

Buffers, titration curves and indicators

AP Chemistry · Lab

Name: _____ Date: _____ Class: _____

Where is the equivalence point, and what does the curve tell you about the acid? You titrate ethanoic acid with sodium hydroxide while a pH meter records the change, then find the concentration, the pKa and the best indicator from your graph.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 8

Aim

To plot the pH curve for the titration of ethanoic acid with sodium hydroxide, find the equivalence volume, determine pKa from the half-equivalence point and choose an indicator.

Equipment

- 0.100 mol/dm³ NaOH in a 50 cm³ burette
- 25.0 cm³ of ethanoic acid of unknown concentration
- pH meter and probe, calibrated with pH 4 and pH 7 buffers
- Conical flask, 25.0 cm³ pipette, funnel, stand, white tile
- Distilled water, eye protection

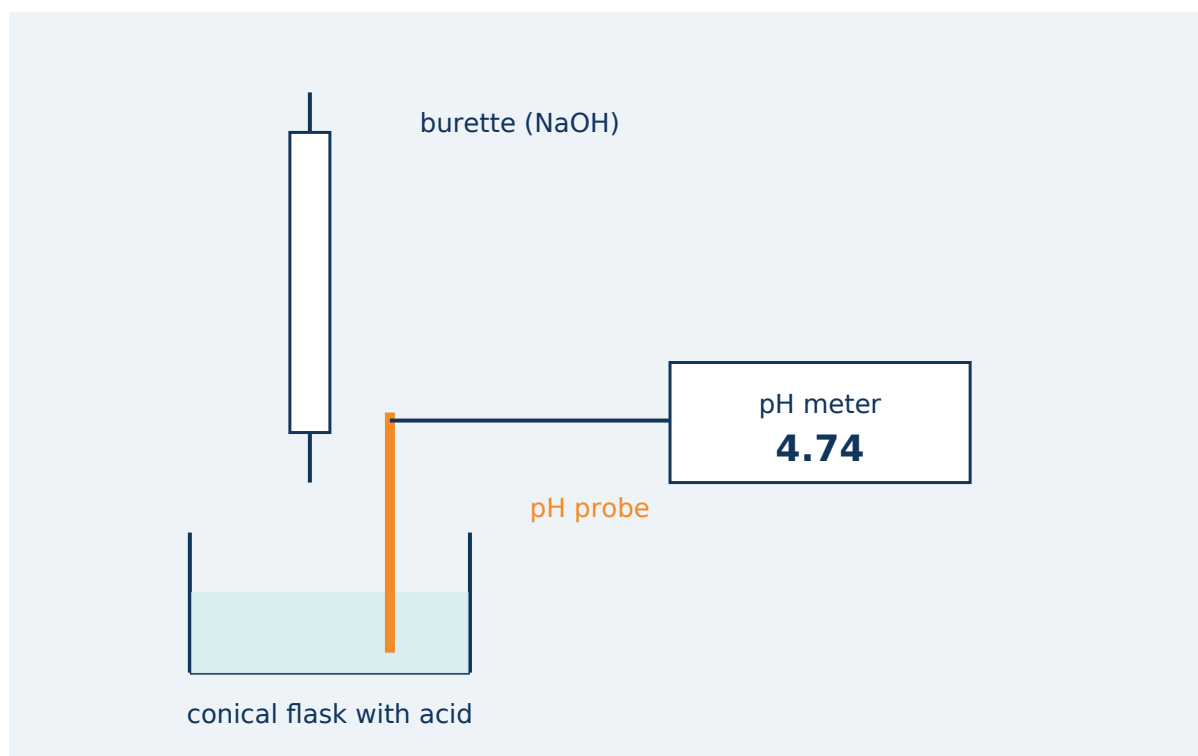
Safety

Safety

Wear eye protection. Sodium hydroxide at 0.1 mol/dm³ is irritant to eyes and skin, so wash splashes with plenty of water at once. Mop up spills straight away and fill the burette below eye level.

Method

1. Rinse the burette with NaOH and fill it. Record the starting reading.
2. Pipette 25.0 cm³ of the acid into the flask and add the pH probe.
3. Record the initial pH.
4. Add NaOH in 5 cm³ portions, swirling and recording pH each time, then in 1 cm³ portions near the steep rise.
5. Add 0.1 cm³ portions around equivalence, then continue to 30 cm³.
6. Plot pH against volume.



Set-up for a pH titration.

Results

Sample readings for 25.0 cm³ of acid with 0.100 mol/dm³ NaOH:

volume NaOH (cm ³)	pH
0	2.88
5	4.14
10	4.57
12.5	4.74
15	4.92
20	5.35
24	6.12
24.9	7.14
25	8.72
25.1	10.30
26	11.29
30	11.96

Analysis questions

Question 1 Equivalence volume

Use the steepest part of the data to state the equivalence volume.

Question 2 Concentration of acid

Calculate the concentration of the ethanoic acid.

Question 3 Finding pKa

State the half-equivalence volume and read pKa from the data.

Question 4 Ka value

Calculate Ka from your pKa and compare with 1.8×10^{-5} .

Question 5 Indicator choice

The equivalence pH is about 8.7. Choose between methyl orange (3.1–4.4), bromothymol blue (6.0–7.6) and phenolphthalein (8.3–10.0).

Question 6 Buffer region

Explain why the pH changes slowly between 5 cm³ and 20 cm³.

Question 7 Uncertainty

The burette is read to ± 0.05 cm³ at start and finish. Calculate the percentage uncertainty in the equivalence volume of 25.0 cm³.