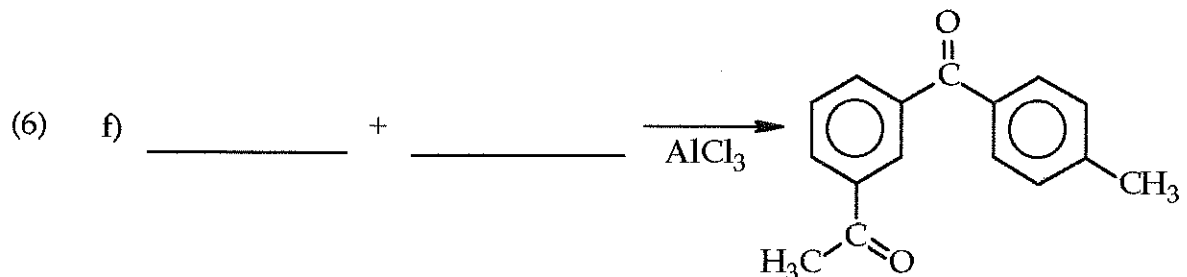
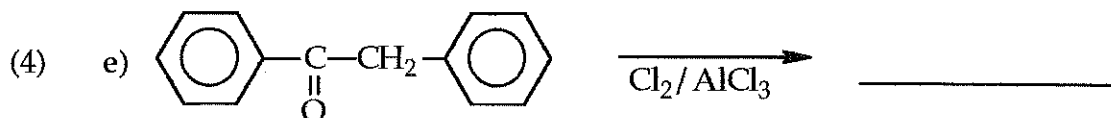
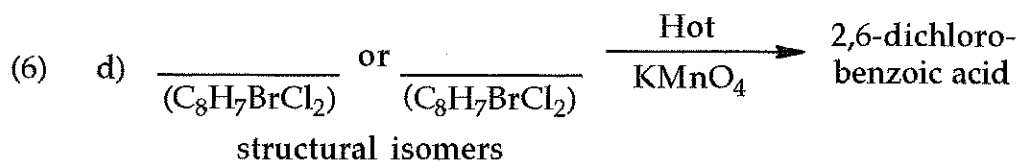
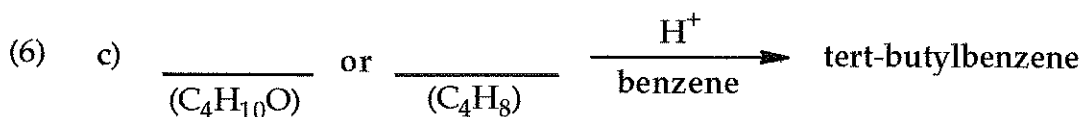
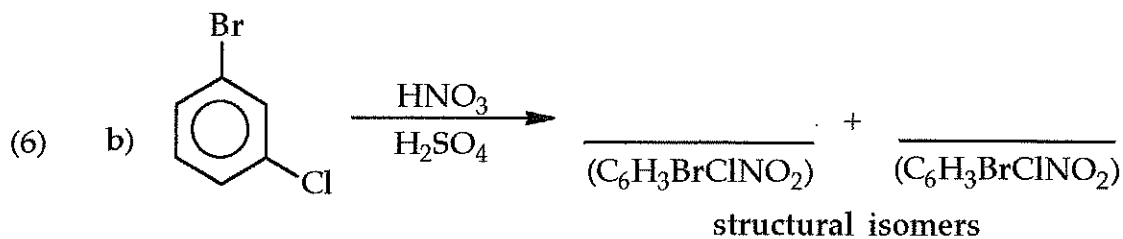
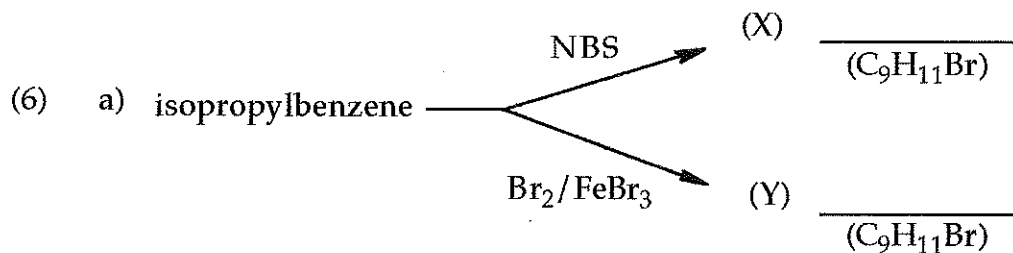


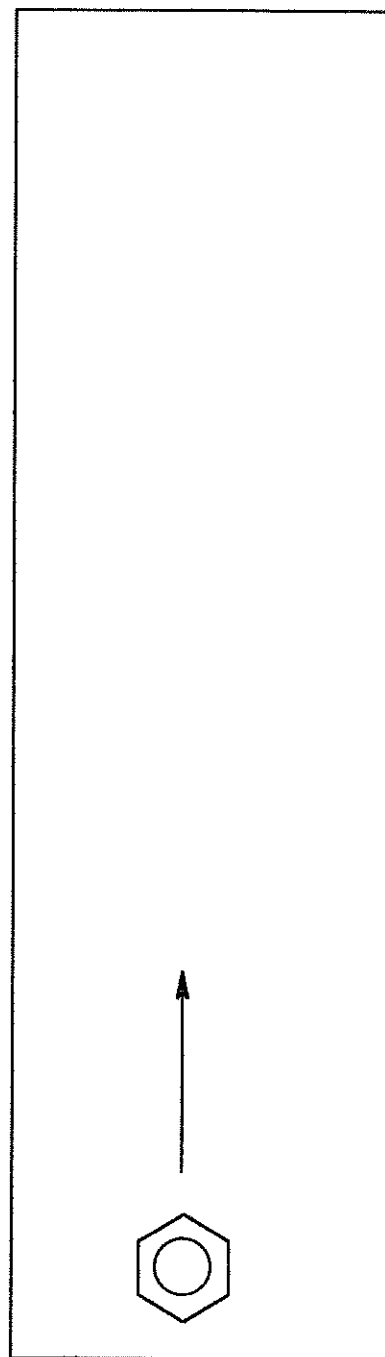
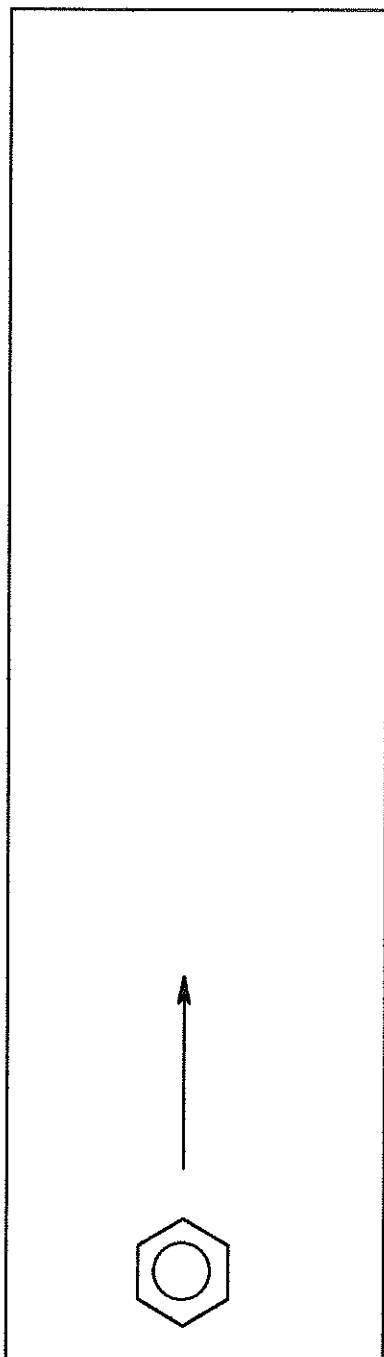
1. Complete the following chemical equations by supplying the proper reactants or major products:



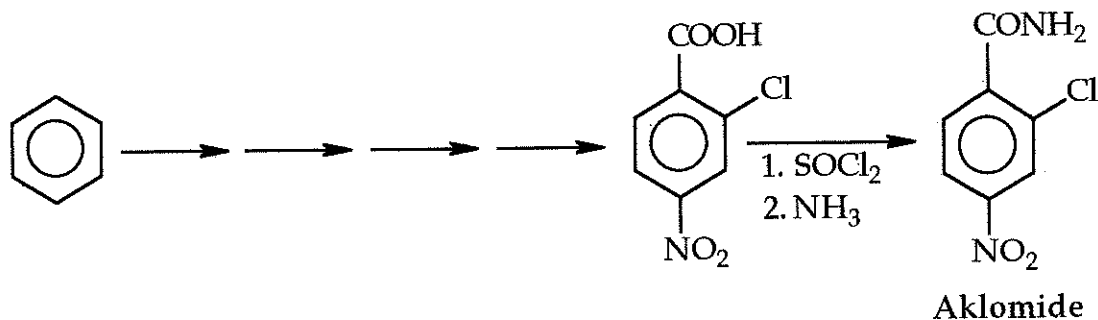
(18) 2. Outline all steps in the syntheses of the two following compounds starting from benzene and any other necessary organic and inorganic reagents.

a) 5-chloro-2-bromobenzoic acid

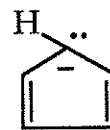
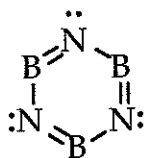
b) 3-ethylchlorobenzene



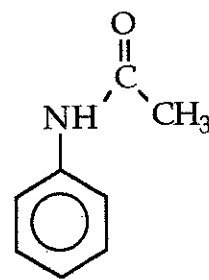
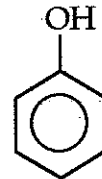
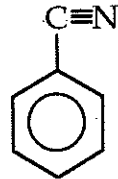
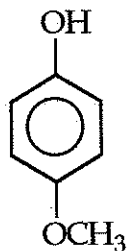
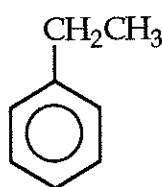
- (8) 3. Aklomide, a pharmaceutical agent used to treat certain fungal and protozoal infections in veterinary medicine, is the amide derivative of 2-chloro-4-nitrobenzoic acid. Complete the following reaction sequence for the synthesis of Aklomide.



- (12) 4. Designate each of the following species as **aromatic**, **antiaromatic**, or **non-aromatic**:



- (6) 5. Arrange the following benzene derivatives in order of **decreasing reactivity towards electrophilic aromatic substitution**:



I

II

III

IV

V

VI

_____ > _____ > _____ > _____ > _____ > _____

- (12) 6. Compounds (X) and (Y) are structural isomers of formula $C_{10}H_{12}$. Both (X) and (Y) are chiral and, upon hot $KMnO_4$ oxidation, both produce phthalic acid (1,2-benzenedicarboxylic acid). Draw structural formulas for (X) and (Y) that are consistent with all the data provided. (From the data provided, it will not be possible to differentiate between the $C_{10}H_{12}$ structural isomers).

- (10) 7. Compounds (J) and (K) are structural isomers of formula $C_{18}H_{30}$. Each has a pmr spectrum that consists of only two singlet signals. Compound (J) has a cmr spectrum that has four signals, whereas that of (K) has five signals. Draw structural formulas for (J) and (K) that are consistent with all the spectral data provided.

(J)

(K)