Buffer Capacity

Buffers:

- Buffer solutions are solutions that can resist changes in pH upon addition of **small amounts** of acid/base.

- Common buffer mixtures contain two substances:
  conjugate acid and a conjugate base .

- Together the two species (conjugate acid and conjugate base) **resist large changes in pH** by absorbing the H+ ions or OH- ions added to the system.

How buffers resist the change in pH:

1. When **H^+ ions** are added to the buffer system they will react with the conjugate base in the buffer as following:

2. When **OH^- ions** are added they will react with the conjugate acid in the buffer as following:

➔ **Thus the buffer is effective as long as it does not run out of one of its components.**

(There are enough conjugated base and conjugated acid to absorb the H^+ ions or OH^- ions added to the system respectively).

Buffer Capacity:

- Quantitative measure of this resistance to pH changes is called **buffer capacity.**

- Buffer capacity can be defined in many ways, **it can be defined as:**

➔ The number of moles of H^+/OH^- ions that must be added to one liter of the buffer in order to decrease /increase the pH by one unit respectively.

- The buffer capacity is **expressed as β** and can be derived from Henderson Hasselbalch equation:

$$\beta = \frac{2.3\, K_a [H^+][C]}{(K_a + [H^+])^2}$$

From the equation ➔ the buffer capacity is directly proportional to the buffer concentration.

- **Where :**

β = the buffer capacity , [H+] = the hydrogen ion concentration of the buffer , [C] = concentration of the buffer and Ka= acid dissociation constant

Practical Part

Objective:

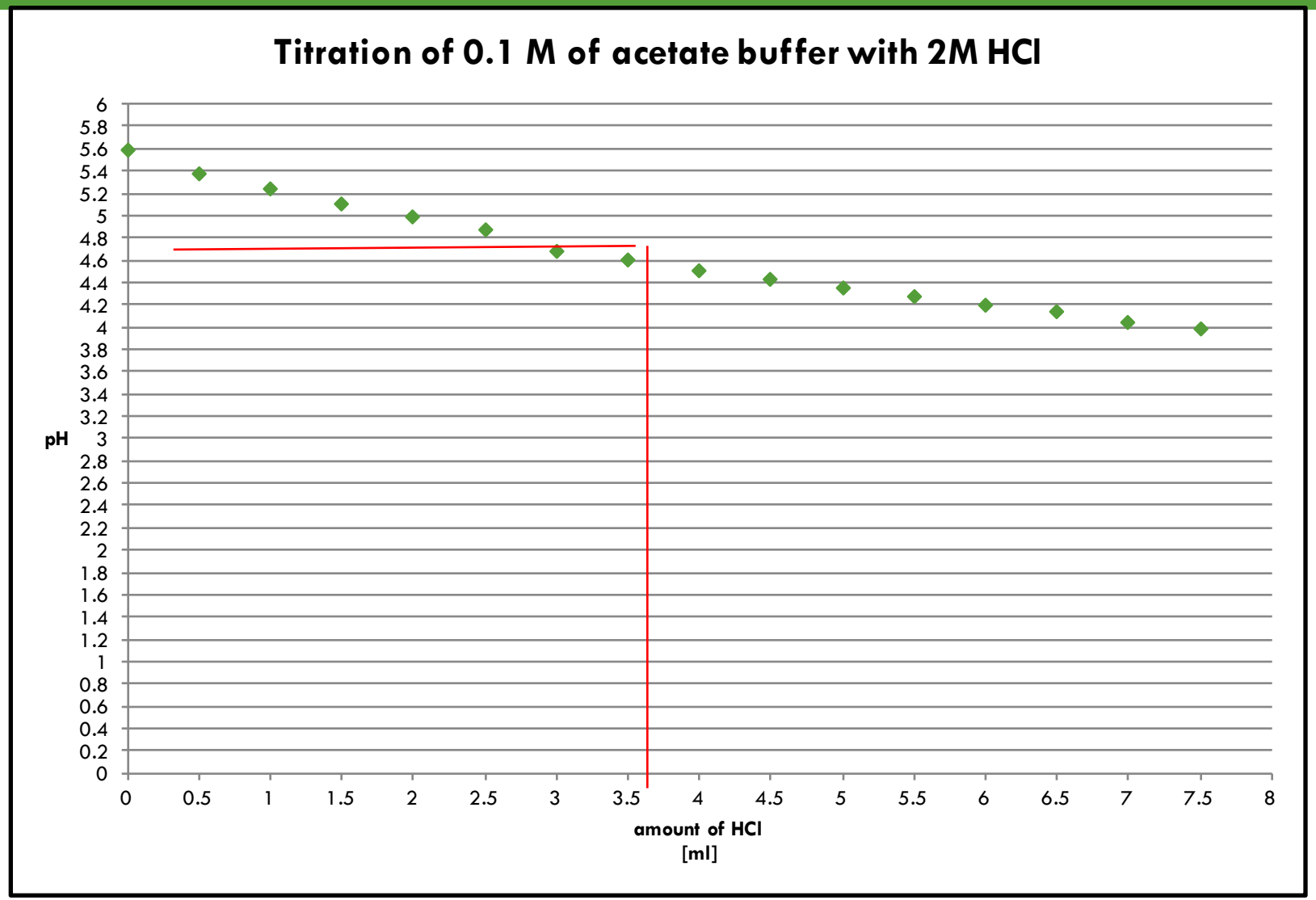
- To understand the concept of buffer capacity.
- To determine the maximum buffer capacity of a number of buffer solutions.
- To establish the relationship between buffer capacity and buffer concentration.

Method:

- You are provided with two acetate buffer (pH=5) ; 0.1 M acetate buffer and 0.2 M acetate buffer .
- In one beaker add 8ml of the 0.1 M acetate buffer buffer, and in another beaker add 8ml of 0.2 M acetate buffer.
- Start the titration by adding 0.5 ml of 0.1 M HCl from the burette and determine the pH of the solution after each addition.
- Continue adding acid in until pH falls to about 2 pH units from your starting pH .
- Plot a Curve of pH against ml of HCl added.
- Calculate the buffer capacity (which one has higher buffer capacity. why?)

What do you conclude finally about the relationship between, Buffer concentration and buffer capacity ?

Results:



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