

# Chapter 8

$$(26) \quad 100 \text{ mL} \left| \frac{\text{L}}{1000 \text{ mL}} \right| \left| \frac{0.200 \text{ mol}}{\text{L}} \right| \left| \frac{60.05 \text{ g}}{1 \text{ mol}} \right| \left| \frac{\text{mL}}{1.049 \text{ g}} \right| = 1.14 \text{ mL acetic acid}$$

$$5.00 = 4.756 + \log \frac{[\text{base}]}{[\text{acid}]} ; \quad [\text{acid}] + [\text{base}] = 0.200 \text{ M}$$

$$\frac{[\text{base}]}{[\text{acid}]} = 1.754$$

$$[\text{acid}] = \frac{[\text{base}]}{1.754}$$

$$\frac{[\text{base}]}{1.754} + [\text{base}] = 0.200$$

$$\frac{1}{1.754} + 1 = \frac{0.200}{[\text{base}]}$$

$$[\text{base}] = 0.127 \text{ M}$$

$$[\text{acid}] = 0.0726 \text{ M}$$

$$0.100 \text{ L} \left| \frac{0.127 \text{ mol base NaOH}}{\text{L}} \right| \left| \frac{1 \text{ mol}}{1 \text{ mol}} \right| \left| \frac{1000 \text{ mL}}{3 \text{ mol}} \right| = 4.2 \text{ mL of NaOH}$$

- Add 1.14 mL of liquid acetic acid to ~90 mL H<sub>2</sub>O
- Add 3M NaOH until pH reaches 5.00 as measured by a pH meter (should use ~4 mL of NaOH)
- Transfer solution to a 100 mL volumetric flask
- Dilute to the mark

(27) The pH of a buffer depends on the ratio of weak base to weak acid. If a buffer solution is diluted, the ratio remains the same.

28) Buffer capacity is a measure of how much acid or base can be added to a buffer solution without having a large effect on the solution's pH. As the concentration of weak acid and conjugate base in a buffer increase, it takes a larger amount of added acid or base to change the ratio  $\frac{[\text{base}]}{[\text{acid}]}$ .

29) Very acidic and very basic solutions contain a ~~large~~ high concentration of protons or hydroxide already. Additional protons or hydroxide will not make much of a contribution to the solution's pH.

31) When using the Henderson-Hasselbalch equation, we assume that the weak acid does not dissociate, and that the weak base does not hydrolyze. This is usually a good assumption until the ratio  $\frac{[\text{base}]}{[\text{acid}]}$  either becomes very large or small.

32) 4-aminobenzenesulfonic acid is the most suitable because its pKa is closest to the desired pH.

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$$\text{pH} = 3.744 + \log \frac{[\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$$

$$a. 3.000 = 3.744 + \log \frac{[\text{A}^-]}{[\text{HA}]} \Rightarrow \frac{[\text{A}^-]}{[\text{HA}]} = \boxed{0.180}$$

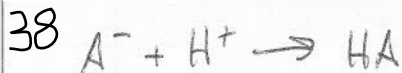
$$b. 3.744 = 3.744 + \log \frac{[\text{A}^-]}{[\text{HA}]} \Rightarrow \frac{[\text{A}^-]}{[\text{HA}]} = \boxed{1.00}$$

$$c. 4.000 = 3.744 + \log \frac{[\text{A}^-]}{[\text{HA}]} \Rightarrow \frac{[\text{A}^-]}{[\text{HA}]} = \boxed{1.80}$$

$$36 \quad a. 2.00 = \frac{3.15}{\cancel{10.85}} + \log \frac{[\text{NO}_2^-]}{[\text{HNO}_2]} = \frac{[\text{HNO}_2]}{[\text{NO}_2^-]} = \boxed{14.1}$$

$$b. 10.00 = 3.15 + \log \frac{[\text{NO}_2^-]}{[\text{HNO}_2]} = \boxed{1.41 \times 10^{-7}}$$

$$4.19 = 4.34 + \log \frac{[\text{A}^-]}{[\text{HA}]} \Rightarrow \frac{[\text{A}^-]}{[\text{HA}]} = 0.708 \text{ and } [\text{A}^-] + [\text{HA}] = 0.00666 \text{ M}$$



$$\frac{0.00666 - [\text{HA}]}{[\text{HA}]} = 0.708$$

$$[\text{HA}] = 3.90 \times 10^{-3} \text{ M}$$

$$3.90 \times 10^{-3} \frac{\text{mol HA}}{\text{L}} \bigg| 0.213 \text{ K} \bigg| \frac{\cancel{\text{L}}}{1 \text{ mol HA}} \bigg| \frac{1000 \text{ mL HNO}_3}{0.246 \cancel{\text{ mol HNO}_3}} = \boxed{3.38 \text{ mL}}$$

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$$7.40 = 7.48 + \log \frac{[\text{A}^-]}{[\text{HA}]}$$

$$5.00 \text{ g} \left| \frac{\text{mol}}{223.29 \text{ g}} \right| = 0.0224 \text{ mol}$$

$$\frac{[\text{A}^-]}{[\text{HA}]} = 0.832 = \frac{\text{mol A}^-}{\text{mol HA}}$$

$$\text{mol A}^- + \text{mol HA} = 0.0224 \text{ mol}$$

$$\text{mol HA} = 0.0224 \text{ mol} - \text{mol A}^-$$

$$0.832 = \frac{\text{mol A}^-}{0.0224 \text{ mol} - \text{mol A}^-}$$

$$\text{mol A}^- = \frac{0.0102}{\cancel{0.0102} \text{ mol A}^-} \left| \frac{1 \text{ mol KOH}}{1 \text{ mol A}^-} \right| \left| \frac{1000 \text{ mL}}{0.626 \text{ mol KOH}} \right| = \boxed{16.3 \text{ mL}}$$