pH and Henderson-Hasselbalch

1.

3-5. Calculate the pH of 0.1 M ammonia.

(hint: involves an ICE table and the 'small X approximation' rule)

2.

You are trying to prepare a 1L buffer solution at pH=5.5 by titrating 0.01M sodium acetate with 20M acetic acid (pKa 4.76). Find the volume of acetic acid that you need to use to prepare this buffer solution.

Answers

ammonia = weak

$pOH = pK_b + \log \frac{NH_4^+}{NH_3}$

$K_b = \frac{[OH^-][NH_4^+]}{[NH_3]}$

$pK_b = -\log(K_b)$

$4.75 = -\log(K_b)$

$-4.75 = \log(K_b)$

$1.778 \cdot 10^{-5} = K_b$

	NH_3	NH_4^+	OH^-
I	0.1	0	0
C	-x	+x	+x
E	0.1-x	+x	+x

$$\frac{(x)(x)}{0.1 - x} = 1.778 \cdot 10^{-5}$$

$$\frac{(x)(x)}{0.1} = 1.778 \cdot 10^{-5}$$

$x^2 = (1.778 \cdot 10^{-6})$

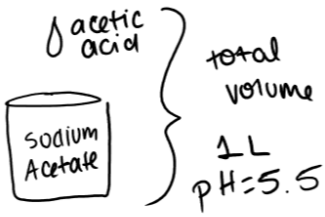
$x = 0.0013$

$pOH = pK_b + \log \frac{NH_4^+}{NH_3}$

$4.75 + \log \frac{0.001}{0.1 - 0.001}$

$pOH = 2.75$

$pH = 11.24$



0.01 M A^- (Na^+ acetate)

20 M HA (acetic acid

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

$[A^-] = 0.01\,(1\text{ liter} - V)$

$[HA] = 20(V)$

} where V = volume of acetic acid added

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

↓

$5.5 = 4.76 + \log \frac{(0.01)(1-V)}{20(V)}$

$10^{0.74} = \frac{(0.01)(1-V)}{20(V)}$

$109.91(V) = 0.01 - 0.01(V)$

$\frac{109.92(V)}{109.92} = \frac{0.01}{109.92}$

$V = 9.1 \cdot 10^{-5}\,L \rightarrow 0.09\,mL \rightarrow$ **91 μL of acetic acid**