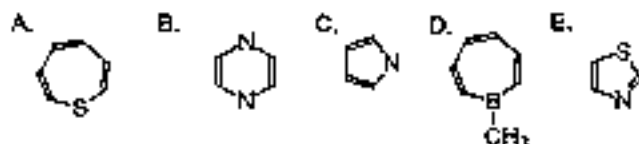
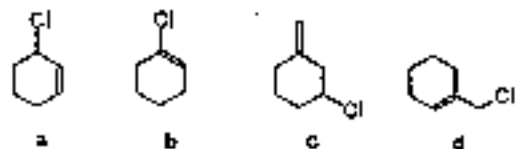


1. Which of the following heteroatom-containing compounds is not an aromatic? (單選, 3%)

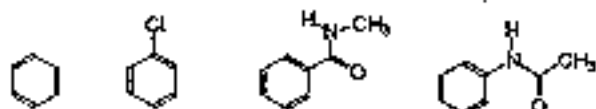


2. Arrange the following compound a, b, c, and d in order of decreasing reactivity toward solvolysis with ethanol. (單選, 3%)

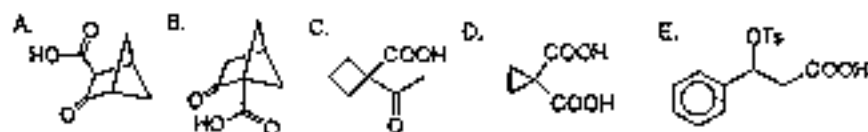


A. b>c>d>a B. b>a>c>d C. a>d>c>b D. a>c>b>d E. c>b>a>d

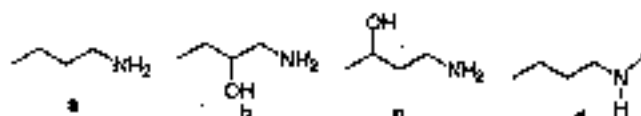
3. Arrange the following compound a, b, c, and d in order of decreasing reactivity toward sulfonation. (單選, 3%) A. a>d>c>b B. d>c>a>b C. b>c>d>a D. d>b>c>a E. d>a>b>c



4. Which one of the following compounds will not undergo decarboxylation on heating. (單選, 3%)



5. Arrange the following compound a, b, c, and d in order of decreasing basicity. (單選, 3%)



A. a>d>b>c B. a>d>c>b C. d>c>a>b D. d>a>c>b E. c>b>d>a

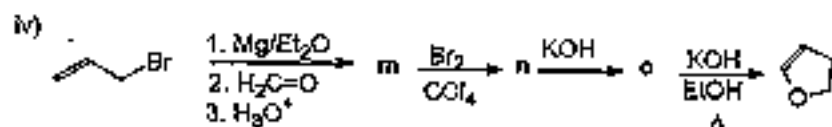
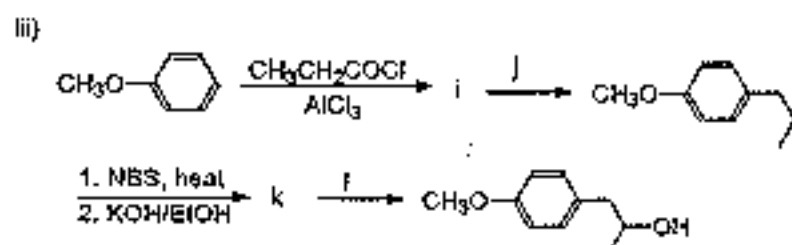
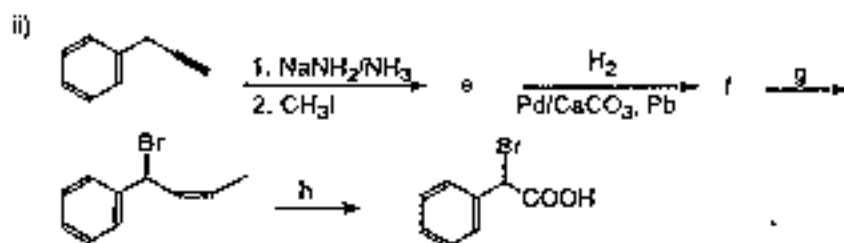
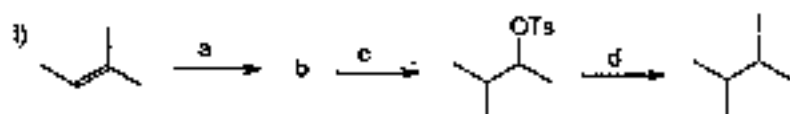
6. Draw structures of the following compounds.

(a) 2-chloroethyl benzoate (3%) (b) trans-3-phenylcyclohexylamine (3%)

7. (a) Draw the major product formed when the optically active compound shown below is treated with H_2SO_4/H_2O . (3%) (b) Is the product optically active? Why or Why not? (3%)



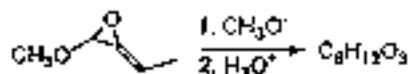
B. Complete the following reactions by adding the appropriate reagents and products. (各3%, 共45%)



9. The ^1H NMR spectrum of compound A ($\text{C}_{12}\text{H}_{14}\text{O}$) shows only two signals: a multiplet at 7.15 and a singlet at 3.55 ppm in a 5:2 ratio. The IR spectra has no absorption in the $3200\text{--}4000\text{ cm}^{-1}$ region but a strong peak can be found near 1700 cm^{-1} . Compound A reacts with NaBH_4 followed by acidification to give compound B of the molecular formula $\text{C}_{12}\text{H}_{16}\text{O}$. The reaction of A with CH_3MgBr , and then with H_3O^+ gives C, with a molecular formula of $\text{C}_{13}\text{H}_{18}\text{O}$. Suggest structure for A-C. (各3%, 共9%)

10. Compound A of the molecular formula $\text{C}_{10}\text{H}_{12}\text{O}$ exhibits the following resonances in its ^1H NMR spectrum: 2.05 (s, 3H), 2.60-2.90 (two overlapping triplets, 4H), 7.20 (multiplet, 5H) ppm. Its ^{13}C NMR spectrum shows eight distinct signals- three between 20 and 50 ppm, four between 120 and 145 ppm, and a single peak at 207 ppm. Treatment of A with I_2/OH^- gives a yellow precipitate and reaction with $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4/\text{H}_2\text{O}$ yields benzoic acid. Suggest a structure for A and justify your answer. (5%)

11. When the epoxide shown below was treated with CH_3O^- followed by an acidic workup, a compound of the molecular formula $\text{C}_8\text{H}_{12}\text{O}_3$ was formed as the major product. Its ^1H NMR spectrum exhibited signals at 1.07 (t, 3H), 2.00 (q, 2H), 3.41 (s, 6H), 4.50 (s, 1H) ppm, and a strong adsorption was seen at 1730 cm^{-1} in its IR spectrum. Propose a structure for this molecule and provide a reaction mechanism to account for its formation. (7%)



12. Provide a mechanistic explanation for the reaction. (6%)

