

LM 19  
 LM 20.  
 NGILM 101 - bonus pts. 1m Participation.

1/19/13

Quiz 1) Which of following is not strong acid?

a) HF

2) Which of following not strong base?

D. Mg(OH)<sub>2</sub>. not soluble in H<sub>2</sub>O.

3) Which of following not match?

Ammonia NH<sub>3</sub> ← memorize.

Perchloric acid HClO<sub>3</sub> / HClO<sub>4</sub>

Nitric acid HNO<sub>3</sub>

Sulfuric H<sub>2</sub>SO<sub>4</sub>

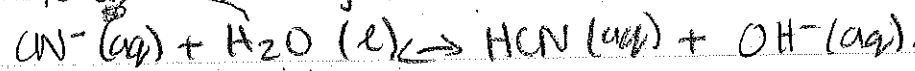
hydrobromic HBr

HCl & CH<sub>3</sub>COOH solutions both turned yellow when indicator was added. Very dif. chemical structures? why?

acid - proton donor

base - proton acceptor

4) Which reactant behaving like a base?

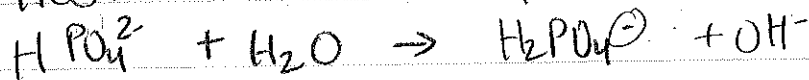
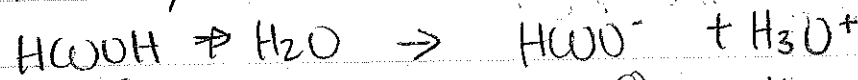


(D) CN<sup>-</sup>

5) What is conjugate base of HCOOH?

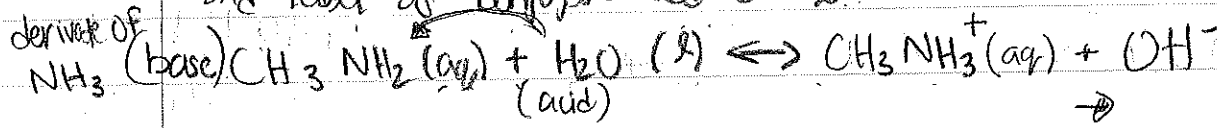
What is conjugate acid of HPO<sub>4</sub><sup>2-</sup>

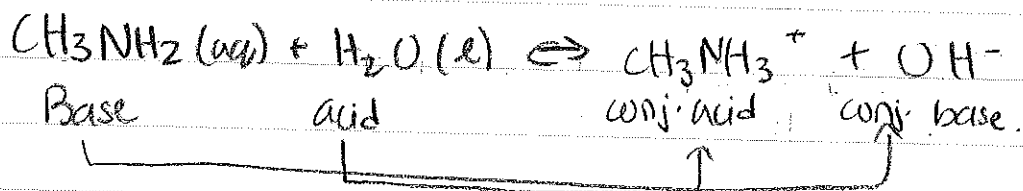
(C) HCOO<sup>-</sup>, H<sub>2</sub>PO<sub>4</sub><sup>-</sup>



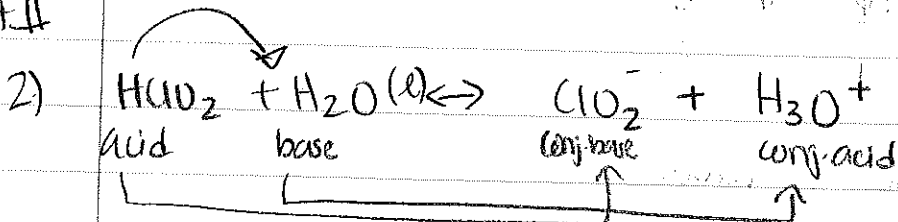
Review 1st label reactants as acid or base.

2nd label as conjugate acid or base.





Part II



$$K_a = \frac{[\text{ClO}_2^-][\text{H}_3\text{O}^+]}{[\text{HClO}_2]}$$

stronger acid strength  $\rightarrow$  bigger  $K_a$ .

P11

The acids in 1<sup>st</sup> data table are listed:

(B)

In order of  $\downarrow$  acid strength.

P11:

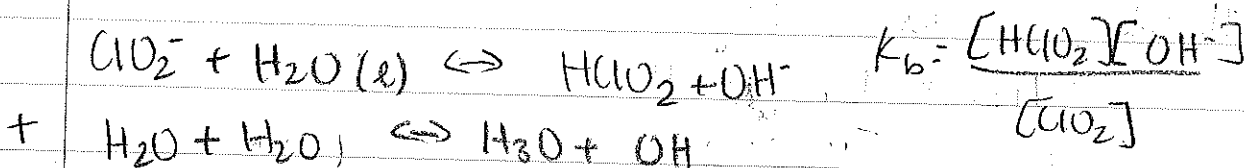
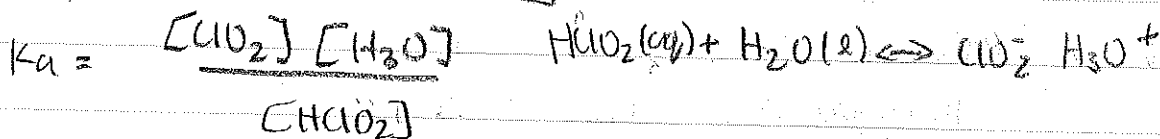
After examining  $K_a$  &  $K_b$  the inferred relationship between the strength of acid & bases.

(B)

The stronger acid  $\rightarrow$  weaker conjugate base partner.

Part 3:

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$



$$K_a \cdot K_b =$$

If adding different  $K$  you multiply it.

$$\frac{[\text{ClO}_2^-][\text{H}_3\text{O}^+]}{[\text{HClO}_2]} \cdot \frac{[\text{HClO}_2][\text{OH}^-]}{[\text{ClO}_2^-]} = K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

any  
Multiplying conjugate acid base partners the product is  $K_w$ .

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

$$1.2 \times 10^{-2} \cdot 8.3 \times 10^{-13}$$

$$\boxed{1 \times 10^{-14}}$$

Auto-ionization of water.

$$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$$

In pure water you always have a little bit of  $H_3O^+$  &  $OH^-$ .

• If Equal amounts = neutral.

? If more hydronium = acidic, toward reactants, shift left

• If more hydroxide = basic, toward reactants, shift left.

→  $K_w$  small so reactant favored.

Add HCl → dissociates.

Add  $H_3O^+$  →  $OH^-$  ↓

Add  $OH^-$  →  $H_3O^+$  ↓

q: Calculate  $[H_3O^+]$  &  $[OH^-]$ .

Determine the  $[H_3O^+]$  &  $[OH^-]$  @  $25^\circ C$   $6.0 \times 10^{-2} M$  HI (aq).

HI → strong acid. dissociate fully.



$$[H_3O^+] = 6.0 \times 10^{-2} M. \text{ (strong acid, ionization)}$$

Split apart so same.

$$[OH^-] = ?$$

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

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

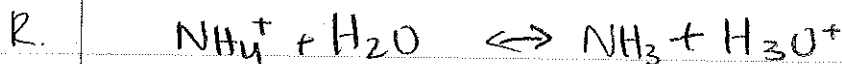
$$[OH^-] = \boxed{1.66 \times 10^{-13}}$$

q

Determine the  $[H_3O]^+$  &  $[OH^-]$  in  $6.0 \times 10^{-2} M$   $NH_4^+$   
 $NH_3$  weak base  $\leftarrow$  weak base.

$NH_4^+$  conj. acid.  $\leftarrow$  weak acid

Some bases weaker than other.



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



$K_a = \frac{[x][x]}{6.0 \times 10^{-2} - x}$

$K_a \cdot K_b = 1.0 \times 10^{-14}$

$5.6 \times 10^{-10} = \frac{x^2}{6 \times 10^{-2}}$

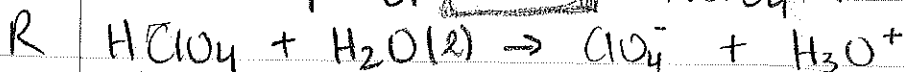
$x = 5.8 \times 10^{-6} [H_3O^+]$

$x = 1.725 \times 10^{-9} [OH^-]$

Express degree of acidity using pH & degree of basicity using pOH.

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

Calculate pH of  $6 \times 10^{-5} M$   $HClO_4$  perchloric.



$[H_3O^+] = 6 \times 10^{-5}$

$pH = 4.2$

Calculate pOH of  $.077 M$   $NaOH$

$pOH = -\log [0.077] M$   $pOH = 1.11$