16-3

1. Draw the conjugate bases

   a. HCN

   b. HCl

   c. CH_4

2. Draw the conjugate acids

   a. SO_4^{2-}

   b. NH_3

   c. $Cl^{\ominus}$

3. Identify each as an acid or base

$$NH_3 + HClO \rightleftharpoons NH_4^{\oplus} + ClO^{\ominus}$$

① HF is stronger than HNO_2. Predict the "direction" of the reaction, and say whether K will be greater or less than 1. (ID) each as Acid or base

$$HF + Na^{\oplus}NO_2^{\ominus} \quad Na^{\oplus}F^{\ominus} + HNO_2 \quad K\ 1$$

② $HF + Cl^{\ominus} \quad HCl + F^{\ominus} \quad K\ 1$

③ $HA + B^{\ominus} \rightleftharpoons A^{\ominus} + HB \quad K > 1$

Classify each as the weaker or stronger acid or base.

④ Ditto for

$$HCN + SO_4^{2-} \rightleftharpoons HSO_4^{-} + {}^{\ominus}CN \quad K < 1$$

① Classify as Strong Acid, Weak Acid, Strong Base, Weak Base, or Non-acid/base

a. HBr

b. HF

c. $CH_3CH_2NH_2$

d. CH_3CH_2COOH

e. H_2SO_4

f. H_3PO_4

g. $HClO$

h. $ClO^{\ominus}$

i. $Cl^{\ominus}$

j. $NO_3^{\ominus}$

k. O^{2-}

l. CH_4

m. $NaOH$

1. Find pH for following

a. $[H_3O^+] = 1.0 \times 10^{-4}$

b. $[H^+] = 1.0 \times 10^{-11}$

c. $[H^+] = 3.2 \times 10^{-4}$

d. $[OH^-] = 1.0 \times 10^{-8}$

e. $[OH^-] = 5.8 \times 10^{-4}$

g. $pOH = 8.30$

2. Find pOH.

a. $[H^+] = 3.9 \times 10^{-5}$

b. $[OH^-] = 3.9 \times 10^{-5}$

c. $pH = 3.95$

3. Find both $[H^+]$ $[OH^-]$

a. $pH = 3.72$

b. $pH = 9.81$

c. $[H^+] = 3.5 \times 10^{-8}$

d. $[OH^-] = 4.1 \times 10^{-3}$

16-13

① which is the stronger acid?

H_3PO_4 $H_2PO_4^-$

H_2SO_4 HSO_4^-

② which is the stronger base?

HCO_3^- CO_3^{2-}

HSO_4^- SO_4^{2-}

① What is pH of 1.36×10^{-3} M H_2SO_4?

② An HCl solution has pH = 2.16. What is [HCl]?

③ What is pH for 0.013 M KOH solution?

④ What is pH for a solution that is 0.013 M in $Ca(OH)_2$?

⑤ What is pH if 22g of $Ba(OH)_2$ (90g/mol) is dissolved in 760 mL of water?

1. pH → K_a What is K_a for an acid if an 0.15 M solution is prepared and found to have pH = 4.86?

2. K_a → pH What is pH for a 0.15 M solution of an acid with $K_a = 2.2 \times 10^{-6}$?

3. If an 0.23 M solution of an acid gives pH = 3.82, what is K_a for acid?

4. If a 0.11 M solution has a $K_a = 1.3 \times 10^{-8}$ acid, what is pH?

16-18

① pH → K_b What is K_b if an 0.173 M solution of a weak base gives pH = 10.62?

② K_b → pH If K_b for a weak base is 1.6×10^{-5}, what is the pH of an 0.227 M solution of the base?

	K_a
HCN	4.9×10^{-10}
HF	6.8×10^{-4}
HN_3	1.9×10^{-5}

1. What is K_b for N_3^-?

2. Rank the basicity, 1 being highest.

$^{\ominus}CN$ $F^{\ominus}$ $N_3^{\ominus}$

3. What is pH for a solution that is 0.12 M in NaF?

4. What is pH for a solution that is 0.20 in NaCN?

16-22

1. Predict as Acidic, Basic, Neutral, or Can't Tell

a. Na_2SO_3

b. $MgCl_2$

c. NH_4CN

d. $CoCl_2$

e. $NaNO_3$

f. KN_3

g. $AlCl_3$

h. CH_3NH_3Br

2. Rank the following in terms of increasing pH, 1 being lowest. (ID as strong/weak acid, strong/weak base, or neutral first!)

NaCl CaF_2 $ZnBr_2$ HNO_3 KOH

16-27

① Which are acidic vs. basic vs. neutral in water?

$HClO_3$ CH_3COOH CH_3NH_2 $Ca(OH)_2$

② Rank Acidity (1 strongest)

HF H_2O H_2SO_4 CH_4

③ Rank Acidity

$HClO_4$ $HClO_3$ H_2SO_4 H_2SO_3

④ Rank Acidity H_2O H_2S H_2Se

⑤ " " HBr H_2Se H_3As H_4Ge

⑥ Which would be strong? $HBrO_3$ $HBrO$

H_2CO_3 H_3PO_3

⑦ Rank basicity $^{\ominus}CH_3$ $^{\ominus}NH_2$ $^{\ominus}OH$ $F^{\ominus}$

⑧ " " HPO_4^{2-} $H_2PO_4^-$ HSO_4^-

16-29

① Identify the Lewis acid + Lewis base

a. $Fe^{3+} + 6\,H_2O \rightarrow [Fe(H_2O)_6]^{3+}$

b. $H^{\oplus} + CH_3NH_2 \longrightarrow CH_3\overset{\oplus}{N}H_3$

c. $Br-CH_3 + I^{\ominus} \rightarrow Br^{\ominus} + CH_3-I$

d. $Ni^{2+} + 4\,N_3^- \longrightarrow [Ni(N_3)_4]^{2-}$

② Which would not be a Lewis acid?

$AlCl_3$ Ti^{4+} NO_3^- $ZnSO_4$