

CELL PHYSIOLOGY Special Lecture - Calculations for pH

I. Simple pH problems:

If a 1.0 mL solution of 0.01 M HCl is diluted to 100 mL at 25 °C, what is the pH of the resulting solution?

SOLUTION: CALCULATE $[H^+]$ AND TAKE THE NEGATIVE LOG OF THAT VALUE

$$[H^+] = \frac{(0.01 \text{ mol/L}) \left(1 \text{ mL} \right) \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right)}{\left(100 \text{ mL} \right) \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right)} = \frac{1 \times 10^{-5} \text{ mol}}{1 \times 10^{-1} \text{ L}}$$

$$= 1 \times 10^{-4} \text{ mol/L}; \quad -\log[1 \times 10^{-4}] = \underline{\underline{4.00}}$$

If a 1.0 mL solution of 1.0 M NaOH is diluted to 100 L at 25 °C, what is the resulting pH of the solution?

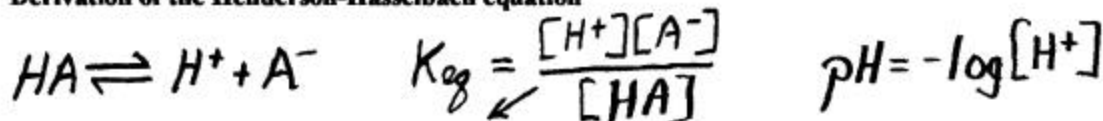
SOLUTION: CALCULATE $[OH^-]$ AND THEN DETERMINE pOH
SUBTRACT pOH FROM 14 TO GET pH

$$[OH^-] = \frac{(1.0 \text{ mol/L}) \left(1 \text{ mL} \right) \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right)}{100 \text{ L}} = \frac{1 \times 10^{-3} \text{ mol}}{1 \times 10^2 \text{ L}}$$

$$= 1 \times 10^{-5} \text{ mol/L}; \quad -\log[1 \times 10^{-5}] = 5.00;$$

$$14.0 - 5.00 = \underline{\underline{9.00}}$$

II. Derivation of the Henderson-Hasselbach equation



① REARRANGE $[H^+] = \frac{K_{eq}[HA]}{[A^-]}$

② MULTIPLY $\times (-1)$ AND APPLY \log OF BOTH SIDES

$$-\log[H^+] = -\log K_{eq} - \log \frac{[HA]}{[A^-]}$$

③ $pH = -\log K_{eq} + \log \frac{[A^-]}{[HA]}$

ASSUME FOR ACID, $K_{eq} = K_A$

④ $pH = pK_{eq} + \log \frac{[A^-]}{[HA]}$

$$pH = pK_A + \log \frac{[A^-]}{[HA]}$$