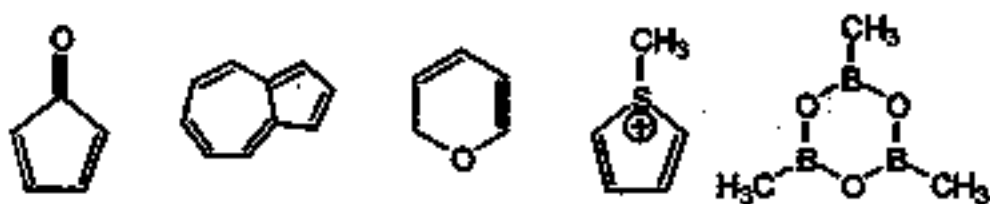
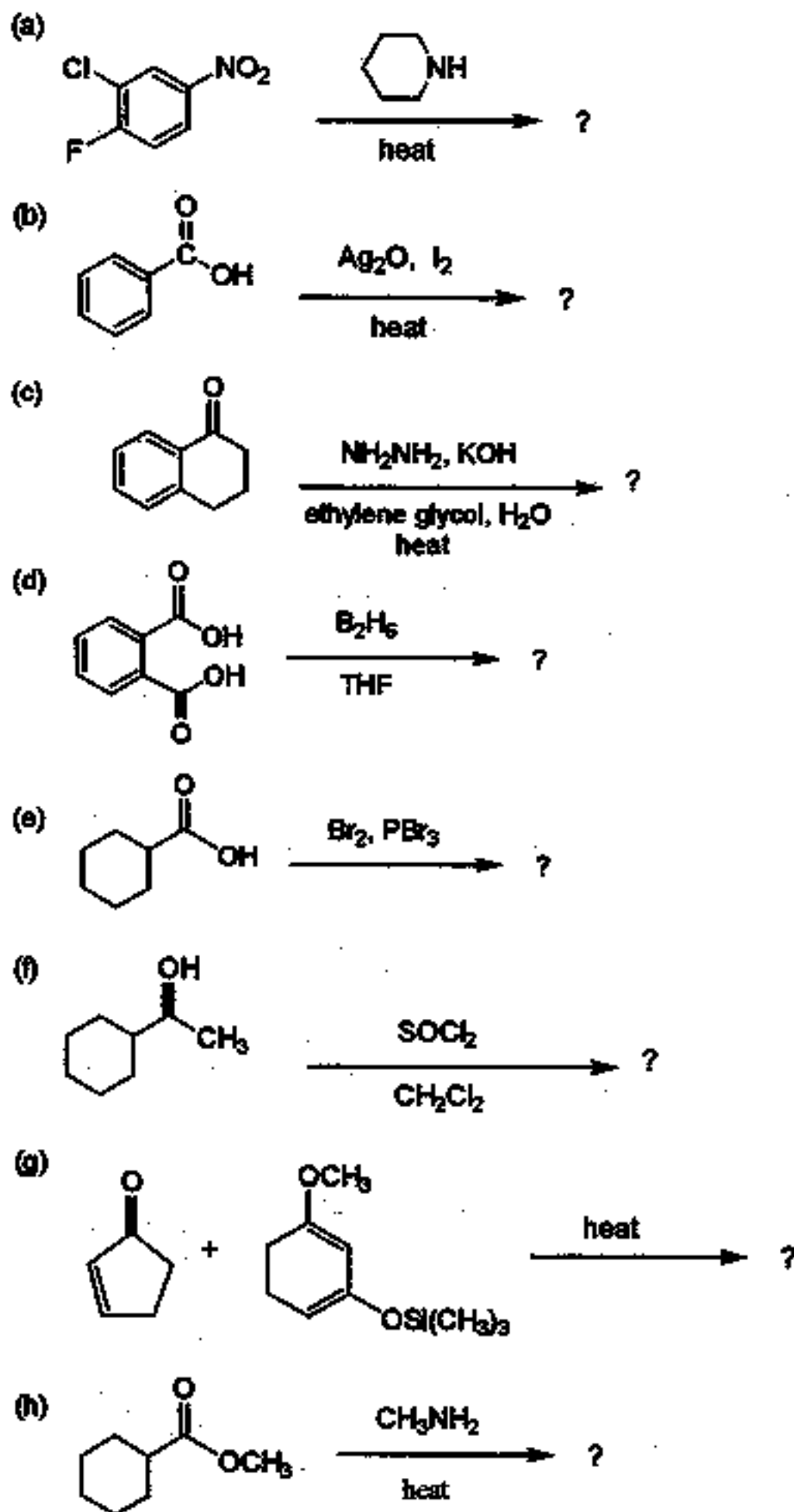


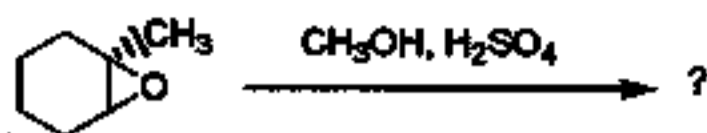
1. Classify each of the following molecules and ions as aromatic, antiaromatic, or nonaromatic species. (5%)



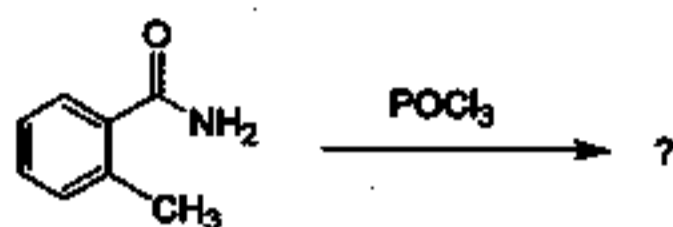
2. Provide the structure of the major product for each of the following reactions, and clearly indicate the stereochemistry where appropriate. (40%)



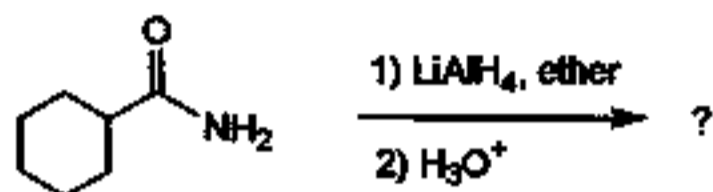
①



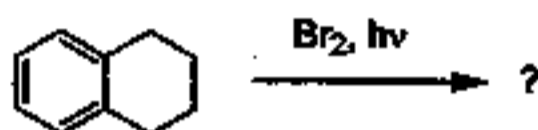
②



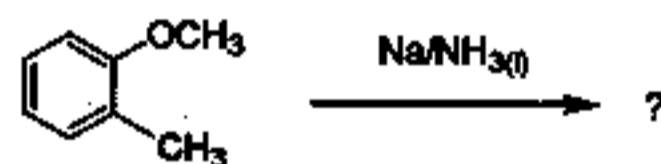
(k)



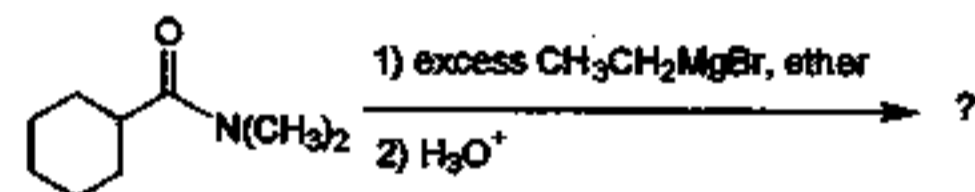
③



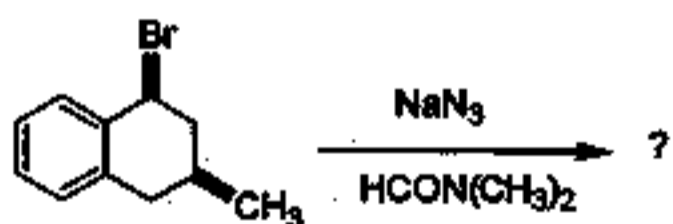
(m)



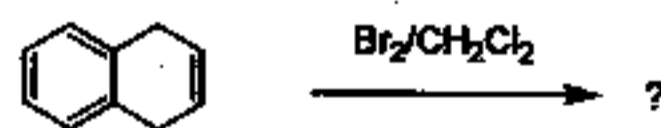
(n)



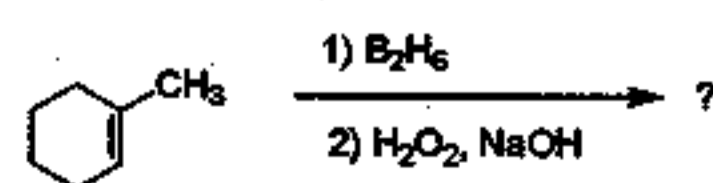
(o)



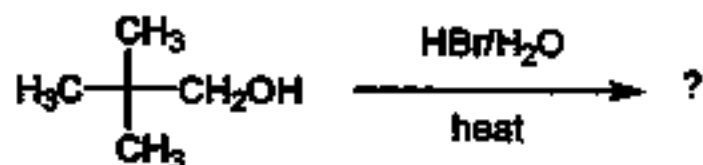
(p)



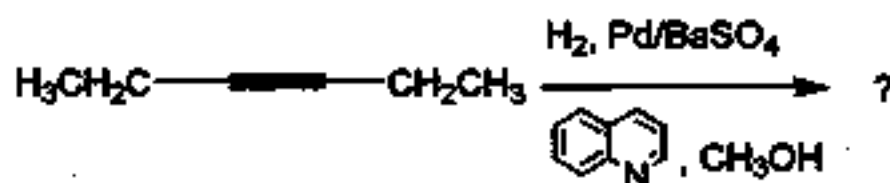
(q)



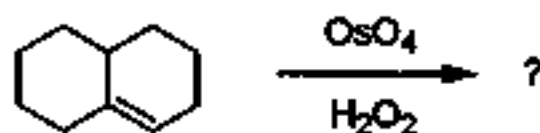
(r)



(s)

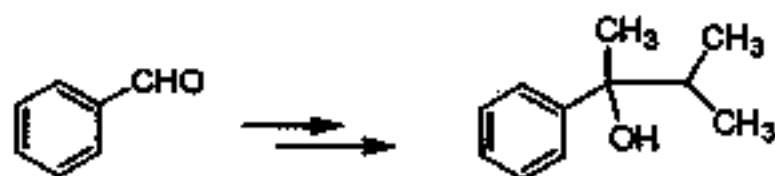


(t)



3. Provide necessary reagents to complete each of the following transformations, and show all intermediates. (16%)

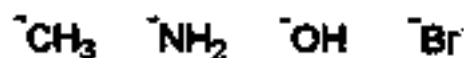
(a)



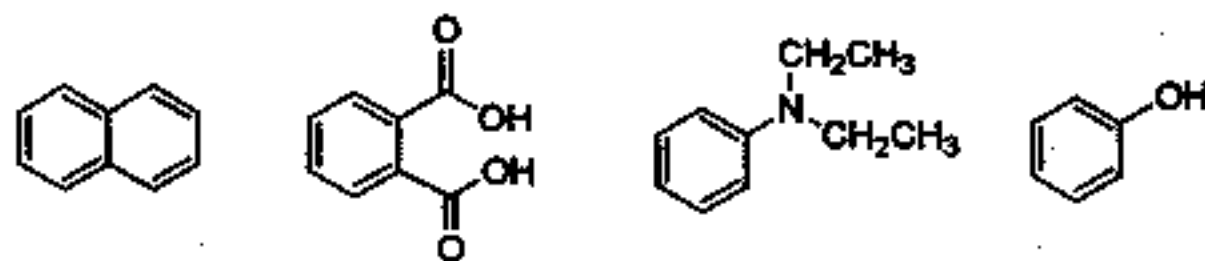
(b)



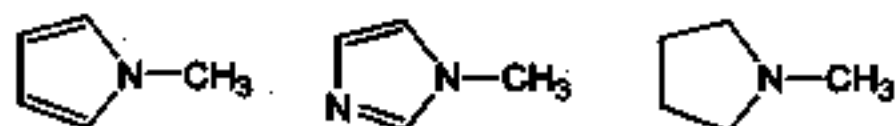
4. Rank the following species in an order of increasing nucleophilicity. (5%)



5. Show how one could separate a mixture of the following compounds using extractions with a separatory funnel. (5%)



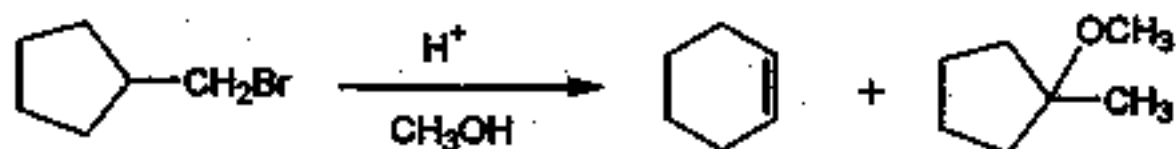
6. Arrange the following compounds in an order of increasing basicity. (4%)



7. Draw a Fischer projection for (2R,3R)-2-chloro-3-hydroxyhexane. (3%)

8. Draw the most stable conformation for (1S,3R)-1-bromo-3-methylcyclohexane. (3%)

9. Give a plausible mechanism for the following transformation. (6%)



10. An unknown compound ( $\text{C}_3\text{H}_2\text{NCl}$ ) shows moderately strong IR absorptions around  $1650$  and  $2200\text{cm}^{-1}$ . Its  $^1\text{H}$  NMR spectrum consists of two doublets ( $J = 14\text{ Hz}$ ) at  $\delta 5.9$  and  $7.1$ . Deduce a structure consistent with these data. (5%)

11. Deduce the molecular structure for the compound that is consistent with the following spectral data. (8%)

