THE RETURN OF THE MOLE

Sneak preview

Stoichiometry

- Stoichiometry comes from the Greek words stoicheion meaning "*element*" and metron meaning "*measures*"

- In this section we will used balanced chemical equations to give us information about the reactants and the products.

How do you know the number of moles of reactants and products involved in a reaction?

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

The coefficients tell us how many moles of each reactant and product are involved in a reaction.

So in the following equation:

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

2 moles H_2O

2 moles H_2

1 mole O_2

Using this we can make MOLE RATIOS!

What is a MOLE RATIO?

It is a comparison of the number of moles of the compounds involved in a reaction.

If you know the number of moles of one substance in a balanced equation then you can find the number of moles of all other substances in the reaction!
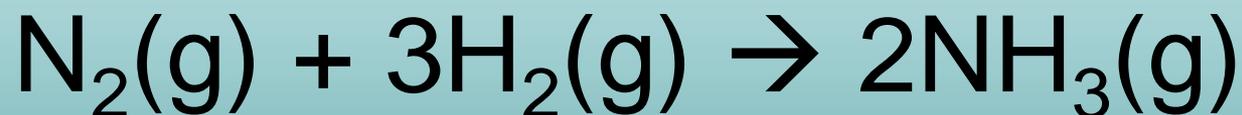
What is a mole ratio?

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$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

$$\dfrac{2 \text{ moles } H_2O}{2 \text{ moles } H_2} \qquad \text{or} \qquad \dfrac{1 \text{ mole } O_2}{2 \text{ moles } H_2O}$$

Now you try

Using the equation below write out the 6 mole ratios:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

The Answers are…

$\dfrac{1 \text{ mol } N_2}{3 \text{ mol } H_2}$ or $\dfrac{3 \text{ mol } H_2}{1 \text{ mol } N_2}$

$\dfrac{2 \text{ mol } NH_3}{1 \text{ mol } N_2}$ or $\dfrac{1 \text{ mol } N_2}{2 \text{ mol } NH_3}$

$\dfrac{2 \text{ mol } NH_2}{3 \text{ mol } H_2}$ or $\dfrac{3 \text{ mol } H_2}{2 \text{ mol } NH_2}$

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

For every 3 moles of H_2 you will get 2 moles NH_3 …

So if you had 6 moles of H_2 how many moles of NH_3 would you have?

6 mol H_2 x $\dfrac{2 \text{ mol } NH_3}{3 \text{ mol } H_2}$ = 4 mol NH_3

Practice

$2HgO(s) \rightarrow 2Hg(l) + O_2(g)$

- Write out all the possible mole ratios

- How many moles of O_2 can be produced if you have 11 moles of HgO?

The Answers are…

$$2HgO(s) \rightarrow 2Hg\ (l) + O_2\ (g)$$

$\dfrac{2\ mol\ HgO}{2\ mol\ Hg}$ or $\dfrac{2\ mol\ Hg}{2\ mol\ HgO}$

$\dfrac{2\ mol\ HgO}{1\ mol\ O_2}$ or $\dfrac{1\ mol\ O_2}{2\ mol\ HgO}$

$\dfrac{2\ mol\ Hg}{1\ mol\ O_2}$ or $\dfrac{1\ mol\ O_2}{2\ mol\ Hg}$
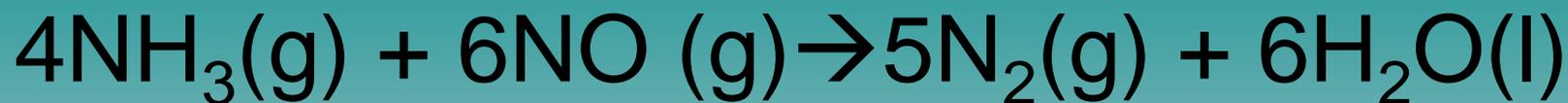
$2HgO(s) \rightarrow 2Hg\ (l) + O_2\ (g)$

2. How many moles of O_2 can be produced if you have 11 moles of HgO?

11 mol HgO x $\dfrac{1\ mol\ O_2}{2\ mol\ HgO}$ = 5.5 mol O_2

Practice

$$4NH_3(g) + 6NO\ (g) \rightarrow 5N_2(g) + 6H_2O(l)$$
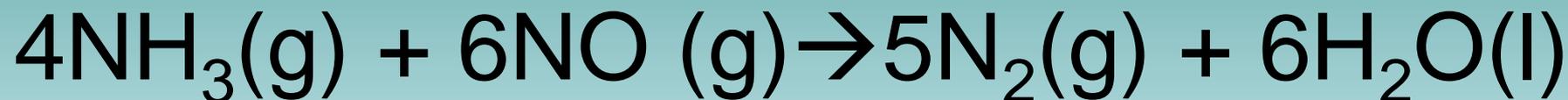
3. Write out all the possible mole ratios

4. How many moles of H_2O can be produced if you have 20 moles of NO?

$4NH_3(g) + 6NO\ (g) \rightarrow 5N_2(g) + 6H_2O(l)$

4. How many moles of H_2O can be produced if you have 20 moles of NO?

20 mol NO x $\underline{6\ mol\ H_2O}$ = 20 mol H_2O

$\qquad\qquad\qquad$ 6 mol NO

Reminders for conversions

- Always write out the units
- Cross out your units

How do we use molar mass?

- $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

$\dfrac{1 \text{ mol } H_2O}{18 \text{ g } H_2O}$ or $\dfrac{18 \text{ g } H_2O}{1 \text{ mo } H_2O}$

$\dfrac{1 \text{ mol } H_2}{2 \text{ g } H_2}$ or $\dfrac{2 \text{ g } H_2}{1 \text{ mol } H_2}$

$\dfrac{1 \text{ mol } O_2}{32 \text{ g } O_2}$ or $\dfrac{32 \text{ g } O_2}{1 \text{ mol } O_2}$

Molar mass problem:
$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

Using equation above, if you had 27.0 g H_2O, how many moles of H_2O would you produce?

$\underline{27.0 \text{ g } H_2O}$ x $\underline{1 \text{ mol } H_2O}$ x = 1.5 moles H_2O

1   18.0 g H_2O

Molar mass of H_2O

Now you try:
$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

Using equation above, if you had 25.0 g H_2, how many moles of H_2 would you produce?

$\underline{25.0\ g\ H_2}$ x $\underline{1\ mol\ H_2}$ x = 12.5 moles H_2
   1   2.0 g H_2

Molar mass of H_2

Now one more step..
$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

Using equation above, if you had 27.0 g H_2O, how many moles of O_2 would you produce?

$$\frac{27.0 \text{ g } H_2O}{1} \times \frac{1 \text{ mol } H_2O}{18.0 \text{ g } H_2O} \times \frac{1 \text{ moles } O_2}{2 \text{ moles } H_2O} = 0.75 \text{ moles } O_2$$

Molar mass of H_2O

MOLE RATIO

Now you try..
$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

Using equation above, if you had 27.0 g H_2O, how many moles of H_2 would you produce?

$\underline{27.0 \text{ g } H_2O}$ x $\underline{\text{1 mol } H_2O}$ x $\underline{\text{2 moles } H_2}$ = 1.5 moles O_2

1   18.0 g H_2O 2 moles H_2O

Molar mass of H_2O MOLE RATIO

Reminders for conversions

- Always write out the units

- Cross out your units

- Start Stoichiometry worksheet--A