Key Thursday:

1. A buffer is prepared by combining 0.50mol of HA, $K_a = 1.3 \times 10^{-5}$, and 0.50 mol of NaA in a total volume of 500. mL at 25 °C.
   a. (5 points) 0.20L of 1.5 M HCl solution is added to the buffer above, and the resulting solution is allowed to come to equilibrium. Calculate the equilibrium pH of the solution.

	HCl (aq)	+	A^-(aq)	→	HA(aq) +	Cl^-(aq)
Initial:	0.30 mol(L.R.)		0.50 mol		0.50mols	
Change	-0.30 mol		-0.30 mol		+0.30 mol	
Final:	0mol		0.20mol		0.80mol	

pH- **pH=4.28**

Equilibrium:	**HA(aq)**	+	**H_2O(l)** ⇄	**H_3O^+ (aq)**	+	**A^-(aq)**	**K_a>K_b** Q<K
I	0.80mol/0.70L			10^{-7} M		0.2mol/0.70L	
C	-x			+x		+x	
EQ	0.20mol/0.70L			x		0.80mol/0.70L	

$[H_3O^+] = K_a \frac{[HA]}{[A^-]} = 1.3 \times 10^{-5} \times \frac{\frac{0.80}{0.70}}{\frac{0.2}{0.7}} = \mathbf{5.2 \times 10^{-5}}$; **pH=4.28**

   b. (5 points) If 1.0 mol HCl is added to the original buffer solution, and the resulting solution is allowed to come to equilibrium. Calculate the equilibrium pH of the new solution. Assume that total volume is 0.500L.

	HCl (aq)	+	A^-(aq)	→	HA(aq) +	Cl^-(aq)
Initial:	1.0 mol		0.50 mol(L.R.)		0.50mols	
Final:	0.5mol		0mol		1.00mol	

pH =0

$[HCl]_{new} = \frac{0.5mol}{0.5L} = 1.0M$ excess of a strong Acid

$[H_3O^+] = [HCl]_{new} = 1.0M$; **pH=0**

2. (1 point) At **99 °C,** a 0.020 M solution of a weak base has a pOH of 4.0. The K_a of the conjugate acid of the base of that solution is 2.0 x 10^{-6} at **99 °C**. What is the value of K_w **at 99 °C?**

A^-(aq) + **H_2O(l)** ⇄ OH^-(aq) + HA(aq) $[OH^-]_{equlibrium} = 10^{pOH} = 1 \times 10^{-4}$

$K_b = \frac{[OH^-][HA]}{[A^-]} = \frac{10^{-4} \times 10^{-4}}{0.020} = 5*10^{-7}$ Using the ICE table ;

$K_w = K_b * Ka = 5*10^{-7} * 2.0 \times 10^{-6} = 1 \times 10^{-12}$

K_w at 99 °C =1 x 10^{-12}

Key Friday :

1. A buffer is prepared by combining 0.50mol of HA, $K_a = 1.3 \times 10^{-5}$, and 0.50 mol of NaA in a total volume of 500. mL at 25 °C.
   a. (5 points) 0.20L of 1.5 M NaOH solution is added to the buffer above, and the resulting solution is allowed to come to equilibrium. Calculate the equilibrium pH of the solution.

	OH^- (aq)	+	H A(aq)	→	A^-(aq) +	**H_2O(l)**
Initial:	0.30 mol(L.R.)		0.50 mol		0.50mols	
Change	-0.30 mol		-0.30 mol		+0.30 mol	
Final:	0mol		0.20mol		0.80mol	

$\boxed{\text{pH} = \underline{\mathbf{5.49}}}$

Equilibrium:	**HA(aq)**	**+**	**H_2O(l)** ⇄	**H_3O^+ (aq)**	**+**	**A^-(aq)**	**K_a>K_b** Q<K	I
	0.20mol/0.70L			10^{-7} M		0.8mol/0.70L		
C	-x			+x		+x		
E	0.20mol/0.70L			x		0.80mol/0.70L		

$[H_3O^+] = K_a \dfrac{[HA]}{[A^-]} = 1.3 \times 10^{-5} \times \dfrac{\frac{0.20}{0.70}}{\frac{0.8}{0.7}} = \mathbf{3.25 \times 10^{-6}}$; **pH=5.49**

   b. (5 points) If 1.0 mols of NaOH solution is added to the original buffer solution, and the resulting solution is allowed to come to equilibrium. Calculate the equilibrium pH of the new solution. Assume that the total volume is 0.500L.

	OH^- (aq)	+	H -(aq)	→	A^-(aq) +	**H_2O(l)**
Initial:	1.0 mol		0.50 mol (L.R.)		0.50mols	
Change	-0.50 mol		-0.50 mol		+0.50 mol	
Final:	0.5mol		0mol		1.00mol	

$\boxed{\text{pH} = 14}$

$[OH^-] = \dfrac{0.5mol}{0.5L} = 1.0M$

excess of a strong base pOH=0

2. (1 points) At **99 °C,** a 0.020 M solution of a weak acid has a pH of 4.0. The K_b of the conjugate base of the acid of that solution is 2.0×10^{-6} at **99 °C**. What is the value of K_w **at 99 °C?**

HA(aq) + H_2O(l) ⇔ H_3O^+ (aq) + A^-(aq) $[H_3O^+]_{\text{equlibrium}} = 10^{pH} = 1 \times 10^{-4} = x$

$K_a = \dfrac{[H_3O^{+-}][A^-]}{[HA]} = \dfrac{10^{-4} \times 10^{-4}}{0.020} = 5*10^{-7}$ Using the ICE table ;

$K_w = K_b * K_a = 5*10^{-7} * 2.0 \times 10^{-6} = 1 \times 10^{-12}$

$\boxed{K_w \text{ at } 99\ ^\circ C = 1 \times 10^{-12}}$ **1point**