Acid-Base Titration

SCH 4U1

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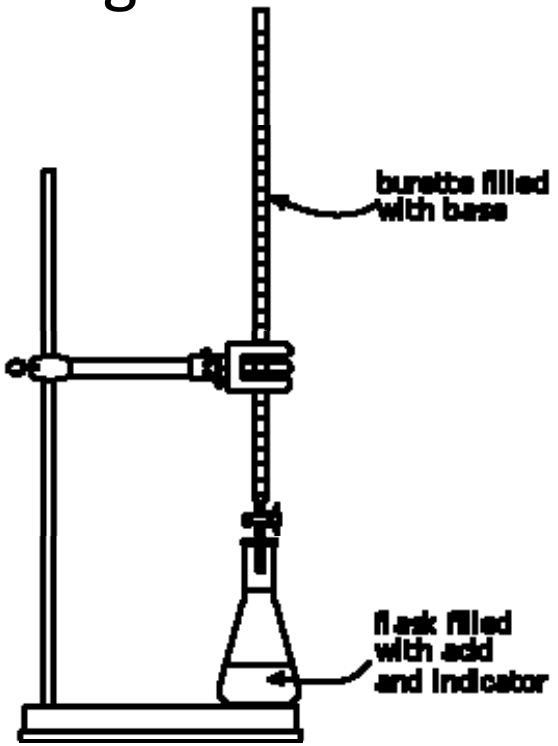
- **<u>TITRATION</u>** is the name the technique of carefully measuring the volume of a solution required to react with another solution. In an acid-base titration, one solution is acidic and one is basic.
- The <u>end point</u> of the reaction is detected with an indicator (such as phenolphthalein) that changes colour in response to pH changes.

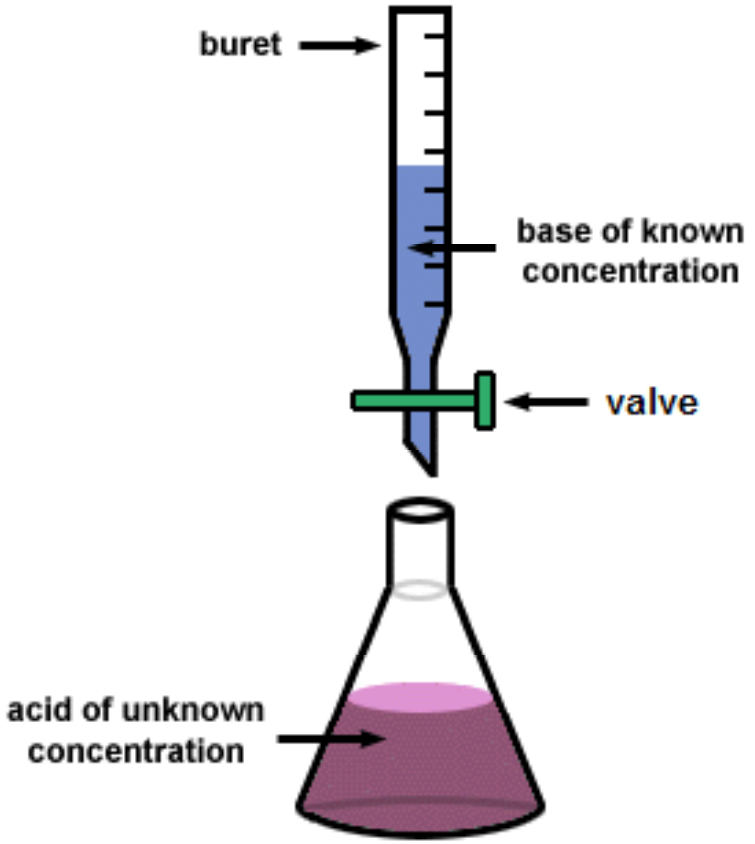


- Titration allows you to find the concentration of an known amount of unknown acid or base by using another base or acid whose volume you already know.

  So by slowly adding the known of acid/base to the unknown base/acid, it will eventually be neutralized.

  When it's neutralized, you can do some calculations to find the unknown concentration/ strength.

- The titrant is the solution in a buret during a titration.
- Same is the solution being analyzed in a titration



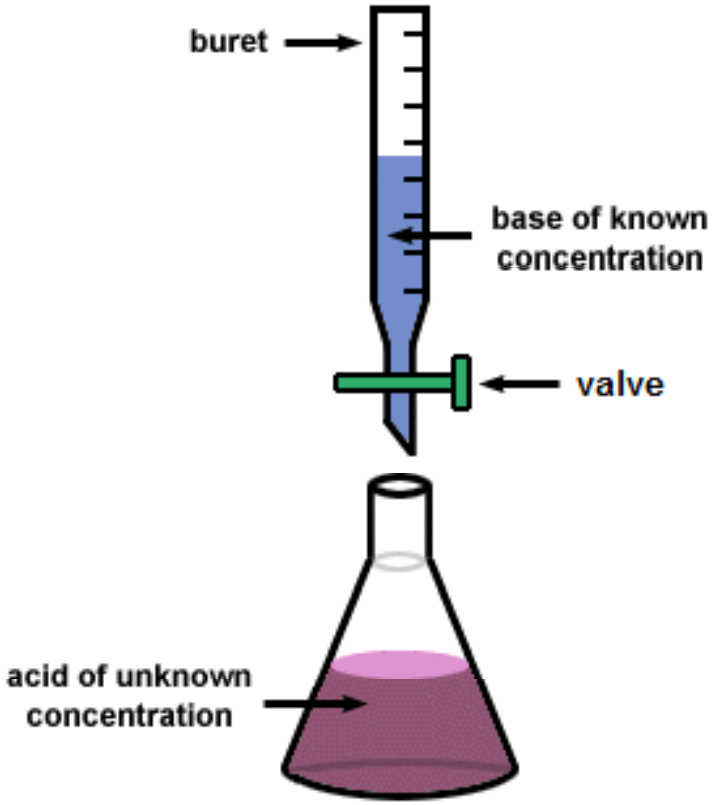
The equivalence point of a titration

Sorting out some confusing terms

- When you carry out a simple acid-base titration, you use an indicator to tell you when you have the acid and alkali mixed in exactly the right proportions to "neutralize" each other. When the indicator changes colour, this is often described as the ***end point*** of the titration.
- In an ideal world, the colour change would happen when you mix the two solutions together in exactly equation proportions. That particular mixture is known as the ***equivalence point***.

- For example, if you were titrating sodium hydroxide solution with hydrochloric acid, both with a concentration of 1 M, 25 ml of sodium hydroxide solution would need exactly the same volume of the acid - because they react 1 : 1 according to the equation.
- In this particular instance, this would also be the ***neutral point*** of the titration, because sodium chloride solution has a pH of 7.
- But that isn't necessarily true of all the salts you might get formed

- For example, if you titrate ammonia solution with hydrochloric acid, you would get ammonium chloride formed. The ammonium ion is slightly acidic, and so pure ammonium chloride has a slightly acidic pH.
- That means that at the equivalence point (where you had mixed the solutions in the correct proportions according to the equation), the solution wouldn't actually be neutral. To use the term "neutral point" in this context would be misleading.



To summarise:

- The term "neutral point" is best avoided.
- The term "equivalence point" means that the solutions have been mixed in exactly the right proportions according to the equation.
- The term "end point" is where the indicator changes colour. That isn't necessarily exactly the same as the equivalence point.

- In a perfect world: nutella would be free, Zach Randolph would play for the Raptors, and an acid-base indicator could be chosen to exactly match an equivalence point such that endpoint = equivalence point – so that the colour change occurs sharply at the point where a complete reaction is attained.

However this is impossible to achieve in the lab so titrations have experimental error.

- The endpoint is defined by the choice of indicator as the point at which the colour changes. Depending on how quickly the colour changes, the endpoint can occur almost instantaneously or be quite wide.

indicator	pH range
litmus	5 - 8
methyl orange	3.1 - 4.4
phenolphthalein	8.3 - 10.0