AP Chemistry
Weak Acids and Bases

Name_____

1. What is the pH of a 0.100 M hydrocyanic acid solution if $K_a = 4.9 \times 10^{-10}$?

$HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$

0.100	0	0
$-x$ (small)	$+x$	$+x$
0.100	x	x

$4.9 \times 10^{-10} = \frac{(x)^2}{[0.100]}$

$x = [H_3O^+] = 7.0 \times 10^{-6} M$

$pH = 5.15$

2. The pH of a 0.250 M hydrofluoric acid solution is 1.50. Determine the K_a.

$HF + H_2O \rightleftharpoons H_3O^+ + F^-$

0.250	0	0
-0.032	$+0.032$	$+0.032$
0.218	0.032	0.032

$[H_3O^+] = 10^{-1.50} = 0.032\ M$

$K_a = \frac{[0.032]^2}{[0.218]} = 4.7 \times 10^{-3}$

3. Pyradine (C_5H_5N) is a weak base. What is the pH of a 0.310 M solution if $K_b = 1.7 \times 10^{-9}$.

$C_5H_5N + H_2O \rightleftharpoons OH^- + C_5H_6N^+$

0.310	0	0
$-x$ (small)	$+x$	$+x$
0.310	x	x

$1.7 \times 10^{-9} = \frac{(x)^2}{0.310}$

$x = [OH^-] = 2.3 \times 10^{-5} M$

$pOH = 4.64$

$pH = 9.36$

4. Caffeine ($C_8H_{10}N_4O_2$) is a weak base. What is the pOH of a 0.250 M caffeine solution if $K_b = 4.1 \times 10^{-4}$.

$C_8H_{10}N_4O_2 + H_2O \rightleftharpoons OH^- + C_8H_{11}N_4O_2^+$

0.250	0	0
$-x$ (small ... barely)	$+x$	$+x$
0.250	x	x

$$4.1 \times 10^{-4} = \frac{x^2}{0.250}$$

$x = 0.010 = [OH^-]$

$\boxed{pOH = 1.99}$

5. What is the pOH of a ~~0.310~~ 3.10 M solution of phosphoric acid? $K_a = 6.9 \times 10^{-3}$.

$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$

3.10	0	0
$-x$ (small ... barely)	$+x$	$+x$
3.10	x	x

$$6.9 \times 10^{-3} = \frac{x^2}{3.10}$$

$x = 0.15\ M = [H_3O^+]$

$pH = 0.83 \rightarrow \boxed{pOH = 13.17}$