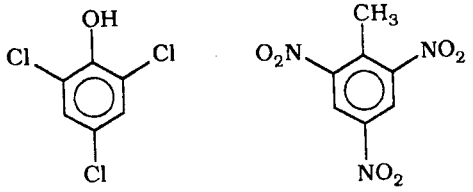
1. Benzene contains delocalised pi electrons and sigma bonds. The weakly held pi electrons make benzene susceptible to electrophilic attack.

(a) Draw a molecule of benzene labelling the sigma and pi bonds.
(b) Explain why benzene behaves as if it is a saturated molecule.
(c) What is an electrophile?

2. There are four possible isomeric benzene based structures with carbon side chains which have the molecular formula C_8H_{10}. One of these is ethyl benzene.

(a) Using the symbol  to represent the benzene ring draw the structure of these isomers
(b) Explain how ethyl benzene could be produced from benzene.

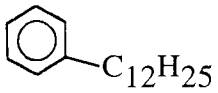
3. Two important aromatic compounds are shown below:



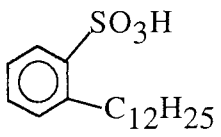
1,3,5 trichlorophenol 1,3,5 trinitrotoluene

(a) What is the molecular formula of each compound?
(b) For 1,3,5 trichlorophenol
  (i) explain why the compound is acidic.
  (ii) explain how the compound could be produced from phenol.
(c) For 1,3,5 trinitrotoluene
  (i) draw the strucure of toluene and give its systematic name.
  (ii) Explain how 1,3,5 trinitrotoluene could be produced from toluene.

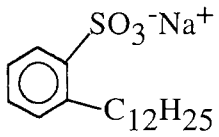
4. Detergents are made by reaction of alkyl benzenes such as the molecule below



The molecule is first converted into molecule A, then into molecule B.



Molecule A

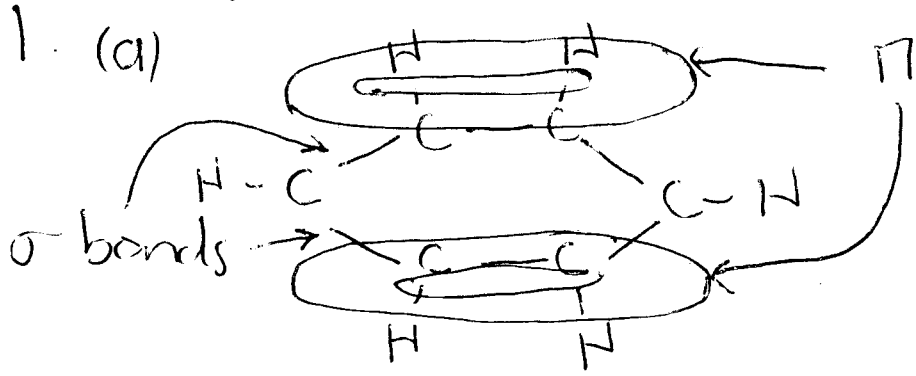


Molecule B

(a) Suggest how benzene could be converted into the alkyl benzene above.
(b) Suggest how the alkyl benzene could be converted into molecule A.
(c) Suggest how molecule A could be converted into molecule B.

3.13 Answers

1. (a)

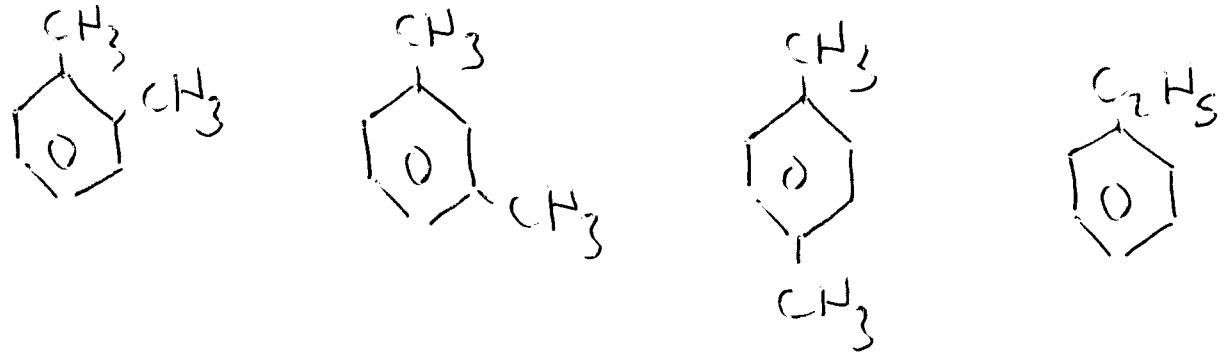


(b) Electrons in π bonds are delocalised and therefore very stable

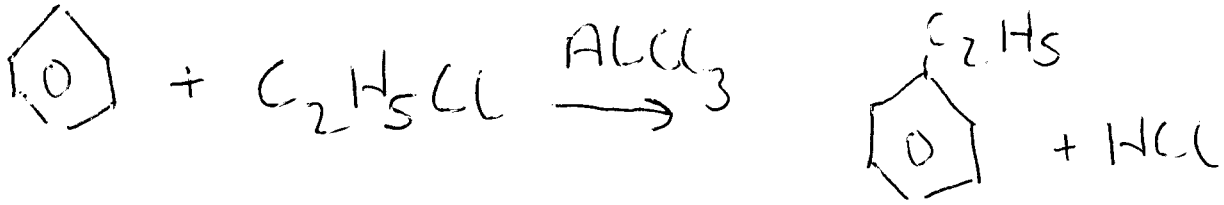
(c) An electrophile is a molecule or ion that is attracted to a negative charge on a molecule

2

(a)



(b)



React benzene with chloroethane using $AlCl_3$ catalyst.

3. (a) $C_6H_2Cl_3OH$ $C_6H_2(CH_3)(NO_2)_3$

1,3,5 trichlorophenol 1,3,5 trinitrotoluene

heterolytically

(b)(i) O-H bond is polar and can break giving H^+ ions

(ii) React phenol with chlorine using $FeCl_3$ catalyst

(c) (i)  methyl benzene

(ii) React toluene with a mixture of concentrated nitric acid and concentrated sulphuric acid.

4. (a) React benzene with chlorododecane using $AlCl_3$ catalyst.

(b) React with concentrated sulphuric acid

(c) React with dilute NaOH.