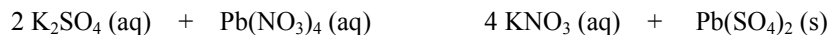


Stoichiometry KEY

1. Please answer the following questions for the balanced equation:



- a. If 2.25 mol of potassium sulfate reacts completely, how many mols of lead (IV) sulfate is produced?

$$2.25 \text{ mol K}_2\text{SO}_4 \left(\frac{1 \text{ mol Pb}(\text{SO}_4)_2}{2 \text{ mol K}_2\text{SO}_4} \right) = 1.13 \text{ mol Pb}(\text{SO}_4)_2$$

- b. If 2.55 g of lead (IV) nitrate is reacted completely, how many grams of potassium nitrate are produced?

$$2.55 \text{ g Pb}(\text{NO}_3)_4 \left(\frac{1 \text{ mol Pb}(\text{NO}_3)_4}{455.24 \text{ g}} \right) \left(\frac{4 \text{ mol KNO}_3}{1 \text{ mol Pb}(\text{NO}_3)_4} \right) \left(\frac{101.11 \text{ g KNO}_3}{1 \text{ mol KNO}_3} \right) = 2.27 \text{ g KNO}_3$$

- c. If 1.75 g of lead (IV) sulfate is produced, how many grams of lead (IV) nitrate was reacted?

$$1.75 \text{ g Pb}(\text{SO}_4)_2 \left(\frac{1 \text{ mol Pb}(\text{SO}_4)_2}{399.34 \text{ g}} \right) \left(\frac{1 \text{ mol Pb}(\text{NO}_3)_4}{1 \text{ mol Pb}(\text{SO}_4)_2} \right) \left(\frac{455.24 \text{ g Pb}(\text{NO}_3)_4}{1 \text{ mol Pb}(\text{NO}_3)_4} \right) = 1.99 \text{ g Pb}(\text{NO}_3)_4$$

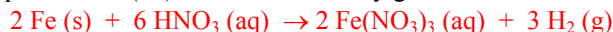
2. Please write out the reaction, balance the equation, and answer the following questions for:

- a. 5.99 g of liquid ethanol ($\text{C}_2\text{H}_6\text{O}$) reacts completely with oxygen gas to produce carbon dioxide and water. How many liters of carbon dioxide gas are produced at STP?



$$5.99 \text{ g C}_2\text{H}_6\text{O} \left(\frac{1 \text{ mol C}_2\text{H}_6\text{O}}{46.08 \text{ g}} \right) \left(\frac{2 \text{ mol CO}_2}{1 \text{ mol C}_2\text{H}_6\text{O}} \right) \left(\frac{22.4 \text{ L}}{1 \text{ mol CO}_2} \right) = 5.82 \text{ L CO}_2$$

- b. Solid iron is dropped into excess nitric acid to produce 7.95 L of hydrogen gas at STP and aqueous iron (III) nitrate. How many grams of iron are used?

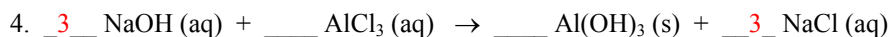


$$7.95 \text{ L H}_2 \left(\frac{1 \text{ mol H}_2}{22.4 \text{ L}} \right) \left(\frac{2 \text{ mol Fe}}{3 \text{ mol H}_2} \right) \left(\frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} \right) = 13.2 \text{ g Fe}$$

3. $\underline{\hspace{1cm}}$ $\text{Pb}(\text{NO}_3)_2 (\text{aq}) + \underline{2}$ $\text{KI} (\text{aq}) \rightarrow \underline{\hspace{1cm}}$ $\text{PbI}_2 (\text{s}) + \underline{2}$ $\text{KNO}_3 (\text{aq})$

a. $23.5 \text{ g Pb}(\text{NO}_3)_2 \left(\frac{1 \text{ mol Pb}(\text{NO}_3)_2}{331.22 \text{ g}} \right) \left(\frac{1 \text{ mol PbI}_2}{1 \text{ mol Pb}(\text{NO}_3)_2} \right) \left(\frac{461.00 \text{ g PbI}_2}{1 \text{ mol PbI}_2} \right) = 32.7 \text{ g PbI}_2$

b. $16.8 \text{ g PbI}_2 \left(\frac{1 \text{ mol PbI}_2}{461.00 \text{ g}} \right) \left(\frac{2 \text{ mol KI}}{1 \text{ mol PbI}_2} \right) \left(\frac{166.00 \text{ g KI}}{1 \text{ mol KI}} \right) = 12.1 \text{ g KI}$



- a. When 33.4 g of sodium hydroxide reacts with 45.9 g of aluminum chloride, how many grams of aluminum hydroxide are produced?

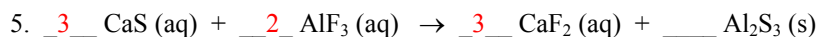
$$33.4 \text{ g NaOH} \left(\frac{1 \text{ mol NaOH}}{40.00 \text{ g}} \right) \left(\frac{1 \text{ mol Al(OH)}_3}{3 \text{ mol NaOH}} \right) \left(\frac{78.01 \text{ g Al(OH)}_3}{1 \text{ mol Al(OH)}_3} \right) = 21.7 \text{ g Al(OH)}_3 \text{ *Answer bz smallest}$$

$$45.9 \text{ g AlCl}_3 \left(\frac{1 \text{ mol AlCl}_3}{133.33 \text{ g}} \right) \left(\frac{1 \text{ mol Al(OH)}_3}{1 \text{ mol AlCl}_3} \right) \left(\frac{78.01 \text{ g Al(OH)}_3}{1 \text{ mol Al(OH)}_3} \right) = 26.9 \text{ g Al(OH)}_3$$

- b. When 25.8 g of aluminum chloride is reacted with 18.9 g of sodium hydroxide, how many grams of sodium chloride are produced?

$$18.9 \text{ g NaOH} \left(\frac{1 \text{ mol NaOH}}{40.00 \text{ g}} \right) \left(\frac{3 \text{ mol NaCl}}{3 \text{ mol NaOH}} \right) \left(\frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} \right) = 27.6 \text{ g NaCl *Answer bz smallest}$$

$$25.8 \text{ g AlCl}_3 \left(\frac{1 \text{ mol AlCl}_3}{133.33 \text{ g}} \right) \left(\frac{3 \text{ mol NaCl}}{1 \text{ mol AlCl}_3} \right) \left(\frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} \right) = 33.9 \text{ g NaCl}$$



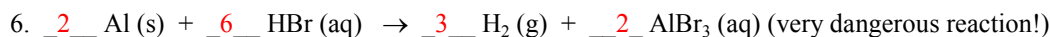
- a. When 24.9 g of calcium sulfide reacts with 22.7 g of aluminum fluoride, what is the theoretical amount of precipitate?

$$24.9 \text{ g CaS} \left(\frac{1 \text{ mol CaS}}{72.15 \text{ g}} \right) \left(\frac{1 \text{ mol Al}_2\text{S}_3}{3 \text{ mol CaS}} \right) \left(\frac{150.17 \text{ g Al}_2\text{S}_3}{1 \text{ mol Al}_2\text{S}_3} \right) = 17.3 \text{ g Al}_2\text{S}_3 \text{ *Answer bz smallest}$$

$$22.7 \text{ g AlF}_3 \left(\frac{1 \text{ mol AlF}_3}{83.98 \text{ g}} \right) \left(\frac{1 \text{ mol Al}_2\text{S}_3}{2 \text{ mol AlF}_3} \right) \left(\frac{150.17 \text{ g Al}_2\text{S}_3}{1 \text{ mol Al}_2\text{S}_3} \right) = 20.3 \text{ g Al}_2\text{S}_3$$

- a. If 15.5 grams of precipitate is collected, what is the percent yield?

$$(15.5 \text{ g} / 17.3 \text{ g}) \times 100\% = 89.6 \% \text{ yield}$$



- a. How many *grams* of hydrogen gas are produced when 18.7 g of aluminum reacts with 15.9 g of hydrobromic acid at STP?

$$18.7 \text{ g Al} \left(\frac{1 \text{ mol Al}}{26.98 \text{ g}} \right) \left(\frac{3 \text{ mol H}_2}{2 \text{ mol Al}} \right) \left(\frac{2.02 \text{ g H}_2}{1 \text{ mol H}_2} \right) = 2.10 \text{ g H}_2$$

$$15.9 \text{ g HBr} \left(\frac{1 \text{ mol HBr}}{80.91 \text{ g}} \right) \left(\frac{3 \text{ mol H}_2}{6 \text{ mol HBr}} \right) \left(\frac{2.02 \text{ g H}_2}{1 \text{ mol H}_2} \right) = 0.198 \text{ g H}_2 \text{ *Answer bz smallest}$$

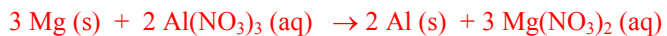
- b. What is the percent yield of hydrogen gas if only 2.00 L of H₂ is collected at STP?

$$18.7 \text{ g Al} \left(\frac{1 \text{ mol Al}}{26.98 \text{ g}} \right) \left(\frac{3 \text{ mol H}_2}{2 \text{ mol Al}} \right) \left(\frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} \right) = 23.3 \text{ L H}_2$$

$$15.9 \text{ g HBr} \left(\frac{1 \text{ mol HBr}}{80.91 \text{ g}} \right) \left(\frac{3 \text{ mol H}_2}{6 \text{ mol HBr}} \right) \left(\frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} \right) = 2.20 \text{ L H}_2 \text{ *Answer bz smallest}$$

$$(2.00 \text{ L} / 2.20 \text{ L}) \times 100\% = 90.9 \% \text{ yield}$$

Harder: When 36.7 g of solid magnesium metal reacts with an aqueous solution containing 40.3g of aluminum nitrate only 68.6 % of solid metal is recovered. Write a balanced equation for this reaction and calculate the mass of metal recovered.



$$36.7 \text{ g Mg } \left(\frac{1 \text{ mol Mg}}{24.31 \text{ g}} \right) \left(\frac{2 \text{ mol Al}}{3 \text{ mol Mg}} \right) \left(\frac{26.98 \text{ g Al}}{1 \text{ mol Al}} \right) = 27.2 \text{ g Al}$$

$$40.3 \text{ g Al(NO}_3)_3 \left(\frac{1 \text{ mol Al(NO}_3)_3}{213.01 \text{ g}} \right) \left(\frac{2 \text{ mol Al}}{2 \text{ mol Al(NO}_3)_3} \right) \left(\frac{26.98 \text{ g Al}}{1 \text{ mol Al}} \right) = 5.10 \text{ g Al} \text{ *Answer bz smallest}$$

$$(x \text{ g} / 5.10) \times 100 \% = 68.6 \% \text{ yield} \quad x \text{ g} = 3.50 \text{ g of Al recovered}$$