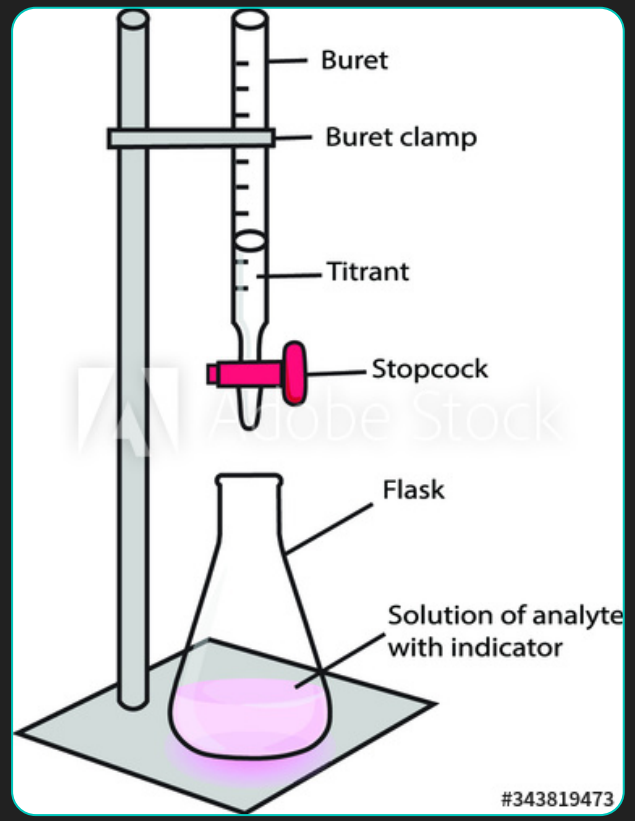
Titration

What is titration and what is its purpose?

- An acid-base titration is an experimental procedure used to determined the unknown concentration of an acid or base by precisely neutralizing it with an acid or base of known concentration.
- The purpose of this is to let us quantitatively analyze the concentration of the unknown solution ("Acid-base titrations | Introduction to chemistry," n.d.)

Instruments/Equipment



Instruments:

- Burette
- White tile (used to see a color change in the solution)
- Pipette
- pH indicator: phenolphthalein indicator
- Erlenmeyer or conical flask

Safety Equipment:

- Safety goggles, gloves and coat

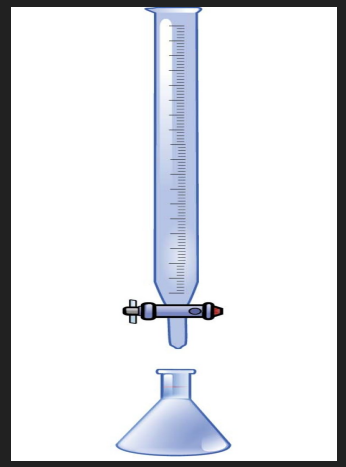
Chemicals

- ACID: Hydrochloric Acid – HCl
- BASE: Sodium Hydroxide – NaOH
- Phenolphthalein - A chemical compound with the formula $C_{20}H_{14}O_4$ and is often used as an indicator in acid–base titrations.

Procedure

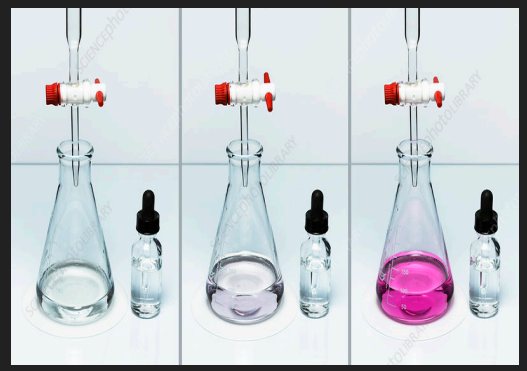
Step 1:
Prepare unknown solution (titrand/acid) in a conical flask. Also add phenolphthalein (indicator).

Step 2:
Prepare burette with known solution (titrant/ base)



Step 3:
Titrant is slowly released from burette and mixed with titrand solution in flask. As the two solutions are mixed, the acid and base are neutralized.

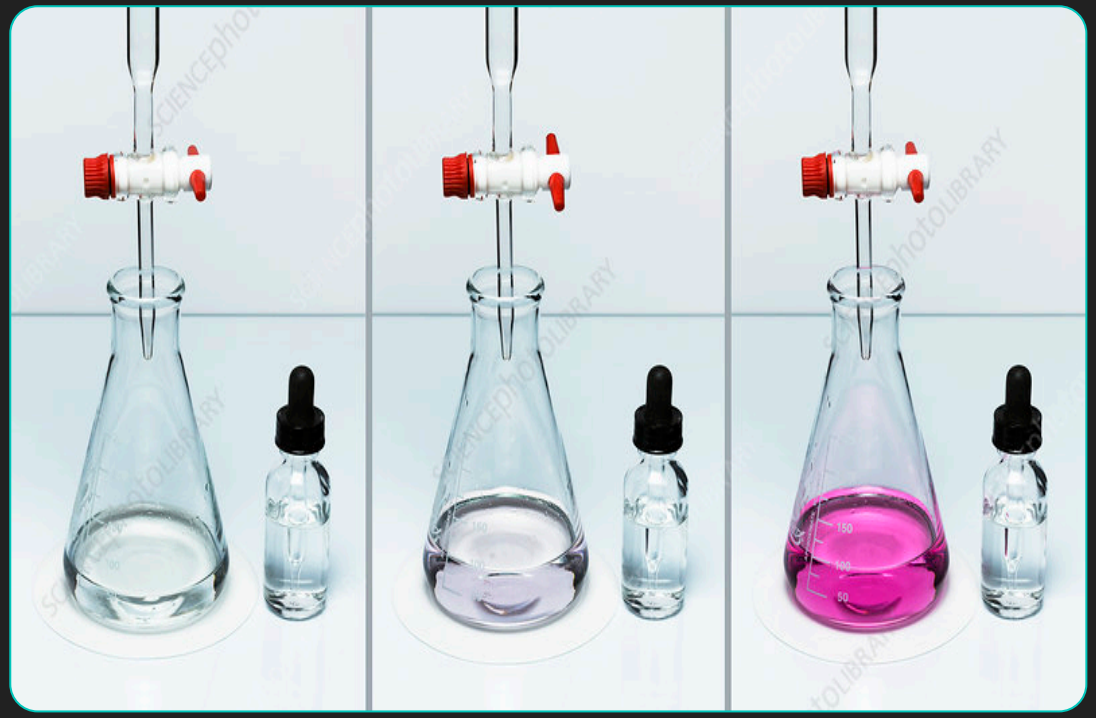
Step 4:
When the end point is reached, the burette tap is closed, and the volume of base added is calculated and recorded.



Step 5:
The titration then needs to be repeated at least two more times and an average taken.

Process

- Two important stages occur in titration.
  - The equivalence point refers to the point when the number of moles of OH^- added equals the number of moles of H^+ originally in the solution (Tro, 2018). In other words, the point at which the added titrant is equivalent to the sample tritand. The equivalence point is typically signaled by the indicator, and in this case, the phenolphthalein.
  - The endpoint is the point where the symbol changes color.



Calculations and results:

Trial	Vol HCl, mL	Vol NaOH, mL	calc.
1	21.43	19.26	0.223
2	18.57	16.73	0.222
3	22.20	21.14	0.210
Average:	20.73	19.04	0.218

Balanced equation:

HCl + NaOH —> NaCL + H20

*Initial 0.00 mL, Final 19.04 mL NaOH = 19.04 mL NaOH

Calculation:

19.04 mL / 1000mL = .01904 L of NaOH

.218 M of NaOH x .01904 L of NaOH
= .00415 mols NaOH

.00415 mols NaOH = .00415 mols HCl

20.73 mL / 1000mL = .02073 L of HCl

.00414 mols HCl / .02073 L HCLl= . 200 M HCl

Mass Percent:

.00415 mols HCl x 36.46 g HCl / 1 mol = .151 g HCl

.151 g HCl / 20.73 g x 100 = .73 %

Importance of Titration in Nursing

- ICU nurses are responsible for the management of vasoactive medications. Variations in practices include preparation, initiation, administration, *titration* and weaning of vasoactive medications, which increases the risk for medication errors and adverse events in a critically ill patients (Hunter et al., 2019).
- For example, vasoactive drugs are an essential part of shock management. Vasoactive drugs have a small therapeutic margin and expose the patients to potentially lethal complications. These drugs require exact therapeutic targets and close monitoring with titration to the minimum effective dose (Annane et al., 2018).
- Selecting a dose regimen that is both safe and effective for patients is one of the most essential elements of a successful drug development program. Titrating the dose regimen of a drug based on patient response may help to identify safe and effective dosages at the individual patient level (Hunter et al., 2019).

References:

- Annane, D., Ouanes-Besbes, L., De Backer, D., DU, B., Gordon, A. C., Hernández, G., Olsen, K. M., Osborn, T. M., Peake, S., Russell, J. A., & Cavazzoni, S. Z. (2018). A global perspective on vasoactive agents in shock. Intensive Care Medicine, 44(6), 833-846. https://doi.org/10.1007/s00134-018-5242-5

- Hunter, S., Considine, J., & Manias, E. (2019). Nurse management of vasoactive medications in intensive care: A systematic review. Journal of Clinical Nursing, 29(3-4), 381-392. https://doi.org/10.1111/jocn.15093

- Tro, N. J. (2018). Introductory chemistry (6th ed.). Pearson Education, Inc.