

ANSWERS TO THE SHORT QUESTIONS

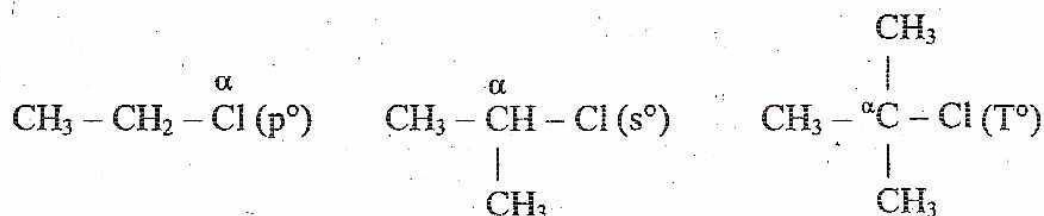
GENERAL FEATURES OF ALKYL HALIDES

Q.1 What are alkyl halides? Give their general formula and name two monohaloalkenes. (Sarg. 2010)

Ans. Those organic compounds which are derived from the hydrocarbons by the replacement of one or more hydrogen atoms by halogen atoms are called alkylhalides. They are represented by $R-X$ and the general formula is $C_nH_{2n+1}-X$. CH_3Cl , C_2H_5Br , C_3H_7I are mono halo alkanes.

Q.2 What are primary, secondary and tertiary alkyl halides? Give examples of each. (Faisalabad 2008, Multan 2012, Multan 2013, D.G. Khan 2013)

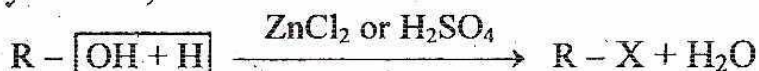
Ans. In primary alkyl halides, α -carbon has at least two hydrogen atoms, in secondary alkyl halides, α -carbon has only one hydrogen and in tertiary alkyl halides α -carbon has no hydrogen.



PREPARATIONS OF ALKYL HALIDES

Q.3 What are the necessary conditions to convert alcohols into alkyl halides by using halogen acids? (Lahore 2008, Lahore 2010, Lahore 2012, F. Abad 2013)

Ans. Alcohols are reacted with halogen acids in the presence of $ZnCl_2$ or H_2SO_4 to get alkyl halides,

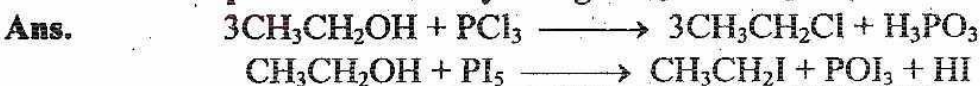


Q.4 $SOCl_2$ is the best reagent to get alkyl halides from alcohols. Which solvent is necessary to complete this reaction?

(Lahore 2008, Guj. 2010, Lahore 2012)

Ans. Alcohols react with $SOCl_2$ to give alkyl chlorides in the presence of pyridine. HCl and SO_2 are gaseous products which are evolved automatically and pure alkyl chloride is obtained. So, this is one of the best methods.

Q.5 Convert to get alkyl chlorides to get alkyl chlorides ethyl alcohol into their respective halides by using PCl_3 and PI_5 . (Lahore 2008, Lahore 2012)

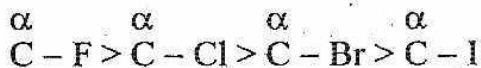


REACTIONS OF ALKYL HALIDES

Q.6 Which two factors are responsible for reactivity of alkyl halides as compared to alkanes? (Faisalabad 2010, Guj. 2012)

Ans. (i) Bond dissociation energy (ii) Polarity

The bond dissociation energy of $C - X$ bond is in the order.



α
It means C – I bond can be broken very easily, so iodides are very reactive substances. In alkanes there is no polarity.

Q.7 Define and give one example of each. (i) Nucleophile (ii) Leaving group

Ans. Nucleophile: (F. Abad 2012, Lahore 2013, D.G. Khan 2013)

Those species which are electron efficient and they donate their electron pairs to make a covalent bond are called nucleophiles.

Examples:

$\text{Cl}^\ominus, \text{Br}^\ominus, \text{I}^\ominus, \text{OH}^\ominus, \text{CN}^\ominus, \text{NO}_2^\ominus, \text{HS}^\ominus, \text{C}_2\text{H}_5\text{O}^\ominus, \text{CH}_3\text{O}^\ominus, \text{SCN}^\ominus, \text{H}_2\text{O}, \text{NH}_3, \text{NH}_2^\ominus$ etc.

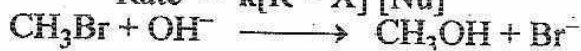
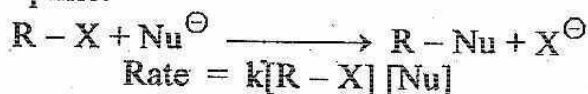
Leaving group or nucleophile:

The halogen ion which breaks the bond from α -carbon is called leaving group or nucleophile.

Q.8 Give the general pattern of the reaction of SN_2 -mechanism. What is its rate expression? Give examples.

(Lahore Board 2007, Guj. 2008, Rwp. 2010, D. G. Khan 2011, Guj. 2012, Multan 2013)

Ans. SN_2 reaction takes place in one step in which the attack of the attacking nucleophile and the leaving of the leaving nucleophile takes place simultaneously. Its rate depends upon the concentration of substrate and the attacking nucleophile.



Q.9 Give the general pattern of reaction of SN_1 mechanism. Why tertiary alkyl halides give this mechanism? (Multan 2006, Guj. 2013)

Ans. In SN_1 mechanism, the reaction takes place in two steps.

In the first step $\text{C}^\alpha - \text{X}$ bond breaks and in the second step, the attacking nucleophile attacks the carbonium ion. Tertiary carbonium ion is more stable than secondary and primary, so tertiary alkyl halides can give this mechanism.

Q.10 What is the role of steric hinderance to decide about SN_1 and SN_2 mechanisms?

Ans. If big groups are attached at the α -carbon of alkyl halides, the backside attack for the attacking nucleophile becomes difficult. For this reason, SN_2 mechanism is favoured rather than SN_1 .

Q.11 What is the role of stability of carbonium ion for determining SN_1 or SN_2 mechanism? (Guj. 2006)

Ans. Greater the stability of the carbonium ion, greater the possibility for two step mechanism which is SN_1 . These alkyl halides which can provide unstable carbonium ion give SN_2 mechanism, which is a single step reaction.

Q.12 How do you compare SN_1 and SN_2 mechanism?

Ans. SN_1 mechanism is in two steps, while SN_2 is in a single step. The rate of SN_1 is controlled by only one molecule. Tertiary alkyl halides mostly give SN_1 while primary give SN_2 .

Q.13 What are elimination reactions? Give examples of E_1 and E_2 .

(Bahawalpur 2006, Sargodha 2008, F. Abad 2008, Multan 2008, Lahore 2012)

Ans. E_1 stands for elimination unimolecular and tertiary alkyl halide give this reaction to give alkenes. E_2 is elimination of bimoleculars in which primary alkyl halides gives alkenes in one step.

Q.14 How tetraethyl lead can be prepared from an alkyl halide?

(Faisalabad 2008)

Ans. When ethyl chloride is reacted with Na_4Pb , tetraethyl lead is produced.



GRIGNARD'S REAGENT

Q.15 How the nature of alkyl group changes when alkyl halide is converted to Grignard's reagent? (Sargodha 2011, D.G. Khan 2013)

Ans. In alkyl halides, the alkyl group is electrophilic in character because the α -carbon bears the partial positive charge. When it is converted to Grignard's reagent, the α -carbon develops the partial negative charge and the alkyl group becomes nucleophilic in character.

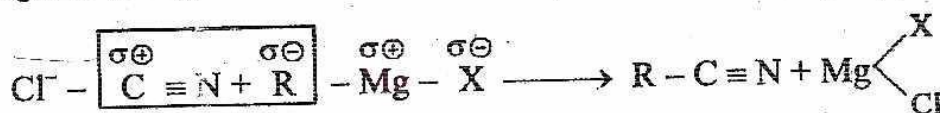
Q.16 Why dry ether is necessary for the preparation of Grignard's reagent?

(Multan 2012, D.G. Khan 2013)

Ans. If ether is wet, the water molecules react with Grignard's reagent to give alkanes and so Grignard's reagent is destroyed. Actually water is an active hydrogen compound for Grignard's reagent.

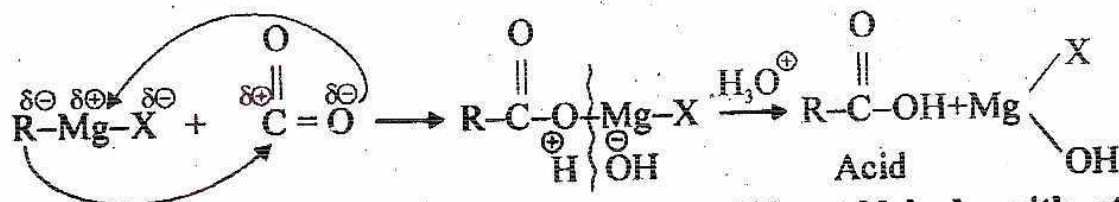
Q.17 How do we get alkyl nitriles from Grignard's reagent? (F. Abad 2012)

Ans. When $\text{Cl}-\text{CN}$ is reacted with Grignard's reagent, the alkyl group of the Grignard's reagent combines with $-\text{CN}$ group to give alkyl nitrile.



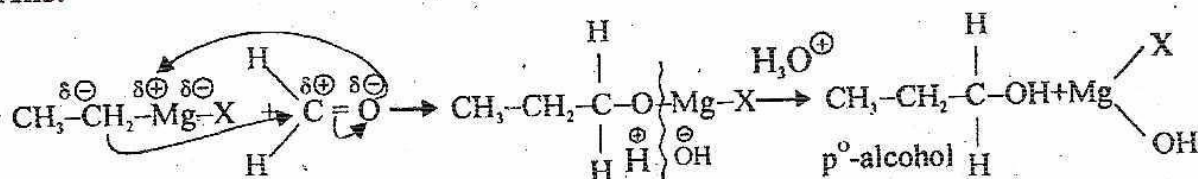
Q.18 Give the mechanism for the addition of Grignard's reagent at CO_2 to give carboxylic acids. (Mirpur 2006, F. Abad 2012, Multan 2013)

Ans. The mechanism is as follows:



Q.19 Give the mechanism for the reaction of formaldehyde with ethyl magnesium bromide. (Lahore 2008, F. Abad 2012, F. Abad 2013, D.G. Khan 2013)

Ans.



$$\begin{array}{c}
 \delta^- \delta^+ \quad \delta^- \delta^+ \\
 \text{R}-\text{Mg}-\text{X} + \text{C}=\text{O} \longrightarrow \text{R}-\text{C}-\text{O} \left\{ \begin{array}{l} \text{CH}_3 \\ \text{H}^+ \\ \text{OH}^- \end{array} \right\} \text{Mg}-\text{X} \xrightarrow{\text{H}_3\text{O}^+} \text{R}-\text{C}-\text{OH} + \text{Mg} \begin{array}{l} \text{X} \\ \text{OH} \end{array} \\
 \text{H} \quad \text{CH}_3
 \end{array}$$

S^o-alcohol

[illegible]
$$\begin{array}{c}
 \delta^- \quad \delta^+ \\
 R - Mg - X + CH_2 - CH_2 \longrightarrow R - CH_2 - CH_2 - O - \left\{ \begin{array}{l} Mg - X \\ H^+ \quad OH^- \end{array} \right. \\
 \qquad \qquad \qquad \searrow \swarrow \downarrow \\
 \qquad \qquad \qquad \text{R} - CH_2 - CH_2 - OH - Mg \begin{cases} X \\ OH \end{cases} \\
 \qquad \qquad \qquad \text{p}^\circ\text{-alcohol}
 \end{array}$$