1. (12 pts.) Draw resonance structures for the following molecules

a. 

b. 

c. 

d. 

2. (12 pts.) Determine the product(s) of the following reactions. Assuming that reactions b, and c are under kinetic control, identify the major product.

a. 

b. 

c. 

3. (8 pts.) Using resonance structures (draw them where appropriate), explain why phenol is a weak acid, but cyclohexanol is not acidic at all.
4. (8 pts.) Provide names for the following compounds
a. 

\[ \text{ } \]

b. 

\[ \text{ } \]

5. (10 pts.) Determine the product(s) of the following reactions.
a. 

\[ \text{ } \]

b. 

\[ \text{ } \]

6. (12 pts.) Determine the products in the following reactions, and identify the kinetic and thermodynamic products.
a. 

\[ \text{HBr} \rightarrow \]

b. 

\[ \text{H}_2\text{SO}_4, \text{H}_2\text{O} \rightarrow \]

c. 

\[ \text{HCl} \rightarrow \]

7. (8 pts.) HBr reacts with 2,4-hexadiene according to the reaction drawn below. Draw a mechanism that accounts for the formation of both products.

\[ \text{HBr} \rightarrow \]
8. Br₂ undergoes a radical initiated bromine substitution reaction with 1,1,1-trichloropropane to form a racemic mixture of R- and S-2-bromo-1,1,1-trichloropropane.
   a. (4 pts.) Draw and label R- and S-2-bromo-1,1,1-trichloropropane.
   b. (6 pts.) Explain why both the R and S enantiomers form (is either enantiomer favored?).

9. (14 pts.) Determine the products of the following reactions. Do not include products that account for less that 1% of the material produced. (Important ratios 1600:82:1 and 5:3.8:1)
   a. 
   
   b. 
   
   c. 

10. (6 pts.) The reaction of 3-methyl-1,4-pentadiene with HCl produces 3-chloro-3-methyl-1-pentene. Draw a mechanism that accounts for the formation of the 3-chloro-3-methyl-1-pentene.