Chemistry: Acid/Bases Assignment 3 Name: Answer key

Be sure to show all your work

1. If a solution has a [H^+] concentration of 4.5 x 10^{-7} M, is this an acidic or basic solution? Explain.

$\boxed{\text{Acidic}}$ $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0\times10^{-14}}{4.5\times10^{-7}} = 2.2\times10^{-8}$ M OH^- ⇒ $[OH^-] < [H^+]$

2.2×10^{-8} M $< 4.5\times10^{-7}$ M

2. An acidic solution has a pH of 4. If I dilute 10 mL of this solution to a final volume of 1000 mL, what is the pH of the resulting solution?

$[H^+] = 10^{-pH} = 10^{-4}$ M H^+

$M_1V_1 = M_2V_2$

1×10^{-4} M $H^+ \cdot 10$ mL $= x \cdot 1000$ mL

$x = 1\times10^{-6}$ M H^+

pH = $-\log(1\times10^{-6}$ M$) = \boxed{6}$

* A 10 mL/1000 mL dilution is a 100-fold dilution.

3. Determine the pH and pOH of the following solutions:

a. a 4.5 x 10^{-3} M HBr solution. – HBr is strong (100% ionization)

pH $= -\log[H^+] = -\log[HBr]_i = -\log(4.5\times10^{-3}) = \boxed{2.35}$

pOH = 14 − pH ⇒ 14 − 2.35 = $\boxed{11.65}$

b. a 3.67 x 10^{-5} M KOH solution. - KOH is strong; 100% dissociation

pOH $= -\log[OH^-] = -\log(3.67\times10^{-5}) = \boxed{4.435}$

pH = 14 − pOH = 14 − 4.435 = $\boxed{9.565}$

c. a solution made by diluting 25 mL of 6.0 M HCl until the final volume of the solution is 1.75 L.

HCl is strong

$M_1V_1 = M_2V_2$

$M_2 = \frac{M_1V_1}{V_2}$ = 6.0 M HCl | 25 mL | 1 L / 1.75 L | 1000 mL = 0.086 M HCl

pH $= -\log(0.086) = \boxed{1.07}$

4. Find the pH of a 0.095M solution of formic acid. The acid dissociation constant (K_a) for formic acid is 1.8 x 10^{-4}.

	HCOOH + H_2O →		$HCOO^-$ +	H_3O^+
[ ]i	0.095	–	0	0
Δ[ ]	−x		+x	+x
[ ]eq	0.095−x		x	x

$K_a = \frac{[HCOO^-][H_3O^+]}{[HCOOH]} = \frac{x \cdot x}{\cancel{0.095} - x}$ (assume 5% rule)

$1.8\times10^{-4} = \frac{x^2}{0.095}$ ⇒ 0.0041 M H^+

pH = −log(0.0041)

$\boxed{= 2.38}$

5. If the pH of $HC_3H_5O_2$ is 4.2 and the K_a = 1.8 x 10^{-5}.

a. what is the equilibrium concentration of $HC_3H_5O_2$?

$[H^+] = 10^{-pH} = 10^{-4.2} = 6.31\times10^{-5}$ M H^+

$HC_3H_5O_2 + H_2O \rightarrow C_3H_5O_2^- + H_3O^+$

$K_a = \frac{[C_3H_5O_2^-][H_3O^+]}{[HC_3H_5O_2]}$ ⇒ $1.8\times10^{-5} = \frac{(6.31\times10^{-5})(6.31\times10^{-5})}{x}$

$x = [HC_3H_5O_2] = \boxed{2.21\times10^{-4}\text{ M}}$

b. what was the initial concentration of HC_3H_5O before dissociation?

$[HC_3H_5O_2]_i = [HC_3H_5O_2]_{eq} + [C_3H_5O_2^-]_{eq}$

$= 2.21\times10^{-4} + 6.31\times10^{-5}$

$= 2.84\times10^{-4}$ M