Titration Problems Name _____

What is a titration?

It is a method to determine the concentration (molarity) of a solution by adding another solution of a known volume and concentration until the reaction is completed, which is indicated by a color change.

We will be focusing on acid-base titrations. We will be mixing one with another until the solution has been neutralized.

What are some common acids?

HCl, HBr, HI, HNO_3, H_2SO_4, $HC_2H_3O_2$

What are some common bases?

NaOH, KOH, LiOH, $Mg(OH)_2$, $Sr(OH)_2$, $Ca(OH)_2$, $Ba(OH)_2$, $Be(OH)_2$,

In this type of acid-base reaction, the reactants will react in a double displacement way.

What information will be given to you in a titration problem?

1. Concentration of your known solution
2. Volume of known solution used to neutralize the unknown solution
3. Volume of the unknown solution that needed to be neutralized

The objective is to find the concentration or Molarity of the unknown solution.

Example: A 15.00 mL sample of acetic acid, $HC_2H_3O_2$, is titrated with 34.13 mL of a 1.499 M solution of NaOH. What is the concentration of the acetic acid?

What is your known solution? NaOH

Why is it your known? *You know both the molarity and the volume used.*

What is your unknown solution? $HC_2H_3O_2$

Why is it your unknown? *You just know the volume of acetic acid*

Step 1: Write a balanced equation (double replacement)

$$NaOH + HC_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O$$

Step 2: Convert all volumes into liters.

Step 3: Determine the number of moles of known (NaOH) that was added to neutralize the unknown ($HC_2H_3O_2$)

$$0.03413\ L \times \frac{1.499\ moles\ NaOH}{1\ Liter} = 0.05116087\ moles\ NaOH$$

Step 4: Determine how many moles of unknown reacted with the known number of moles added in to neutralize the unknown. (moles ratio)

$$0.05116087\ moles\ of\ NaOH \times \frac{1\ mole\ HC_2H_3O_2}{1\ mole\ NaOH} = 0.05116087\ moles\ of\ HC_2H_3O_2$$

Step 5: Determine the molarity of the unknown solution.

$$\frac{0.05116087\ moles\ of\ HC_2H_3O_2}{0.01500\ liters\ of\ HC_2H_3O_2} = 3.411\ M\ HC_2H_3O_2$$

Sample Problems Name _____

1. A 50.00 mL sample of KOH is titrated with 27.87 mL of 0.8186 M solution of HCl. What is the molarity of KOH?

2. 25.00 mL of sulfuric acid of unknown molarity is titrated with a 1.209 M solution of lithium hydroxide. The titration requires 42.27 mL of LiOH to completely neutralize the solution. What is the molarity of the sulfuric acid?

3. A flask contains 41.10 mL of a barium hydroxide solution. The solution is titrated and neutralized with 21.65 mL of a 0.65 M solution of nitric acid. What is the molarity of the base?

4. A bottle is labeled 2.00 M H_2SO_4. You decide to titrate 20.00 mL of the H_2SO_4 with a 1.85 M solution of NaOH. What volume of NaOH would you expect to use if the label was correct?

5. What volume of a 0.52M solution of hydrobromic acid would be needed to titrate 100.0 mL of a 0.15 M solution of strontium hydroxide?