Chapter 4 Part 4

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Stoichiometry and Molarity

How many liters of 0.844 M $Ba(OH)_2$ are required to react with 50.00 mL of 0.0526 M HNO_3? (First you will need to write out and balance the double replacement reaction between $Ba(OH)_2$ and HNO_3)

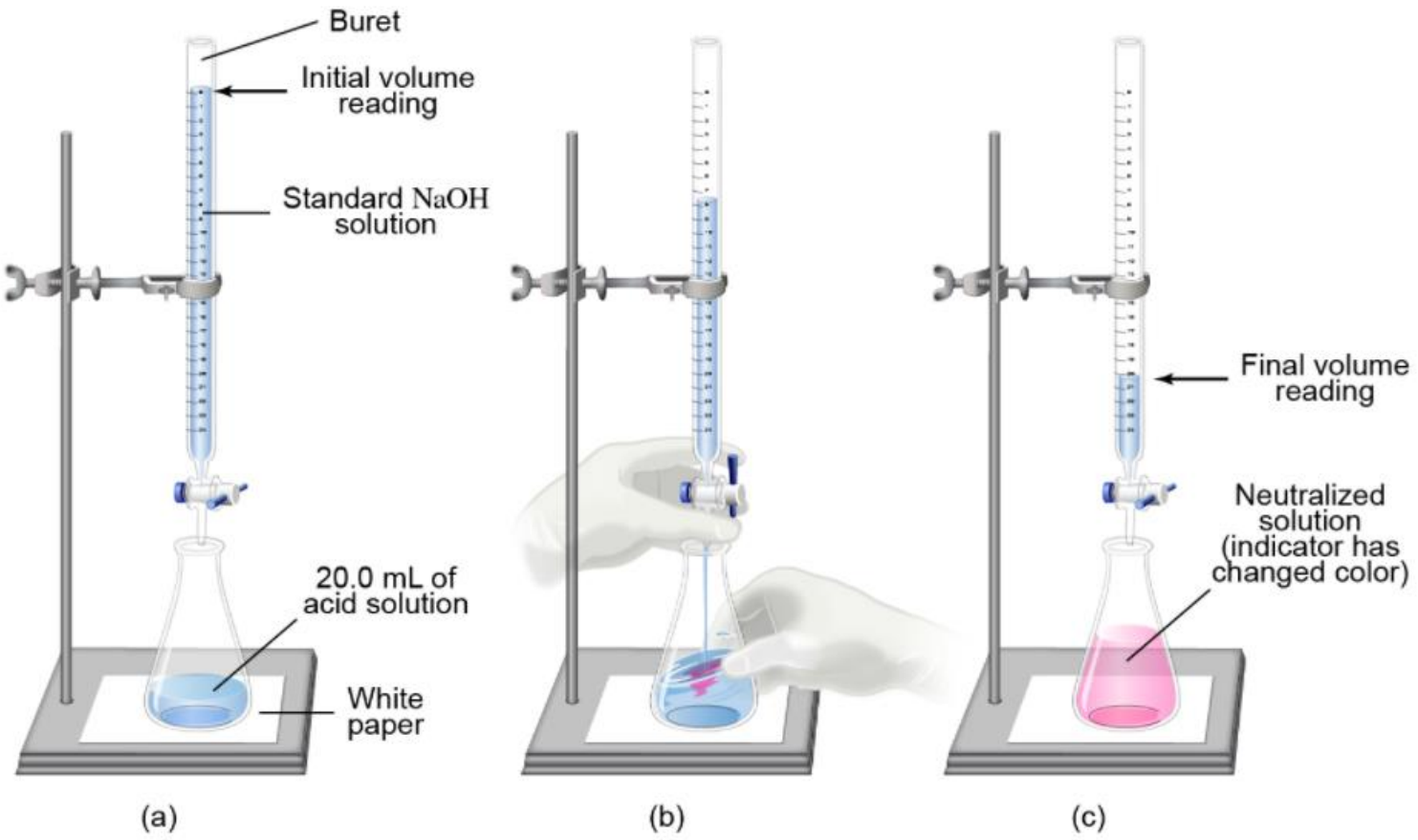
Titrations

- The last problem was an example of a titration
- In titrations, you add just enough of volume of one solution to fully react with another solution.

Titration

- Titration is a laboratory technique for determining the number of moles of a substance dissolved in an aqueous solution (sample solution).
- One reactant, the standard solution, has a precisely known concentration.
- The volume of the standard solution and the sample are both carefully measured.
- The mole ratios and volumes are used to calculate the sample concentration.

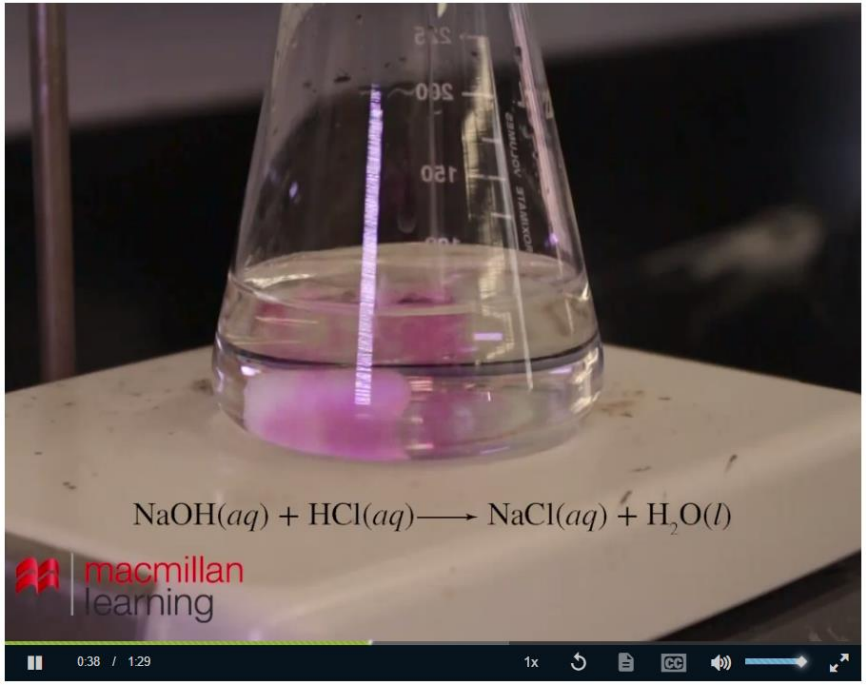
Titration Laboratory Setup



Steps in a Titration

1. One reactant, the titrant, is slowly added to the other.
   - Typically, the titrant is in a buret and the other reactant is in an Erlenmeyer flask to enable mixing by swirling.
2. An indicator is added to the reaction to indicate the end point of the titration.
   - The end point is the volume when indicator changes color.
   - The equivalence point is the volume when all of the sample being titrated has reacted with the titrant.
   - Ideally, the end point and the equivalence point occur at the same volume so that the color change can indicate the end of the titration
3. The volume of the titrant added is determined by comparing the initial and final buret volumes.

Video: Titration Demonstration



Titrations

So instead of:

How many liters of 0.844 M $Ba(OH)_2$ are required to react with 50.00 mL of 0.0526 M HNO_3?

The original problem could also have been written as:

How many liters of 0.844 M $Ba(OH)_2$ are required to titrate 50.00 mL of 0.0526 M HNO_3?

Or:

What is the equivalence point (in mL) of the titration of 50.00 mL of 0.0526 M of HNO_3 with 0.844 M $Ba(OH)_2$?

Working Titration Problems

- Write a balanced reaction for the titration
- Do stoichiometry the same way that we've been doing it
  - Figure out the amount of moles of one thing and use the mole ratio to relate that to the amount of moles of the other thing

Titrations

How many liters of 0.0459 M H_3PO_4 are required to titrate 5.30 grams of $Ca(OH)_2$?

Titrations

Calculate the concentration of an HCl solution if 25.00 mL HCl is titrated with 2.00 M NaOH. The initial buret reading is 2.17 mL, and the final buret reading is 39.42 mL.

Combustion

- Combustion is the process of heating a hydrocarbon (Ex. CH_4, C_6H_6, C_3H_4) in the presence of oxygen gas to make $CO_2(g)$ and $H_2O(g)$

Hydrocarbon(C_xH_y) combustion

- Hydrocarbon $C_xH_y + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

Combustion with C, H, and O

- Combustion can also occur from heating carbon, hydrogen, and oxygen compounds in the presence of oxygen gas.
- $C_xH_yO_z + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

Combustion analysis

When 7.314 g of a hydrocarbon C_xH_y was burned and 22.95 g of CO_2 and 9.393 of H_2O were produced. In a separate experiment, the molar mass of the molecular formula of the compound was found to be 168.32 g/mol. Determine the molecular formula of the hydrocarbon.

Combustion analysis

An organic compound, $C_xH_yO_z$, weighing 1.155 g was burned and 3.241 g of CO_2 and 0.6633 g of H_2O were produced. In a separate experiment, the molar mass of the molecular formula of the compound was found to be 94.11 g/mol. Determine the molecular formula of the organic compound