

Strong and weak acids, bases and pH

AP Chemistry · Lab

Name: _____ Date: _____ Class: _____

Is K_a really a constant? You measure the pH of three dilutions of ethanoic acid, calculate K_a from each, and see that K_a stays steady while the percentage ionised changes. The lab needs a pH meter and uses safe, dilute solutions.

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

Aim

To measure the pH of three dilutions of ethanoic acid, calculate K_a for each, and see how the percentage ionised changes with dilution.

Equipment

- 0.100 mol/dm³ ethanoic acid, 100 cm³
- Distilled water, 250 cm³
- pH meter or probe, calibrated with pH 4 and pH 7 buffers
- Three 100 cm³ beakers and one 100 cm³ volumetric flask
- 10 cm³ and 25 cm³ pipettes with filler
- Wash bottle, tissue paper

Safety

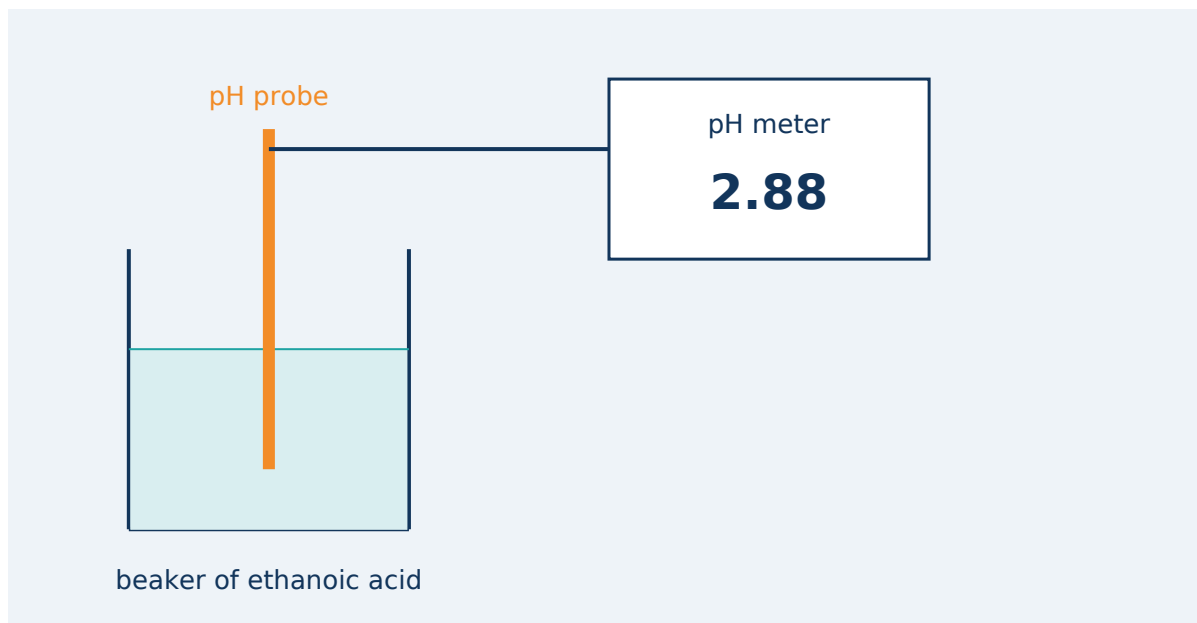
Safety

Wear eye protection. 0.100 mol/dm³ ethanoic acid is only a mild irritant, but rinse any splash on skin with water. Rinse the probe with distilled water between solutions and never store it dry.

Method

1. Calibrate the pH meter using the buffers.
2. Pour about 50 cm³ of 0.100 mol/dm³ acid into a beaker, insert the probe, stir gently and record the steady pH.
3. Pipette 10.0 cm³ of the 0.100 mol/dm³ acid into the flask and dilute to 100 cm³ to make 0.0100 mol/dm³. Mix well.
4. Pour some into a clean beaker and record its pH.
5. Repeat the tenfold dilution once more to make 0.00100 mol/dm³ and record its pH.

6. Rinse the probe between each solution.



Set-up: pH probe in a beaker of ethanoic acid.

Results

Sample measurements at 25 °C:

concentration c (mol/dm ³)	measured pH	[H ₃ O ⁺] (mol/dm ³)	percent ionised	K _a
0.1	2.88	1.32×10^{-3}	1.3	1.76×10^{-5}
0.01	3.41	3.89×10^{-4}	3.9	1.57×10^{-5}
0.001	3.91	1.23×10^{-4}	12.3	1.73×10^{-5}

Analysis questions

Question 1 Hydronium concentrations

Calculate [H₃O⁺] for each pH reading.

Question 2 Percent ionised

Calculate the percent ionised at each concentration and describe the trend.

Question 3 K_a from each reading

Calculate K_a at each concentration using $K_a = \frac{[\text{H}_3\text{O}^+]^2}{(c - [\text{H}_3\text{O}^+])}$.

Question 4 Mean and comparison

Calculate the mean K_a and compare it with the accepted value 1.8×10^{-5} .

Question 5 Predicting the next dilution

Predict the pH of the next tenfold dilution ($0.000100 \text{ mol/dm}^3$) using $K_a = 1.8 \times 10^{-5}$.

Question 6 Pipetting error

The 10.0 cm^3 pipette actually delivers 9.9 cm^3 in the first dilution. Explain the effect on the concentration and on the K_a calculated for that dilution.

Question 7 Random error

State two sources of error in the pH readings and one improvement for each.