Proton Shuffle Supplemental Problems

1. Label each of the following as an Arrhenius acid, Arrhenius base, or neutral.
   a. KOH b. HCl c. KCl d. H_3PO_4 e. $Sr(OH)_2$
   f. $Al(OH)_3$ g. NaOH h. HBr i. KBr j. H_2SO_4
   k. $Ba(OH)_2$ l. HI m. H_2CO_3 n. Na_2SO_4 o. C_3H_7OH
2. For each of the substances above, write the chemical equation upon dissociation with water. If it does not dissociate, state that it does not.

3. Label each of the following as a Bronsted Lowry Acid, Bronsted Lowry Base, or neutral.
   a. HF b. HNO_3 c. CH_3NH_2 d. NH_3 e. N_2H_4
   f. $HC_2H_3O_2$ g. C_3H_6O (acetone) h. NaCl i. C_5H_{12} j. $AlCl_3$
   k. HNO_3 l. $C_4H_8O_2$ (butyric acid) m. C_2H_6NH n. H_2CO_3 o. CH_3OH

4. For each of acids and bases above, write the chemical equation upon reaction with water. (Do not do this for the neutral substances.)

5. Label the following substances in each reaction as acid, base, conjugate acid, and conjugate base.
   a. $HF + N_2H_4 \rightarrow N_2H_5^+ + F^-$

   b. $HNO_3 + CH_3NH_2 \rightarrow CH_3NH_3^+ + NO_3^-$

   c. $HCl + NH_3 \rightarrow Cl^- + NH_4^+$

6. Predict the products of the following reactions AND label each substance as an acid, base, conjugate acid, and conjugate base.
   a. $HBr + NH_3 \rightarrow$

   b. $HI + H_2O \rightarrow$

   c. $C_2H_6NH + HC_2H_3O_2 \rightarrow$

   d. $NH_3 + HF \rightarrow$

Selected Answers:

1c. neutral 1d. acid 1f. base 1o. neutral

2c. $KCl \rightarrow K^+ + Cl^-$ 2j. $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$ 2l. $HI \rightarrow H^+ + I^-$ 2o. does not dissociate

3c. base 3g. neutral 3i. neutral 3k. acid 3o. neutral

4a. $HF + H_2O \rightarrow H_3O^+ + F^-$

4l. $C_4H_8O_2 + H_2O \rightarrow H_3O^+ + C_4H_7O_2^-$

4m. $C_2H_6NH + H_2O \rightarrow C_2H_6NH_2^+ + OH^-$

5c. $HCl + NH_3 \rightarrow Cl^- + NH_4^+$

A B C.B. C.A.

6c. $C_2H_6NH + HC_2H_3O_2 \rightarrow$ **$C_2H_6NH_2^+ + C_2H_3O_2^-$**

B A C.A. C.B.