I. Circle the compound in each set which would be most reactive (i.e. react fastest) in the indicated type of reaction. (20 points = 5 points each)

A. $S_N^2$ Reaction

- $\text{CH}_3\text{-CH}\text{-CH}_2\text{-Cl}$
- $\text{CH}_3\text{-C}\text{-Cl}$
- $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-Cl}$

B. E2 Reaction

- $\text{Br}$
- $\text{H}_3\text{C}$
- $\text{H}_3\text{C}$

C. $S_N1$ Reaction

- $\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-Cl}$
- $\text{CH}_2\text{=}\text{CH}\text{-CH}_2\text{-Cl}$
- $\text{CH}_2\text{=}\text{CH}\text{-CH}_2\text{-Cl}$

D. Electrophilic Addition Reaction (HX addition)

- $\text{CH}_3\text{-CH}_2\text{-CH}\text{=}\text{CH}_2$
- $\text{CH}_3\text{-C}\text{=}\text{CH}_2$
- $\text{CH}_3\text{-CH}\text{=}\text{CH}\text{-CH}_3$

II. Draw the structure of the major organic product of each of the following reactions. Make sure to show correct regiochemistry and stereochemistry where appropriate. (40 points = 5 points each)
III. The ammonium chloride salt of phenylpropanolamine (PPA) is a decongestant and anorexic used as an active ingredient in numerous over-the-counter cold medications and diet pills. Only the (R,S) and (S,R) stereoisomers of phenylpropanolamine are used in these medications. They contain a racemic mixture of the (R,S) and (S,R) enantiomers.

Starting with the correct stereoisomer (cis or trans) of 1-phenylpropene propose a synthesis of (R,S)/(S,R) phenylpropanolamine avoiding formation of the (R,R) and (S,S) stereoisomers. (15 points)

IV. Draw the structure of the major organic product of each of the following reactions. Make sure to show correct regiochemistry and stereochemistry (cis/trans, R/S) where appropriate. (25 points = 5 points each)