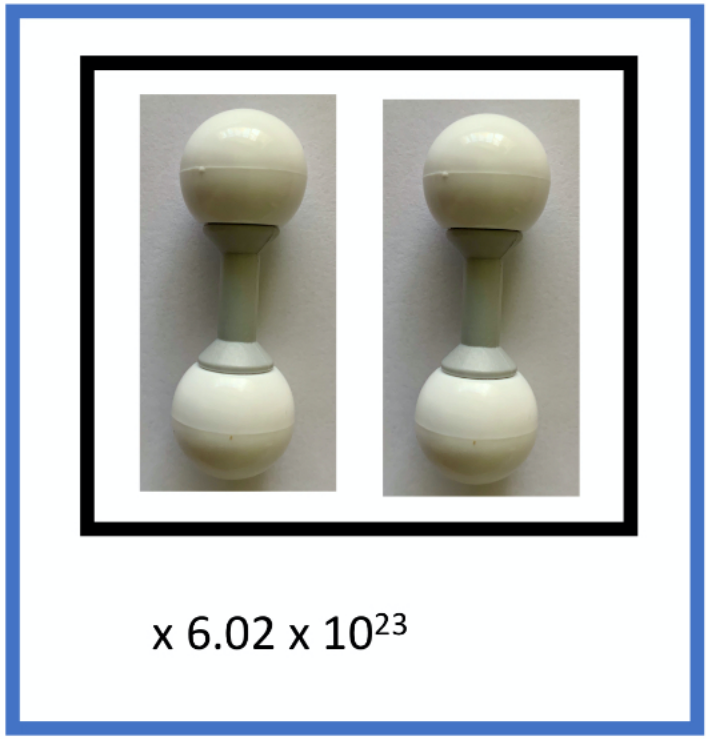
Key Concepts for A Level Chemistry

Introduction to Chemistry Calculations Part 4

$$2H_2 + O_2 \rightarrow 2H_2O$$



x 6.02×10^{23}

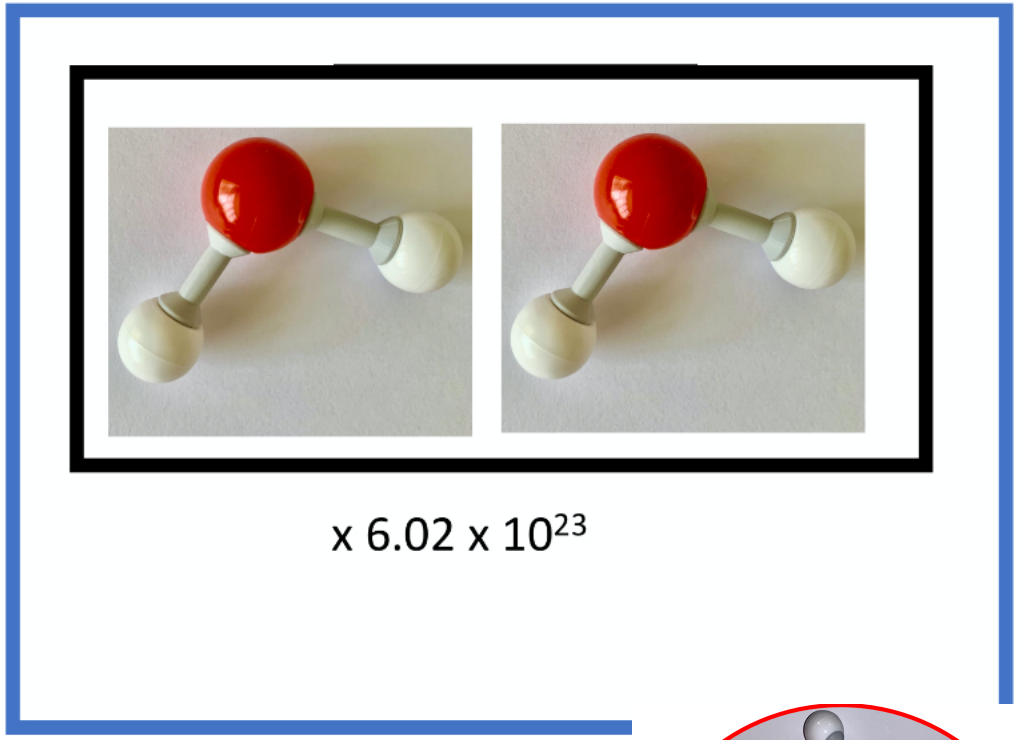
2 moles of H_2 molecules

+

x 6.02×10^{23}

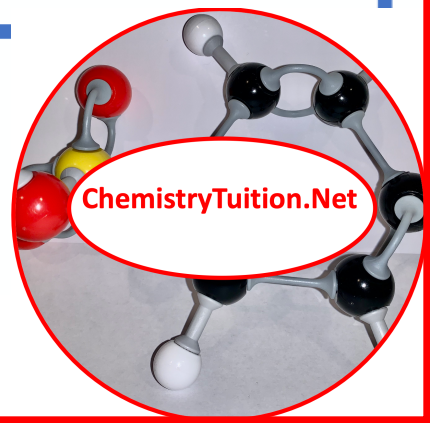
1 mole of O_2 molecules

→



x 6.02×10^{23}

2 moles of H_2O molecules



$$2H_2 + O_2 \rightarrow 2H_2O$$

2 moles of H_2 molecules

1 mole of O_2 molecules

2 moles of H_2O molecules

We can work how much this would be in terms of mass, using

Mass = Moles x Molar Mass

$$2H_2 + O_2 \rightarrow 2H_2O$$

Mass = 2 x 2

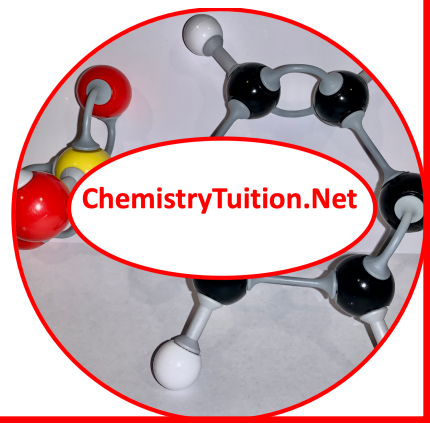
4 g

Mass = 1 x 32

32 g

Mass = 2 x 18

36 g



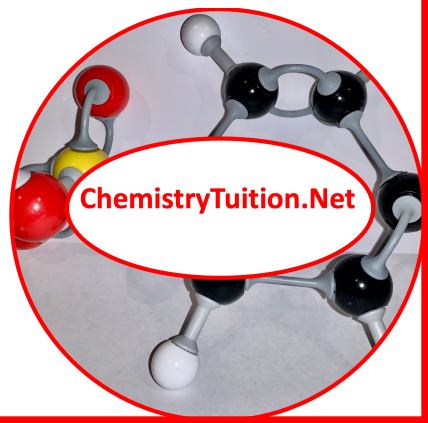
$$2H_2 + O_2 \rightarrow 2H_2O$$

But we may not always be working with these masses, so how can we adapt this?

Example 1 – What mass of oxygen is needed to react with 8 grams of hydrogen?

Step 1 – Work out how many moles of hydrogen we have

$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{8}{2} = 4 \text{ moles}$$



Step 2 – Work out how many moles of oxygen you need to react with all the hydrogen

$$2H_2 + O_2 \rightarrow 2H_2O$$

2 moles of H_2 molecules

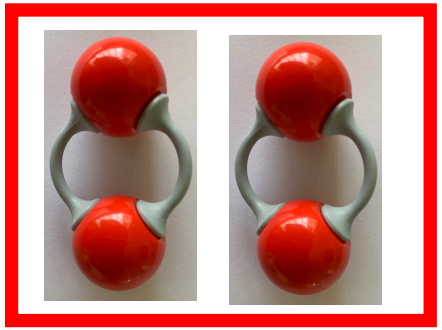
1 mole of O_2 molecules

2 moles of H_2O molecules

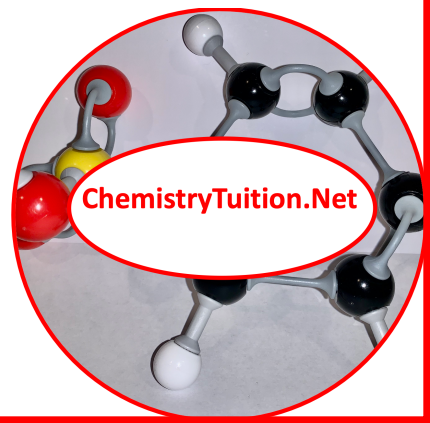
We have 4 moles of hydrogen:

x 6.02×10^{23}

So, from the equation, we need half the moles of oxygen = 2 moles.



x 6.02×10^{23}



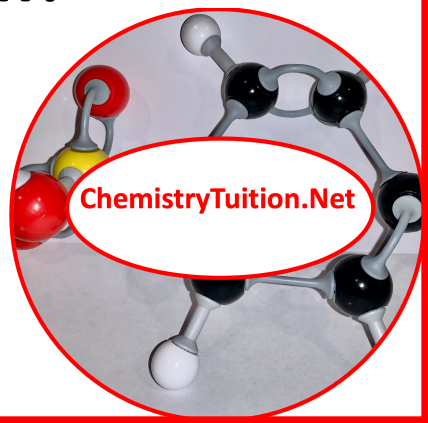
Step 3 – Now we now how many moles of oxygen we need, we can find the mass by

$$\text{Mass} = \text{Moles} \times \text{Molar Mass}$$

Mass of oxygen = 2 x 32 = **64 g**

Example 2 – What mass of magnesium oxide would be produced from 16 g of oxygen in the reaction between magnesium and oxygen?

$$2Mg + O_2 \rightarrow 2MgO$$



Example 2 – What mass of magnesium oxide would be produced from 18 g of oxygen in the reaction between magnesium and oxygen?

$$2Mg + O_2 \rightarrow 2MgO$$

Step 1 – Work out how many moles of oxygen we have:

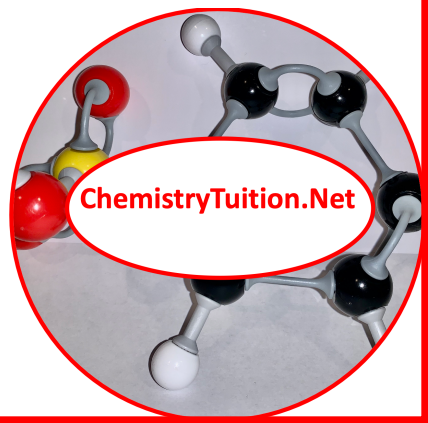
$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{18}{32} = 0.5625 \text{ moles}$$

Step 2 – Work out how many moles of magnesium oxide will be produced:

$$2Mg + O_2 \rightarrow 2MgO$$

1 mole of O_2 molecules → 2 moles of MgO

0.5625 moles → 1.125 moles



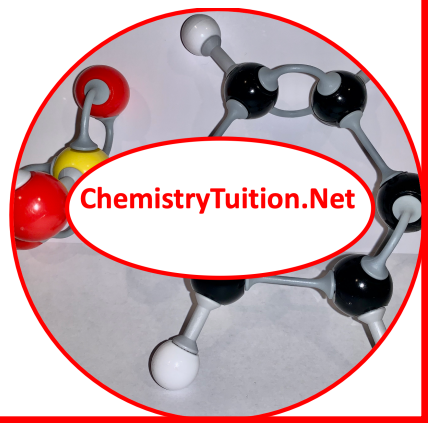
Step 3 – Find the mass of magnesium oxide:

Mass = Moles x Molar Mass

Mass = 1.125 x 40.3 = **45.3 g**

Example 3 – What mass of NH_3 would be produced from 10 g of hydrogen in the reaction below:

$$N_2 + 3H_2 \rightarrow 2NH_3$$



Example 3 – What mass of NH_3 would be produced from 10 g of hydrogen in the reaction below

$$N_2 + 3H_2 \rightarrow 2NH_3$$

Step 1 – Work out how many moles of hydrogen we have:

$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{10}{2} = 5 \text{ moles}$$

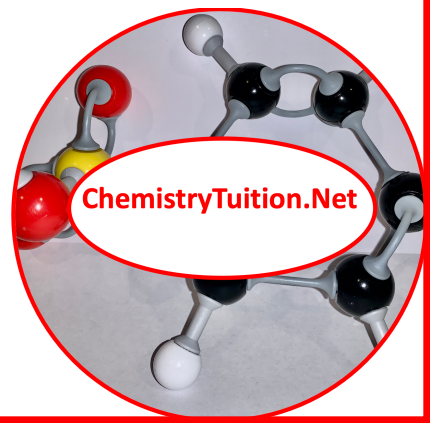
Step 2 – Work out how many moles of ammonia would be formed:

$N_2 +$ $3H_2$ → $2NH_3$

3 moles of H_2 molecules

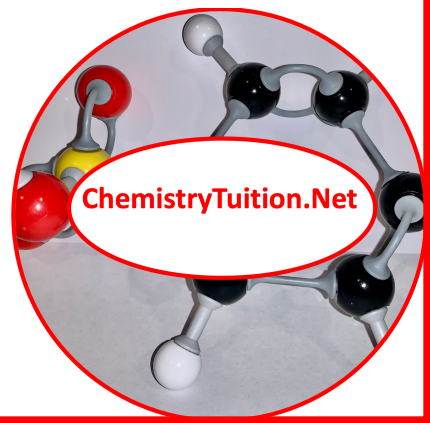
2 moles of NH_3 molecules

5 moles → $\frac{5 \text{ moles}}{3}$ x2 → 3.3 moles



$N_2 + 3H_2 \rightarrow 2NH_3$

5 moles → $\frac{5 \text{ moles}}{3}$ × 2 → 3.3 moles

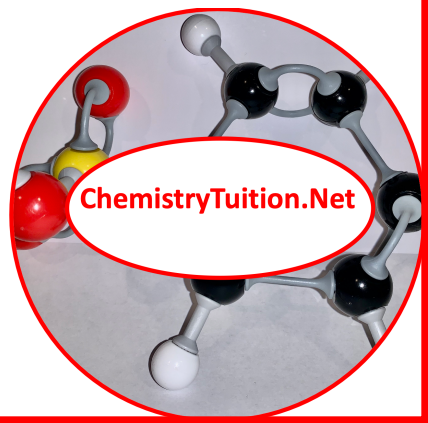


Step 3 – Find the mass of NH_3:

Mass = Moles x Molar Mass

Mass = 3.3 x 17 = **56.67 g**

Coming up …some examples for you…



1) What mass of $PbSO_4$ would be produced by 100 g of $Pb(NO_3)_2$?

$Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$

2) What mass of KCl would be produced from 20 g K_2CO_3?

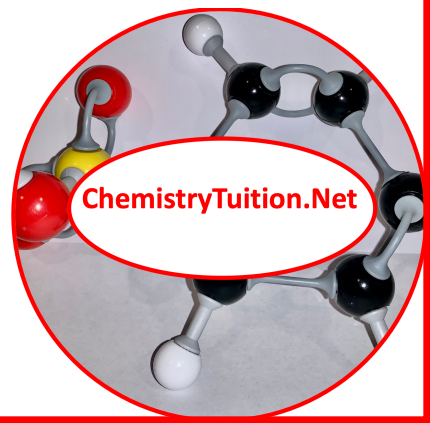
$K_2CO_3 + 2HCl \rightarrow 2KCl + CO_2 + H_2O$

3) What mass of NaCl would be produced from 0.71g of chlorine gas?

$Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$

4) What mass of NaOH would produce 15 g of NaCl?

$6NaOH + 3Cl_2 \rightarrow NaClO_3 + 5NaCl + 3H_2O$



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