

What is Titration?

Worksheet

In acid-base titration, a standardized acid or base is added to an unknown solution until the equivalence point (equal moles of acid and base). An indicator detects this point by colour change, and concentration is calculated from the volume used.

$$M_1 V_1 = M_2 V_2$$

Questions

1. In a titration, 30 mL of 0.5 M HCl required 25 mL of NaOH. $[NaOH] = ?$

- A) 0.6 M
- B) 0.5 M
- C) 1.2 M
- D) 0.3 M

2. What is the equivalence point?

- A) When the indicator changes colour
- B) When moles of acid equal moles of base
- C) When half the titrant is added
- D) When the solution turns colourless

3. Which indicator is best for a strong acid-strong base titration?

- A) Methyl orange (pH 3-4)
- B) Phenolphthalein (pH 8-10)
- C) Methyl red (pH 4-6)
- D) Any of the above equally

4. If 15 mL of 0.2 M HSO is titrated with 0.1 M NaOH, volume of NaOH needed is:

- A) 30 mL
- B) 60 mL
- C) 15 mL
- D) 45 mL

5. 20 mL of 0.1 M NaOH was required to titrate 25 mL of HCl. Calculate the molarity of HCl.

6. A 30 mL sample of HSO requires 45 mL of 0.2 M NaOH. Find $[HSO]$.

7. Phenolphthalein is the indicator used. At what pH does its colour change occur?

8. Define: What is an equivalence point?

9. Define: What is a titrant?

10. Define: What is an analyte?

Answer Key

1. A) $0.6 \text{ M} \cdot \text{MV} = \text{MV} \cdot 0.5 \cdot 30 = \text{M} \cdot 25 \text{ M} = 0.6 \text{ M}$.
2. B) When moles of acid equal moles of base - The equivalence point is stoichiometric: equal moles of acid and base have reacted.
3. D) Any of the above equally - For strong acid-strong base (endpoint \sim pH 7), any indicator with range near 7 works; methyl orange or methyl red are common.
4. B) $60 \text{ mL} \cdot \text{HSO} + 2\text{NaOH} \dots$; moles HSO = $0.2 \cdot 0.015 = 0.003$; moles NaOH needed = 0.006 ; volume = $0.006 / 0.1 = 0.06 \text{ L} = 60 \text{ mL}$.
5. For $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{HO}$, mole ratio is 1:1 $\text{MV} = \text{MV} \cdot 0.1 \text{ M} \cdot 20 \text{ mL} = \text{M} \cdot 25 \text{ mL} \text{ M} = (0.1 \cdot 20) / 25 = 2 / 25 = 0.08 \text{ M}$
6. For $\text{HSO} + 2\text{NaOH} \rightarrow \text{NaSO} + 2\text{HO}$, mole ratio is 1:2 Moles of NaOH used = $0.2 \text{ M} \cdot 0.045 \text{ L} = 0.009 \text{ mol}$ Moles of HSO = $0.009 / 2 = 0.0045 \text{ mol}$ $[\text{HSO}] = 0.0045 \text{ mol} / 0.030 \text{ L} = 0.15 \text{ M}$
7. Phenolphthalein is colourless below pH 8.2 At pH 8.2-10.0, it turns pink For strong acid-strong base titrations (endpoint \sim pH 7), a different indicator (e.g., methyl orange, pH 3-4) might be better
8. The point at which moles of titrant equals moles of analyte; the reaction is stoichiometrically complete.
9. The solution of known concentration added during titration.
10. The substance of unknown concentration being titrated.

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