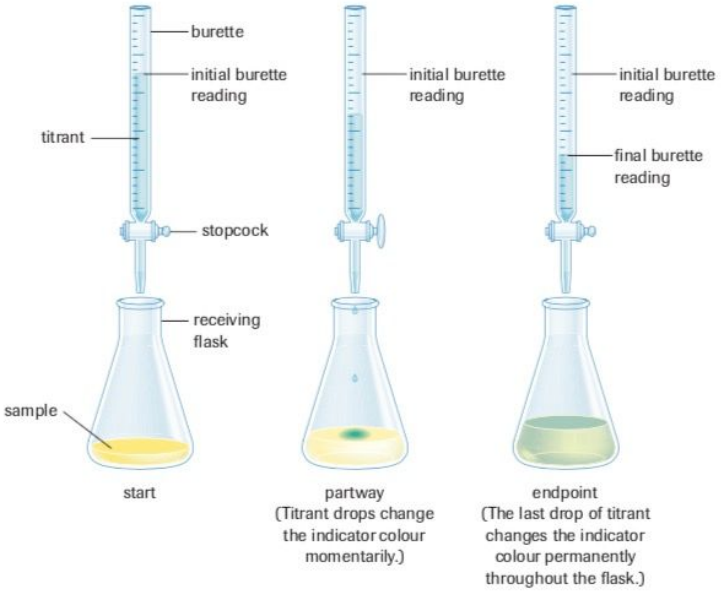
Chemistry 20	Unit 4
Lesson 9 - Titration Analysis	84 mins

Titration Analysis

- Titration is the process of carefully measuring and controlling the addition of a solution, called the titrant, from a burette into a measured fixed volume of another solution, called the sample, usually in an Erlenmeyer flask
- The point at which the exact theoretical amount of titrant has been added to completely react with the sample is called the **equivalence/end** point.
- For titration to be successful, one reactant must be known to an accurate degree.
- A titration analysis should involve several trials, to improve the reliability of the answer.
- The endpoint can be found from using an indicator that has a known change at the equivalence point, generally a pH indicator.
    - BUT colour or conductivity could be used.

Diagram



Example (my unknown HCl (believed to be 1.0M with known standard NaOH) (Show calculations)

Trial	**1**	**2**	**3**	**4**
Final burette reading (mL)				
Initial burette reading (mL)				
Volume of $NaOH_{(aq)}$ added (mL)				
Colour at endpoint				

Standardizing Titrant Solutions

- Standard solution
    - a solution of highly certain concentration
- Primary Standard
    - A chemical that can be obtained at high purity, with mass that can be measured to high accuracy and precision.

- Standardizing a solution means finding the concentration of a solution after it is prepared, by reacting it with another solution that has been prepared from a **primary standard**.

Chemistry 20 - Unit D - Titration Analysis

Name: _____

1) Assume a hydrochloric acid solution is prepared by diluting commercial lab reagent solution (approximately 12 mol/L) by a factor of 20:1. For concentrated HCl(aq) solutions, complete the following:

a) Explain why the label concentration is necessarily uncertain for concentrated solutions of gases dissolved in water. **Hint: Think about opening carbonated beverages.**

b) Explain how the concentration changes each time the stock bottle is opened.

2) Sulfur impurities in fuels produce $SO_{2(g)}$ when the fuel is burned. This is a pollutant that contributes to acid deposition and is a serious respiratory irritant. To analyze the sulfur content in a fuel, the sample may be burned, and the $SO_{2(g)}$ may then be "dissolved" in water, which really means that it reacts with water to become sulfurous acid, $H_2SO_{3(aq)}$. The sulfurous acid can then be analyzed by titration with a standardized solution of $NaOH_{(aq)}$. If, on average, 12.0 mL of 0.110 mol/L $NaOH_{(aq)}$ reacts with 100 mL samples of $H_2SO_{3(aq)}$, what chemical amount of sulfur atoms was present in the 100 mL acid sample?

3) Ammonia is a very useful chemical; our society consumes it in huge quantities. Farmers use the pure substance in liquid form as a fertilizer. Pure liquid ammonia is called anhydrous, which means “without water,” to distinguish it from aqueous solutions. In solution, ammonia has an outstanding ability to loosen dirt, oil, and grease, so it is commonly used in premixed home cleaners such as window cleaning sprays, along with other ingredients. Aqueous ammonia is also sold in most stores for household use, to be diluted at home to make solutions for cleaning and wax stripping. Such solutions can legally be anywhere from 5% to 30% ammonia by weight.

A student wishing to find the concentration of ammonia in a commercial solution decides to do an analysis, titrating 10.00 mL samples of NH3(aq) with a standardized solution of 1.48 mol/L $HCl_{(aq)}$. Her first trials use more than 50 mL (a burette full) of the acid, so she throws out the results and prepares a new ammonia sample solution by diluting the original commercial solution 10:1, that is, increasing a volume tenfold to reduce the concentration to precisely one-tenth of the original value. Using Table 2, complete the Analysis of her investigation report.

Purpose

The purpose of this investigation is to use a titration design to analyze a solution of ammonia.

Problem

What is the amount concentration of the original ammonia solution?

Design

The original ammonia solution is diluted tenfold. Samples of diluted solution are titrated with a standard 1.48 mol/L solution of hydrochloric acid. The colour change of bromocresol green indicator from blue to yellow is used as the endpoint.

Table 2 Titration of 10.00 mL of NH3(aq) with 1.48 mol/L HCl(aq)

Trial	**1**	**2**	**3**	**4**
Final burette reading (mL)	15.0	29.1	43.0	14.4
Initial burette reading (mL)	0.3	15.0	29.1	0.4
Volume of $HCl_{(aq)}$ added (mL)				
Colour at endpoint	Yellow	Green	Green	Green

a) Analyse the data. What is the concentration of the ammonia she has?