Ex: Buffer made by adding 0.300 mol $HC_2H_3O_2$ ($pK_a = 4.74$)

and 0.300 mol $NaC_2H_3O_2$ to enough water to make 1L of soln

Calc. pH after 0.020 mol of NaOH is added

HCH_3COO	H^+	CH_3COO^-
		0.300 mol
0.300 mol		

$$pH = pK_a + \log\frac{[A^-]}{[HA]} = 4.74 + \underbrace{\log\frac{0.300}{0.300}}_{0} = 4.74$$

Initial pH

HCH_3COO	OH^-	CH_3COO^-
0.300 mol	0.02 (Limiting Reagent)	0.300

$$HCH_3COO + OH^- \rightleftharpoons H_2O + CH_3COO^-$$

HCH_3COO	OH^-	CH_3COO^-
0.300	0.02	0.300
−0.02	−0.02	+0.02
0.280 mol	0	0.320 mol

$$pH = pK_a + \log\frac{[A^-]}{[HA]} = 4.74 + \log\frac{0.320}{0.280} = 4.80$$

Final pH

↳ compare to pH of adding 0.020mol NaOH to 1L pure water.

Pure H_2O = pH of 7

$[OH^-] = \frac{0.020 mol}{1 L}$

$= 0.02M$

final pH:

$pOH = -\log(0.02) = 1.70$

$pH = 14 - 1.70 = 12.3$

2 methods for creating buffer soln (equivalent)

Ex: $HC_3HCOO + OH^- \rightleftharpoons CH_3COO^- + H_2O$

①	0.300		0.300	
②	0.600	0.300	0	0
	−0.300	−0.300	+0.300	
final:	0.300	0	0.300	

½ # mole

$$KCN \rightleftharpoons H^+ + CN^-$$

$$CN^- + HCl \rightleftharpoons HCN$$

	0.10 M	0.05	
	−0.05	−0.05	+0.05
	0.05	0	0.05

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

$$pH = pK_a + \log\frac{(0.05)}{(0.05)}$$

$$\log\frac{(0.05)}{(0.05)} = 0$$

$$pH = pK_a$$

$$pK_a = -\log(4.9\times10^{-10}) = 9.3$$

$$pH = 9.3$$

Titration = use concentration of a known acid/base to figure out the unknown concentration of an acid/base

↳ trying to reach equivalence point where:

$$H^+ + OH^- \rightleftharpoons H_2O \text{ (neutral soln)}$$

↳ moles of acid = moles of base

$$\text{moles } H^+ = \text{mole } OH^-$$

$$M_a V_a = M_b V_b$$

Calc. pH when a) 40.0 mL and b) 49.0 mL and c) 49.95 mL of 0.100 M NaOH have been added to 50 mL of 0.100 M HCl soln

$$\text{Initial pH} = -\log(0.100) = 1.00$$

a) 40 mL of NaOH

$(0.050\,L)(0.100) = 0.0050$ moles H^+

$(0.04\,L)(0.100) = 0.0040$ mol OH^-

$$H^+ + OH^- \rightleftharpoons H_2O$$

	H^+	OH^-	
I	0.0050	0.0040	
C	−0.0040	−0.0040	
E	0.0010 mol	0	

$$pH = -\log[H^+]$$

$$= -\log\left(\frac{0.0010\ \text{mol}}{(0.05 + 0.04)}\right) = 1.95$$