Last Name: KEY **Ch: 14, Quiz 1 on Acids and Bases**

1) Designate which of the following is (1) an Arrhenius acid, (2) an Arrhenius base, (3) a Bronsted-Lowry acid, (4) a Bronsted-Lowry base (5) both an Arrhenius acid and a Bronsted-Lowry acid, (6) both an Arrhenius base and a Bronsted-Lowry base, (7) not an acid or a base.

A) H_2SO_4 5 proton generator/donator

B) LiOH 6 proton acceptor and OH^- generator

C) NH_2CH_3 4 proton acceptor / no OH^- generation

D) CH_3CH_3 7 not a proton donator/acceptor, no OH^- generation

2) Which of the following species is amphoteric? (can be 0, 1 or 2 answers)

A) CO_3^{2-} B) H_2O C) NH_4^+ D) HPO_4^{2-} E) None of the above

The answer(s) is/are letter(s) B & D

3) Designate which is (1) the acid, (2) the base, (3) the conjugate acid, (4) the conjugate base?

$$H_2CO_3 + NH_3 \Leftrightarrow HCO_3^- + NH_4^+$$

H_2CO_3 = 1

NH_3 = 2

HCO_3^- = 4

NH_4^+ = 3

4) Based on Ka values, which of the following acids is the STRONGEST?

A) HF 3.5×10^{-4} D) $HCHO_2$ 1.8×10^{-4}

B) HCN 4.9×10^{-10} E) $HClO_2$ 1.1×10^{-2}

C) HNO_2 4.6×10^{-4}

The answer is letter E

5) Which of the following is a polyprotic acid?

A) HF

B) H_2SO_4

C) HCN

D) CH_4

E) $HC_2H_3O_2$

The answer is letter B

6) Calculate the concentration of OH- in a solution that contains 3.9 x 10-4 M H_3O^+ at 25°C. Identify the solution as acidic, basic or neutral.

$K_w = [H_3O^+][OH^-] = 1.0\times10^{-14} = (3.9\times10^{-4}\,M)[OH^-]$

$[OH^-] = 1.0\times10^{-14} / 3.9\times10^{-4} = 2.6\times10^{-11}$

$pH = -\log[H_3O^+] = -\log 3.9\times10^{-4} = 3.4$ ACIDIC

7) Calculate the hydronium ion concentration in an aqueous solution with a pH of 9.85 at 25°C.

$pH = 9.85$ $\quad [H_3O^+] = 10^{-pH} = 10^{-9.85} = 1.4\times10^{-10}\,M$

9) Find pH for a 0.023 M HNO_3 solution. $HNO_3(aq) + H_2O(l) \Leftrightarrow NO_3^-(aq) + H_3O^+(aq)$

$[H_3O^+] = 0.023M$ $\quad -\log[H_3O^+] = -\log 0.023 = 1.64$ pH (2 sig figs)

$= 2.3\times10^{-2}M$ (2 sig figs)

10) Given that the solution contains 0.00115M HCl and 0.01000M HClO2. For the reaction:

$HClO_2(aq) + H_2O(l) \Leftrightarrow H_3O^+ + ClO_2^-$ with $K_a = 1.1\times10^{-2}$

Find the pH of the solution.

$[HClO_2]$	$[H_3O^+]$	$[ClO_2^-]$
.01	.00115	0
$-x$	$+x$	$+x$
$0.01-x$	$0.00115+x$	x
.004	.00755	.006

$K_a = \dfrac{[H_3O^+][ClO_2^-]}{[HClO_2]}$

$= \dfrac{(.00115+x)\,x}{.01-x}$

$K_a = 1.1\times10^{-2} = \dfrac{(0.00115+x)\,x}{.01-x} = \dfrac{0.00115x + x^2}{.01-x}$

$1.1\times10^{-2}(.01-x) = .00115x + x^2$

$1.1\times10^{-4} - 1.1\times10^{-2}x = .00115x + x^2$

$0 = x^2 + .01215x - 1.1\times10^{-4}$

$x = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

$x = \dfrac{-.01215 \pm \sqrt{1.48E^{-4} + 4.4E^{-4}}}{2} = \dfrac{-.01215 + .0242}{2} = .006$ (the neg. number would give a neg. x)

$K_a = \dfrac{(.00755)(.006)}{.004} = 1.1\times10^{-2}$ ✓

$[H_3O^+] = 0.00755$ $\quad pH = -\log 0.00755 = 2.12$