2/19/13

(1) ✓

(2) ✓

(3) ✓

Acid = proton donor → $[H_3O^+]$

Base = proton acceptor → $[OH^-]$

(4) X

(5) X

$CH_3NH_2(aq) + H_2O(l) \rightleftharpoons CH_3NH_3^+(aq) + OH^-(aq)$

base — conj acid

To identify acids

Hydracids

Ex) HCl, HCN

Oxyacids

Ex) nitrous acid, nitric acid

carboxylic acid

Ex) benzoic, acetic, formic

To identify bases

Metal hydroxide

Ex) KOH, NaOH, $Ba(OH)_2$

Deriv of ammonia

(6) + 10 points (pull)

Part II

2) $HClO_2 (aq) + H_2O (l) \leftrightarrow H_3O^+ (aq) + ClO_2^- (aq)$

3) $K_a = \frac{[H_3O^+][ClO_2^-]}{[HClO_2]} = 1.2 \times 10^{-2}$

4) Acid strength depends on the K_a (equilibrium constant) and the hydronium ion conc.
larger K_a, greater hydronium conc, stronger acid.

5) the acids listed in decreasing acid strength

6,7) +10 points (poll)

6) $CH_3NH_2 (aq) + H_2O (l) \leftrightarrow CH_3NH_3^+ (aq) + OH^- (aq)$

7) $K_b = \frac{[OH^-][CH_3NH_3^+]}{[CH_3NH_2]} = 4.38 \times 10^{-4}$

8) larger K_b, more OH^- ions, stronger base

9) decreasing base strength

10) yes, K_a & K_b is decreasing ∴ acids / bases decreasing in strength

11) conj acid-base are indirectly proportional
- stronger the acid, weaker conjugate base partner

8) +10 points (poll)

12) equilibrium constant exp for water

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

(4) + 10 points (poll)

13) $HClO_2(aq) + H_2O(\ell) \rightleftharpoons ClO_2^-(aq) + H_3O^+$

$$K_a = \frac{[ClO_2^-][H_3O^+]}{[HClO_2]} = 1.2 \times 10^{-2}$$

14) $ClO_2^-(aq) + H_2O(\ell) \rightleftharpoons HClO_2(aq) + OH^-(aq)$

$$K_b = \frac{[HClO_2][OH^-]}{[ClO_2^-]} = 8.3 \times 10^{-13}$$

15) $$K_a \cdot K_b = \frac{[ClO_2^-][H_3O^+]}{[HClO_2]} \cdot \frac{[HClO_2][OH^-]}{[ClO_2^-]}$$

$$K_a \cdot K_b = [H_3O^+][OH^-]$$

16) $HClO_2 + H_2O + ClO_2^- + H_2O \rightleftharpoons ClO_2^- + H_3O^+ + HClO_2 + OH^-$

$$\boxed{H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-}$$

17) $K_w = (1.2 \times 10^{-2})(8.3 \times 10^{-13}) = \boxed{1 \times 10^{-14}}$ ← very small!

Auto-ionization of water

- water acts as acid & base
- equal amts - neutral
- more hydronium - acidic
- more hydroxide - basic

Determine $[H_3O^+]$ & $[OH^-]$ at 25°C in

6.0×10^{-2} M $HI_{(aq)}$ ← strong acid

$$HI + H_2O \longrightarrow H_3O^+ + I^-$$

$$[H_3O^+] = 6.0 \times 10^{-2} \text{ M}$$

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

$$1 \times 10^{-14} = 6.0 \times 10^{-2} [OH^-]$$

$$[OH^-] = 1.7 \times 10^{-13}$$

Determine $[H_3O^+]$ & $[OH^-]$ in 6.0×10^{-2} M NH_4^+ ← weak acid

$$NH_4^+ + H_2O \longleftrightarrow H_3O^+ + NH_3$$

$$K_a = \frac{[H_3O^+][NH_3]}{[NH_4^+]}$$

R			
I	6×10^{-2}	0	0
C	$-x$	$+x$	$+x$
E	$6 \times 10^{-2} - x$	x	x

$K_a = ?$

$K_b = NH_3$

$K_a \cdot K_b = 1 \times 10^{-14}$

$\frac{1 \times 10^{-14}}{1.8 \times 10^{-5}}$

$$K_a = 5.6 \times 10^{-10} = \frac{(x)(x)}{(6.0 \times 10^{-2} - x)} \quad = \quad x = \sqrt{(5.6 \times 10^{-10})(6 \times 10^{-2})}$$