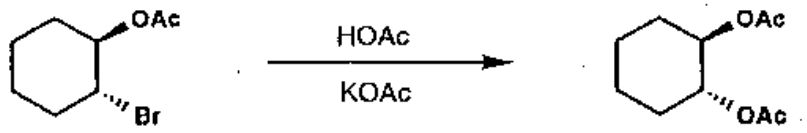
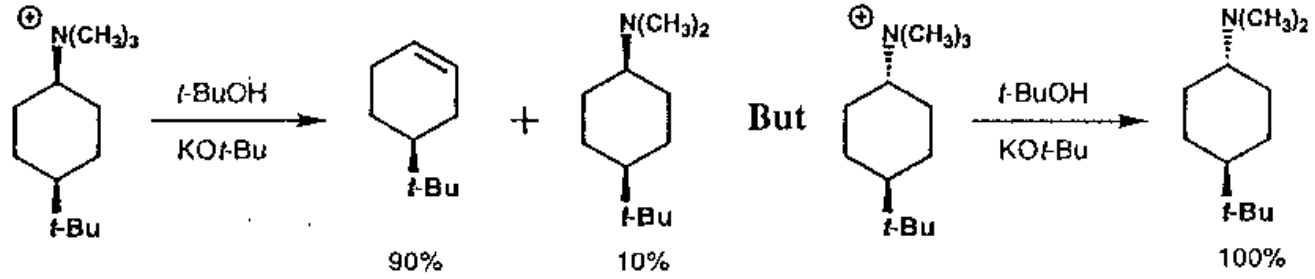
1. Provide plausible mechanisms for the following reactions. Point out any stereoelectronic effects which are likely to be operating. (32 pts)

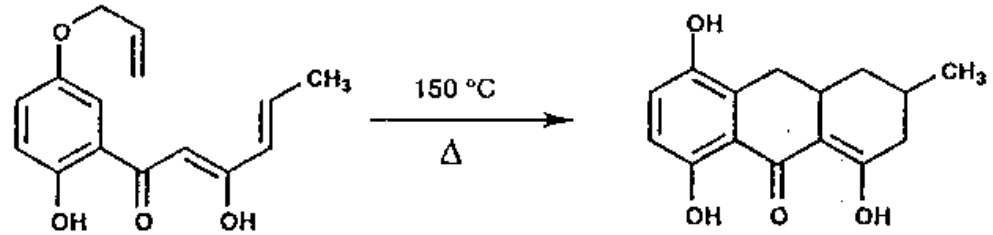
(a)



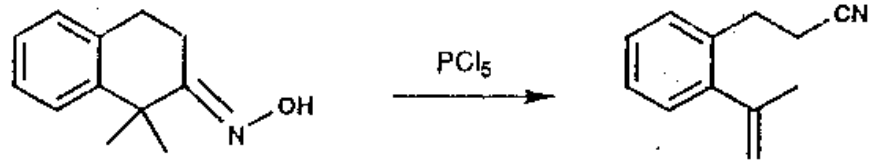
(b)



(c)

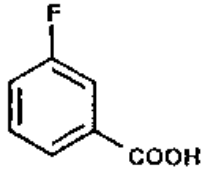


(d)

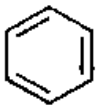


2. Propose efficient syntheses of each of the following molecules, beginning with the indicated starting materials. (24 pts)

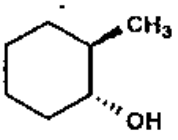
(a)



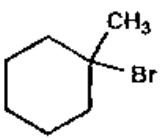
from



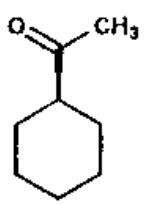
(b)



from



(c)



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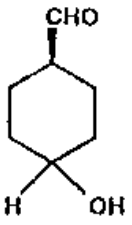
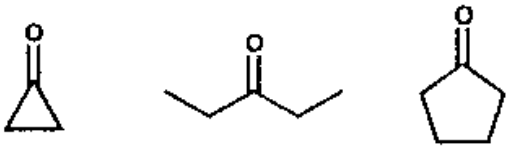


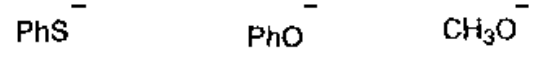
3. Arrange the following compounds in increasing order of the property specified and give the reasons of your arrangement. (24 pts)

(a) Reactivity toward addition of a nucleophile to the most electrophilic carbon



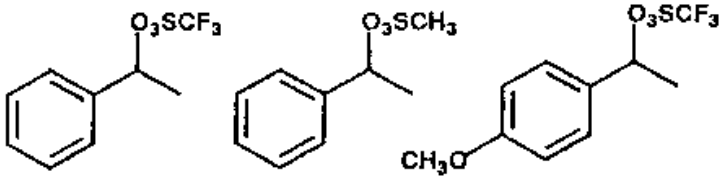
A　B　C

(b) Soft base character of the heteroatom



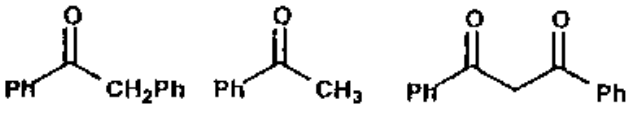
D　E　F

(c) Rate of solvolysis (S_N1)



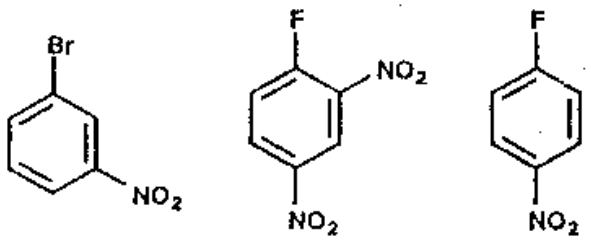
G　H　I

(d) Acidity



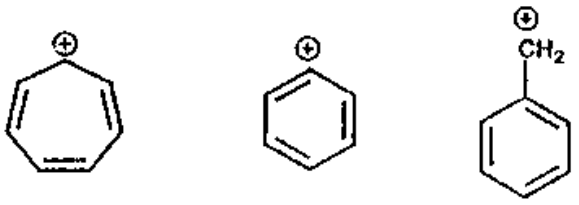
J　K　L

(e) Rate of reaction in nucleophilic aromatic substitution



M　N　O

(f) Value of pK_R+



P　Q　R

4. Use a specific example to illustrate each of the following terms: (8 pts)
   (a) Mannich reaction
   (b) McLafferty rearrangement

5. Distinguish the following pairs of compounds by using a chemical method and the characteristic infrared absorptions: (12 pts)
   (a) cyclohexene and cyclohexanone
   (b) pentane and 1-pentyne
   (c) 4-methylphenol and 4-methylbenzoic acid