Acid–Base Titrations & Equivalence

INSTRUCTOR / SELF-STUDY ANSWER KEY

Answers and reasoning appear in red. Use these to discuss why incorrect choices are incorrect.

Part A — Concept checks

1. **What defines the equivalence point?**

   Answer: B. stoichiometric amount of titrant added — The acid and base have reacted according to their balanced mole ratio.

2. **At 25 °C, ideal strong acid–strong base equivalence pH is approximately…**

   Answer: C. 7 — The salt of a strong acid and strong base does not hydrolyze appreciably.

3. **20.0 mL of 0.100 M HCl needs what volume of 0.100 M NaOH?**

   Answer: B. 20.0 mL — Equal molarities and a 1:1 reaction require equal volumes.

4. **Which glassware precisely delivers a variable volume of titrant?**

   Answer: C. buret — A buret measures delivered titrant volume.

5. **Endpoint vs equivalence: which is correct?**

   Answer: B. endpoint is observed, equivalence is stoichiometric — Endpoint is the indicator signal and equivalence is mole balance.

6. **The net ionic reaction of HCl with NaOH is…**

   Answer: A. $H^+ + OH^- \rightarrow H_2O$ — Strong acid/base ions form water while Na^+ and Cl^- are spectators.

Part B — Application and explanation

7. What volume of 0.100 M NaOH neutralizes 25.00 mL of 0.100 M HCl?

   Model solution: $n(HCl) = 0.100 \times 0.02500 = 0.00250$ mol. At 1:1 stoichiometry $V_{NaOH} = 0.00250 / 0.100 = 0.0250$ L. Final answer: 25.0 mL NaOH

8. Explain why this guideline matters, with an example of what could go wrong if you ignore it: The indicator endpoint is an experimental observation; equivalence is a stoichiometric condition. Their difference contributes to titration error.

   Model explanation: The indicator endpoint is an experimental observation; equivalence is a stoichiometric condition. Their difference contributes to titration error. Example/check: Start with balanced mole ratios. For HCl + NaOH, one mole of acid reacts with one mole of base.

REFERENCE RELATIONSHIP

at strong monoprotic acid–base equivalence: $M_{acid} V_{acid} = M_{base} V_{base}$