1.  a. Rank the following alkyl halides in order of expected reactivity under $S_{N}2$ conditions. Write NR for any alkyl halides that would not be expected to react.

   ![Alkyl Halides Diagram]

   b. Now rank the same alkyl halides in order of expected reactivity under $S_{N}1$ conditions. Again, write NR for any alkyl halides that would not be expected to react.

2.  Which reaction in each pair is expected to take place more rapidly? Give a one-sentence explanation of your answer.

   a.  
   
   ![Reaction 1 Diagram]
   
   explanation:_________________________________________________________

   b.  
   
   ![Reaction 2 Diagram]
   
   explanation:_________________________________________________________

   c.  
   
   ![Reaction 3 Diagram]
   
   explanation:_________________________________________________________

3.  Which would you expect to be a stronger nucleophile? Circle the correct answer for each set.

   a.  $\text{CH}_3\text{S}^-$ or $\text{CH}_3\text{SH}$?

   b.  $(\text{CH}_3)_2\text{P}$ or $(\text{CH}_3)_2\text{N}$ in acetone?

   c.  $(\text{CH}_3)_2\text{P}$ or $(\text{CH}_3)_2\text{N}$ in methanol?
4. For the following set, write in the box a compound number or numbers which correctly completes the statement.

![Chemical structures](image)

a. Which alkene is the least stable?
b. Which alkene is the most stable?
c. Which alkene would have the smallest heat of hydrogenation?
d. On 4, label the allylic and vinylic hydrogens.

5. Write the compound number in the box which correctly answers the following questions.

![Chemical structures](image)

a) The most stable carbocation is?
b) The least stable carbocation is?

6. Conversion of the following allyl bromide into the corresponding allyl alcohol gives two different product mixtures depending on the nucleophile that is used. Provide the products, and give a brief explanation of why two different product mixtures are obtained.

![Chemical structures](image)