

Determination of pKa by Half Neutralization

Practical 02 | Physical Pharmaceutics I

Aim

To determine pKa by Half Neutralization, and interpret the recorded observations.

Principle

- For a monoprotic weak acid, the Henderson-Hasselbalch relation gives $\text{pH} = \text{pKa}$ when the amounts of acid and conjugate base are equal.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

Materials and Apparatus

- Assigned weak acid, standardized base, calibrated pH meter and titration glassware.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

Method

1. Measure the assigned monoprotic weak-acid portion and calibrate the pH meter.
2. Add the standardized base incrementally and retain the volume-pH readings.
3. Identify the equivalence volume from the appropriate titration-curve interpretation.
4. Read the pH at half that equivalence volume.
5. Estimate pKa from the half-neutralization pH under the stated weak-acid assumptions.
6. State the temperature and explain possible effects of concentration or nonideal behaviour.

Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

Observation / parameter	Record / finding
Added base volume	_____
pH	_____
Equivalence-volume estimate	_____
Half-equivalence pH	_____

Calculations and Interpretation

- $\text{pH} = \text{pK}_a + \log_{10}([\text{A}^-]/[\text{HA}])$.
- At half neutralization, $\text{pK}_a = \text{pH}$ for the stated weak-acid model.

Worked Illustration

Illustration: an equivalence volume of 20.0 mL makes the half-equivalence volume 10.0 mL. If its measured pH is 4.20 under the stated weak-acid model, pK_a is approximately 4.20.

The values in this illustration are for calculation practice.

Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: _____

Conclusion: _____

Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

Viva Questions

1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

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