WKS
Brønsted Acids and Bases

Name Key______________________________
Period ____ Date _______________

1) The Arrhenius definitions of acids and bases are somewhat limited because they can only describe acids and bases that have been dissolved in water. Thus, sometimes the Brønsted acid/base definitions are more useful because they can be used when acids and bases are in other liquids. Complete the Brønsted definitions below:
   a) A Brønsted acid **(donates, accepts)** a proton (H^+).
   b) A Brønsted base **(donates, accepts)** a proton (H^+).

2) Write the conjugate base for each of the following acids. [Remember, the an acid *loses one* H^+]

   a) $HNO_3 \rightarrow NO_3^-$ (loses H^+)
   b) $HS^- \rightarrow S^{2-}$
   c) $HPO_4^{2-} \rightarrow PO_4^{3-}$
   d) $HC_3H_5O_2 \rightarrow C_3H_5O_2^-$
   e) $H_2SO_3 \rightarrow HSO_3^-$
   f) $C_6H_5COOH \rightarrow C_6H_5COO^-$

3) Write the conjugate acid for each of the following bases. [Remember, the a base *gains one* H^+]

   a) $HPO_4^{2-} \rightarrow H_2PO_4^-$ (gains H^+)
   b) $NO_2^- \rightarrow HNO_2$
   c) $NH_3 \rightarrow NH_4^+$ HNH_3^+ ok
   d) $HS^- \rightarrow H_2S$
   e) $S^{2-} \rightarrow HS^-$
   f) $C_5H_4N \rightarrow C_5H_4NH^+$ $C_5H_4N^+$ $HC_5H_4N^+$

4) For the following reactions:
   – draw an arrow showing the transfer of the H^+ between reactants (Look at the products—which way does the H^+ go?)
   – Label the acid (A), the base (B), the conjugate acid (CA), and the conjugate base (CB).

a) HNO_3 (aq) + OH^- (aq) $\rightleftharpoons$ NO_3^- (aq) + H_2O (*l*)
A B CB CA

b) HCO_3^- (aq) + HCl (aq) $\rightleftharpoons$ H_2CO_3 (aq) + Cl^- (aq)
B A CA CB

c) NH_3 (aq) + $H_2PO_4^-$ (aq) $\rightleftharpoons$ NH_4^+ (aq) + HPO_4^{2-} (aq)
B A CA CB

d) HCOOH (aq) + H_2O (*l*) $\rightleftharpoons$ $HCOO^-$ (aq) + H_3O^+ (aq)
A B CB CA

5) For the following reactions:
- show arrow for transfer of H^+ *(Remember-- the acid always gives its H^+ to the base.)*
- determine the products of each reactions (Watch your charges!! *Losing a positive? Gaining?)*
- Label the conjugate acid (CA) and the conjugate base (CB)

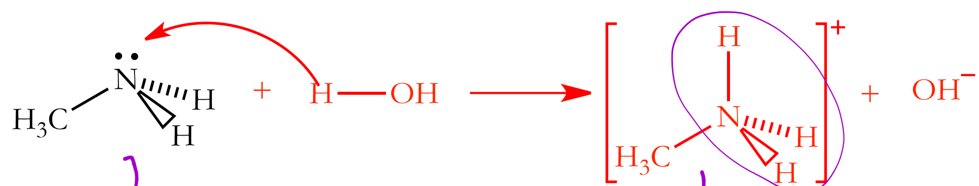
a) NH_2^- (aq) + H_2O (*l*) ⇌ NH_3 (aq) + OH^- (aq)
base *acid* CA CB

b) H_2S (aq) + NH_3 (aq) ⇌ HS^- (aq) + NH_4^+ (aq)
acid *base* CB CA

c) HSO_4^- (aq) + OH^- (aq) ⇌ SO_4^{2-} (aq) + H_2O (*l*)
acid *base* CB CA

d) CO_3^{2-} (aq) + NH_4^+ (aq) ⇌ HCO_3^- (aq) + NH_3 (aq)
base *acid* CA CB

6) Methylamine (CH_3NH_2, Lewis structure below) forms hydroxide in aqueous solution. Draw the transfer of H^+ from water (H–OH) and explain why methylamine is a Brønsted-Lowry base but not an Arrhenius base. [Hint: in the products, the N is tetrahedral with one additional H and a + charge, like NH_3 becoming NH_4^+.]



Because it has a lone pair of electrons, CH_3NH_2 can accept H^+ from H_2O to form $CH_3NH_3^+$ and OH^-, but does not contain OH^-

$CH_3NH_3^+$

$HCH_3NH_2^+$