Problem Set 1 #1-8 KEY

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2. Differentiate between the terms *strength* and *concentration* as they apply to acids and bases. When is HCl strong? Weak? Concentrated? Dilute?	strength - degree of dissociation/ionization concentration - moles/liter HCl - strong in dilute solution; "weak" in concentration solution (think in terms of Le Chatelier); concentrated when high number of moles per liter; dilute when low number of moles per liter
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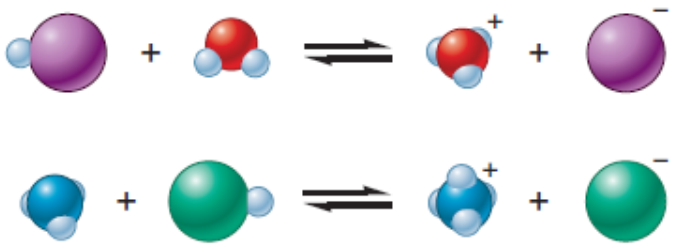
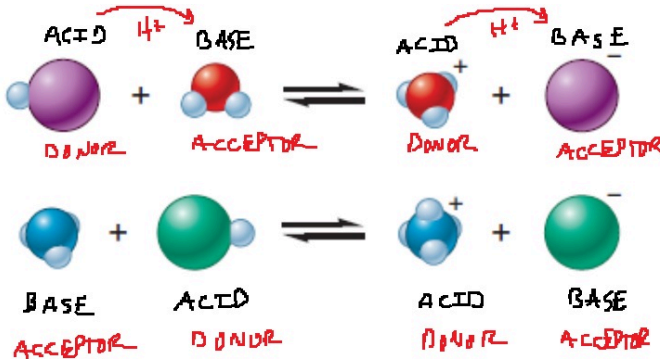
26. The following are representations of acid–base reactions:  **a.** Label each of the species in both equations as an acid or a base and explain your answers.	
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16.17 **(a)** Give the conjugate base of the following Brønsted–Lowry acids: **(i)** HIO_3, **(ii)** NH_4^+. **(b)** Give the conjugate acid of the following Brønsted–Lowry bases: **(i)** O^{2-}, **(ii)** $H_2PO_4^-$.	ai) IO_3^{-1} aii) NH_3 bi) OH^- bii) H_3PO_4
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37. For each of the following aqueous reactions, identify the acid, the base, the conjugate base, and the conjugate acid. **a.** $H_2O + H_2CO_3 \rightleftharpoons H_3O^+ + HCO_3^-$ **b.** $C_5H_5NH^+ + H_2O \rightleftharpoons C_5H_5N + H_3O^+$ **c.** $HCO_3^- + C_5H_5NH^+ \rightleftharpoons H_2CO_3 + C_5H_5N$	**a.** $\overset{B}{H_2O} + \overset{A}{H_2CO_3} \rightleftharpoons \overset{CA}{H_3O^+} + \overset{CB}{HCO_3^-}$ **b.** $\overset{A}{C_5H_5NH^+} + \overset{B}{H_2O} \rightleftharpoons \overset{CB}{C_5H_5N} + \overset{CA}{H_3O^+}$ **c.** $\overset{B}{HCO_3^-} + \overset{A}{C_5H_5NH^+} \rightleftharpoons \overset{CA}{H_2CO_3} + \overset{CB}{C_5H_5N}$
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35. Write balanced equations that describe the following reactions. **a.** the dissociation of perchloric acid in water **b.** the dissociation of propanoic acid ($CH_3CH_2CO_2H$) in water **c.** the dissociation of ammonium ion in water	a) $HClO_4 \Rightarrow H^{+1} + ClO_4^{-1}$ or $HClO_4 + H_2O \Rightarrow H_3O^{+1} + ClO_4^{-1}$ b) $CH_3CH_2CO_2H + H_2O \Leftrightarrow H_3O^{+1} + CH_3CH_2CO_2^{-1}$ c) $NH_4^{+1} + H_2O \Leftrightarrow NH_3 + H_3O^{+1}$
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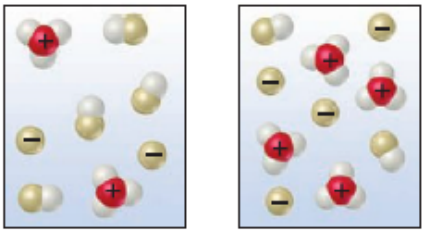
5. Consider the reaction of acetic acid in water: $HC_2H_3O_2\ (aq) + H_2O\ (l) \longleftrightarrow C_2H_3O_2^-\ (aq) + H_3O^+\ (aq)$ Keq = 1.8×10^{-5} a) Which two bases are competing for the proton? b) Which is the stronger base? c) In light of your answer to (b), why do we classify the acetate ion as a weak base? Use an appropriate reaction to justify your answer.	a) H_2O and $C_2H_3O_2^{-1}$ b) Since Keq << 1, equilibrium favors reactants, meaning $C_2H_3O_2^{-1}$ must be the stronger base since it has the higher tendency to take/hold on to the H^{+1}.

	c)It does not fully ionize in water as shown in the reaction below: $C_2H_3O_2^{-1} + H_2O \Leftrightarrow HC_2H_3O_2 + OH^-$
7 **16.2** The following diagrams represent aqueous solutions of two monoprotic acids, HA (A = X or Y). The water molecules have been omitted for clarity. **(a)** Which is the stronger acid, HX or HY? **(b)** Which is the stronger base, X^- or Y^-? **(c)** If you mix equal concentrations of HX and NaY, will the equilibrium $HX(aq) + Y^-(aq) \rightleftharpoons HY(aq) + X^-(aq)$ lie mostly to the right ($K_c > 1$) or to the left ($K_c < 1$)? [Section 16.2] = HA = H_3O^+ = A^- HX HY 	a) HY - higher degree of ionization/dissociation b) X^- - the weaker the acid, the stronger the conjugate base and vice-versa c) The weaker acid will remain in the molecular form to a greater degree. In this case, HX is the weaker acid, so this EQ should favor the reactants as written making Kc < 1
8 7. Anions containing hydrogen (for example HCO_3^- and $H_2PO_4^-$) usually show amphoteric behavior. Write equations illustrating the amphoterism of these two anions.	Acid: $HCO_3^{-1} + H_2O \Leftrightarrow CO_3^{-2} + H_3O^{+1}$ Base: $HCO_3^{-1} + H_2O \Leftrightarrow H_2CO_3 + OH^-$ Acid: $H_2PO_4^{-1} + H_2O \Leftrightarrow H_3O^{+1} + HPO_4^{-2}$ Base: $H_2PO_4^{-1} + H_2O \Leftrightarrow H_3PO_4 + OH^-$