ANSWER KEY.

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Titrations

Chemistry | ANSWER KEY

Use the full roadmap: M titrant × L titrant → mol titrant → mole ratio → mol analyte ÷ L analyte. MaVa = MbVb works only for a 1 : 1 ratio. Keep the sig figs of the data (usually four).

1. A buret reads 0.50 mL at the start and 21.35 mL at the endpoint. What volume was used?

21.35 − 0.50 = 20.85 mL

2. In a titration of HCl with NaOH using phenolphthalein, name the titrant, the analyte, and the color at the endpoint.

Titrant: NaOH (known, in the buret).
Analyte: HCl (unknown, in the flask).
Endpoint: the first faint pink that stays about 30 seconds.

3. 25.00 mL of HCl is titrated with 21.60 mL of 0.1000 M NaOH. HCl + NaOH → NaCl + H_2O. What is the molarity of the HCl?

mol NaOH = 0.1000 M × 0.02160 L = 0.002160 mol
Mole ratio: 0.002160 mol × (1 mol HCl / 1 mol NaOH) = 0.002160 mol HCl
M HCl = 0.002160 mol ÷ 0.02500 L = 0.08640 M

4. 20.00 mL of NaOH is titrated with 16.25 mL of 0.1200 M HCl. What is the molarity of the NaOH?

mol HCl = 0.1200 M × 0.01625 L = 0.001950 mol
Mole ratio: 0.001950 mol × (1 mol NaOH / 1 mol HCl) = 0.001950 mol NaOH
M NaOH = 0.001950 mol ÷ 0.02000 L = 0.09750 M

5. H_2SO_4 + 2NaOH → Na_2SO_4 + $2H_2O$. 25.00 mL of H_2SO_4 needs 30.00 mL of 0.2000 M NaOH. What is the molarity of the acid? What would MaVa = MbVb give, and why is it wrong?

mol NaOH = 0.2000 M × 0.03000 L = 0.006000 mol
Mole ratio: 0.006000 mol × (1 mol H_2SO_4 / 2 mol NaOH) = 0.003000 mol H_2SO_4
M H_2SO_4 = 0.003000 mol ÷ 0.02500 L = 0.1200 M
MaVa = MbVb gives (0.2000)(30.00) ÷ 25.00 = 0.2400 M, twice too big, because the ratio is 1 : 2, not 1 : 1.

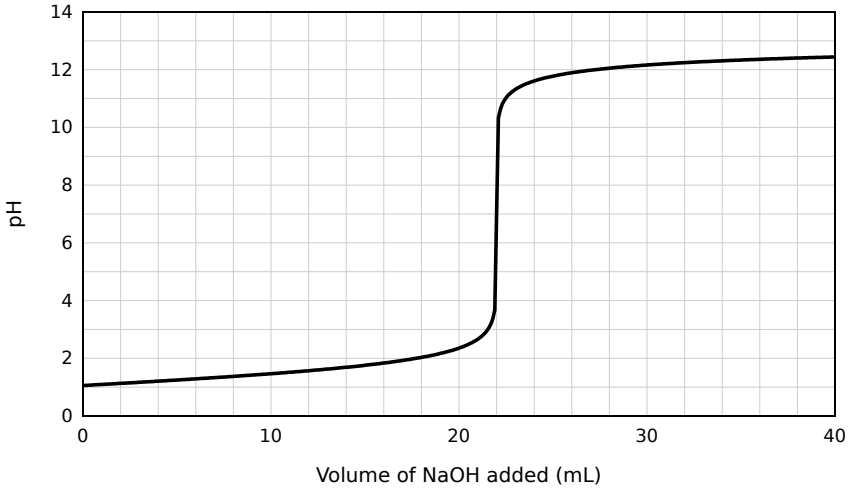
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6. $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$. 20.00 mL of $Ca(OH)_2$ is titrated with 15.00 mL of 0.1000 M HCl. What is the molarity of the $Ca(OH)_2$?

mol HCl = 0.1000 M × 0.01500 L = 0.001500 mol
Mole ratio: 0.001500 mol × (1 mol $Ca(OH)_2$ / 2 mol HCl) = 0.0007500 mol $Ca(OH)_2$
M $Ca(OH)_2$ = 0.0007500 mol ÷ 0.02000 L = 0.03750 M

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7. The curve shows 25.0 mL of HCl titrated with 0.100 M NaOH. (a) What volume of NaOH reaches the equivalence point? (b) What is the pH there? (c) Find the molarity of the HCl.



(a) About 22.0 mL (the middle of the steep jump). (b) pH 7 (strong acid with strong base).
(c) mol NaOH = 0.100 × 0.0220 L = 0.00220 mol = mol HCl (1 : 1)
M HCl = 0.00220 ÷ 0.0250 L = 0.0880 M

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8. A student titrates until the solution is dark pink. Will the calculated molarity of the acid be too high or too low? Explain using the endpoint and the equivalence point.

Too high. Dark pink means extra base went past the equivalence point, so the volume of base is too large. More moles of base means the calculated moles and molarity of the acid are too high.

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