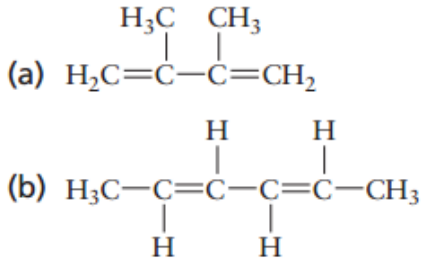
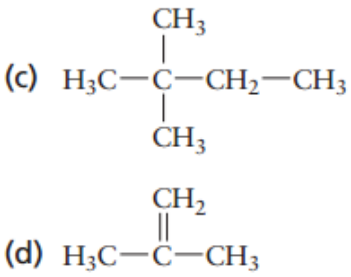
Homework 6

1. Name the following hydrocarbons

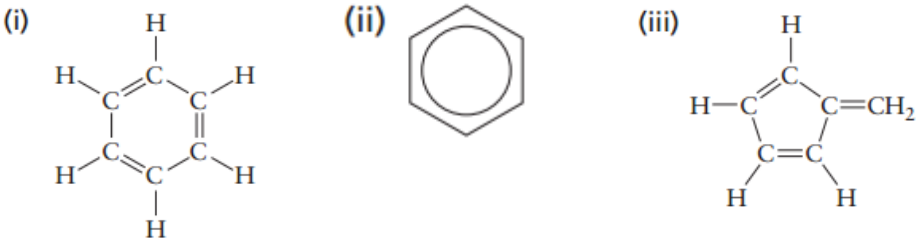




2. Outline, using chemical equations, the synthesis of the following from easily available petrochemicals and inorganic starting materials.

(a) Vinyl acetate ($CH_3COOCH=CH_2$) (b) Formamide ($HCONH_2$) (c) 1,2-Difluoroethane

3. Consider the following proposed structures for benzene, each of which is consistent with the molecular formula C_6H_6



(iv) CH_3-C≡C-C≡C-CH_3 (v) CH_2=CH-C≡C-CH=CH_2

(a) When benzene reacts with chlorine to give C_6H_5Cl, only one isomer of that compound forms. Which of the five proposed structures for benzene are consistent with this observation?

(b) When C6H5Cl reacts further with chlorine to give $C_6H_4Cl_2$, exactly three isomers of the latter compound form. Which of the five proposed structures for benzene are consistent with this observation?

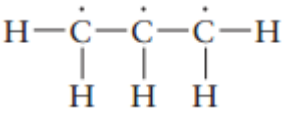
4. Acetyl chloride, CH_3COCl, reacts with the hydroxyl groups of alcohols to form ester groups with the elimination of HCl. When an unknown compound X with formula $C_4H_8O_3$ reacted with acetyl chloride, a new compound Y with formula $C_8H_{12}O_5$ was formed.

(a) How many hydroxyl groups were there in X?

(b) Assume that X is an aldehyde. Write a possible structure for X and a possible structure for Y consistent with your structure for X.

5. For each of the following molecules, construct the π MOs from the $2p_z$ atomic orbitals perpendicular to the plane of the carbon atoms.

(a) Cyclobutadiene 

(b) Allyl radical 

Indicate which, if any, of these orbitals have identical energies from symmetry considerations. Show the number of electrons occupying each π MO in the ground state, and indicate whether either or both of the molecules are paramagnetic. (Hint: Refer to Figs. 7.15 and 7.16.)

6. The naphthalene molecule has a structure that corresponds to two benzene molecules fused together: 

The π electrons in this molecule are delocalized over the entire molecule. The wavelength of maximum absorption in benzene is 255 nm. Will the corresponding wavelength in naphthalene be shorter or longer than 255 nm?