TITRATION CURVES
A **titration curve** is a graph of the **pH** changes that occur during an acid-base titration versus the **volume** of acid or base added.

The **equivalence point** is the end of a **titration** where the **stoichiometry** of the reaction is exactly satisfied, or **moles H^+ = moles OH^-**.

The **end point** refers to when an **indicator** changes color and **[HInd] = [Ind^-]**.
Intro to Titration Curves Assignment

**pH Changes as 0.10M NaOH is added to 10.0mL of 0.10M HCl**

- **Brom Blue** would work best. Changes colour at equivalence point.
- Moles of $H^+ = OH^-$
- pH = 7
- Equivalence Point

BUFFER ZONE
Choosing an Indicator

When you **choose** an indicator, you must pick one so that the **transition point** of the indicator matches the **equivalence point** of the titration.

**Rule of thumb**

<table>
<thead>
<tr>
<th>Dominant</th>
<th>Equivalence Point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neither</strong></td>
<td>7</td>
</tr>
<tr>
<td><strong>Base</strong></td>
<td>9 (Basic)</td>
</tr>
<tr>
<td><strong>Acid</strong></td>
<td>5 (Acidic)</td>
</tr>
</tbody>
</table>

- **Neither**: strong acid, strong base
- **Base**: strong base, weak acid
- **Acid**: strong acid, weak base.
1. Titration Curve: **Strong Acid** and **Strong Base**

   \[ \text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{HOH} \]

   Endpoint: \( \text{pH} = 7 \)  
   Bromothymol Blue - see page 7

50 mL of 0.10 M KOH **is added to** 25 mL of 0.10 M HCl

We start here

The pH of 0.10 M KOH is **13.0**

The pH of 0.10 M HCl is **1.0**

**Endpoint pH = 7.0**
2. Titration Curve: **Weak Acid** and **Strong Base**

\[
\text{HCN} + \text{KOH} \rightarrow \text{KCN} + \text{H}_2\text{O} \quad \text{strong base dominates!}
\]

Endpoint \( \text{pH} \sim 9 \quad \text{Phenolphthalein- see page 7} \)

20 mL of 1.0 M HCN **is added to** 10 mL of 1.0 M KOH

We start here \( \text{pH} = 14 \)

We end here \( \text{pH} \sim 3 \) (weak acid)
3. Titration Curve: **Strong Acid** and **Weak Base**

HCl + NH₃ → NH₄⁺ + Cl⁻ strong acid dominates!

Endpoint pH ~ 5  **Methyl Red** - see page 7

60 mL of 1.0 M NH₃ is added to 30 mL of 1.0 M HCl

**1.0 M NH₃** pH ~ 10 (weak base)

**1.0 M HCl** pH = 0
4. Match the Curve with the Reaction

A. \( \text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Cl}^- \)

B. \( \text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{HOH} \)

C. \( \text{HCN} + \text{KOH} \rightarrow \text{KCN} + \text{HOH} \)

✓
5. Match the Curve with the Reaction

A. $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Cl}^-$
B. $\text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{HOH}$
C. $\text{HCN} + \text{KOH} \rightarrow \text{KCN} + \text{HOH}$

√
6. Match the Curve with the Reaction

A. \( \text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Cl}^- \)

B. \( \text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{HOH} \)

C. \( \text{HCN} + \text{KOH} \rightarrow \text{KCN} + \text{HOH} \)

\( \sqrt{\text{C.}} \)