1. Determine the [H_3O^+] and pH of 0.200 M lactic acid ($HC_3H_5O_3$, $K_a = 1.4 \times 10^{-4}$).

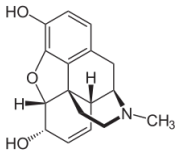
	$HC_3H_5O_3$	+	H_2O	$\rightleftharpoons$	H_3O^+	+	$C_3H_5O_3^-$
I	0.200 M		–		0		0
C	-x		–		+x		+x
E	0.200 - x		–		x		x

$K_a = 1.4 \times 10^{-4} = \frac{x^2}{0.200-x} \approx \frac{x^2}{0.200}$

$x = 5.29 \times 10^{-3}\ M$ (quadratic equation)

$pH = -\log[H_3O^+] = -\log(5.29 \times 10^{-3}) = 2.28$

2. Determine the pH of 0.015 M morphine, a weak base with $K_b = 1.6 \times 10^{-6}$. (Call morphine B in your equilibrium.)



	B	+	H_2O	$\rightleftharpoons$	BH^+	+	OH^-
I	0.015 M		–		0		0
C	-x		–		+x		+x
E	0.015 - x		–		x		x

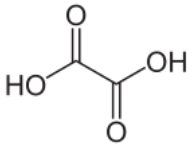
$K_b = 1.6 \times 10^{-6} = \frac{x^2}{0.015-x} \Rightarrow x = 1.54 \times 10^{-4} \Rightarrow pOH = 3.81 \Rightarrow pH = 10.19$

3. Calculate the pH of a solution of 0.500 M sodium acetate (for acetic acid, $K_a = 1.8 \times 10^{-5}$)
Acetate is a weak base with $K_b = \frac{K_w}{K_a} = \frac{1\times10^{-14}}{1.8\times10^{-5}} = 5.56 \times 10^{-10}$.

	CH_3COO^-	+	H_2O	$\rightleftharpoons$	CH_3COOH	+	OH^-
I	0.500 M		–		0		0
C	-x		–		+x		+x
E	0.500 - x		–		x		x

$x = 1.67 \times 10^{-5}\ M \Rightarrow pOH = 4.78 \Rightarrow pH = 9.22$

4. Calculate the pH of 0.100 M oxalic acid (HOOC-COOH), a diprotic acid with $K_{a1} = 6.0 \times 10^{-2}$ and $K_{a2} = 6.1 \times 10^{-5}$. What is the concentration of the oxalate ion ($C_2O_4^{2-}$)?



	H_2A	+	H_2O	$\rightleftharpoons$	H_3O^+	+	HA^-
I	0.100 M		–		0		0
C	-x		–		+x		+x
E	0.100 - x		–		x		x

$K_{a1} = \frac{x^2}{0.100-x}$. Cannot use approximation here, but solve quadratic equation to get $x = 0.053$ M.

Second (weak) dissociation does not contribute much to the pH, so $pH = -\log(0.053) = 1.28$.

Second dissociation is very weak and leads to $[A^{2-}] = K_{a2} = 6.1 \times 10^{-5}$

5. Calculate the K_a value of a weak acid, (HA) if a 0.115 M solution has a pH of 3.29.

$K_a = \frac{x^2}{0.115-x}$, but in this case, you know x because $[H_3O^+] = 10^{-pH} = 5.1 \times 10^{-4}\ M$

Then, $K_a = \frac{(5.1\times10^{-4})^2}{0.115-5.1\times10^{-4}} = 2.3 \times 10^{-6}$

6. Calculate the pH and percent ionization of 0.225 M benzoic acid ($K_a = 6.5 \times 10^{-5}$).

$K_a = 6.5 \times 10^{-5} = \frac{x^2}{0.225-x} \Rightarrow x = 0.00382 \Rightarrow pH = 2.42$

$\%\ ionization = \frac{0.00382}{0.225} \times 100\% = 1.7\%$