? Identify the limiting and excess reactants in this single replacement reaction. Determine how much excess remains.



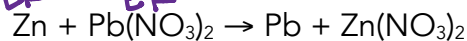
$$\begin{array}{|l|l|l|l|}
 \hline
 25.3 \text{ g Al} & 1 \text{ mol Al} & 3 \text{ mol Cu} & 63.546 \text{ g Cu} = 89.4 \text{ g Cu} \\
 \hline
 26.982 \text{ g Al} & 2 \text{ mol Al} & 1 \text{ mol Cu} & \\
 \hline
 \end{array}$$

$$\begin{array}{|l|l|l|l|}
 \hline
 25.3 \text{ g CuSO}_4 & 1 \text{ mol CuSO}_4 & 3 \text{ mol Cu} & 63.546 \text{ g Cu} = 10.1 \text{ g Cu} \\
 \hline
 159.608 \text{ g CuSO}_4 & 3 \text{ mol CuSO}_4 & 1 \text{ mol Cu} & \\
 \hline
 \end{array}$$

$$\begin{array}{|l|l|l|l|}
 \hline
 10.1 \text{ g Cu} & 1 \text{ mol Cu} & 2 \text{ mol Al} & 26.982 \text{ g Al} = 2.86 \text{ g Al} \\
 \hline
 63.546 \text{ g Cu} & 3 \text{ mol Cu} & 1 \text{ mol Al} & \text{used} \\
 \hline
 \end{array}$$

$$25.3 \text{ g} - 2.86 \text{ g} = 22.4 \text{ g remain}$$

16. Identify the limiting and excess reactants when 1.00 g of zinc reacts with .0375 moles  $\text{Pb}(\text{NO}_3)_2$ . How many grams of lead are formed in this single replacement reaction?



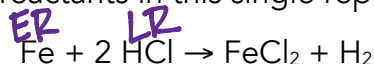
$$\begin{array}{|l|l|l|l|}
 \hline
 1.00 \text{ g Zn} & 1 \text{ mol Zn} & 1 \text{ mol Pb} & 207.2 \text{ g Pb} = 3.17 \text{ g Pb} \\
 \hline
 65.38 \text{ g Zn} & 1 \text{ mol Zn} & 1 \text{ mol Pb} & \\
 \hline
 \end{array}$$

$$\begin{array}{|l|l|l|}
 \hline
 .0375 \text{ mol Pb}(\text{NO}_3)_2 & 1 \text{ mol Pb} & 207.2 \text{ g Pb} = 7.77 \text{ g Pb} \\
 \hline
 & 1 \text{ mol Pb}(\text{NO}_3)_2 & 1 \text{ mol Pb} \\
 \hline
 \end{array}$$

$$\begin{array}{|l|l|l|}
 \hline
 3.17 \text{ g Pb} & 1 \text{ mol Pb} & 1 \text{ mol Pb}(\text{NO}_3)_2 = .0153 \text{ mol Pb}(\text{NO}_3)_2 \\
 \hline
 207.2 \text{ g Pb} & 1 \text{ mol Pb} & \text{used} \\
 \hline
 \end{array}$$

$$.0375 \text{ mol} - .0153 \text{ mol} = .0222 \text{ mol remain}$$

17. If 24.5 g of iron are placed in 0.25 moles HCl, how many grams of  $\text{FeCl}_2$  are obtained? Identify the limiting and excess reactants in this single replacement reaction.

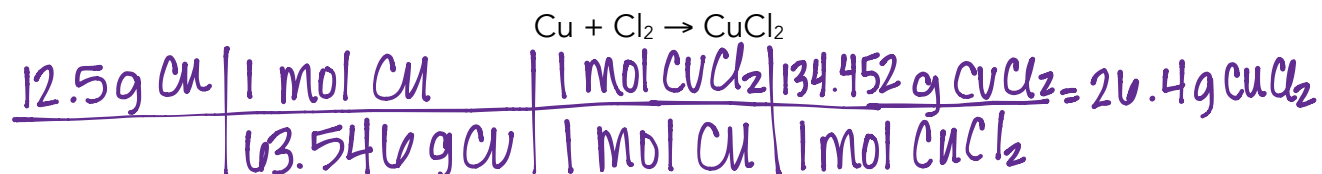


$$\begin{array}{|l|l|l|l|}
 \hline
 24.5 \text{ g Fe} & 1 \text{ mol Fe} & 1 \text{ mol FeCl}_2 & 126.75 \text{ g FeCl}_2 = 55.6 \text{ g FeCl}_2 \\
 \hline
 55.845 \text{ g Fe} & 1 \text{ mol Fe} & 1 \text{ mol FeCl}_2 & \\
 \hline
 \end{array}$$

$$\begin{array}{|l|l|l|}
 \hline
 0.25 \text{ mol HCl} & 1 \text{ mol FeCl}_2 & 126.75 \text{ g FeCl}_2 = 116 \text{ g FeCl}_2 \\
 \hline
 2 \text{ mol HCl} & 1 \text{ mol FeCl}_2 & \\
 \hline
 \end{array}$$

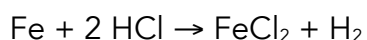
PERFORM THE FOLLOWING PERCENT YIELD CALCULATIONS:

18. If 12.5 g of copper react with excess chlorine gas, then 25.4 g of copper(II) chloride are produced. Find the theoretical and percent yields.



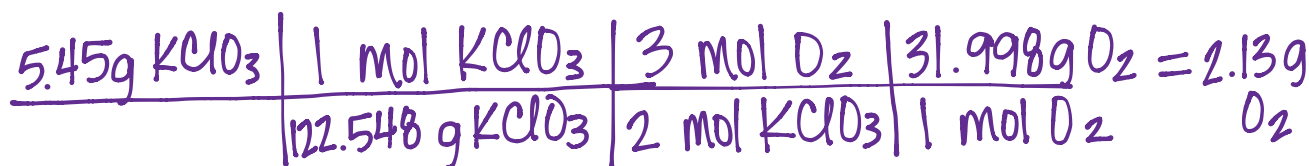
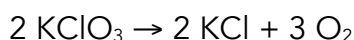
$$\% \text{ Yield} = \frac{\text{actual}}{\text{theo}} \times 100 = \frac{25.4 \text{ g}}{26.4 \text{ g}} \times 100 = 96.2\%$$

19. If 6.57 g of iron react with an excess of hydrochloric acid, HCl, then 11.2 g of iron(II) chloride are obtained in addition to hydrogen gas. Find the theoretical and percent yields.



$$\% \text{ Yield} = \frac{11.2 \text{ g}}{14.9 \text{ g}} \times 100 = 75.2\%$$

20. If 5.45 g of potassium chlorate are decomposed to form potassium chloride, 1.75 g of oxygen gas are also given off. Find the theoretical and percent yields.



$$\% \text{ Yield} = \frac{1.75 \text{ g}}{2.13 \text{ g}} \times 100 = 82.1\%$$