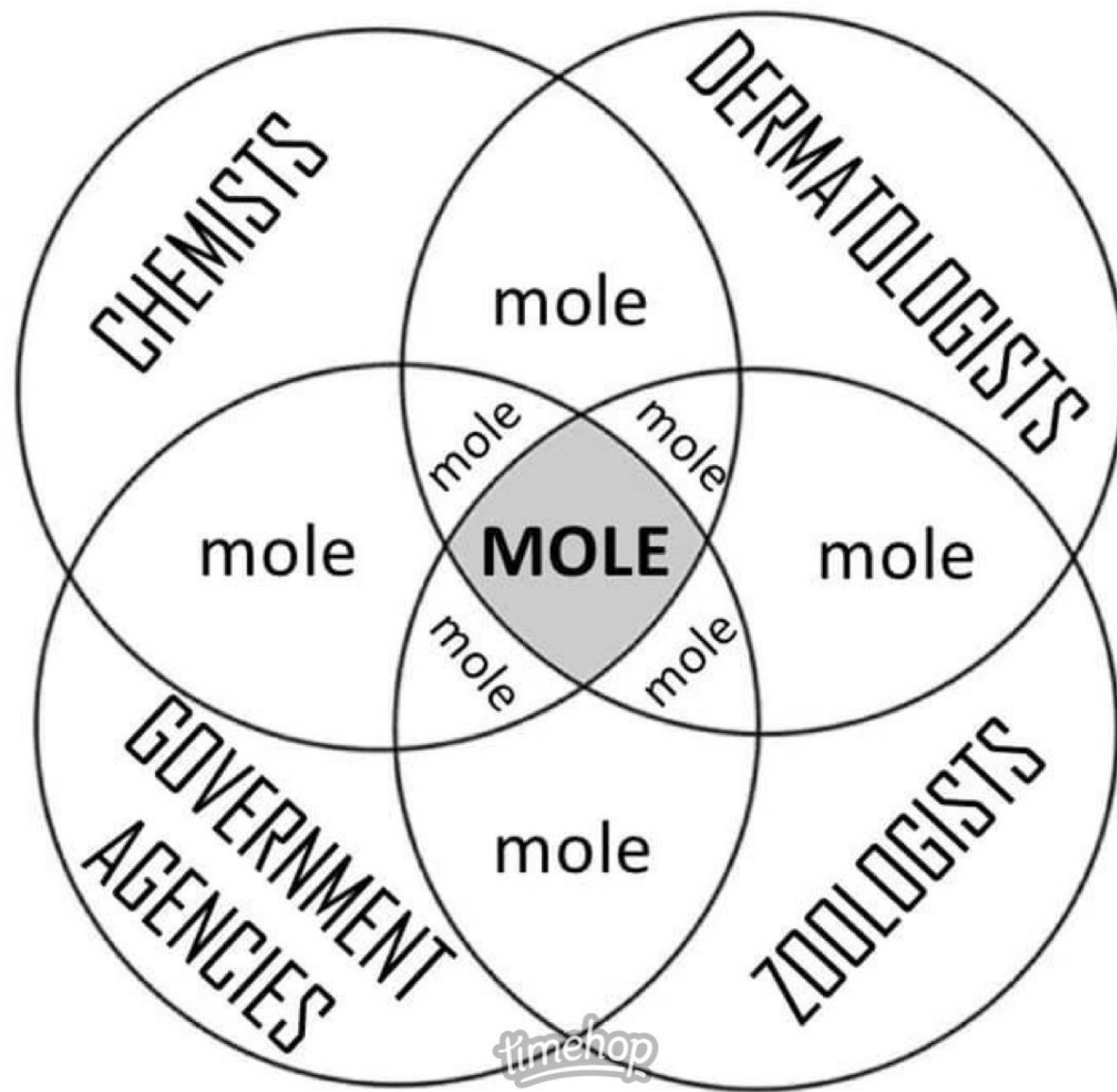


N26 – THE MOLE RATIO AND **STOICHIOMETRY**

N26 – THE MOLE RATIO AND **STOICHIOMETRY**

Target: I can use a balanced equation to determine the “mole ratio” between various molecules in a reaction, so that I can perform “stoichiometry” where I convert from an amount of one molecule to an amount of a totally different molecule.

Link to YouTube Presentation: https://youtu.be/FjNpLz_Wxt4



Stoichiometry

Calculating the amounts of reactants and/or products that are involved in a reaction

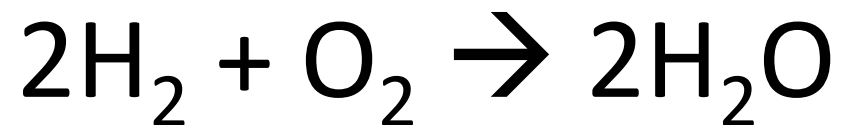
How much do I have, need, or make?

Stoichiometry

We need a balanced equation before we can do stoichiometry.

The coefficients in the balanced equation gives insight into how much of each thing we need or make

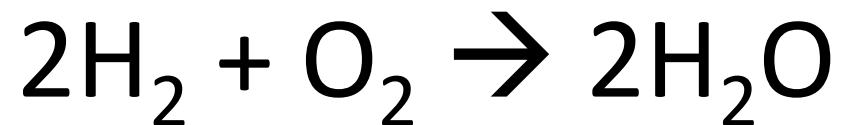
Balanced Equation Coefficients



Can be thought of as how many molecules are needed

- 2 hydrogen molecules
- 1 oxygen molecule
- 2 water molecules

Balanced Equation Coefficients



***Can ALSO be thought of as
how many MOLES of molecules***

- 2 ***moles*** hydrogen molecules
- 1 ***moles*** oxygen molecule
- 2 ***moles*** water molecules

Why use Molar Coefficients and not Grams for our calculations?

Allows us to compare “apples to apples”



**Grams of
molecule A**



**Grams of
molecule B**



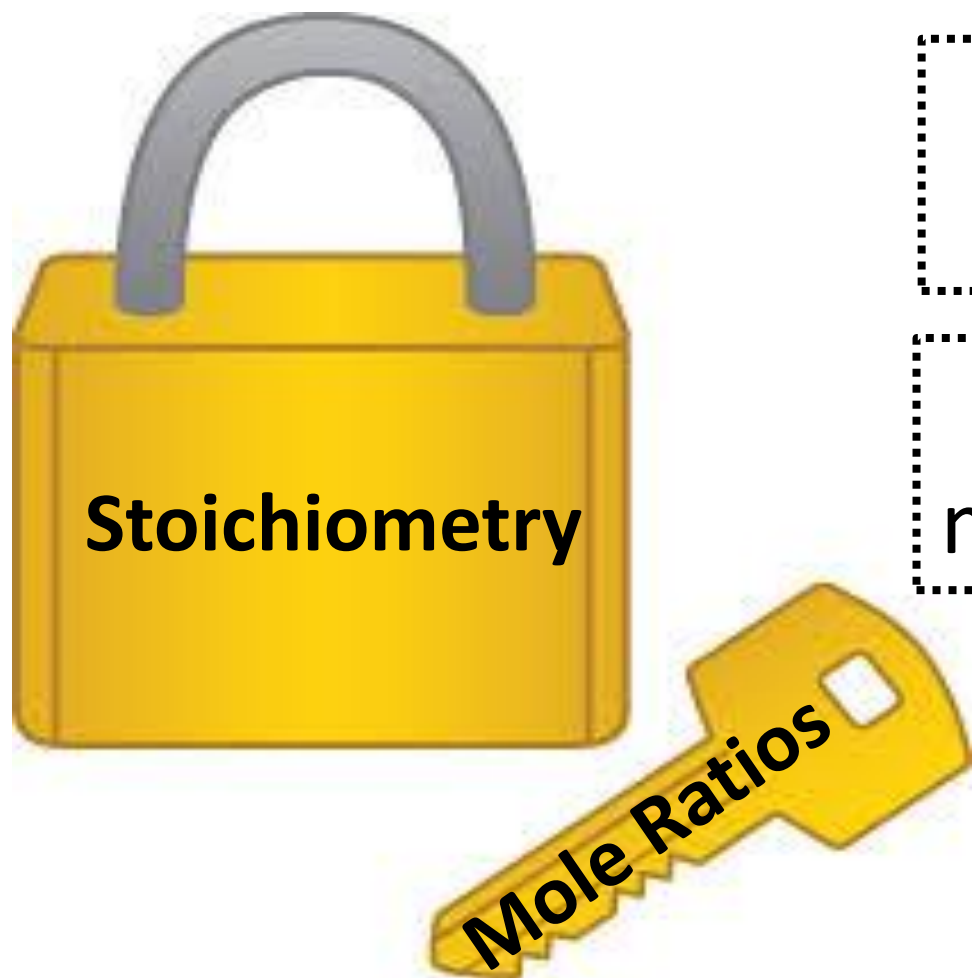
**MOLES of
molecule A**



**MOLES of
molecule B**

Mole Ratios

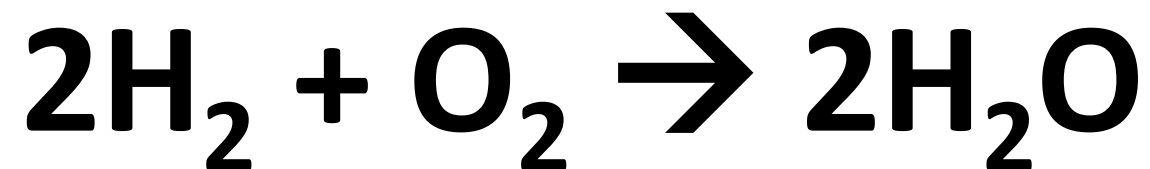
The “KEY” to stoichiometry!



If I have 3 moles of this, how many moles of that do I have?

If I have 2 moles of this, how many moles of that can I make?

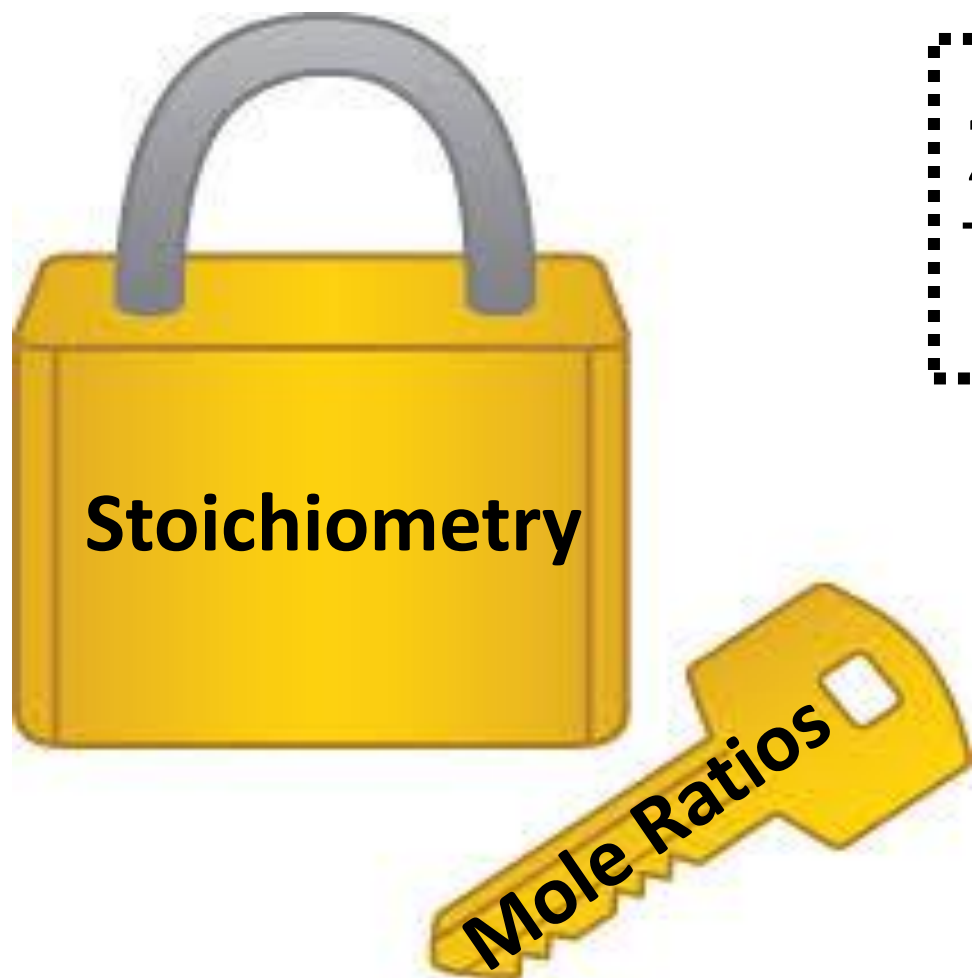
Mole Ratios



$$\frac{2 \text{ moles } \text{H}_2}{1 \text{ mole } \text{O}_2}$$

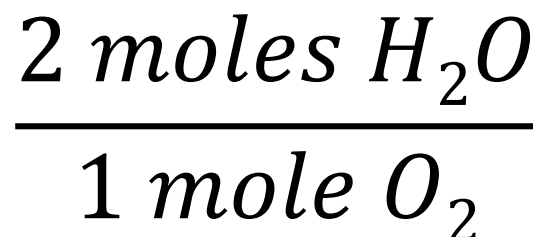
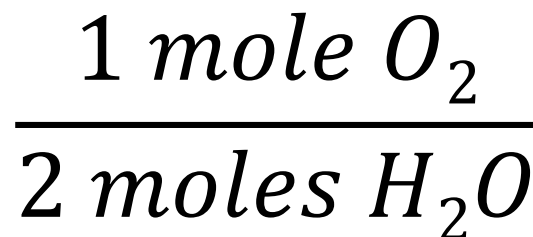
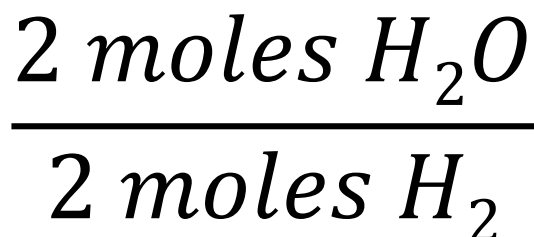
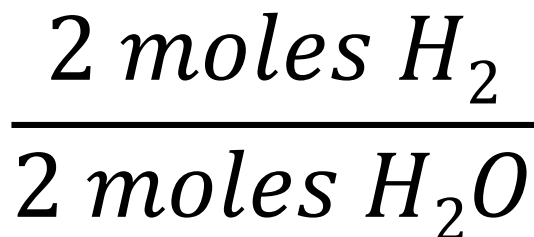
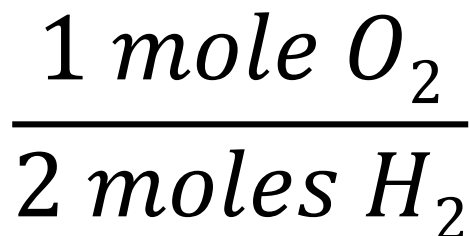
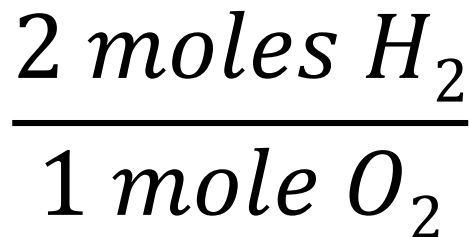
$$\frac{2 \text{ moles } \text{H}_2}{2 \text{ moles } \text{H}_2\text{O}}$$

$$\frac{1 \text{ mole } \text{O}_2}{2 \text{ moles } \text{H}_2\text{O}}$$



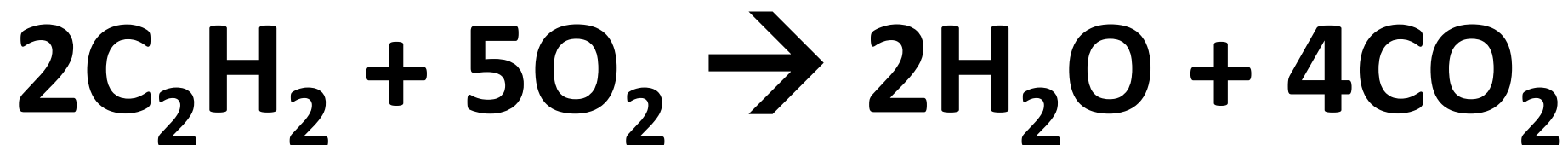
Mole Ratios

You can flip all mole ratios



Mole Ratios

Write all the mole ratios



$$\frac{2 \text{ mole } \text{C}_2\text{H}_2}{5 \text{ moles } \text{O}_2}$$

$$\frac{2 \text{ mole } \text{C}_2\text{H}_2}{2 \text{ moles } \text{H}_2\text{O}}$$

$$\frac{2 \text{ mole } \text{C}_2\text{H}_2}{4 \text{ moles } \text{CO}_2}$$

$$\frac{5 \text{ moles } \text{O}_2}{2 \text{ moles } \text{H}_2\text{O}}$$

$$\frac{5 \text{ moles } \text{O}_2}{4 \text{ moles } \text{CO}_2}$$

$$\frac{2 \text{ moles } \text{H}_2\text{O}}{4 \text{ moles } \text{CO}_2}$$

Mole Ratios $2\text{C}_2\text{H}_2 + 5\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 4\text{CO}_2$

Can be used as conversion factors!

How many moles of carbon dioxide can be made from 19.46 moles of oxygen gas?

$$\frac{19.46 \text{ moles } \text{O}_2}{5 \text{ moles } \text{O}_2} \times \frac{4 \text{ moles } \text{CO}_2}{1} = 15.57 \text{ moles } \text{CO}_2$$

Mole Ratios $2\text{C}_2\text{H}_2 + 5\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 4\text{CO}_2$

Can be used as conversion factors!

If you made 13.42 moles of water, how many moles of oxygen gas did you start with?

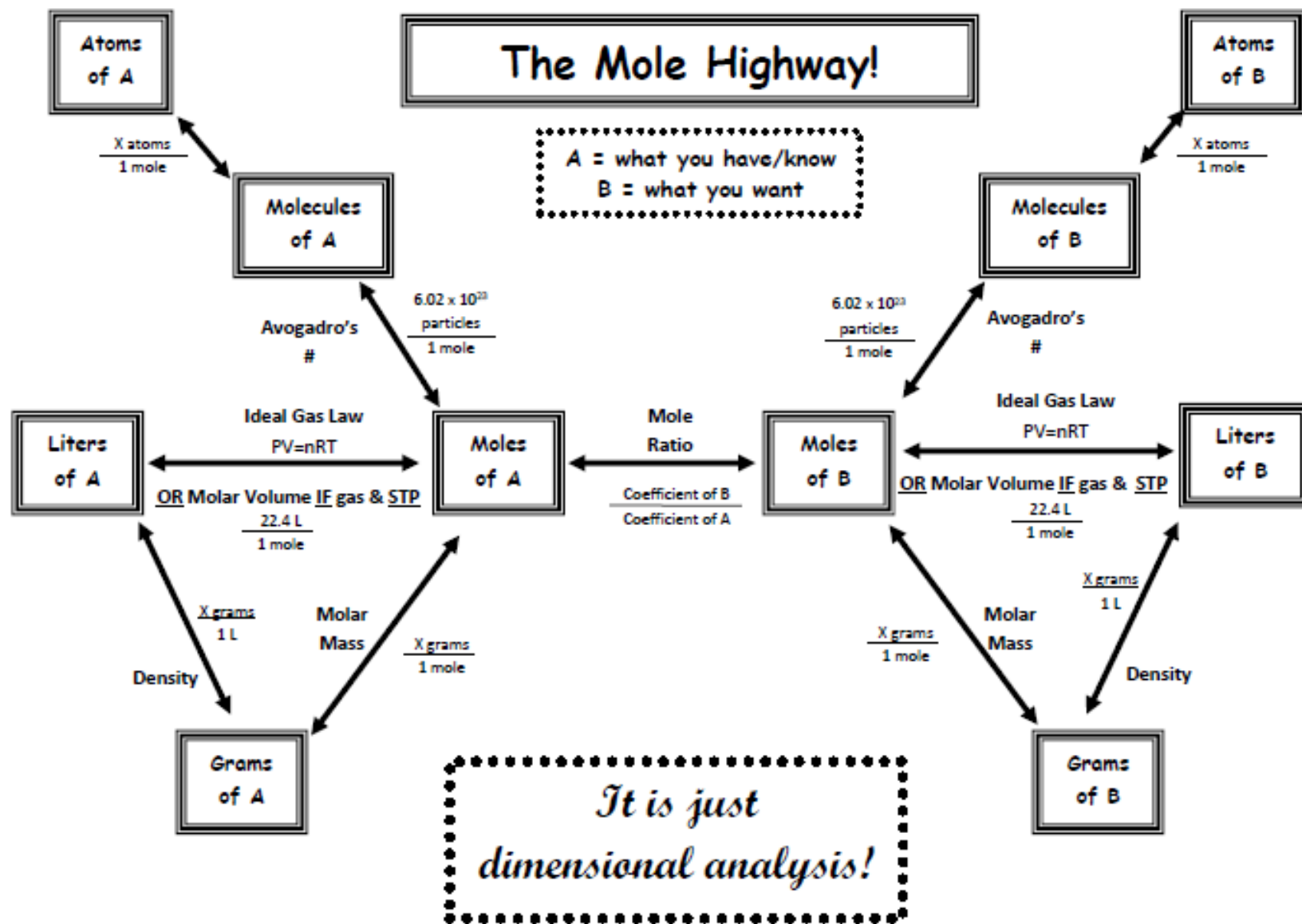
$$\frac{13.42 \text{ moles H}_2\text{O}}{2 \text{ moles H}_2\text{O}} \times \frac{5 \text{ moles O}_2}{5 \text{ moles O}_2} = 33.55 \text{ moles O}_2$$

What if you don't want
your answer in moles?
What if you weren't given moles?

THE MOLE HIGHWAY

All roads lead to the mole!

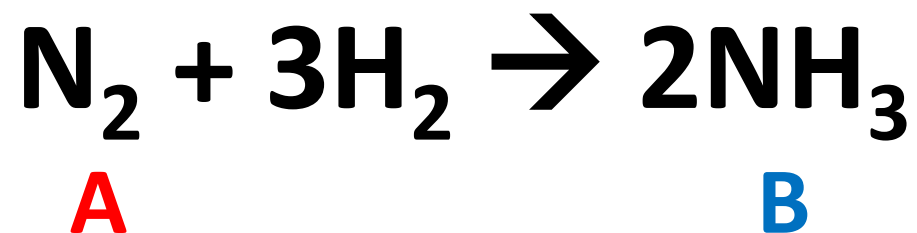




Guided Stoichiometry

Practice Problems

Q #1



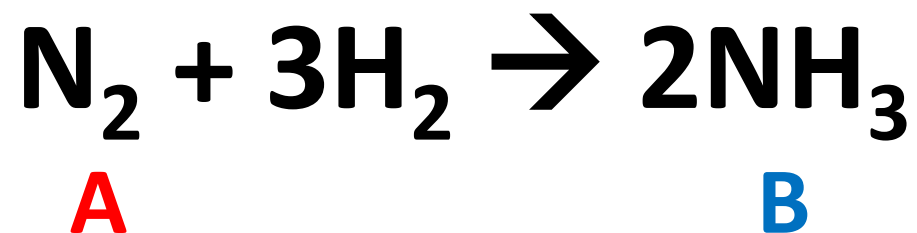
54 grams $\text{N}_2 \rightarrow ?$ moles NH_3

Pathway: *grams A $\rightarrow$ moles A $\rightarrow$ moles B*

*Molar
mass of A
X g A
1 mole A*

*Mole Ratio
moles B
moles A*

Q #1



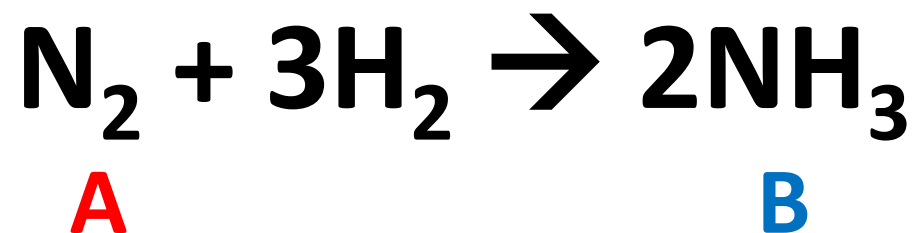
54 grams $\text{N}_2 \rightarrow ?$ moles NH_3

Pathway: *grams A $\rightarrow$ moles A $\rightarrow$ moles B*

*Molar
mass of A
X g A
1 mole A*

*Mole Ratio
moles B
moles A*

Q #1

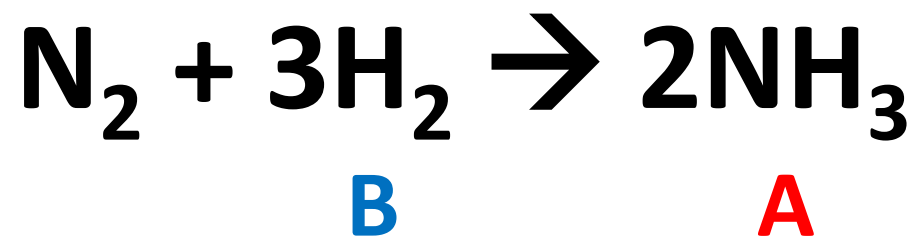


54 grams $\text{N}_2 \rightarrow ?$ moles NH_3

54 g N_2	1 mole N_2	2 mole NH_3
	28.01 g N_2	1 mole N_2

= 3.9
moles NH_3

Q #2



75 grams $\text{NH}_3 \rightarrow ? \text{ g H}_2$

Pathway:

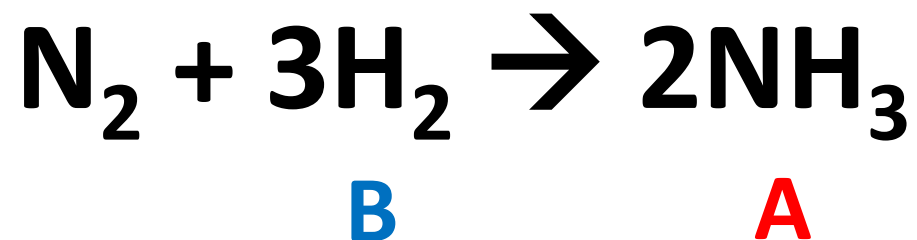
grams A $\rightarrow$ moles A $\rightarrow$ moles B $\rightarrow$ grams B

*Molar
mass of A
X g A
1 mole A*

*Mole Ratio
moles B
moles A*

*Molar
mass of B
X g B
1 mole B*

Q #2



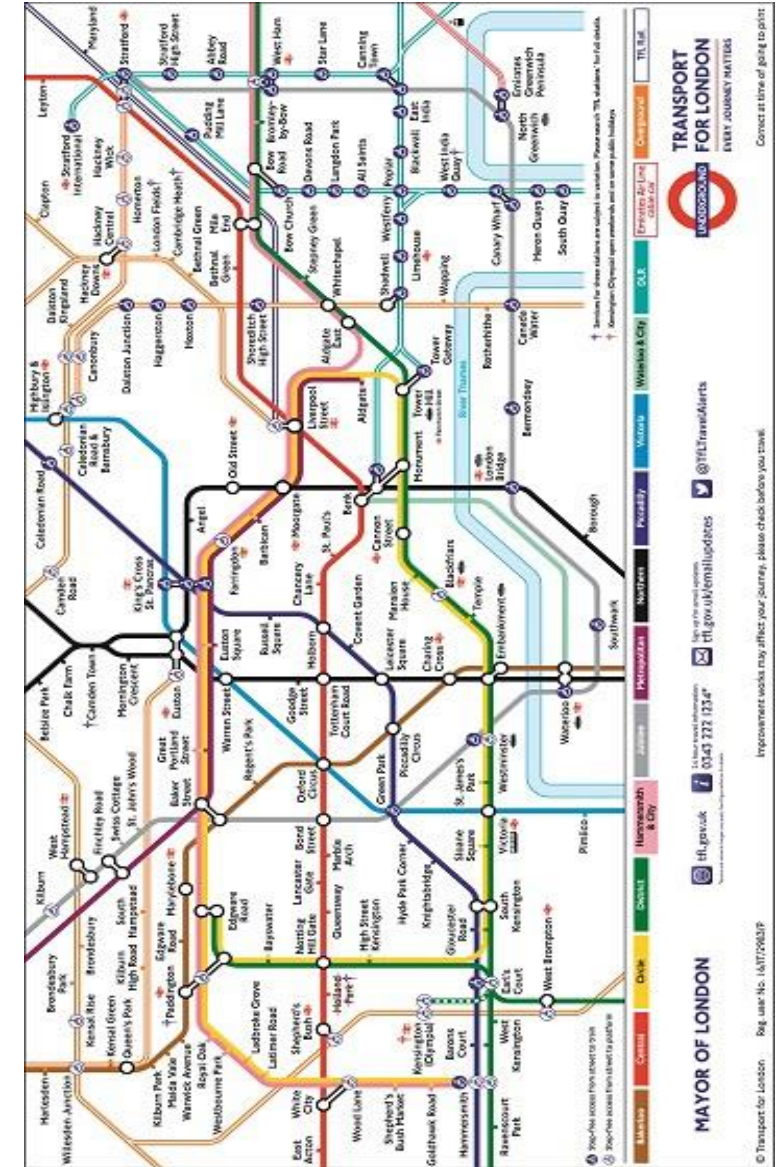
75 grams $\text{NH}_3 \rightarrow ? \text{ g H}_2$

75 g NH_3	1 mole NH_3	3 mole H_2	2.02 g H_2
	17.03 g NH_3	2 mole NH_3	1 mole H_2

= 13.34 g H_2

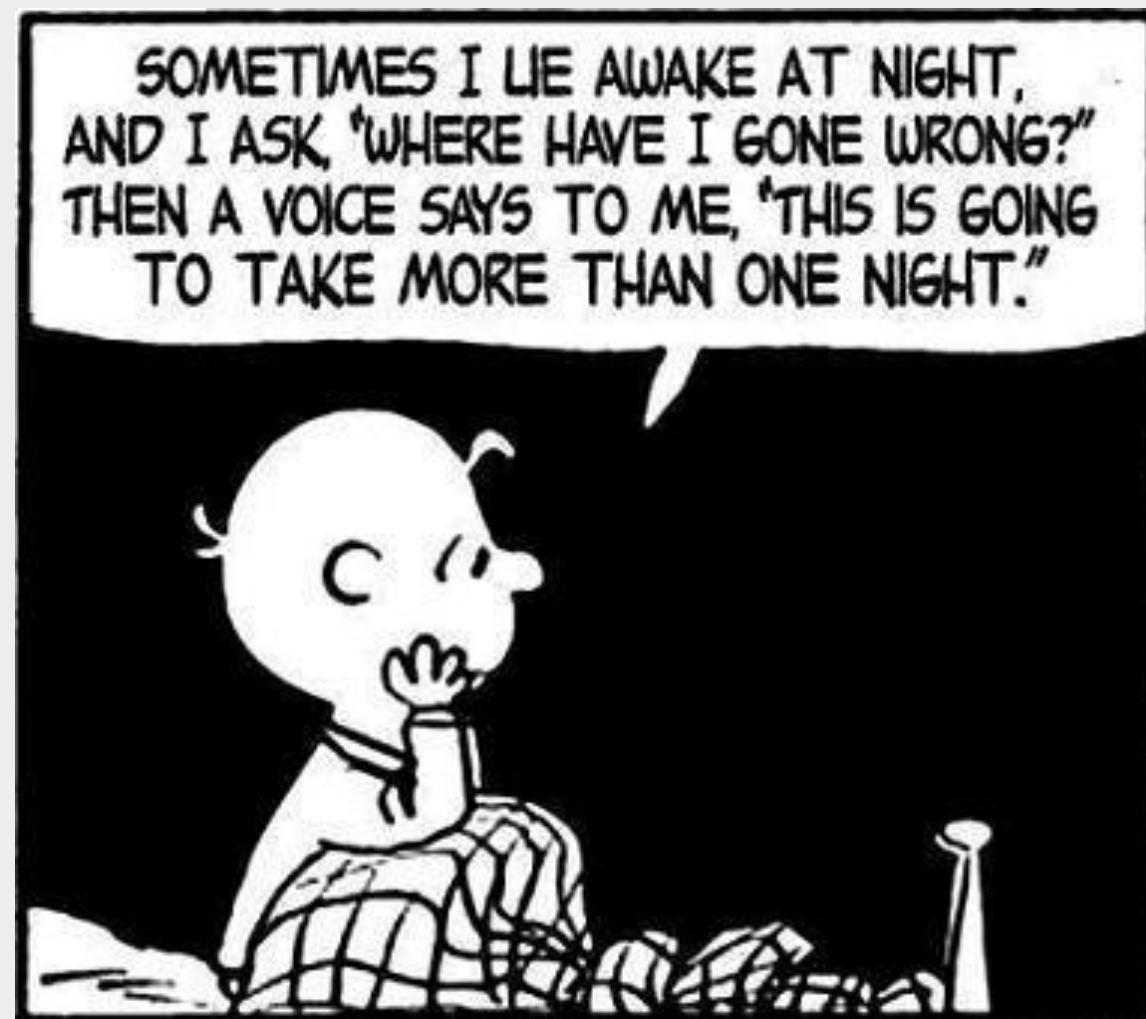
LOTS of possible routes!

- Just follow the mole highway
- Use dimensional analysis
- Flip conversion factors
- Cancel units



Things don't always work perfectly...

In the lab sometimes you don't make 100% of what your stoichiometry calculation says you should make



Theoretical Yield

The quantities that the stoichiometry calculations predict should be made

Actual/Experimental Yield

The quantity that you
actually made in the lab experiment

% Yield

How good did you do!?

$$\text{percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

Not the same as % error!!!

Careful finding extra stuff online!

Do not do anything that says “limiting reagents” – we haven’t learned that yet. Don’t do problems that give you two starting values (you start with 15 grams of N_2 and 7 grams of H_2 , how much NH_3 can you make?) – that is a limiting reagent problem. We will do limiting reagents after winter break!

Class Group Practice

15 g sodium nitrate and excess calcium hydroxide react. How many grams of your calcium containing product can be made?

14.5 g
 $\text{Ca}(\text{NO}_3)_2$

Class Individual Practice – timed!

15 g magnesium nitrite and excess ammonium phosphate react. How many grams of your magnesium containing product can be made?

11.3 g
 $\text{Mg}_3(\text{PO}_4)_2$

YouTube link to presentation

https://youtu.be/FjNpLz_Wxt4