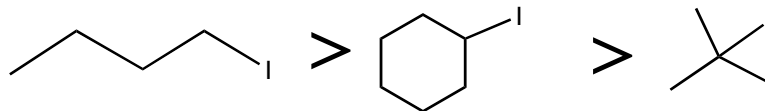


Additional Problems for practice:

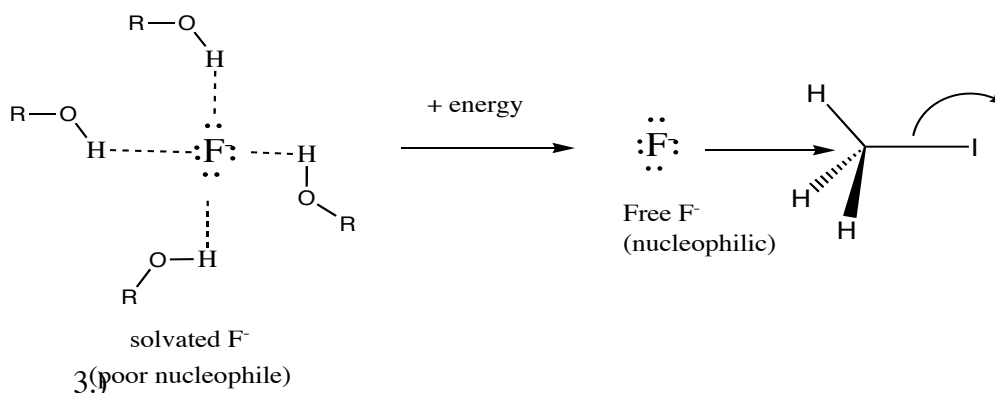
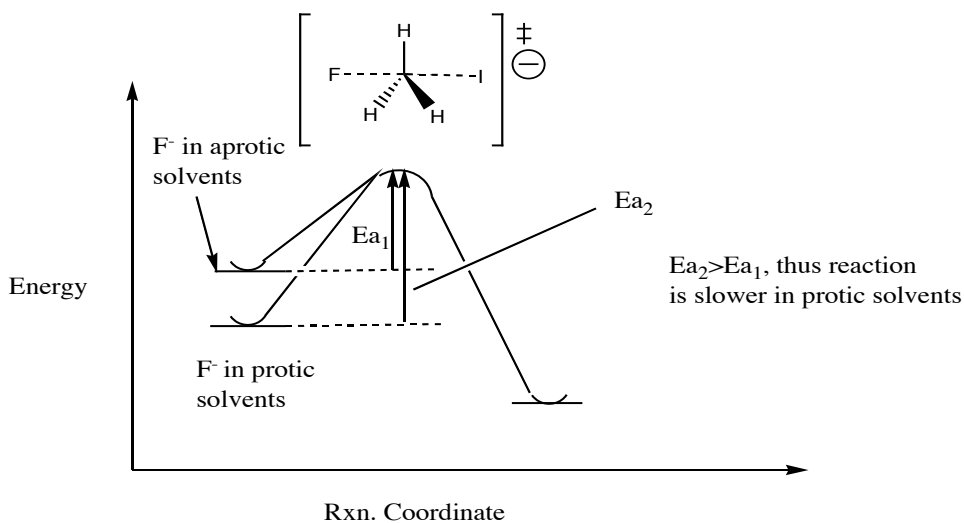
1.) Which of the following compounds is the best SN2 substrate:



For SN2 reactions, backside attack by a nucleophile will be fastest for a primary alkyl halide, followed by a secondary halide. Tertiary halides do not undergo SN2 reactions

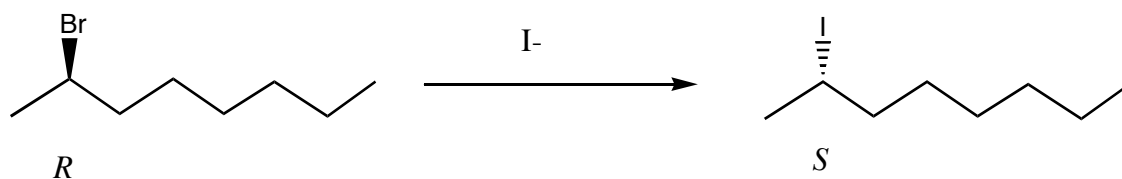
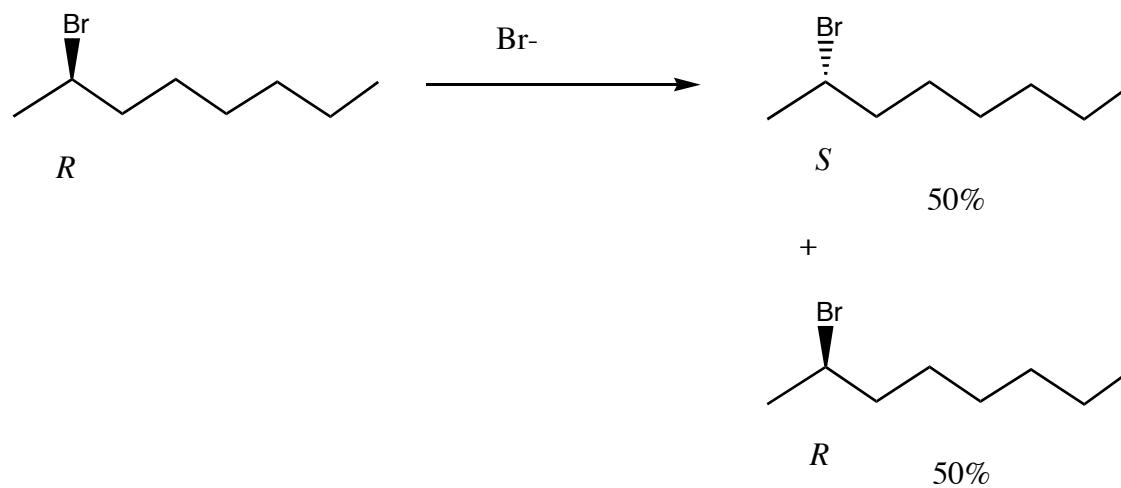
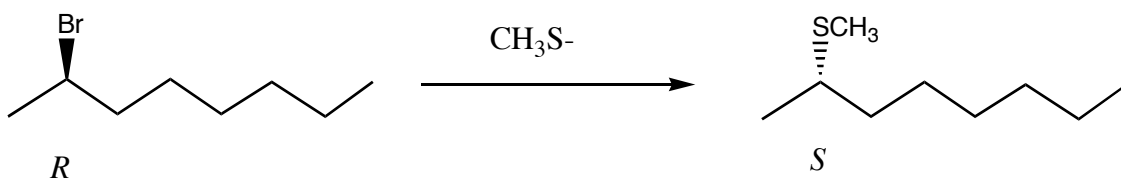
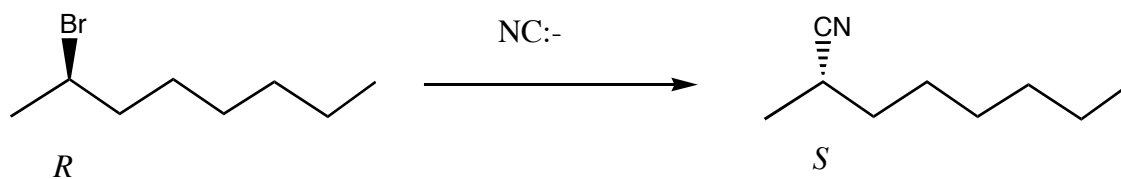
2.) Explain why an SN2 reaction proceeds more rapidly in a polar, aprotic solvent than in a polar protic solvent. Draw a reaction-energy diagram to illustrate your answer.

In polar protic solvents, hydrogen bonding stabilizes the nucleophile; more energy must be expended to strip away the layer of hydration so that attack can occur at an electrophilic carbon atom. Polar aprotic solvents can stabilize cations by ion-dipole interactions, but not anions (nucleophiles); thus nucleophiles are more free to react with electrophilic carbon atoms in polar aprotic solvents.



4.) Predict the product and give the stereochemistry resulting from the reaction of the following nucleophiles with R-2-bromooctane:

(a)  $\text{NC}^-$       (b)  $\text{CH}_3\text{S}^-$       (c)  $\text{Br}^-$       (d)  $\text{I}^-$



5.) Which reagent in each pair will react faster in an SN2 reaction with hydroxide ion?

(a) CH<sub>3</sub>Br or CH<sub>3</sub>I

CH<sub>3</sub>I will react faster, since I is a better leaving group than Br<sup>-</sup> (larger and more polarizable)

(b) CH<sub>3</sub>CH<sub>2</sub>I in ethanol or dimethyl sulfoxide

From problem 2 above, we know that nucleophiles in SN2 reactions will be more reactive in polar aprotic solvents like DMSO rather than polar protic solvents like ethanol

(c) (CH<sub>3</sub>)<sub>3</sub>CCl or CH<sub>3</sub>Cl

The reactivity order of halides in SN2 reactions is CH<sub>3</sub>X > 1° > 2° > 3°  
Thus CH<sub>3</sub>Cl will be more reactive than (CH<sub>3</sub>)<sub>3</sub>CCl (3°)

6.) Which reagent in each of the following pairs is more nucleophilic? Explain your answer?

(a) H<sub>2</sub>N<sup>-</sup> or H<sub>3</sub>N

Negatively charged nucleophiles are much more reactive in SN2 reactions than neutral nucleophiles. Thus H<sub>2</sub>N<sup>-</sup> is most reactive

(b) BF<sub>3</sub> or F<sup>-</sup>

BF<sub>3</sub> is a Lewis acid and is therefore not a nucleophile. F<sup>-</sup> is more reactive

(c) I<sup>-</sup> or Cl<sup>-</sup>

I<sup>-</sup> is more reactive than Cl<sup>-</sup> since it is bigger and more polarizable; it can form a bond at a further distance in the transition state

(d) (CH<sub>3</sub>)<sub>3</sub>P or (CH<sub>3</sub>)<sub>3</sub>N

(CH<sub>3</sub>)<sub>3</sub>P is more reactive than (CH<sub>3</sub>)<sub>3</sub>N, since P is larger and more polarizable than N.

(e) H<sub>2</sub>O or CH<sub>3</sub>COO<sup>-</sup>

Negatively charged nucleophiles are much more reactive in SN2 reactions than neutral nucleophiles. Thus CH<sub>3</sub>COO<sup>-</sup> is more reactive than water.