Stoichiometry

FT. Isaacs Teach

What is it?

- Stoichiometry: How many moles of one thing equals the number of moles in another thing
- It's a way of determining how many "ingredients" you need to make your chemical "cake"
- Stoichiometry works like a recipe: One you have a balanced equation, you can determine how much of an element is needed for your experiment through a simple process of dimensional analysis and fractions

Anything that requires items to make something can be used as an example for stoichiometry. Making pizza could work just as well as a cake.

Example 1

- How it works:
  - $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
- Can also be written as:
  - 1 mole N_2 + 3 moles H_2 → 2 moles NH_3
- The BIG numbers can be interpreted to mean moles, which will come in very handy

Not this kind of mole though. You don't want a shrew. You want the chemical kind.

Grandmama would be so proud if you mastered Stoichiometry.

Baking in Chemistry

- Baking is a chemical process, and it is also a great way to explain stoichiometry
- In baking, you have ingredients such as: 1 packet of Cake Mix (Cm), 1.5 cups of Water (W), 1 stick of Butter (B), and 3 Eggs (E)
- The end result you want is 18 servings worth of delicious cake (Dc)
- This can be written in chemistry form:
  - $1Cm + 1.5W + 1B + 3E \rightarrow 18Dc$

Chem Cake Cont.

- Now, if you only wanted to make half of that cake, you would need to half those ingredients
- Instead of
  - 1Cm + 1.5W + 1B + 3E → 18Dc
- You would want
  - 0.5Cm + 0.75W + 0.5B + 1.5E → 9Dc
- All that happened here was dividing the first equation by 2
- If you wanted more cake, you could multiply the amount of ingredients
- The same idea applies in Stoichiometry

In stoichiometry, the quantities aren't measured in moles; moles are calculated based on actual laboratory measurements.

Stoichiometry Cake

Just like with the cake, the numbers in Stoichiometry can be scaled up or down.

One important rule to remember here though, is that the BIG numbers in the problem must be whole numbers.

The LCD (lowest common denominator) may be used to reach the smallest balance, but they can never be half numbers. (For NOW)

Example 2

- In the problem $N_2(g) + 3H_2(g) \rightarrow 2\ NH_3(g)$, discover the following:
  - How many moles of ammonia are produced when 4 moles of $H_2(g)$ react with an excess of nitrogen gas?
- Solution:
  - 4 ~~mols~~ H_2 x 2 $mol\ NH3/3\ mol\ H2$ = 2.67 mol NH_3
- The ratio of 2/3 comes from the equation above of $3H_2$: $2NH_3$
- That ratio is called the Mole Ratio

Mole Ratio: A mole ratio between one thing and another that tells you how much it takes of the first to get the second. The numbers in the ratio come from the balanced equation. If you are having difficulties with balancing equations, review the previous slides on it.

Using Actual Numbers for Measurements

- There are 3 key steps to using stoichiometry to find a chemistry solution:
  1. Converting the given quantity (grams, liters, etc.) to moles
  2. Use the mole ratio from the balanced equation
  3. Convert back into the quantities you were given/ want

When you are given a problem that says "STP", that stands for standard temperature and pressure. Why is this important? Because 1 mole of ANY gas at STP is equal to 22.4L

Example 3a

- How many liters of $O_2(g)$ are consumed at STP?
- Balanced equation:
  - $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
- Given 40 grams of Al to start reaction
- Solution:
  - 40g Al x 1 $mol\ Al$ /27.0 $g\ Al$ x 3 $mol\ O2$/4 $mol\ Al$ = 1.11 mol O_2 x 22.4/1 mol = 24.9 L O_2
- When the units are canceled out, you are left with liters

If you have the number of moles, you can get the mass. Moles → Mass. Get it, got it, good.

Example 3b

- Balanced equation:
  - $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
- If you start with 40 grams of aluminum, how many grams of Al_2O_3 are formed?
- Solution:
  - 40g Al x 1 *mol Al*/27.0 *g Al* = 1.48 mol Al x 2 *Al2O3*/4 *Al* = 0.74 mol Al_2O_3 → 0.74 mol x 102 *g Al2O3*/1 *mol Al2O3* = 75.6g Al_2O_3

The 102 g for Al_2O_3 comes from adding the two elements together; it was an extra step, but it's quick to do

Challenge #1

Select font size T T T

Define Stoichiometry

Allow Single Choice Only

Allow Multiple Choices

Shuffle Answers

Allow Retry

Limit Attempts 3

How many moles of one thing = the number of moles in another thing

How many atoms of one thing = the number of atoms in another thing

Baking a cake

Preview

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Challenge #2

Challenge #3

Select font size T T T

In Stoichiometry, all BIG numbers must be whole numbers

☑ Allow Retry

True

False

Preview

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Resources

Everything in the informational slides come from the following links:

https://www.youtube.com/watch?v=HEjU0zfxS4U

https://www.youtube.com/watch?v=quSKiSs4peY

They are short videos, and are incredibly helpful.

You should check them out.