Today: Sections 16.4 (Buffers), 16.5-16.7 (titrations)
Tuesday: Problem club with Ali
Wednesday: Sections 16.8 and 16.9
Thursday: Expt 7
Friday: no class

Buffers

$pH = pKa + \log\left(\frac{n_{wb}}{n_{wa}}\right)$ also... $pH = pKa + \log\left(\frac{[wb]}{[wa]}\right)$

#1 Mix wa and cwb

↳ example: Mix 0.033 mol wa + 0.037 mol cwb.

$pKa = 7.21$

wa = $H_2PO_4^-$ cwb = HPO_4^{2-}

$pH = 7.21 + \log\left(\frac{0.037}{0.033}\right)$

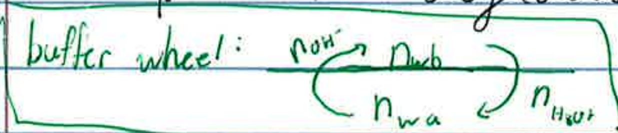
$pH = 7.28$

*not dependent on the volume of the solution

- Add 0.002 mol OH^- to the buffer.

$pH = 7.21 + \log\left(\frac{0.037 + 0.002}{0.033 - 0.002}\right)$

$pH = 7.31$



* buffer capacity is equal to the moles of wa in this case. (you can only add 0.033 mol of OH^-, then there is no buffer since wa is "used up")

- Adding 0.005 mol H_3O^+ to original buffer

$pH = 7.21 + \log\left(\frac{.037 - 0.005}{.033 + 0.005}\right)$

$pH = 7.14$

$$pH = pka^{HA} + \log\left(\frac{0 + n_{OH^-}}{n_{wa} - n_{OH^-}}\right)$$

Recipe 2. $wa + OH^-$ (LR) (reaction not mixture)

↳ example: 0.041 mol wa react with 0.017 mol OH^-

$$pH = pka + \log\left(\frac{0 + 0.017\,mol\,OH^-}{.041\,mol - 0.017\,mol\,OH^-}\right)$$

$$pH = 7.21 + \log\left(\frac{0.017\,mol}{0.024\,mol}\right)$$

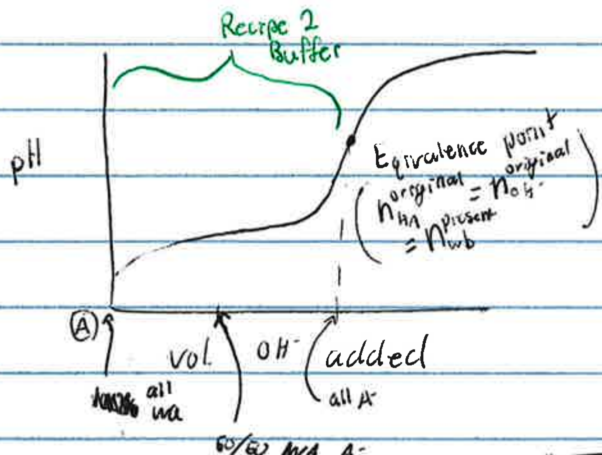
$$pH = 7.06$$

Recipe 3. $wb + H_3O^+$ (LR) (reaction not mixture)

↳ ~~place~~ $pH = pka + \log\left(\frac{n_{wb} - n_{H_3O^+}}{0 + n_{H_3O^+}}\right)$

Titrations $H_3O^+ + OH^- \longrightarrow 2H_2O \quad K_n = 1 \times 10^{14}$

$wa + OH^- \rightleftharpoons H_2O + cwb \quad K_n = \frac{1}{K_b^{A^-}}$



(A) no OH^- added yet (ch 15 ka, 400 rule, MICE)

M	$HA + H_2O \rightleftharpoons$	H_3O^+	A^-
I	0.20	0	0
C	$-x$	$+x$	$+x$
E	$0.20-x$	x	x

Recipe 2.

$pH = pka + \log\left(\frac{n_{wb}}{n_{wa}}\right)$ *$n_{wb} = n_{wa}$ at 1/2 way to Equiv pt.

*So... pH = pka at this one point

you can use this to find ka and pH and other points

Suppose 25.00 mL 0.100 M HA is titrated with 0.15 M OH^-.
What is the pH after 10.00 mL OH^- added? $pK_a = 4.79$

$$pH = pK_a + \log\left(\frac{0 + n_{OH^-}}{n_{HA} - n_{OH^-}}\right)$$

$n_{HA} = M \cdot V = (.100M)(.025L) = 0.0025 mol$

$n_{OH^-} = M \cdot V = (.15M)(.010L) = 0.0015 mol$

$$pH = 4.79 + \log\left(\frac{.0015 mol}{.0025 - 0.0015}\right)$$

$$pH = 4.97$$

At equivalence point...

$$n_{HA}^{original} = n_{OH^-}^{original} = n_{A^-}^{now\ present}$$

$$M_{HA} V_{HA} = M_{OH^-} V_{OH^-}$$

Suppose 30.0 mL of an unknown HA is titrated to the equivalence point with 0.0732 M OH^-. If it took 24.31 mL OH^- to reach equivalence point. What is the concentration of HA?

$$MV = MV$$

$$M_{HA}(30.0 mL) = (0.0732 M)(24.31 mL)$$

$$M_{HA} = 0.0593 M$$