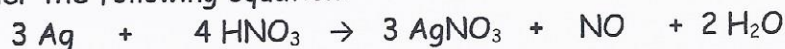


## Stoichiometry worksheet

1. Consider the following equation:



What mass of nitric acid,  $\text{HNO}_3$ , is necessary to obtain 6 moles of water?

*Given*  $6 \text{ mol H}_2\text{O}$   $\times$   $\frac{4 \text{ mol HNO}_3}{2 \text{ mol H}_2\text{O}}$   $\times$   $\frac{63.02 \text{ g HNO}_3}{1 \text{ mol HNO}_3}$  =  $800 \text{ g HNO}_3$

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



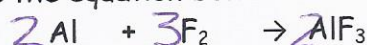
a- If 4.0 moles of  $\text{H}_2$  gas are reacted, how many grams of water would be produced?

*Given*  $4.0 \text{ mol H}_2$   $\times$   $\frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol H}_2}$   $\times$   $\frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}}$  =  $72 \text{ g H}_2\text{O}$

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

*Given*  $2.45 \times 10^2 \text{ molec O}_2$   $\times$   $\frac{1 \text{ mol O}_2}{(6.02 \times 10^{23} \text{ molec O}_2)}$   $\times$   $\frac{2 \text{ mol H}_2}{1 \text{ mol O}_2}$  =  $8.04 \times 10^{-22} \text{ mol H}_2$

3. a- Balance the equation below:



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

*Given*  $4.5 \text{ mol F}_2$   $\times$   $\frac{2 \text{ mol Al}}{3 \text{ mol F}_2}$  =  $3.0 \text{ mol Al}$

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

*Given*  $42 \text{ g AlF}_3$   $\times$   $\frac{1 \text{ mol AlF}_3}{83.98 \text{ g AlF}_3}$   $\times$   $\frac{2 \text{ mol Al}}{2 \text{ mol AlF}_3}$   $\times$   $\frac{26.98 \text{ g Al}}{1 \text{ mol Al}}$  =  $13 \text{ g Al}$

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

Given  

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

4. a- Write a balanced equation for the combustion of methane gas (CH<sub>4</sub>) to form carbon dioxide (CO<sub>2</sub>) and water vapour (H<sub>2</sub>O).



- b- If 124.5 g of CO<sub>2</sub> is produced, how many moles of CH<sub>4</sub> must have been reacted?

Given  

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

5. a- Write a balanced equation for the reaction of nitrogen gas (N<sub>2</sub>) and hydrogen gas (H<sub>2</sub>) to produce ammonia gas (NH<sub>3</sub>).

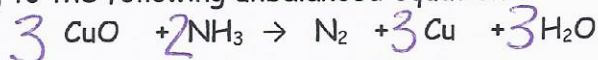


- b- If 212.5 g of ammonia gas is produced, how many molecules of hydrogen gas must have reacted with the nitrogen?

Given  

$$212.5 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \times \frac{3 \text{ mol H}_2}{2 \text{ mol NH}_3} \times \frac{6.02 \times 10^{23}}{1 \text{ mol H}_2} = 1.126 \times 10^{25} \text{ H}_2$$

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



How many moles of ammonia (NH<sub>3</sub>) are needed to obtain 9.0 moles of copper (Cu)?

Given  

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



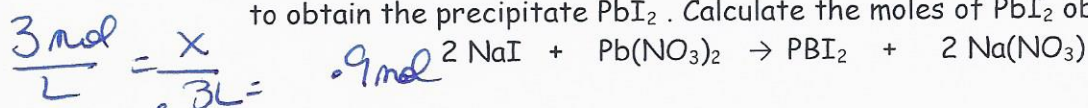
7. Iron (Fe) and carbon monoxide (CO) are produced when iron oxide ( $\text{Fe}_2\text{O}_3$ ) reacts with carbon (C). Write a balanced equation for this reaction.



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

$$\begin{array}{l} \text{G} \\ 50 \text{ mol Fe} \end{array} \times \begin{array}{l} \text{R} \\ \frac{1 \text{ mol Fe}_2\text{O}_3}{2 \text{ mol Fe}} \end{array} \times \begin{array}{l} \text{m m} \\ \frac{159.7 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} \end{array} = \text{4000 g Fe}_2\text{O}_3$$

8. 300 mL of NaI whose concentration is 3 mol/L are reacted with  $\text{Pb}(\text{NO}_3)_2$  in order to obtain the precipitate  $\text{PbI}_2$ . Calculate the moles of  $\text{PbI}_2$  obtained.



$$\begin{array}{l} \text{G} \\ .9 \text{ mol NaI} \end{array} \times \begin{array}{l} \text{R} \\ \frac{1 \text{ mol PbI}_2}{2 \text{ mol NaI}} \end{array} = .5 \text{ mol PbI}_2$$

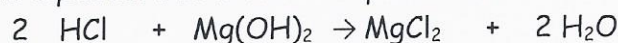
9. When a solution of aluminum hydroxide,  $\text{Al}(\text{OH})_3$ , reacts with a solution of sulfuric acid,  $\text{H}_2\text{SO}_4$ , the result is a salt, aluminum sulphate,  $\text{Al}_2(\text{SO}_4)_3$  and water,  $\text{H}_2\text{O}$ . The reaction is seen by the following unbalanced equation:



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

$$\begin{array}{l} \text{G} \\ 100.0 \text{ g Al}_2(\text{SO}_4)_3 \end{array} \times \begin{array}{l} \text{m m} \\ \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{342.17 \text{ g Al}_2(\text{SO}_4)_3} \end{array} \times \begin{array}{l} \text{R} \\ \frac{2 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}_2(\text{SO}_4)_3} \end{array} \times \begin{array}{l} \text{m m} \\ \frac{78.01 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} \end{array} = 45.6 \text{ g Al}(\text{OH})_3$$

10. Use the equation below to solve questions a and b.



- a- If 650 g of water was produced, how many molecules of magnesium hydroxide  $\text{Mg}(\text{OH})_2$  must have reacted?

$$\begin{array}{l} \text{G} \\ 650 \text{ g H}_2\text{O} \end{array} \times \begin{array}{l} \text{m m} \\ \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \end{array} \times \begin{array}{l} \text{R} \\ \frac{1 \text{ mol Mg}(\text{OH})_2}{2 \text{ mol H}_2\text{O}} \end{array} \times \begin{array}{l} \text{m m} \\ \frac{6.02 \times 10^{23} \text{ molec Mg}(\text{OH})_2}{1 \text{ mol Mg}(\text{OH})_2} \end{array} = 1.1 \times 10^{25} \text{ molec Mg}(\text{OH})_2$$

b- If  $5.3 \times 10^9$  molecules of water are available, how many moles of HCl react with it?

G

$$5.3 \times 10^9 \text{ molec H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{(6.02 \times 10^{23}) \text{ molec H}_2\text{O}} \times \frac{2 \text{ mol HCl}}{2 \text{ mol H}_2\text{O}} = 8.8 \times 10^{-15} \text{ mol HCl}$$

11. Use the equation below to answer questions a and b.



a- If  $4.33 \times 10^7$  molecules of Ag are available, how many moles of silver nitrate  $\text{AgNO}_3$  would react with it?

G

$$4.33 \times 10^7 \text{ molec Ag} \times \frac{1 \text{ mol Ag}}{(6.02 \times 10^{23}) \text{ molec Ag}} \times \frac{2 \text{ mol AgNO}_3}{2 \text{ mol Ag}} = 7.19 \times 10^{-17} \text{ mol AgNO}_3$$

b- If 450.0 g of copper nitrate  $\text{Cu(NO}_3)_2$  was produced, how many Ag atoms must have reacted with the copper nitrate?

G

$$450.0 \text{ g Cu(NO}_3)_2 \times \frac{1 \text{ mol Cu(NO}_3)_2}{187.50 \text{ g Cu(NO}_3)_2} \times \frac{2 \text{ mol Ag}}{1 \text{ mol Cu(NO}_3)_2} \times \frac{6.02 \times 10^{23} \text{ atoms Ag}}{1 \text{ mol Ag}} = 2.890 \times 10^{24} \text{ atoms Ag}$$

12. 85 mL of  $\text{BaCl}_2$  is used to produce  $\text{BaCrO}_4$ . If 9.81 g of  $\text{BaCrO}_4$  is made, what is the concentration of the  $\text{BaCl}_2$  used? The following equation represents the reaction:



G

$$9.81 \text{ g BaCrO}_4 \times \frac{1 \text{ mol BaCrO}_4}{253.33 \text{ g BaCrO}_4} \times \frac{1 \text{ mol BaCl}_2}{1 \text{ mol BaCrO}_4} = \frac{0.038724 \dots}{0.085} = 0.46 \text{ mol/L}$$

13. How many L of a 7.0 M solution of HCl are needed to react with 9.85 g of  $\text{CO}_2$ ? The equation that represents the reaction follows.



G

$$9.85 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol HCl}}{1 \text{ mol CO}_2} = 0.2238 \dots \times \frac{7.0 \text{ mol}}{\text{L}} = 1.5666 \dots \text{ L}$$

14. Kim neutralizes 250 mL of HCl at a concentration of 4.5 mol/L using  $\text{Ca(OH)}_2$

according to the following equation:  $2 \text{HCl} + \text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 + 2 \text{H}_2\text{O}$

What is the mass of the  $\text{CaCl}_2$  that will be left in the beaker?

G

Given

$$1.125 \text{ mol HCl} \times \frac{1 \text{ mol CaCl}_2}{2 \text{ mol HCl}} \times \frac{110.97 \text{ g CaCl}_2}{1 \text{ mol CaCl}_2} = 62.3 \text{ g CaCl}_2$$