

8.5 Acid-Base Titrations

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS titration curve 滴定曲线 • equivalence point 等当点 • acid 酸 • pH 值
• weak acid 弱酸

Objective

Build the skills to answer exam questions on **acid-base titrations** — reading the titration curve.

You must be able to:

- identify the **equivalence point** 等当点 on a titration curve
- locate the **half-equivalence point** where $\text{pH} = \text{p}K_a$
- describe the curve shape for strong and weak acids

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ The equivalence point

The **equivalence point** is where the moles of added base exactly equal the moles of acid. On the curve it is the **steep vertical jump** in pH.

■ Equivalence pH depends on the acids

- **Strong acid + strong base** → equivalence $\text{pH} = 7$.
- **Weak acid + strong base** → equivalence $\text{pH} > 7$ (the conjugate base is basic).

■ The half-equivalence point

At the **half-equivalence point** (half the base added), $[\text{HA}] = [\text{A}^-]$, so

$$\text{pH} = \text{p}K_a.$$

This is the flattest part (the buffer region) and a quick way to read $\text{p}K_a$ off a curve.

■ Reading K_a from a curve

Find the half-equivalence volume (half the equivalence volume), read its pH — that is $\text{p}K_a$, and $K_a = 10^{-\text{p}K_a}$.

2 Practice

Now apply the methods above.

2.1 What is true of the moles of acid and base at the equivalence point? [1]

2.2 At the half-equivalence point, pH equals what? [1]

2.3 For a strong acid-strong base titration, what is the equivalence pH? [1]

3 Exam-style questions

3.1 The equivalence point of a weak acid titrated with a strong base has a pH that is [1]

- **A** exactly 7
- **B** greater than 7
- **C** less than 7
- **D** zero

3.2 A weak acid is titrated with NaOH. The equivalence point is at 20.0 mL of base.

(a) At what volume is the half-equivalence point? [1]

(b) If the pH there is 4.7, find $\text{p}K_a$ and K_a . [3]

3.3 Explain why the equivalence pH of a weak acid-strong base titration is above 7. [2]

Solutions

2.1 They are equal (in the stoichiometric ratio).

2.2 $\text{p}K_a$.

2.3 7.

3.1 B — greater than 7.

3.2 (a) 10.0 mL (half of 20.0). (b) $\text{p}K_a = \text{pH} = 4.7$; $K_a = 10^{-4.7} = 2.0 \times 10^{-5}$.

3.3 At equivalence all the acid has become its conjugate base A^- , which is a weak base and reacts with water to give OH^- , raising the pH above 7.