Dilutions and Titrations

- Sometimes you know the concentration of a solution but it’s not what you require
  - Therefore, you must dilute the stock solution
    - The amount of substance (mol) is the same in the diluted sample as the undiluted sample
    - The volume is the only variable that changes

- To dilute a sample, take the volume of the original solution and add a known volume of solvent to produce a more dilute solution
  - The undiluted and diluted sample has the following equations respectively:
    - Moles = \( C_1 \times V_1 \)
    - Moles = \( C_2 \times V_2 \)
  - Therefore: \( C_1 V_1 = C_2 V_2 \)

- For example, if you have 100ml of a 2M HCL solution and you add 900ml of H\(_2\)O, what is the concentration of the diluted sample?
  - It will be 0.1x2 = 1(c)
    - It will then be 0.2/1 = c
    - \( C = 0.2 \text{ mol L}^{-1} \)

- You can also work out the volume needed to give a certain concentration in a diluted solution, for example:
  - If the concentration of the undiluted sample is 2M, the volume is 0.2L and the concentration of the diluted solution is 0.2M then the volume of the new sample will be:
    - \( (0.2\times2)/0.2 \) which is 2L

- Sometimes you need to dilute a solution by a significant amount, and so this is done using serial dilutions
  - This is done by adding small dilutions to the stock solution and then taking that as the new stock solution. This is then repeated and yields many different sample dilutions

- Titration is used to directly measure the concentration of a sample
  - This is done using a series of chemical reactions to measure amounts in a sample
  - The production of a product is key in this process
    - A burette is used to deliver the second reactant to a flask and an indicator is used to detect the endpoint of the reaction

- A coupled reaction is when the product from one reaction is then used straight way as the ingredient for another reaction, for instance A+B=C and C+D=E, therefore you cannot get E without A or B

- UV spectroscopy can be used to detect the concentration of a sample:
  - The amount of light that passes through the sample is indirectly proportional to the concentration
    - In a low concentration, much light passes through the sample
    - In a high concentration, little light passes through
  - The Beer-Lambert law states that the absorbance of light is equal to the molar absorptivity (L mol\(^{-1}\) cm\(^{-1}\)) (\( \varepsilon \)) x the concentration (mol L\(^{-1}\)) (c) x the path length (cm) (l):

\[
A = \varepsilon cl
\]