CBSE Test Paper-03

Class - 12 Chemistry (Haloalkanes and Haloarenes)

1. The most common freons in industrial use is manufactured by
   a. Swarts reaction
   b. Fittig reaction
   c. Sandmeyer reaction
   d. Wurtz reaction
2. A mixture containing two enantiomers in equal proportions
   a. will be called a racemic mixture
   b. will be called a racemic mixture and will have a zero optical rotation.
   c. will have inverted configuration
   d. will have zero optical rotation
3. In the reaction, R – X + NaoR’ → ROR’ + X (– ve ion) The main product formed is
   a. Ether
   b. Alcohol
   c. Ester
   d. Amine
4. Hydrocarbons are prepared from Grignard reagent by
   a. by reacting them with sodium
   b. by reacting them with water
   c. by exposing them to Magnesium
   d. by exposing them to diethyl ether
5. In alkyl halide
   a. All of these
   b. the carbon atom of C-halogen bond bears a partial positive charge
   c. the halogen atom bears a partial negative charge
   d. the carbon-halogen bond of alkyl halide is polarised

6. Write the structural formula of p-Bromochlorobenzene.

7. Name the following halide according to IUPAC system and classify it as alkyl, allyl, benzyl (primary, secondary, tertiary) vinyl or aryl halide.

$p\text{-}ClC_6H_4CH_2CH(CH_3)_2$

8. An alkyl halide having molecular formula C_4H_9Cl is optically active. What is its structure?

9. How is chlorobenzene prepared by
   a. direct chlorination
   b. diazotization method?

10. How will you bring the following conversion?
    Ethane to bromoethene

11. Write the structure of the major organic product in the following reaction:
    $(CH_3)_3\,CBr + KOH \xrightarrow[heat]{ethanol}$

12. A compound 'A' contains carbon and hydrogen only and has molecular mass of 72. Its photo chlorination gives a mixture containing only one monochloro and two dichloro hydrocarbons. Deduce the structure of A and the chlorinated products.

13. p-Dichlorobenzene has higher m.p. and lower solubility than those of o- and m-isomers. Discuss.

14. Discuss the mechanism of S_N1 reaction of haloalkanes.

15. Predict all the alkenes that would be formed by dehydrohalogenation of the following halides with sodium ethoxide in ethanol and identify the major alkene:
    i. 1-Bromo-1-methylcyclohexane
    ii. 2-Chloro-2-methylbutane
    iii. 2,2,3-Trimethyl-3-bromopentane.

CBSE Test Paper-03
Class - 12 Chemistry (Haloalkanes and Haloarenes)
Solutions

1. (a) Swarts reaction

   Explanation: The chlorofluorocarbon compounds of methane and ethane are collectively known as freons. They are extremely stable, unreactive, non-toxic, non-corrosive and easily liquefiable gases. Freon 12 (CCl_2F_2) is one of the most common freons in industrial use. It is manufactured from tetrachloromethane by Swarts reaction
2. (b) will be called a racemic mixture and will have a zero optical rotation.

   Explanation: Enantiomers are chiral molecules that are *mirror images* of one another. Furthermore, the molecules are *non-superimposable* on one another. This means that the molecules cannot be placed on top of one another and give the same arrangement of atoms in space. If they are present in equal proportions, the mixture is called a racemic mixture and it is optically inactive, as one isomer will rotate light in the direction opposite to another.
3. (a) Ether

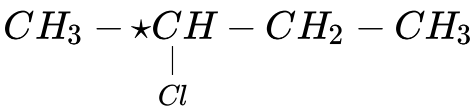
   Explanation: This is normal substitution reaction.
4. (b) by reacting them with water

   Explanation: Grignard reagents are highly reactive and react with any source of proton to give hydrocarbons. Even water, alcohols, amines are sufficiently acidic to convert them to corresponding hydrocarbons. Thus Grignard reagent abstracts acidic hydrogen from H_2O forming alkane.

   $$RMgX + H_2O \rightarrow RH + Mg(OH)X$$
5. (a) All of these

   Explanation: Since halogen atoms are more electronegative than carbon, the carbon-halogen bond of alkyl halide is polarised; the carbon atom bears a partial positive charge whereas the halogen atom bears a partial negative charge.
6. 

7. IUPAC name: 1-Chloro-4-(2 methylpropyl)benzene
   It is an aryl halide because it contains a benzene ring.

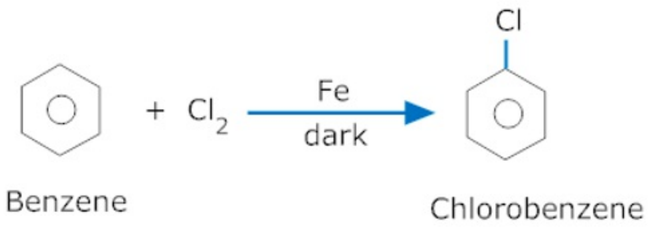
8. 

$$CH_3 - \star\underset{\underset{Cl}{|}}{C}H - CH_2 - CH_3$$

   2 - Chlorobutane

   Here the $\star C$ is the chiral center attached to 4 different groups.

9. a. by direct chlorination-

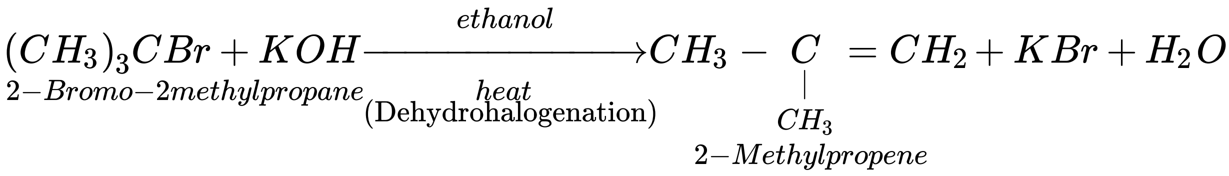


   b. by diazotization method-

$$C_6H_5NH_2 \xrightarrow[0-5^o]{NaNO_2,HCl} C_6H_5N_2^+Cl^- \xrightarrow{Cu_2Cl_2} C_6H_5Cl + N_2$$

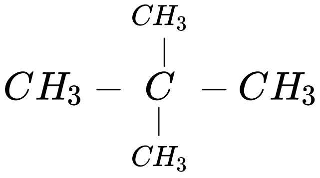
10. $CH_3\text{-}CH_3 \xrightarrow{Br_2/UVlight} CH_3\text{-}CH_2Br + HBr \xrightarrow{alc.KOH} CH_2 = CH_2 \xrightarrow{Br_2/CCl_4} Br\text{-}CH_2\text{-}CH_2\text{-}Br$
    $\xrightarrow{alc.KOH} CH_2 = CH\text{-}Br$

    First ethane is treated with Br_2 in presence of UV light to give Bromoethane which when treated with alc. KOH gives ethene and HBr. Ethene on treating with Br_2 in presence of CCl_4 gives 1, 2-dibromoethane which on treating with alc. KOH gives CH_2=CH-Br (Bromoethene)

11. 

$$\underset{2-Bromo-2methylpropane}{(CH_3)_3CBr + KOH} \xrightarrow[\substack{heat \\ \text{(Dehydrohalogenation)}}]{ethanol} \underset{2-Methylpropene}{CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2} + KBr + H_2O$$

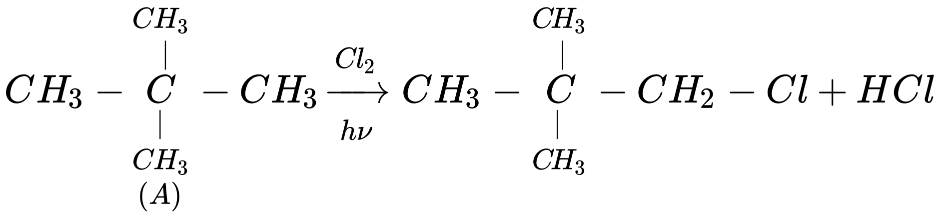
12. A is C_5H_{12} (mol. wt. 72) Since its gives one mono chloro and two dichloro derivatives on photochemical chlorination, it is



$$CH_3 - \overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}} - CH_3$$

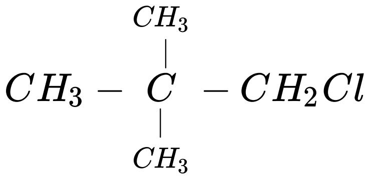
    neo-pentane
    The reactions are

monochloro derivative

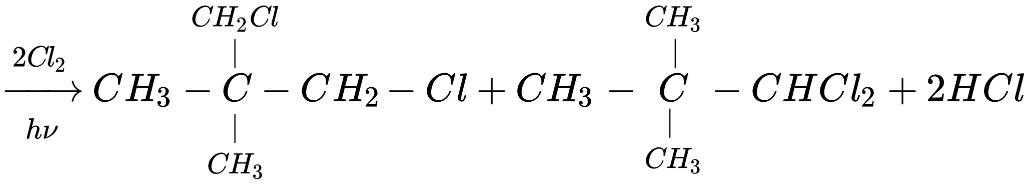


$$\underset{(A)}{CH_3-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3} \xrightarrow[h\nu]{Cl_2} CH_3-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-Cl+HCl$$

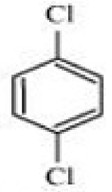
dichloro derivatives



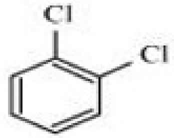
$$CH_3-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2Cl$$



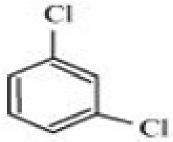
$$\xrightarrow[h\nu]{2Cl_2} CH_3-\overset{CH_2Cl}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-Cl+CH_3-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CHCl_2+2HCl$$

13\. 

p-Dichlorobenzene



o-Dichlorobenzene

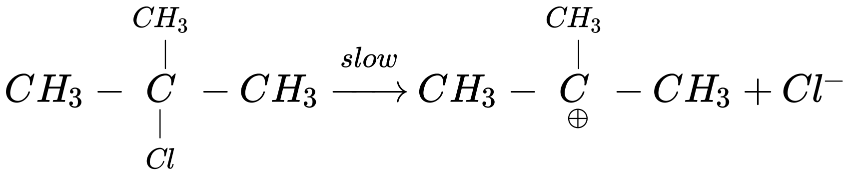


m-Dichlorobenzene

p-Dichlorobenzene is more symmetrical than o-and m-isomers. For this reason, it fits more closely than o-and m-isomers in the crystal lattice. Therefore, more energy is required to break the crystal lattice of p-dichlorobenzene. As a result, p-dichlorobenzene has a higher melting point and lower solubility than o-and m-isomers.

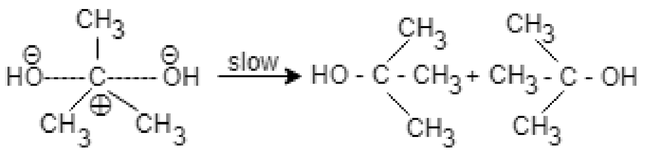
14\. Tertiary halides undergo nucleophilic substitution through S_N1 mechanism. It is a two step mechanism. First step involves formation of carbocation by loss of halide ion.

1st Step:

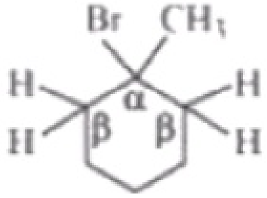


$$CH_3-\overset{CH_3}{\underset{Cl}{\overset{|}{\underset{|}{C}}}}-CH_3 \xrightarrow{slow} CH_3-\overset{CH_3}{\underset{\oplus}{\overset{|}{C}}}-CH_3+Cl^-$$

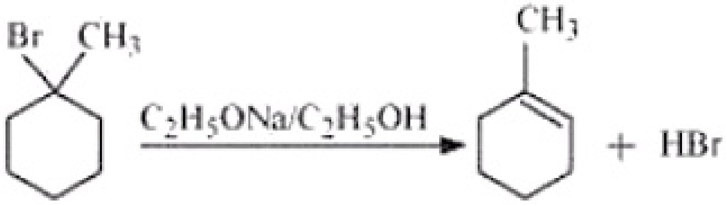
2nd Step: Second step involves attack of nucleophile which can happen from either side of the plane of the molecule

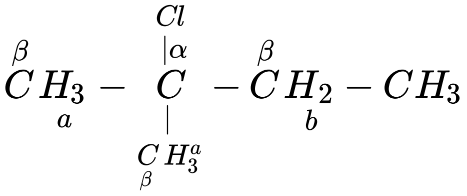


Thus, the compound which gives the most stable carbocation on losing the halide ion will preferably undergo nucleophilic substitution by S_N1 mechanism.

15. i. 

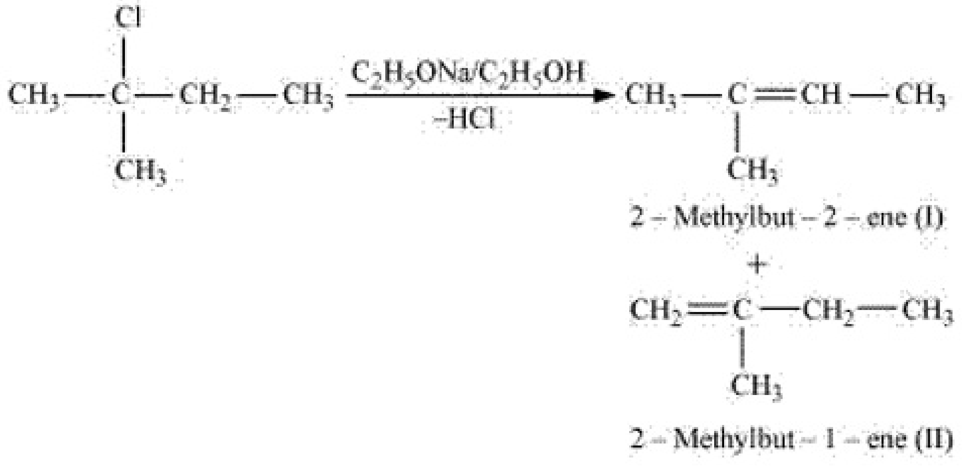
In the given compound, there are one type of βhydrogen atoms are present. Thus, dehydrohalogenation of this compound gives only one alkene.



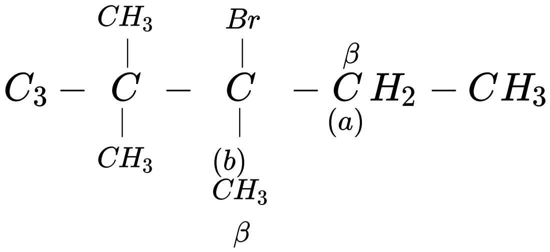
ii. 

$$\overset{\beta}{\underset{a}{CH_3}} - \overset{\overset{Cl}{|\alpha}}{\underset{\underset{\underset{\beta}{CH_3^{a}}}{|}}{C}} - \overset{\beta}{\underset{b}{CH_2}} - CH_3$$

In the given compound, there are two different sets of equivalent -hydrogen atoms labelled as a and b. Thus, dehydrohalogenation of the compound yields two alkenes.



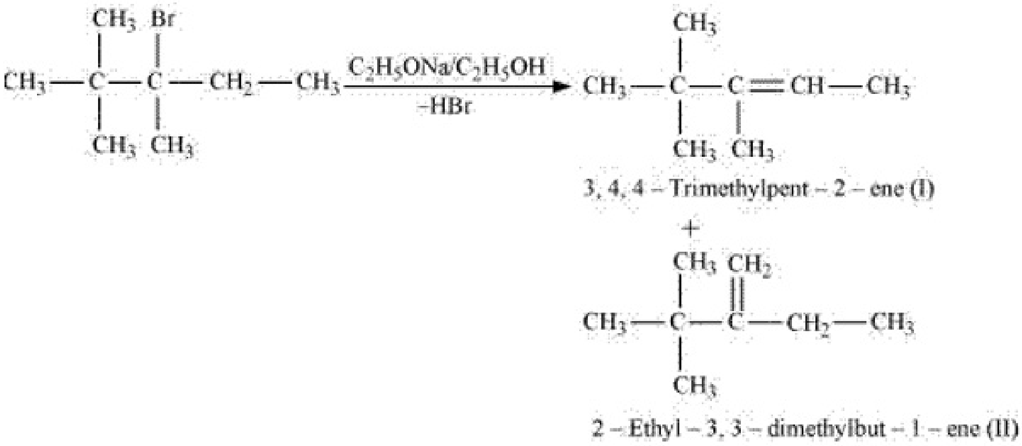
Saytzeff's rule implies that in dehydrohalogenation reactions, the alkene having a greater number of alkyl groups attached to a doubly bonded carbon atoms is preferably produced. Therefore, alkene (I) i.e., 2-methylbut-2-ene is the major product in this reaction.

iii. 

$$C_3 - \underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}} - \underset{\underset{\beta}{CH_3}}{\underset{(b)}{\underset{|}{\overset{Br}{\overset{|}{C}}}}} - \underset{(a)}{\overset{\beta}{C}}H_2 - CH_3$$

2, 2, 3 - triamethyl - 3 bromopentane

In the given compound, there are two different sets of equivalent β -hydrogen atoms labelled as a and b. Thus, dehydrohalogenation of the compound yields two alkenes.



According to Saytzeff's rule, in dehydrohalogenation reactions, the alkene having a greater number of alkyl groups attached to the doubly bonded carbon atom is preferably formed. Hence, alkene (I) i.e., 3,4,4-trimethylpent-2-ene is the major product in this reaction.