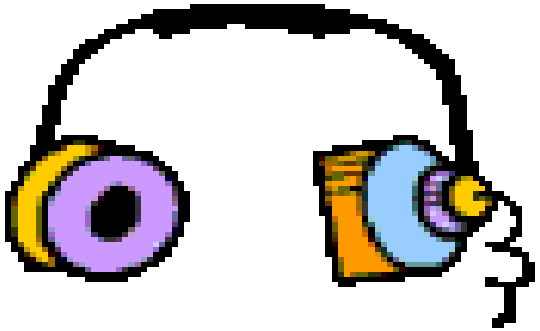
Chemical Quantities (Stoichiometry)



9.2 A

Using Chemical Equations Moles to Moles

9.2 Using Balanced Chemical Equations

Objective

To learn to relate ratios of reactants and products in a chemical reaction

Using Balanced Equations

- Previously, we saw how to use the balanced equation for a reaction is used to understand the numbers of moles, molecules and particles of reactants and products.

- For example in this balanced equation:

$$1_{\text{(understood)}}C_3H_{8\ (g)} + 5O_{2\ (g)} \rightarrow 3CO_{2\ (g)} + 4H_2O_{(g)}$$

there is 1 mole/molecule of C_3H_8 used
there are 5 moles/molecules O_2 used
there are 3 moles/molecules CO_2 produced
there are 4 moles/molecules H_2O produced

So,if you have 5 moles of O_2 you will always produce 4 moles of H_2O

Or, if you have 1 molecules of C_3H_8 you will always produce 3 molecules of CO_2

Using Balanced Equations

- We can also use the balanced equation to calculate number of moles used or produced when the moles available change.
- For example: If we have 8 moles of O_2 available instead of just 5, how many moles of H_2O would be produced?

- $1C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

- We use **mole ratios** to determine that.
- We just look at the ratio between O_2 and H_2O $= 5O_2 : 4H_2O$
- We have to create an equation that solves this problem
- Start with what you are given: 8 moles of O2

Moles to Moles

- Continued…
- If we have 8 moles of O_2 available instead of just 5, how many moles of H_2O would be produced?
- $1C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O\ (g)$

- We have to create an equation that solves this problem and uses the ratio $5O_2 : 4H_2O$
- Start with what you are given: 8 moles of O2
- $8\text{moles } O_2 \times \frac{4\text{moles } H_2O}{5\text{ moles O2}} = \frac{8 \times 4 \text{ moles } H_2O}{5 \text{ moles}} = \frac{32 \text{ moles } H_2O}{5} =$ **6.4 moles H_2O**

Continued…For example: If we have 8 moles of O_2 available instead of just 5, how many moles of H_2O would be produced?

$1C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

- Start with what you are given: 8 moles of O2
- 8moles O_2
- Then use the ratio from the balanced equation $5O_2 : 4H_2O$ but you want to cancel the moles O2 so you flip the ratio upside down

$$8\text{moles } O_2 \times \frac{4\text{moles } H_2O}{5\text{ moles } O_2}$$

$$8\text{moles } O_2 \times \frac{4\text{moles } H_2O}{5\text{ moles O2}} = \frac{8 \times 4\text{ moles } H_2O}{5\text{ moles}}$$

- Calculate

$$\frac{8 \times 4\text{ moles } H_2O}{5} = \frac{32\text{ moles } H_2O}{5} = \textbf{6.4 moles } H_2O$$

- The whole equation will look like this:

$$8\text{moles } O_2 \times \frac{4\text{moles } H_2O}{5\text{ moles O2}} = \frac{8 \times 4\text{ moles } H_2O}{5\text{ moles}} = \frac{32\text{ moles } H_2O}{5} = \textbf{6.4 moles } H_2O$$

Another example

- If we have 5 moles of C_3H_8 available, how many moles of CO_2 can be produced?

- $1C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O\ (g)$

- Step 1- find the mole ratio between C_3H_8 and CO_2 from the balanced equation $1C_3H_8 : 3CO_2$
- Step 2- Start with what is given- 5 moles C_3H_8
- Step 3 – Write the equation so you cancel out moles C_3H_8
- 5 moles C_3H_8 x $\frac{3 \text{ moles } CO_2}{1 \text{ mole } C_3H_8} = \frac{5 \text{ moles x } 3 \text{moles } CO_2}{1 \text{ mole}}$

- Step 4 Calculate= 15moles CO_2 are produced from 5 moles of C_3H_8
- Step 5 – rewrite the whole equation:

- 5 moles C_3H_8 x $\frac{3 \text{ moles } CO_2}{1 \text{ mole } C_3H_8} = \frac{5 \text{ moles x } 3\text{moles } CO_2}{1 \text{ mole}} = 15\text{moles } CO_2$

The End