Strong acid - Strong base titration

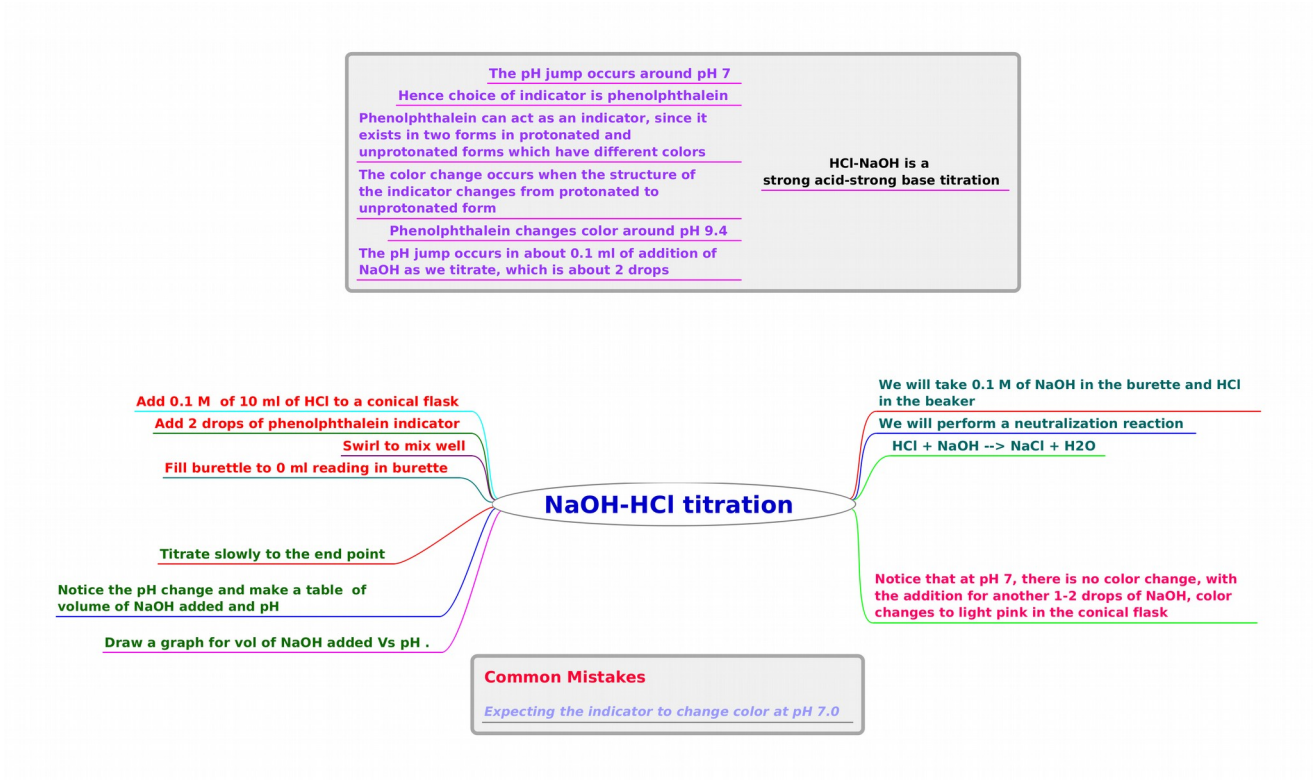
In this experiment, we will titrate HCl acid with NaOH. HCl has one ionization proton and NaOH has one ionizable OH^- group each. This is an example of strong acid-strong base titration. In the Vlabs interface, we will add phenolphthalein indicator to detect the end point, and also monitor the titration with pH mesurement.

0.1M HCl will be taken in a conical flask. We will fill the burette with 0.1M NaOH. As NaOH is added, monitor color of the solution and the pH change of the solution. Determine the end point of the titration. Create a table with volume of NaOH added and the pH in two columns and plot the data.

$HCl + NaOH \quad <-> NaCl + H_2O^-$

The following steps that are involved will be described,

1. Reagents needed
2. Setting up the experiment
3. Titration and note down the pH values
4. Plot the data to obtain the titration curve
5. Why color change is not seen at pH 7 for the neutralization reaction



1. *Reagents needed*
   - 0.1 M HCl and 0.1 M NaOH for titration. Phenolphthalein will be used as an indicator.

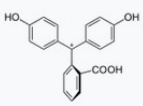
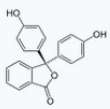
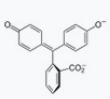
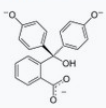
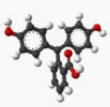
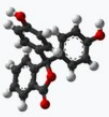
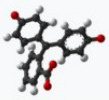
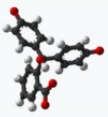
2. *Setting up the experiment*
   - Take a 50 ml burrette and fill it with 0.1M NaOH solution. First add 50 ml and follow it it with 0.1ml increment addition to bring the meniscus reading to 0.
   - Take a conical flask and pour 10 ml of 0.1M phosphoric acid.
   - Place the burettee above the conical flask and align it to show it green + sign. Now, we are set up to start the titration.
   - I will also open a spreadsheet editor to enter the pH values in the titration.

3. *Titration and note down the pH values*
   - Select the conical flask and note down the pH.
   - Enter the value in the spreadsheet.
   - I will start with 0.2 ml increment for addition of NaOH. After each addition, take the pH reading of the solution.
   - After every drop, gently swirl the flask to mix well.
   - Take the pH reading and enter the values in the spreadsheet/table. On first column enter the volume of NaOH that is added. In the second column enter the pH reading.
   - Around pH 6, start to add NaOH in 0.1 ml increments.

4. *Plot the data to obtain the titration curve*
   - Plot the graph, using a plotting program or graph paper.
   - Volume of NaOH is in x-axis and pH values are in y-axis.
   - Notice that the pH jump is very fast around pH 7.0.

5. *Why color change is not seen at pH 7 for the neutralization reaction*
   - At pH 7, phenolphthalein does not change color. In this titration, phenolphalein is used as an indicator. The color change occurs due to structure change of the indicator molecule due to protonation-deprotonation during titration. This occurs at the pK_a of phenolththalein, which is at pH 9.4 . From pH 7 to 9.4 only 1-2 drops of NaOH base is required, which gives an accurate titration reading.

   - https://en.wikipedia.org/wiki/Phenolphthalein

Species	H_3In^+	H_2In	In^{2-}	$In(OH)^{3-}$
Structure				
Model				
pH	<-1[3]	0–8.3	8.3–10.0[4]	>10.0
Conditions	strongly acidic	acidic or near-neutral	basic	strongly basic
Color	orange	colorless	pink to fuchsia	colorless
Image				

   - The Henderson-Hasselbalch equation an be used to calculate the ratio of the two forms of phenolphthalein. *pH = pK_a + log [base]/[acid]*