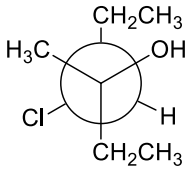
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
II Semester, 2017-2018

Course No.: CHEM F111 **Course Title: General Chemistry** **Max. Marks: 15**

Assignment Set 3 *[based on Lecture Nos.: 30 –41 in the course handout]*

Instructions to the students: The following problems should be solved as home assignment within a week of distribution.

Q1. (a) Convert the given Newman projection to Fisher projection and assign R/S configuration of each chiral center present in this compound. **[4]**

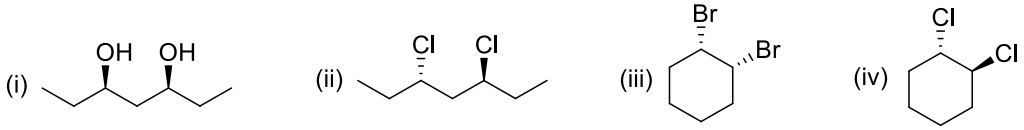


(b) Draw the Newman projection for the most stable conformation of the given compounds: **[6]**

(i) FCH_2CH_2OH (ii) $CH_3CH_2CH(CH_3)_2$ (along C_2-C_3) (iii) $ClCH_2CH_2Cl$ (in polar solvent)

(c) An enantiomer (1.5 g) is dissolved to make its 50 mL solution in ethanol. If the solution has an observed rotation of $+2.79^o$ in polarimeter tube (10 cm) then find the specific rotation at 20 ^oC (D line Sodium light, $\lambda = 589.3$ nm). **[5]**

Q2. (a) Identify the given compounds as chiral/achiral and justify your answer. **[8]**



(b) Draw the most stable chair conformation for *cis*-cyclohexane-1,3-diol and *trans*-cyclohexane-1,3-diol. Which one will rotate the plane polarized light? **[7]**

Q3. (a) Draw the possible chair conformations of *cis*- and *trans*-1,3-diethylcyclohexane and predict the most stable one among all. Calculate the conformational energy for the *trans*-1,3-diethylcyclohexane. **[8]**

(b) Draw the possible chair conformations for *cis*- and *trans*-1-(*t*-butyl)-3-methylcyclohexane and identify the most stable conformation of each pair. **[7]**

(c) Which one of *cis*- and *trans*-1,3-cyclopentanediols can exists as a pair of enantiomers, explain by drawing appropriate stereochemical structures. **[5]**

Q4. (a) Explain the stability of cyclopropane, cyclobutane, cyclopentane and cyclohexane in terms of angle and torsional strains. **[8]**

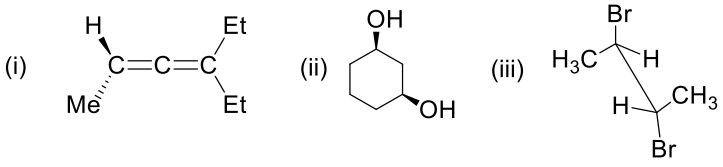
(b) Draw different conformations of n-butane (along C1-C2 and C2-C3) and mention the most stable conformations viewing through C2-C3. **[4]**

(c) How many stereoisomer(s) are possible for tartaric acid? Draw Sawhorse projection (staggered) for all of them and mention chiral/achiral ones? **[3]**

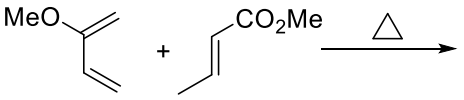
Q5. (a) Draw the most stable chair conformation(s) for *cis*- and *trans*-1-*tert*-butyl-cyclohexan-4-ol. Comment on the chirality of each stereoisomer. **[4]**

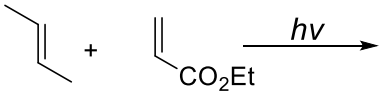
(b) Draw the possible chair conformations of *cis*- and *trans*-1,2-dimethylcyclohexane and predict themost stable conformer for each pair. Calculate the energy difference between the most stable conformations of *cis* and *trans*-1,3-dimethylcyclohexane. **[8]**

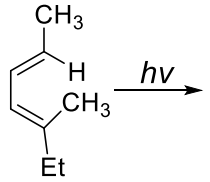
(c) Comment on the chirality of the given compounds. **[3]**

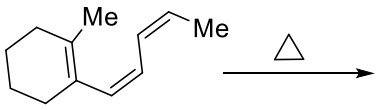


Q6 (a) Draw the structure of the preferred product for the following pericyclic reactions with correct stereochemistry. **[3×4 =12]**

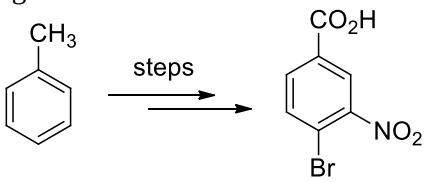
(i) 

(ii) 

(iii) 

(iv) 

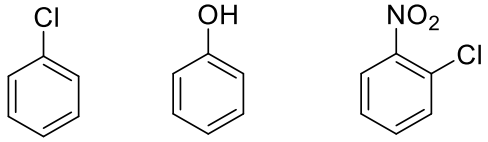
(b) Write down all the steps involved in the given transformation. **[3]**



Q7 (a) Why *p*-nitroaniline is not obtained from direct nitration of aniline but can be obtained through acetanilide? Elaborate the effect of amino and acetanilide group on orientation in electrophilic aromatic substitution. **[3]**

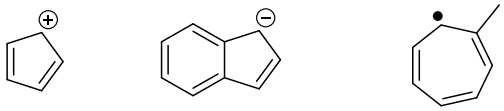
(b) Draw the resonance contributor that shows how the -NO_2 group in nitrobenzene ($C_6H_5NO_2$), withdraws electron density from the π system of the aromatic ring. **[3]**

(c) Arrange following molecules in order of their relative rate of reaction with $Cl_2/FeCl_3$. Justify the order. **[3]**

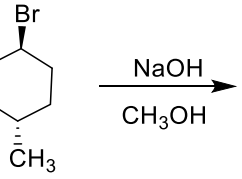


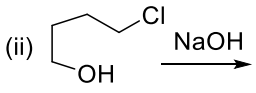
(d) Write all the possible products obtained from the nitration of *tert*-butylbenzene. Arrange them in the increasing order according to the % yield and justify your answer. **[3]**

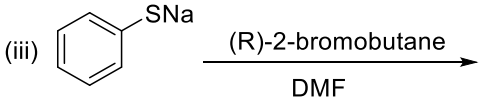
(e) Comment on aromaticity of the following compounds. **[3]**

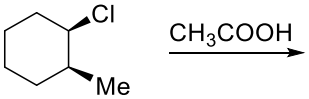


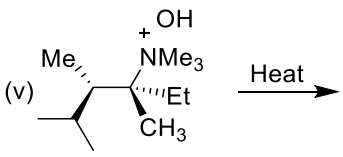
Q8. (a) Predict the structure of the product(s) (with correct stereochemistry, if any) from the following reaction. **[2×6 = 12]**

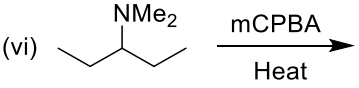
(i) 

(ii) 

(iii) 

(iv) 

(v) 

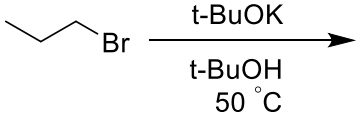
(vi) 

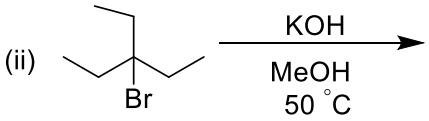
(b) Which of the following reactions will be expected to proceed at a faster rate, justify your choice. **[3]**

(i) $CH_3CH_2CH_2Br + NaCN \xrightarrow{DMF} CH_3CH_2CH_2CN + NaBr$

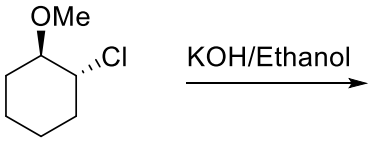
(ii) $CH_3CH_2CH_2Br + NaCN \xrightarrow{EtOH} CH_3CH_2CH_2CN + NaBr$

Q9. (a) Draw structure of the major product(s) in each of the following reactions and indicate the type of mechanism. **[3×4 =12]**

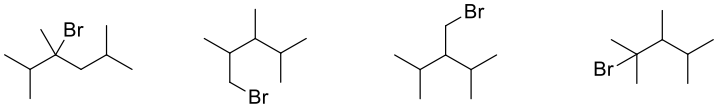
(i) 

(ii) 

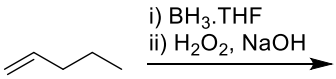
(iii) 2R-bromo-3S-phenylpentane $\xrightarrow[\text{Heat}]{\text{KOH/ethanol}}$

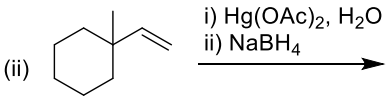
(iv) 

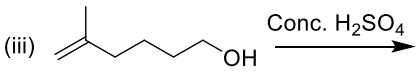
(b) Which one of the following alkyl halides will give 2,3,4-trimethyl-2-pentene upon reaction with KOH in ethanol. **[3]**

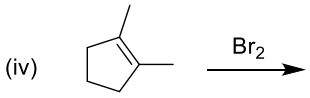


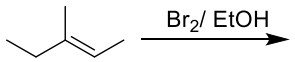
Q10. (a) Predict the product(s) of the following reactions. **[2×6 =12]**

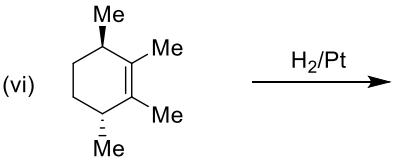
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(b) Draw a stepwise mechanism for the following transformation. **[3]**