# Buffers, Titration Curves, and Capacity

g11_u04_w15

**Purpose and boundary**

Use supplied original fictional concentration cards and text-described curve data. No materials, mixing, titration, pH testing, or procedure is requested.

**Targets:** I can distinguish range from capacity, calculate a conjugate-pair ratio, and interpret a bounded titration model. **Vocabulary:** buffer, capacity, half-equivalence, equivalence. **Prerequisites:** pH, p$K_a$, ratios, mole accounting.

For a fictional pair $HX/X^-$, use $\text{pH} = \text{p}K_a + \log([X^-]/[HX])$ only when both are present.

1. Define a buffer in terms of a conjugate pair and a small stated addition.

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2. Distinguish buffer range from capacity.

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3. For $\text{p}K_a = 4.80$, $HX = .100\,\text{M}, X^- = .100\,\text{M}$, find pH.

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4. If $X^-/HX = 10$, how far is pH from p$K_a$?

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5. If $X^-/HX = .10$, how far is pH from p$K_a$?

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6. Explain why equal pair concentrations give pH=p$K_a$ in this model.

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7. With .080 mol HX, .020 mol $X^-$, $\text{p}K_a = 4.70$, find pH.

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8. Which inventory limits response to a stated added base-model quantity in item 7?

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9. A card has five times both item-7 amounts. Compare ratio and capacity.

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10. Why can dilution preserve a ratio estimate while changing capacity?

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11. A text curve rises slowly near pH 4.8 then sharply near 25.0 mL fictional addition. Identify half-equivalence and equivalence-region evidence.

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12. Why does a sharp curve region not prove a mechanism?

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13. At half-equivalence in a monoprotic model, what is $X^-/HX$?

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14. For pH 5.10 and $\mathrm{p}K_a = 4.80$, calculate $X^-/HX$.

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15. A card has .010 mol each; a model removes .008 mol HX. Give remaining amounts.

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16. Does item 15 support an equally effective-buffer claim? Explain.

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17. Name one limitation of a supplied titration curve.

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18. Distinguish equivalence from half-equivalence.

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19. Why does little pH change not show unlimited capacity?

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20. Write a bounded conclusion comparing ratio, range, and capacity.

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