Questions-Q & A

Worksheet

2. $pH = 5.2 \rightarrow [H_3O^+] = 6.3 \times 10^{-6}$

$HA + H_2O \rightleftharpoons H_3O^+ + A^-$

I	1.0	0	0
C	-6.3×10^{-6}	6.3×10^{-6}	6.3×10^{-6}
E	~1.0	6.3×10^{-6}	6.3×10^{-6}

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$K_a = \frac{(6.3 \times 10^{-6})(6.3 \times 10^{-6})}{1.0}$$

$$K_a = 4.0 \times 10^{-11}$$

4. $$\%\ \text{ioniz} = \frac{[H_3O^+]}{[HZ]} \times 100\%$$

$$7.5 = \frac{[H_3O^+]}{0.50\ \text{mol/L}} \times 100\%$$

$$\frac{7.5 \times 0.50}{100\%} = [H_3O^+]$$

$$0.0375 = [H_3O^+]$$

$HZ + H_2O \rightleftharpoons H_3O^+ + Z^-$

I	0.5000	0	0
C	0.0375	0.0375	0.0375
E	0.4625	0.0375	0.0375

$$K_a = \frac{(0.0375)(0.0375)}{0.4625} = 3.04 \times 10^{-3}$$

7. $HClO + H_2O \rightleftharpoons H_3O^+ + ClO^-$

	$HClO$	H_2O	H_3O^+	ClO^-
I	0.75		0	0
C	$-x$		x	x
E	$0.75-x$		x	x

$$4.0\times10^{-8} = \frac{x \cdot x}{0.75-x}$$

$$4.0\times10^{-8} \times 0.75 = x^2$$

$$\sqrt{3.0\times10^{-8}} = \sqrt{x^2}$$

$$1.73\times10^{-4} = x = [H_3O^+]$$

$$pH = 3.76$$

8. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

	NH_3	H_2O	NH_4^+	OH^-
I	1.4		0	0
C	$-x$		x	x
E	$1.4-x$		x	x

$$K_b = \frac{x^2}{1.4-x}$$

$$\sqrt{2.5\times10^{-5}\times1.4} = \sqrt{x^2}$$

$$5.9\times10^{-3} = x = [OH^-]$$

$$\%\ \text{ion.} = \frac{5.9\times10^{-3}}{1.4}\times100\%$$

$$= 0.42\%$$

Ionization of Water - Kw

Recall- H_2O is amphoteric

$$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons [H_3O^+][OH^-]$$

$$K_{eq} = \frac{[H_3O^+][OH^-]}{[H_2O][H_2O]}$$

Constants

new constant

$$K_w = [H_3O^+][OH^-]$$

for all dilute solutions

pure H_2O

$$[H_3O^+] = 1.0 \times 10^{-7} = [OH^-]$$

$$K_w = (1.0 \times 10^{-7})(1.0 \times 10^{-7})$$

$$K_w = 1.0 \times 10^{-14}$$

Examples- What is $[OH^-]$ of a solution with $pH = 2.5$?

(i) $pH = -\log [H_3O^+]$

$2.5 = -\log [H_3O^+]$

$0.0032 = [H_3O^+]$

$K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = 0.0032\ [OH^-]$

$3.1 \times 10^{-12} = [OH^-]$

Text p.566

#12, 14

14. $K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = x \cdot 5.6 \times 10^{-14}$

$\frac{1.0 \times 10^{-14}}{5.6 \times 10^{-14}} = x$

$0.18 = x$

mol/L

$HCl + H_2O \rightarrow H_3O^+ + Cl^-$

6.

Ionization of Water - Continued

Example- weak acid or base

An acid, HX, has $K_a = 4.6 \times 10^{-8}$. What is $[OH^-]$ if initial $[HX]$ is 0.10 mol/L?

$HX + H_2O \rightleftharpoons H_3O^+ + X^-$

	HX	H_2O	H_3O^+	X^-
I	0.10	?	0	0
C	x		x	x
E	0.10-x		x	x

$$K_a = \frac{[H_3O^+][X^-]}{[HX]}$$

$$4.6 \times 10^{-8} = \frac{x \cdot x}{0.10 - x}$$

$$(4.6 \times 10^{-8})(0.10) = x^2$$

$$\sqrt{4.6 \times 10^{-9}} = \sqrt{x^2}$$

$$6.8 \times 10^{-5} = x = [H_3O^+]$$

$$K_w = [H_3O^+][OH^-]$$

$$1.0 \times 10^{-14} = 6.8 \times 10^{-5}[OH^-]$$

$$\frac{1.0 \times 10^{-14}}{6.8 \times 10^{-5}} = [OH^-] = 1.6 \times 10^{-10}$$

Worksheet #5,6

Ionization-general problems

Text p. 591 #5-10

p. 595 #11-16

Acid/Base Indicators