Lesson 16

Chemistry 0

Feb 2021, L. Tracey Gao

Week 16 HW Review

1. True or false: Pure water is an example of a neutral substance.

2. When an acid and a base react, the reaction is called a ______ reaction.

3. The products of neutralization reactions are water and a ______.

Week 16 HW Review

4. Which of the following is a salt?

A. H_2O
B. HCl
C. KOH
D. KCl

5. On the pH scale, a pH=1 would be:

A. Acidic
B. Basic
C. Neutral

Week 16 HW Review

6. Of the following solution, select the one that is most acidic:

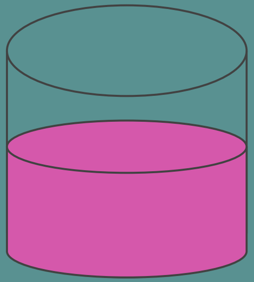
A. Milk (pH=6.5)
B. Tomato juice (pH=4)
C. Bleach (pH=11)
D. Coffee (pH=5)

7. Which of the following reactions represents an acid-base neutralization reaction?

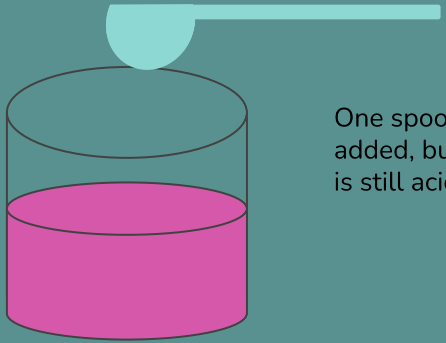
A. $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + H_2O$
B. $KI + Pb(NO_3)_2 \rightarrow KNO_3 + PbI_2$
C. $H_2 + NO \rightarrow H_2O + N_2$
D. $C_7H_6O_2 + O_2 \rightarrow CO_2 + H_2O$

8. Which of the following reactions represents an acid-base neutralization reaction?

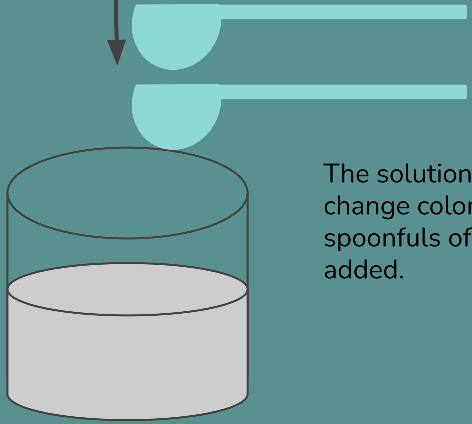
Acid- Base Titration



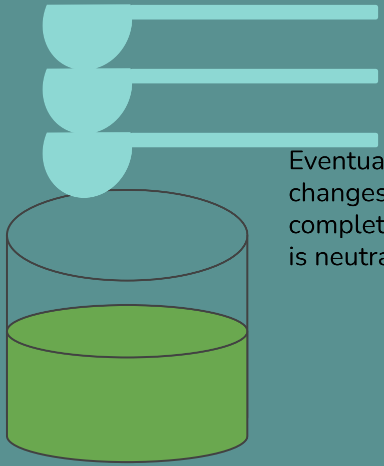
An acid with indicator showing red color, no base added.



One spoonful of base added, but the solution is still acidic.

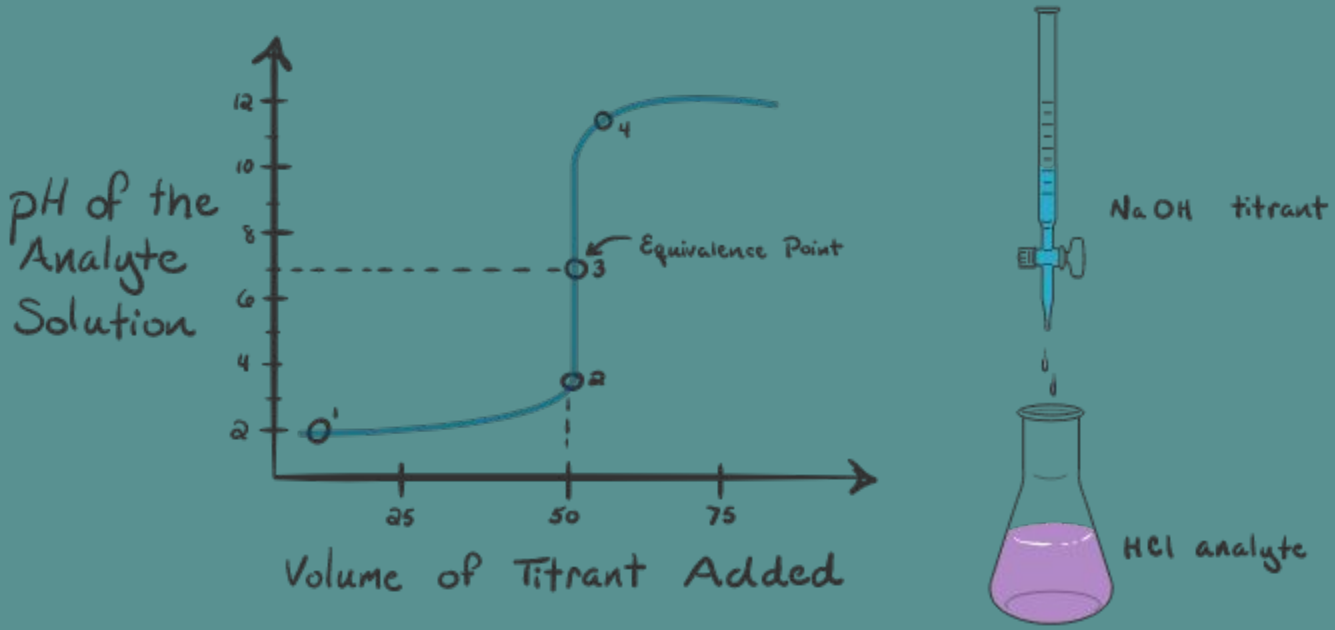


The solution starts to change color as more spoonfuls of base are added.



Eventually the solution changes color completely as the acid is neutralized.

Plot of an Acid- Base Titration



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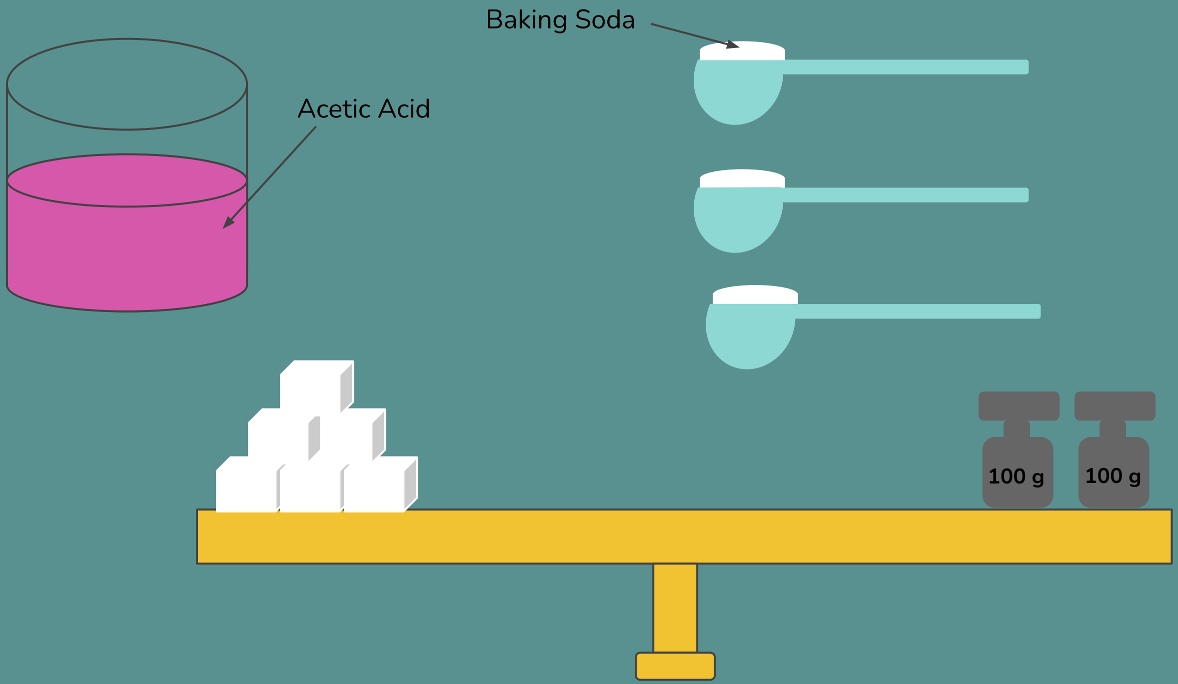
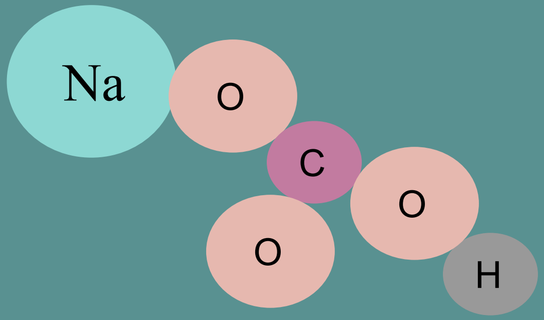
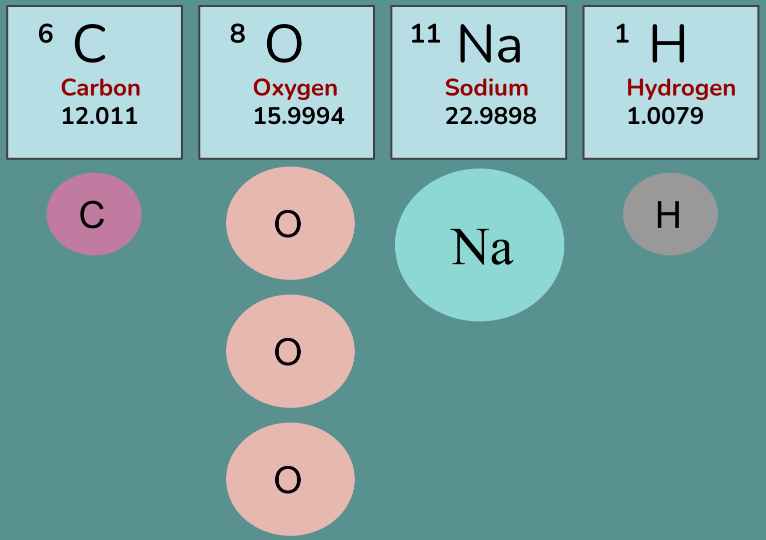
How to find out the concentration of an unknown acid or base



Molecular Weight of Baking Soda

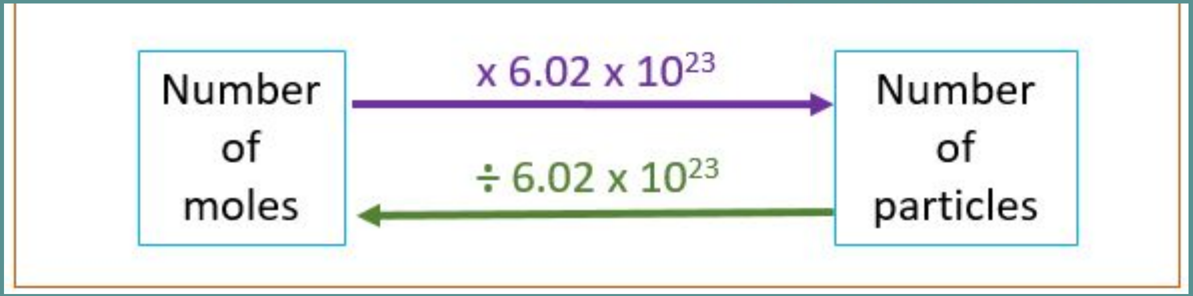




Molecular weight of baking soda ($NaHCO_3$)
= (1x12 amu) + (3x16 amu) + (1x23 amu)+ (1x1 amu) = 84 amu

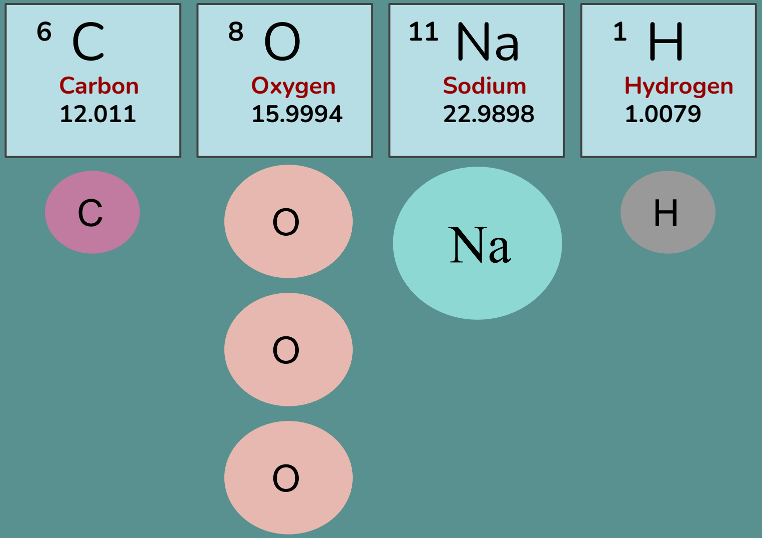
Atomic Mass Unit (amu) and Mole

- 1 amu (atomic mass unit)= $1.67 \text{x} 10^{-24}$ grams
  = 1/12th the mass of the carbon atom
- 1 mole = 602,200,000,000,000,000,000,000
  = $\boxed{6.022 \text{ x } 10^{23}}$ → Avogadro Constant



https://www.onlinemathlearning.com/avogadro-constant.html

Moles and weights



- One mole of carbon atoms = 12 grams
- One mole of hydrogen atoms = 1 gram
- One mole of sodium atoms = 23 grams
- One mole of oxygen atoms = 16 grams

Molecular weight of baking soda ($NaHCO_3$)
= (1x12 amu) + (3x16 amu) + (1x23 amu)+ (1x1 amu) = 84 amu

One mole of baking soda molecules = 84 grams

Acid-Base Titration

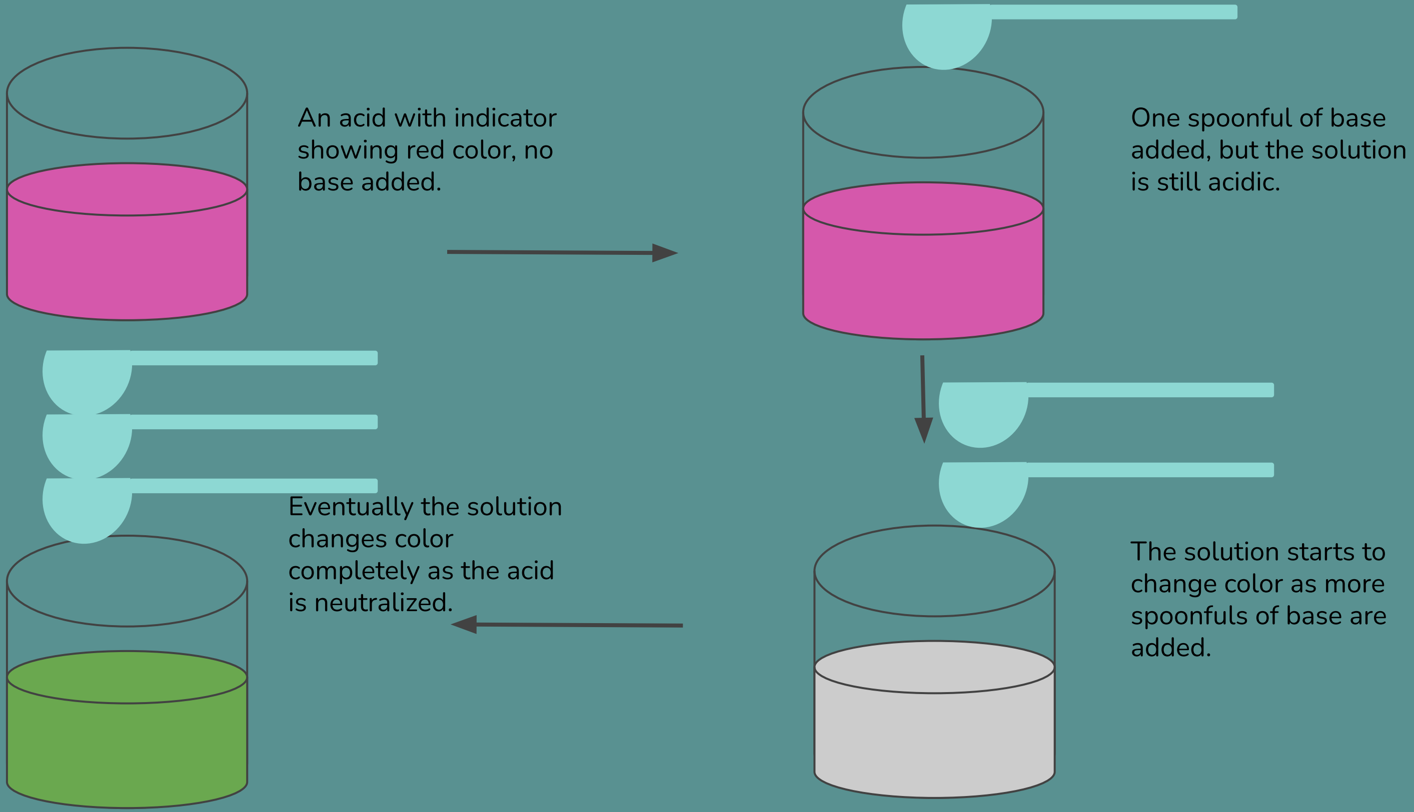
Vinegar Baking Soda

$$C_2H_4O_2 + NaHCO_3 \rightarrow NaC_2H_3O_2 + H_2O + CO_2$$

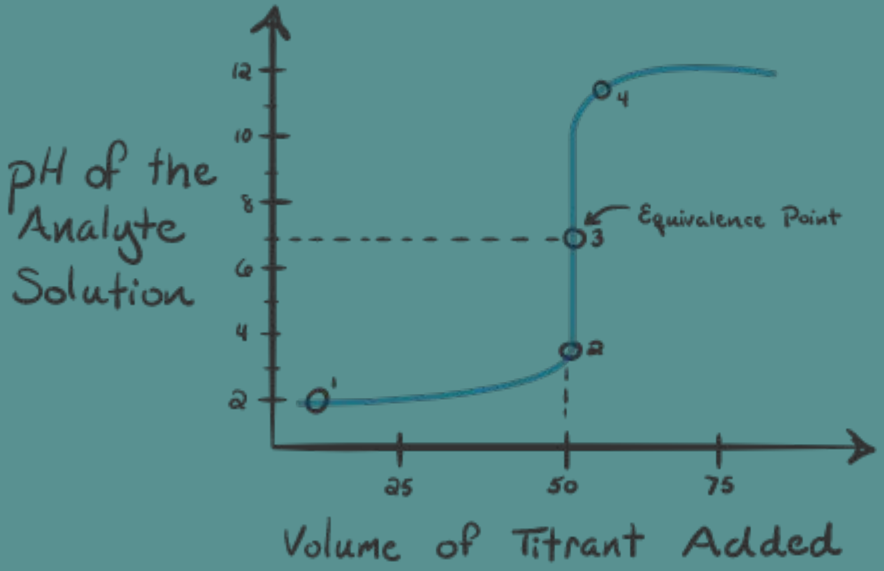
(Acetic Acid) (Sodium Bicarbonate) (Sodium Acetate)

One mole of sodium bicarbonate will neutralize one mole of vinegar!

Acid- Base Titration



Plot of an Acid- Base Titration



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Acid Base Neutralization Questions

- If it takes 84 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?
- If it takes 42 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?
- If it takes 168 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?

Solutions

- We know that **one mole of baking soda molecules = 84 grams**
- Chemical equation for the reaction is:

$$C_2H_4O_2 + NaHCO_3 \rightarrow NaC_2H_3O_2 + H_2O + CO_2$$

- To convert grams to moles we use a conversion factor, which states mathematically the relationship between two quantities. For baking soda, we can write the conversion factor as:

$$\frac{1 \text{ mole}}{84 \text{ grams}} \quad \text{or} \quad \frac{84 \text{ grams}}{1 \text{ mole}}$$

Solutions (cont.)

- If it takes 84 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?

$$\cancel{84 \text{ grams}} \times \frac{1 \text{ mole}}{\cancel{84 \text{ grams}}} = 1 \text{ mole}$$

There is 1 mole of acetic acid that is neutralized by 84 grams of baking soda.

Solutions (cont.)

- If it takes 42 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?

$$\cancel{42\ \text{grams}} \times \frac{1\ \text{mole}}{\cancel{84\ \text{grams}}} = 0.5\ \text{mole}$$

There is 0.5 mole of acetic acid that is neutralized by 42 grams of baking soda.

Solutions (cont.)

- If it takes 168 grams of baking soda to neutralize a beaker of acetic acid, how many moles of acetic acid do you have?

$$\cancel{168\ \text{grams}} \times \frac{1\ \text{mole}}{\cancel{84\ \text{grams}}} = 2\ \text{moles}$$

There are 2 moles of acetic acid that are neutralized by 168 grams of baking soda.

Concentration of solutions

- The most common unit of concentration is molarity (M).
- The molarity (M) is defined as the number of moles of solute present in exactly 1 L of solution:

$$\text{Concentration (Molarity)} = \frac{\text{Amount of Solute (mol)}}{\text{Volume of the solution (L)}}$$

Example:

If we know that the volume of the 1 mole of acetic acid is 1 L, how much is the concentration of the acetic acid solution?

Concentration = 1 mol/ 1 L = 1 mol/L = 1 M

Example question

Q: A 60 mL HCl solution is titrated with 25 mL of a 0.60M KOH solution. What is the concentration of the HCl solution?

A: $HCl + KOH \longrightarrow H_2O + KCl$

1 mol HCl will neutralize 1 mol KOH

60 mL x concentration of HCl = 25 mL x 0.60 M

Concentration of HCl = 25 x 0.60/ 60 = 0.25 M (mol/L)