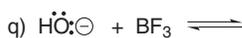
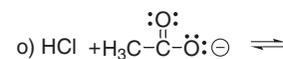
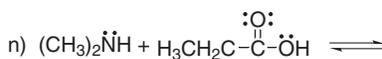
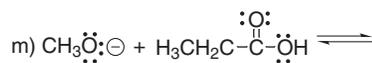
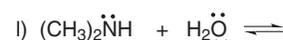
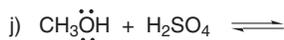
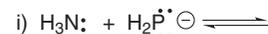
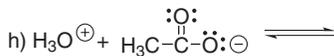
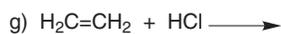
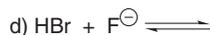
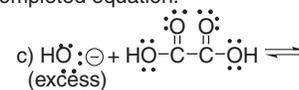
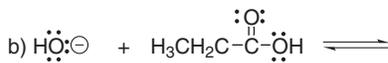
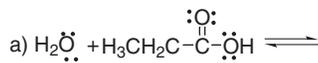
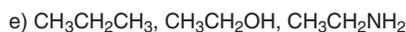
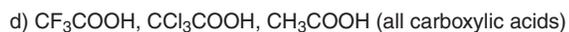
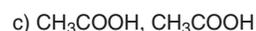


Problem Set  
Acids and Bases

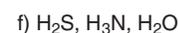
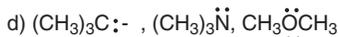
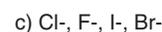
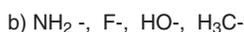
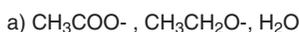
1. For the following pairs of reactants, write an acid-base reaction. Show electron dots and curved arrows that show the movement of electrons. Write an equilibrium arrow that indicates the direction of the equilibrium. Identify the conjugate pairs in each completed equation.



2. For the following groups of compounds, arrange in order of increasing acidity for the underlined hydrogen. EXPLAIN your choices.



3. Arrange the following in order of increasing basicity. Explain.



4. Sodium hydride, NaH, is an ionic compound.

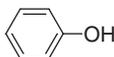
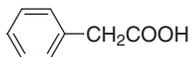
a) Write the Lewis electron-dot structure for NaH.

b) If NaH is placed into water (a foolish thing to do), the hydride ion is converted to hydrogen gas ( $\text{H}_2$ ). The resulting solution turns red litmus paper blue and has a  $\text{pH} \gg 7$ . Write a balanced equation showing the reaction of NaH with water.

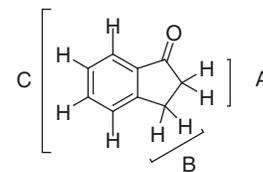
c) Is the hydride ion an acid or a base? What is the relationship of hydrogen and hydride?

d) Sodium hydride reacts with alcohols in a similar way. Write the reaction of NaH with ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ ).

5. From the  $K_a$  values in the table, calculate the  $\text{p}K_a$  for each compound. Using these data, arrange the compounds in order of increasing acidity and explain the trend. (Hint: be sure to identify the hydrogen to which the  $K_a$  applies.)

	$K_a$		$K_a$
$\text{CH}_3\text{COOH}$	$1.75 \times 10^{-5}$	$\text{CH}_3\text{CH}_2\text{OH}$	$1 \times 10^{-16}$
	$1.0 \times 10^{-10}$		$5.2 \times 10^{-5}$
$\text{CH}_3\text{CH}_2\text{NH}_2$	$1 \times 10^{-36}$	$\text{CH}_3\text{CH}_3$	$10^{-50}$

6. 1-Indanone (below) has three different types of hydrogen atoms (labeled A, B, and C in the structure). Removing the most acidic proton forms an anion that is stabilized by resonance. Draw a structure for the anion and its resonance form(s).



7. The conjugate acids of the following amines have the  $\text{p}K_a$  values shown. Explain the trend.

	$\text{p}K_a$ of conjugate acid
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$	10.60
$\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_2\text{NH}_2$	9.92
$(\text{CH}_3\text{O})_2\text{CHCH}_2\text{CH}_2\text{NH}_2$	8.54
$\text{N}(\text{CCH}_2\text{CH}_2\text{NH}_2)_2$	7.80