Lesson 16

Chemistry 0

Feb 2022, L. Tracey Gao

Week 15 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 15 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 15 HW Review

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

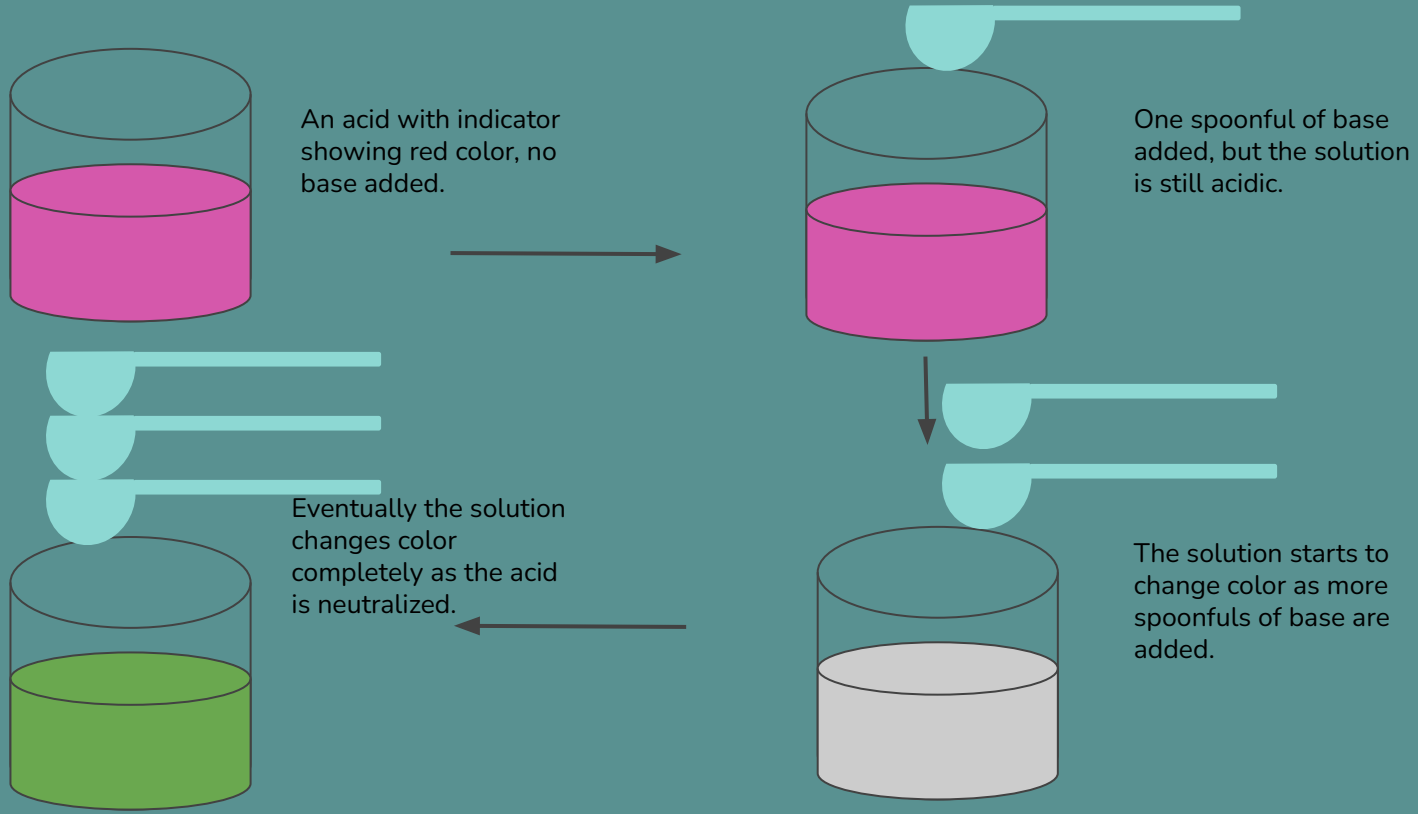
A. Milk (pH=6.5)
B. Tomato juice (pH=4)
C. Bleach (pH=11)
D. Coffee (pH=5)

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

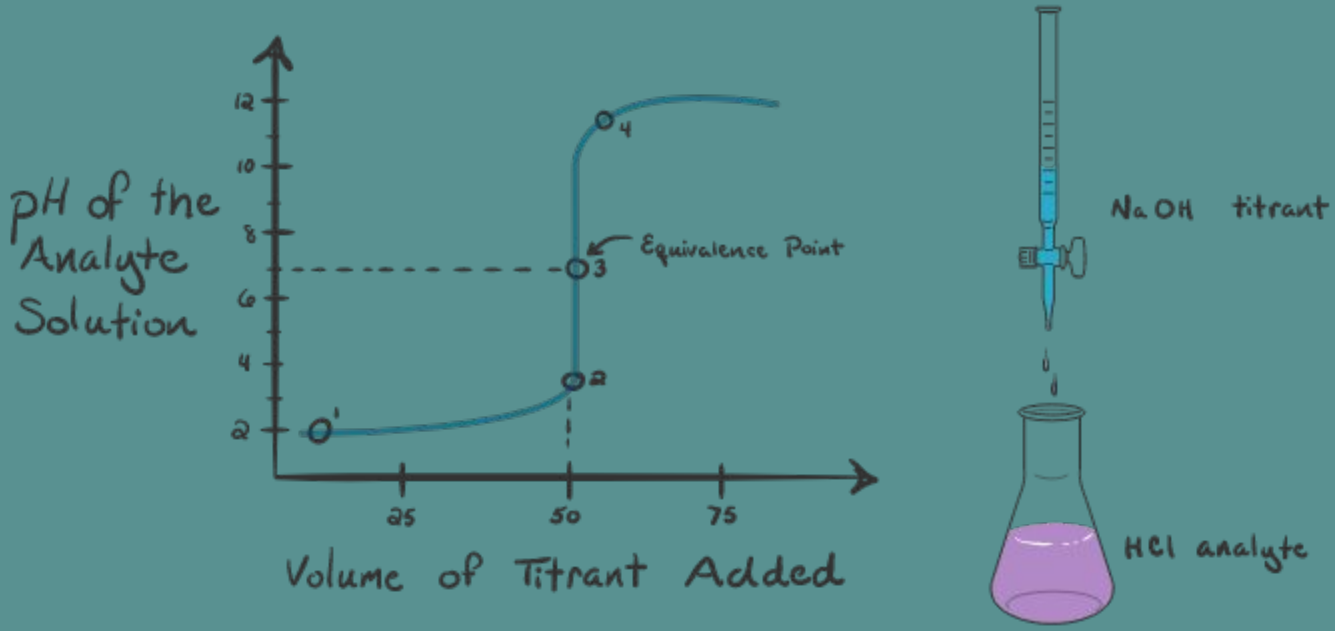
A. $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + H_2O$
B. $KI + Pb(NO_3)_2 \rightarrow KNO_3 + PbI_2$
C. $H_2 + NO \rightarrow H_2O + N_2$
D. $C_7H_6O_2 + O_2 \rightarrow CO_2 + H_2O$

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

Acid- Base Titration



Plot of an Acid- Base Titration



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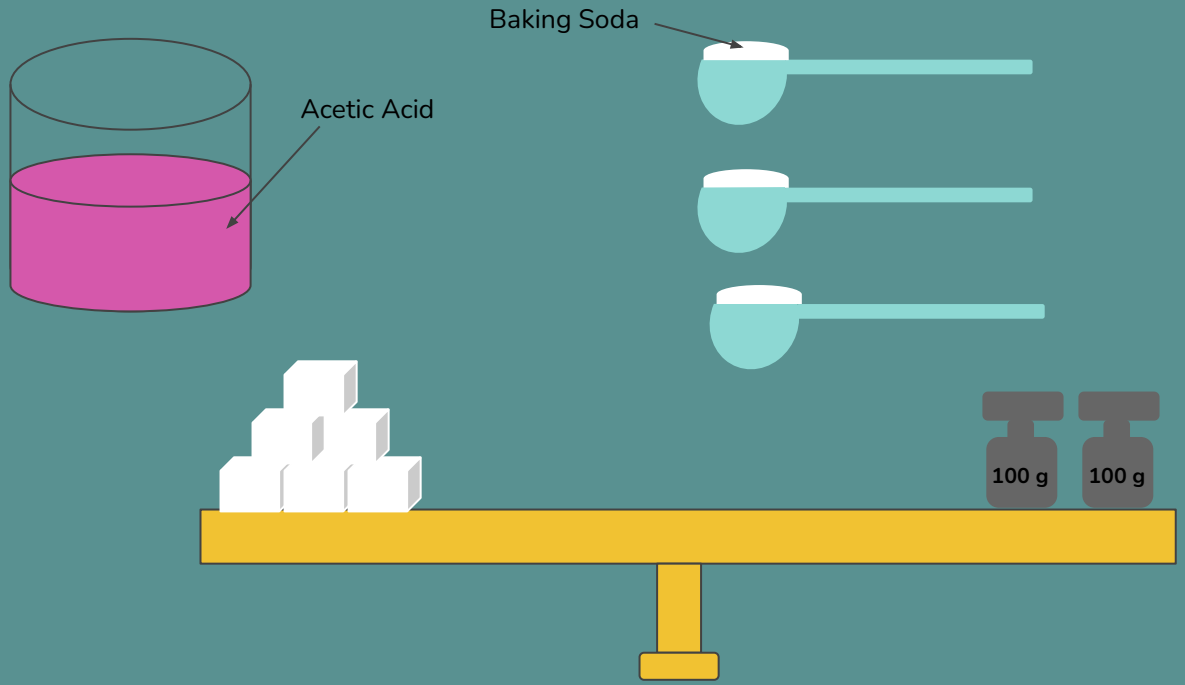
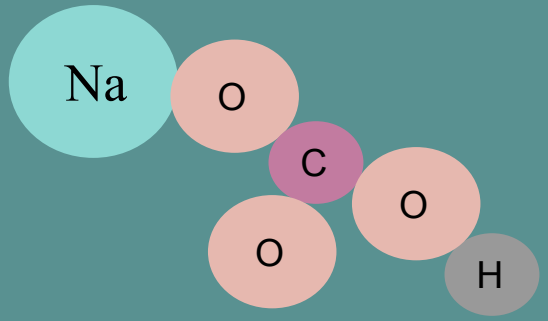
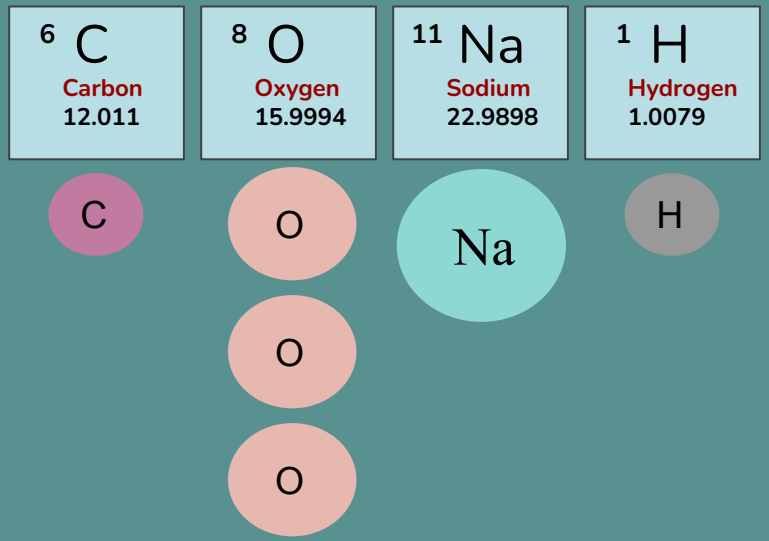
How to find out the concentration of an unknown acid or base



Molecular Weight of Baking Soda

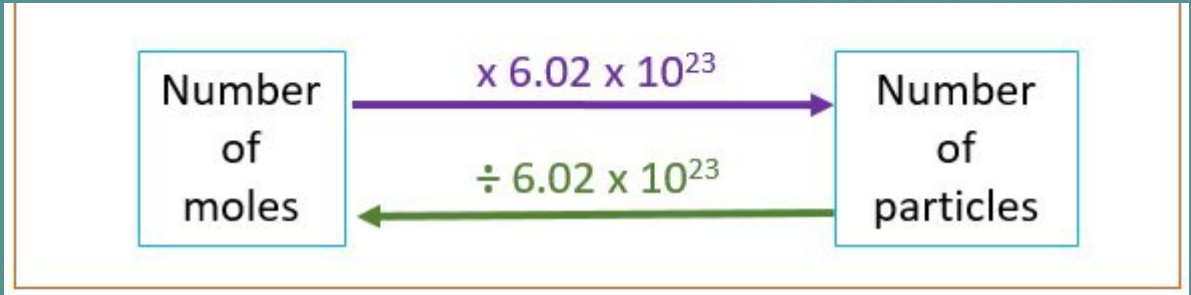




Molecular weight of baking soda ($NaHCO_3$)
= (1x12 amu) + (3x16 amu) + (1x23 amu)+ (1x1 amu) = 84 amu

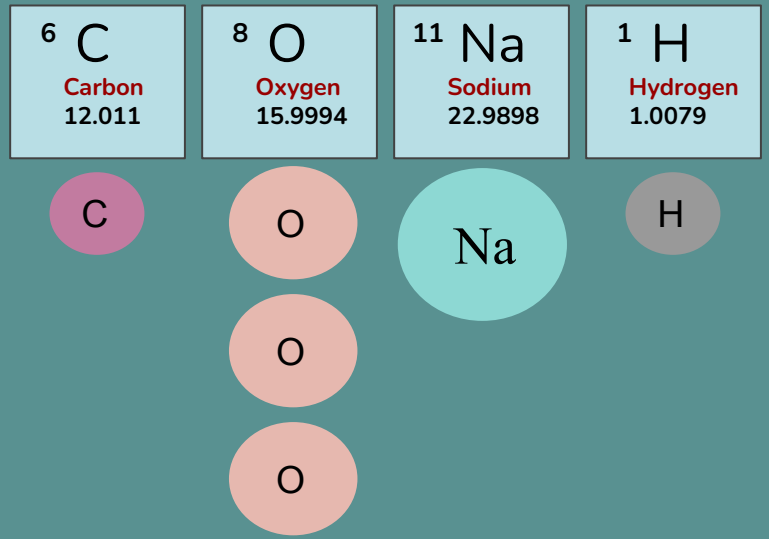
Atomic Mass Unit (amu) and Mole

- 1 amu (atomic mass unit)= 1.67×10^{-24} grams
  = 1/12th the mass of the carbon atom
- 1 mole = 602,200,000,000,000,000,000,000
  = 6.022×10^{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

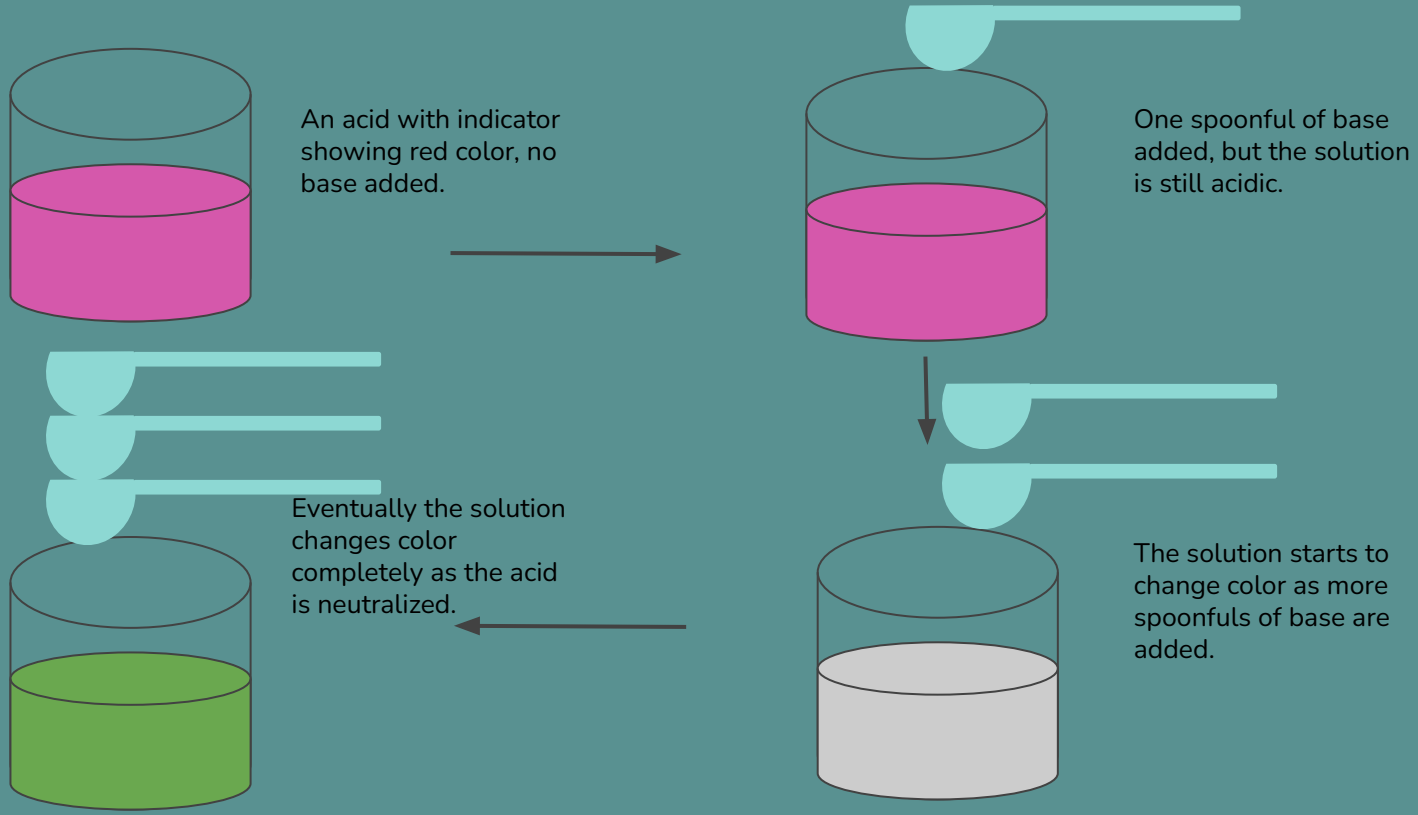
Vinegar **Baking Soda**

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

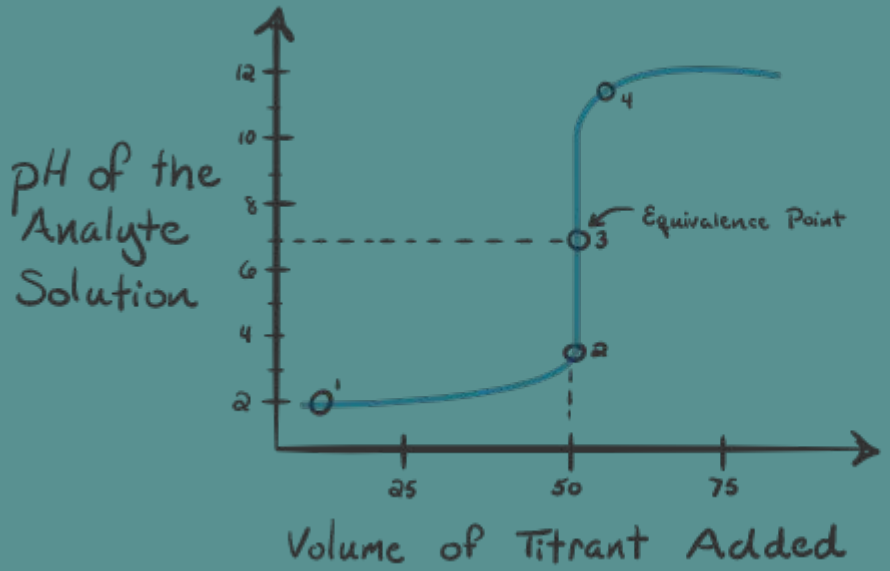
(Acetic Acid) **(Sodium Bicarbonate)** **(Sodium Acetate)**

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)