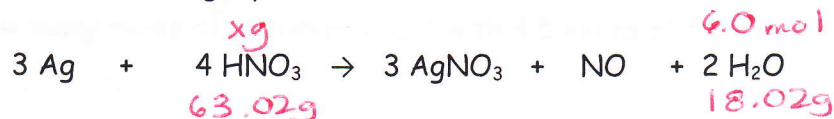


## Stoichiometry Practice #2

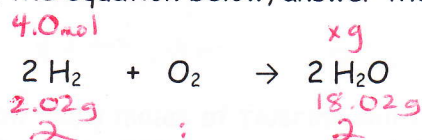
1. Consider the following equation:



What mass of nitric acid,  $\text{HNO}_3$ , is necessary to obtain 6.0 moles of water?

$$6.0 \text{ mol H}_2\text{O} \times \frac{4 \text{ mol HNO}_3}{2 \text{ mol H}_2\text{O}} \times \frac{63.02 \text{ g HNO}_3}{1 \text{ mol HNO}_3} \rightarrow 756.24 \rightarrow \boxed{760 \text{ g HNO}_3}$$

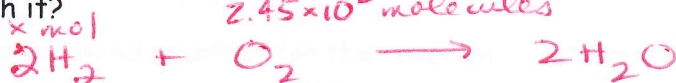
2. Using the equation below, answer the following questions.



- a- If 4.0 moles of  $\text{H}_2$  gas are reacted, how many grams of water would be produced?

$$4.0 \text{ mol H}_2 \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 72.08 \rightarrow \boxed{72 \text{ g H}_2\text{O}}$$

- b- If  $2.45 \times 10^2$  molecules of oxygen gas are available, how many moles of  $\text{H}_2$  would react with it?

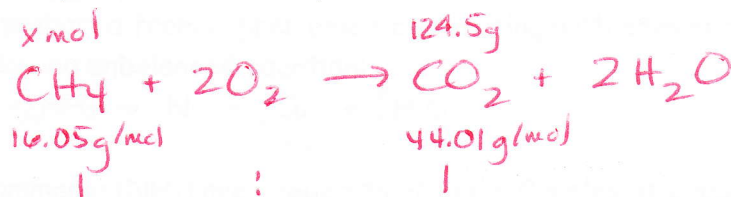


$$2.45 \times 10^2 \text{ molecules O}_2 \times \frac{1 \text{ mol O}_2}{6.023 \times 10^{23} \text{ molecules O}_2} \times \frac{2 \text{ mol H}_2}{1 \text{ mol O}_2} = 8.135 \times 10^{-22} \rightarrow \boxed{8.14 \times 10^{-22} \text{ mol}}$$

3. a- Write a balanced equation for the combustion of methane gas ( $\text{CH}_4$ ) to form carbon dioxide ( $\text{CO}_2$ ) and water vapour ( $\text{H}_2\text{O}$ ).

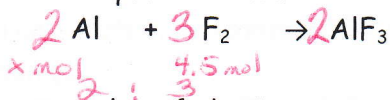


- b- If 124.5 g of  $\text{CO}_2$  is produced, how many moles of  $\text{CH}_4$  must have been reacted?



$$124.5 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol CH}_4}{1 \text{ mol CO}_2} = 2.8289 \rightarrow \boxed{2.829 \text{ mol CH}_4}$$

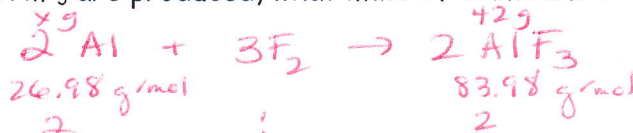
4. a- Balance the equation below:



b- How many moles of aluminum react with 4.5 moles of fluorine?

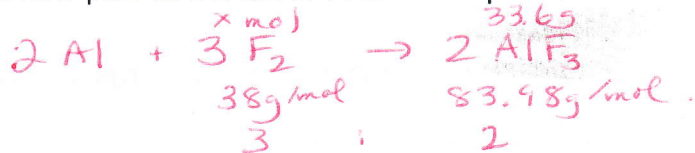
$$4.5 \text{ mol F}_2 \times \frac{2 \text{ mol Al}}{3 \text{ mol F}_2} \rightarrow \boxed{3 \text{ mol Al}}$$

c- If 42 g of aluminum fluoride,  $\text{AlF}_3$  are produced, what mass of aluminum is reacted with fluorine?



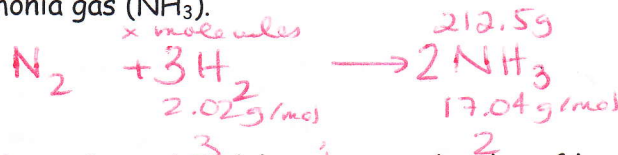
$$42 \text{ g AlF}_3 \times \frac{1 \text{ mol AlF}_3}{83.98 \text{ g AlF}_3} \times \frac{2 \text{ mol Al}}{2 \text{ mol AlF}_3} \times \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = 13.493 \rightarrow \boxed{13 \text{ g Al}}$$

d- How many moles of fluorine will take part in the above reaction to produce 33.6 g of aluminum fluoride?



$$33.6 \text{ g AlF}_3 \times \frac{1 \text{ mol AlF}_3}{83.98 \text{ g AlF}_3} \times \frac{3 \text{ mol F}_2}{2 \text{ mol AlF}_3} \rightarrow 0.6001 \rightarrow \boxed{0.600 \text{ mol F}_2}$$

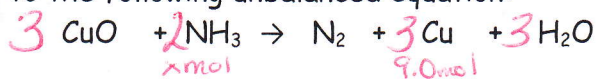
5. a- Write a balanced equation for the reaction of nitrogen gas ( $\text{N}_2$ ) and hydrogen gas ( $\text{H}_2$ ) to produce ammonia gas ( $\text{NH}_3$ ).



b- If 212.5 g of ammonia gas is produced, how many molecules of hydrogen gas must have reacted with the nitrogen?

$$212.5 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \times \frac{3 \text{ mol H}_2}{2 \text{ mol NH}_3} \times \frac{6.023 \times 10^{23} \text{ molecules H}_2}{1 \text{ mol H}_2} = 1.12666 \times 10^{25} \rightarrow \boxed{1.127 \times 10^{25} \text{ molecules H}_2}$$

6. Solid copper can be prepared from copper oxide by reacting with ammonia, according to the following unbalanced equation:

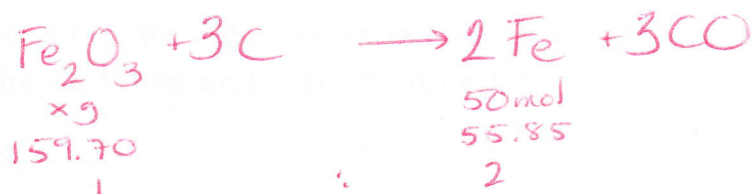


How many moles of ammonia ( $\text{NH}_3$ ) are needed to obtain 9.0 moles of copper ( $\text{Cu}$ )?

$$9.0 \text{ mol Cu} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol Cu}} \rightarrow \boxed{6.0 \text{ mol NH}_3}$$

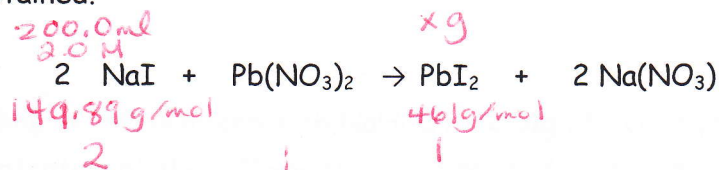
7. Iron (Fe) and carbon monoxide (CO) are produced when iron oxide (Fe<sub>2</sub>O<sub>3</sub>) reacts with carbon (C).

You would like to produce 50 mol of iron, what mass of iron oxide is required?



$$50 \text{ mol Fe} \times \frac{1 \text{ mol Fe}_2\text{O}_3}{2 \text{ mol Fe}} \times \frac{159.70 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = 3992.5 \text{ g} \rightarrow \boxed{4000 \text{ g Fe}_2\text{O}_3}$$

8. 200.0 mL of NaI whose concentration is 2.0 M are reacted with Pb(NO<sub>3</sub>)<sub>2</sub> in order to obtain the precipitate PbI<sub>2</sub> according to the equation below. Calculate the mass of PbI<sub>2</sub> obtained.

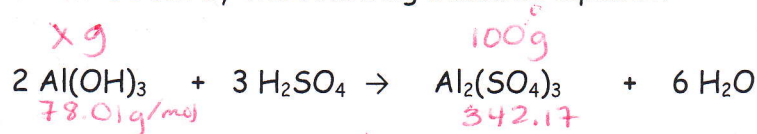


$$\textcircled{1} \quad \frac{2.0 \text{ mol}}{1000 \text{ mL}} : \frac{x \text{ mol}}{200.0 \text{ mL}} \rightarrow 0.4 \text{ mol}$$

$$\textcircled{2} \quad 0.4 \text{ mol NaI} \times \frac{1 \text{ mol PbI}_2}{2 \text{ mol NaI}} \times \frac{461 \text{ g PbI}_2}{1 \text{ mol PbI}_2} = 92.2 \rightarrow \boxed{92 \text{ g PbI}_2}$$

9. When a solution of aluminum hydroxide, Al(OH)<sub>3</sub>, reacts with a solution of sulfuric acid, H<sub>2</sub>SO<sub>4</sub>, the result is a salt, aluminum sulphate, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> and water, H<sub>2</sub>O.

The reaction is seen by the following balanced equation:

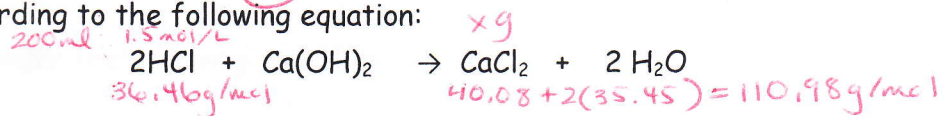


What mass of aluminum hydroxide is required to produce 100.0 g of aluminum sulphate?

$$100.0 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{342.17 \text{ g Al}_2(\text{SO}_4)_3} \times \frac{2 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}_2(\text{SO}_4)_3} \times \frac{78.01 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} = 45.5972 \rightarrow \boxed{45.60 \text{ g Al}(\text{OH})_3}$$



10. Sandy neutralizes 200 mL of HCl at a concentration of 1.5 mol/L using Ca(OH)<sub>2</sub> according to the following equation:

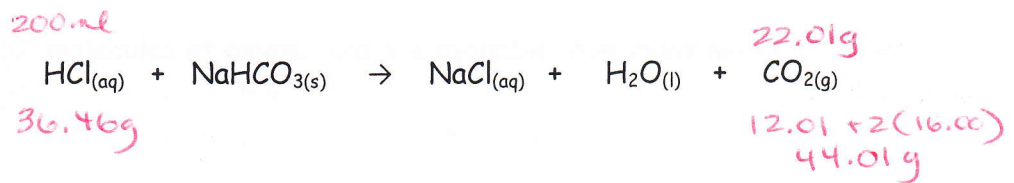


After the neutralization, she allows the water from the beaker to evaporate. What is the mass of the CaCl<sub>2</sub> that will be left in the beaker?

①  $\frac{1.5 \text{ mol}}{1000 \text{ mL}} : \frac{x \text{ mol}}{200 \text{ mL}} \quad 0.3 \text{ mol HCl}$

②  $0.3 \text{ mol HCl} \times \frac{1 \text{ mol CaCl}_2}{2 \text{ mol HCl}} \times \frac{110.98 \text{ g CaCl}_2}{1 \text{ mol CaCl}_2} = 16.647$   
 $\downarrow$   
20 g CaCl<sub>2</sub>

11. When 200 mL of HCl is mixed with NaHCO<sub>3</sub>, 22.01 g of CO<sub>2</sub> is produced. What was the concentration of the HCl solution used to produce this much gas?



①  $22.01 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol HCl}}{1 \text{ mol CO}_2} = 0.5001 \rightarrow 0.5001 \text{ mol HCl}$

②  $\frac{0.5001 \text{ mol HCl}}{200 \text{ mL}} : \frac{x \text{ mol}}{1000 \text{ mL}} = 2.5006$   
 $\downarrow$   
3 mol/L HCl