base
$C_2H_3O_2^-$

1. What is the pH of a buffer solution made by mixing 100.0 mL of 1.0 M sodium acetate and 100.0 mL of 1.0 M acetic acid?

$HC_2H_3O_2$

$pH = pKa + \log\left(\frac{[base]}{[acid]}\right)$

$pH = 4.74 + \log\left(\frac{0.5}{0.5}\right)$

$pH = 4.74$

$V_{final} = 200\,mL$ or $0.2\,L$

moles $C_2H_3O_2^-$

$[base] = \frac{0.100\,mol}{0.2\,L} = 0.50\,M\ HC_2H_3O_2$

$0.100\,L \times \frac{1.0\,mol}{L} = 0.100\,mol$

$0.100\,L \times \frac{1.0\,mol}{L} = 0.100\,mol$

"acid" $= 0.50\,M$

$0.100\,mol$

2. Calculate the pH when 5.00 mL of 1.0 M HCl is added to 1.0 L of buffer solution with an ammonia concentration of 0.100 M and ammonium chloride concentration of 0.100 M. You can assume the change in volume is negligible to simplify.

$HCl \rightarrow$ 100% ionizes

mol H_3O^+ : $0.00500\,L \times \frac{1.0\,mol}{L} = 0.00500\,mol\ H_3O^+$

buffer

NH_3

NH_4^+

$NH_{3(aq)} + H_3O^+_{(aq)} \rightarrow NH_4^+_{(aq)} + H_2O_{(l)}$

	0.100 mol	0.00500 mol	0.100 mol
	$-0.00500\,mol$	$-0.00500\,mol$	$+0.00500\,mol$
	$0.0950\,mol$	$\emptyset$	$0.105\,mol$

$pH = pKa + \log\left(\frac{[base]}{[acid]}\right)$

$pH = 9.25 + \log\left(\frac{0.0950}{0.105}\right)$

$pH = 9.25 - 0.04$

pH = 9.21

3. Pick the best choice to make a buffer solution with a pH of 7.20. You will need to look up Ka or Kb values.

CH_3COOH/CH_3COOK
b) $HClO_2/KClO_2$
c) NH_3/NH_4Cl
d) HClO/KClO

pKa ≈ 7.5

4. Using your choice from QUESTION 3, calculate the volume of acid and base needed to prepare 1.0 L of a 0.100 M buffer solution with a pH of 7.2. You have available 1.0 M stock solutions of the acid and base in the lab. (For example, 1.0 M HA (generic weak acid) and 1.0 M NaA (sodium salt of the conjugate base).

"x" acid
"y" base
1.0 M HClO
1.0 M ClO^-

total moles = mol acid + mol base

$0.100\ mol = x + y$ (1st eq.)

2nd eq.

$$pH = pKa + \log\left(\frac{[base]}{[acid]}\right)$$

$$7.2 = 7.5 + \log\left(\frac{y}{x}\right)$$

$$-0.3 = \log\left(\frac{y}{x}\right)$$

$10^{-0.3} = \frac{y}{x}$

$\frac{y}{x} = 0.50$

$y = 0.100 - x$

$\frac{0.100 - x}{x} = 0.50$

$0.100 - x = 0.50x$

$+x \quad +x$

$0.100 = 1.5x$

$x = 0.067$ mol acid

$y = 0.100 - 0.067 =$

0.033 mol base

67.0 mL of 1.0 M acid + 33.0 mL of 1.0 M base salt