Worksheet – Advanced pH

Example:

Acetic Acid, $HC_2H_3O_2$, has a dissociation constant, K_a, of $1.82 \cdot 10^{-5}$. Find the pH of a 0.2 M solution of Acetic Acid, using the following equilibrium table.

Concentrations	$[HC_2H_3O_2]$	$[H^+]$	$[C_2H_3O_2^-]$
Initial	0.2	0	0
Change	– x	+ x	+ x
Equilibrium	0.2 – x	x	x

(1) Set up: $K_a = \dfrac{[H^+][C_2H_3O_2^-]}{[HC_2H_3O_2]}$ (2) Plug in: $1.82 \cdot 10^{-5} = \dfrac{(x)(x)}{(0.2 - x)}$

(3) Assume $x << 0.2$ (3) Plug in again: $1.82 \cdot 10^{-5} = \dfrac{x^2}{0.2}$

(4) Solve for x^2: $x^2 = (1.82 \cdot 10^{-5}) \cdot (0.2) = 3.64 \cdot 10^{-6}$

(5) Solve for x: $x = 1.91 \cdot 10^{-3}$

(6) Find pH. Since $x = [H^+]$ at equilibrium, $pH = -\log x = -\log (1.91 \cdot 10^{-3}) = 2.72$

Use the same plan of attack to find the pH of the following .

1. A 0.015 M sample of Phosphoric Acid, H_3PO_4, $K_a = 7.5 \times 10^{-3}$ pH = _____

Concentrations	$[H_3PO_4]$	$[H^+]$	$[H_2PO_4^-]$
Initial			
Change			
Equilibrium			

2. A 0.12 M sample of Formic Acid, HCOOH, $K_a = 1.8\times10^{-4}$ pH = _____

Concentrations	[ ]	$[H^+]$	[ ]
Initial			
Change			
Equilibrium			

3. A 0.08 M sample of Acetic Acid, $HC_2H_3O_2$, $K_a = 1.82\times10^{-5}$ pH = _____

Concentrations	[ ]	$[H^+]$	[ ]
Initial			
Change			
Equilibrium			

4. A 0.025 M sample of Carbonic Acid, H_2CO_3, $K_a = 1.8\times10^{-4}$ pH = _____

Concentrations	[ ]	$[H^+]$	[ ]
Initial			
Change			
Equilibrium			