Alkyl halide :-

In which one hydrogen atom (of alkane) is replaced by another halogen atom.

$$CH_4 \longrightarrow CH_3-X + HX$$

General formula / Identification :-

alkyl $-(R-X)-$ halogen $\underline{C_nH_{2n+1}}X \rightarrow$ halogen

Haloalkane

In haloalkane, there is halogen and an alkane and it doesn't matter how many halogens are present, there can be 1, 2 or 3.

Halogenoalkane

In Halogenoalkane, the halogen is present with an alkane, and usually, there is only one halogen atom.

Types of Halogenoalkane :-

Butane : $CH_3CH_2CH_2\boxed{CH_3-Cl}$ monohaloalkane

$CH_3CH_2CH_2\boxed{CH_3-Cl_2}$ dihaloalkane

$CH_3CH_2CH_2\boxed{CH_3-Cl_3}$ trihaloalkane

Primary alkyl halides :- Alkyl halide in which it's halogen is attached with primary (1 alkyl group) carbon.

example :

CH_3-Cl — n-Methyl-chlororide (chloromethane)

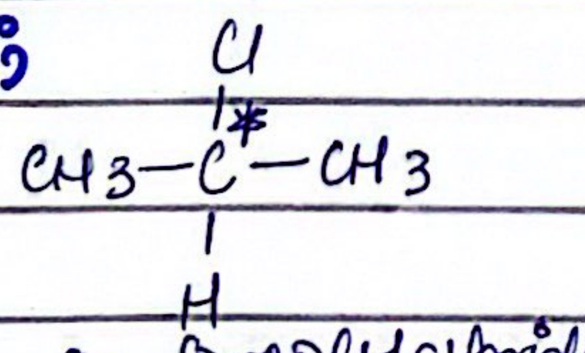
$CH_3(CH_2\boxed{CH_3-Cl}$ — n-Proply-chloride (Chloropropane)

$CH_3(CH_2)_3\boxed{CH_3-Br}$ — n-Pently-bromide (Bromopentane)

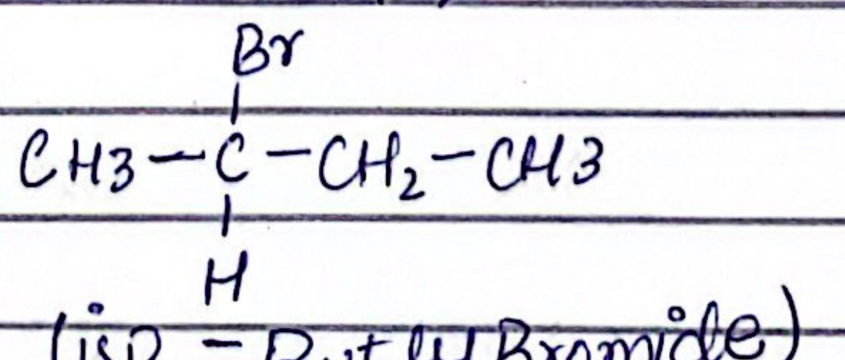
Secondary Alkyl halides :-

Alkyl halide in which it's halogen is attacheed with secondary carbon (two alkyl groups).

e.g :



iso-Propylchloride (2-chloropropane)

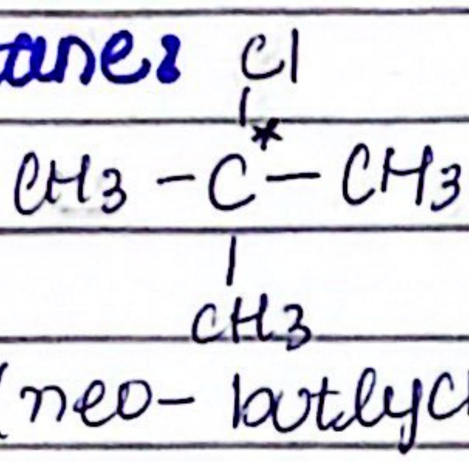


(iso-Butly Bromide) (2-Bromobutane)

Good

Tertiary alkyl halide: Alkyl halide in which it's alkyl halogen atom is attached with tertiary carbon (3-alkyl group)

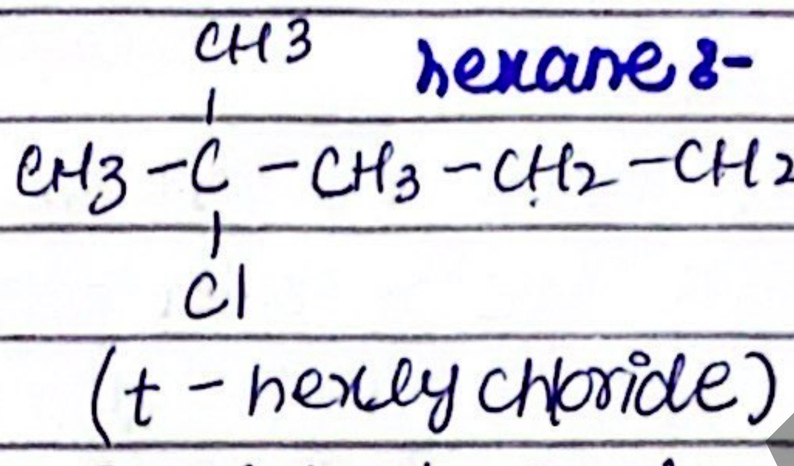
Butane:



(neo-butylchloride)

2-Methyl-2-chaloropropane

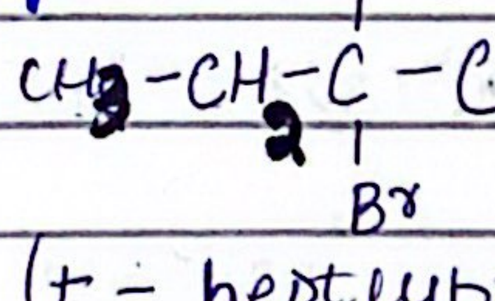
2. **hexane:-**



(t-hexylchloride)

2-Methyl-2chlorohexane

3° **Heptane:-**



(t-heptylbromide)

(3-Methyl-3-bromoheptane) (3-bromo-3-Methyl heptane)

Preparation of alkyl halide:-

From Alcohol:- Alcohol can be converted into alkyl halides using various reagents, as shown;

(2) Reaction with HCl in the presence of Anhydrous $ZnCl_2$:-

$$CH_3CH_2OH + HCl \xrightarrow[ZnCl_2]{\text{anhydrous}} CH_3CH_2-Cl + H_2O$$ (Chloroethane)

In other forms:-

$CH_3-CH_2-CH_2-OH + HCl \xrightarrow{ZnCl_2} CH_3CH_2CH_2-OH + H_2O$ (Chlorobutane)

$CH_3-C(CH_3)_2-OH + HCl \xrightarrow{ZnCl_2} CH_3-C(CH_3)_2-Cl + H_2O$ (2-Methyl-2 Chloro propane)

$CH_3-CH(CH_3)-OH + HCl \xrightarrow{ZnCl_2} CH_3-CH(CH_3)-Cl + H_2O$ (2-Methyl-2-Chloroethane)

SLO:-

Q:- Why is anhydrous $ZnCl_2$ used for the rxn of ethanol with HCl?

Anhydrous $ZnCl_2$ acts as a catalyst and helps to replace hydroxyl (OH) with halogen (Cl^{-1}) to form alkyl halide.

(2) Reaction with Thionyl chloride ($SOCl_2$) :-

$$CH_3CH_2OH + SOCl_2 \xrightarrow{\text{pyridine}} CH_3CH_2Cl + HCl + SO_2$$

(Chloroethane) (Sulphur dioxide)

Explanation :-

This reaction form SO_2 and HCl as by product which a escape gases making the method more efficient and clean.

other forms :

$$CH_3-CH(CH_3)-CH_2-OH + SOCl_2 \longrightarrow CH_3-CH(CH_3)-CH_2-Cl + HCl + SO_2$$

(3) Reaction with Phosphorous Tribromide (PBr_3) :- | Trihalide

$$CH_3CH_2-OH + PBr_2 \longrightarrow CH_3CH_2Br + H_3PO_3$$

(Bromoethane) (ethly bromide) (Phosphoric acid)

explanation :-

PBr_2 react with 3 moles of ethanol to replace the hydroxyl group (OH) of alcohol with a bromine atom forms alkyl halides.

(4) Reaction with Phosphorous Pichloride (PCl_3) :-

$$CH_3CH_2OH + PCl_3 \longrightarrow CH_3CH_2-Cl + H_3PO_3 + HCl$$

(5) Reaction with Phosphorus Pentachloride (PCl_5) :-

$$CH_3CH_2OH + PCl_5 \longrightarrow CH_3CH_2Cl + POCl_3 + HCl$$

SLO :- What is the difference b/w $SOCl_2$ and PCl_5 for converting alcohol Reaction with ?

Alcohol reaction with $SOCl_2$ form SO_2 and HCl gases, as by product, which can easily escape into the air make rxn more efficient. Mean while alcohol rxn with PCl_5 form $POCl_3$ and HCl as by product but HCl remain in the reaction mixture.

Exam Questions :-

$$CH_3CH_2OH + HCl \xrightarrow{ZnCl_2} ? \quad (CH_3CH_2Cl + H_2O)$$

$$CH_3CH_2OH + SOCl_2 \xrightarrow{\text{pyridine}} ? \quad (CH_3CH_2Cl + HCl + SO_2)$$

(6) Reaction with Phosphorous triiodide :-

$$CH_3CH_2OH + PI_3 \longrightarrow CH_3CH_2I + H_3PO_3$$

Good

② **From Alkanes:-** Alkyl halides can be prepared by substituting a hydrogen atom in an alkane with a halogen atom. This rxn occurs in the presence of sunlight and UV light.

- $CH_3 - CH_3 + Cl_2 \xrightarrow{h\nu} CH_3CH_2Cl + HCl$
- $CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl + HCl$

Drawback of this method:-

This reaction is not pure because alkanes produce a mixture of alkyl halides (like CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4) instead of forming only a specific alkyl halide.

③ **From alkenes:-** Alkyl halides can be prepared by reacting alkenes with halogens or halogen acid. There are two methods.

(a) **Hydrohalogenation:-**

Definition:- Addition of hydrogen halide to an alkene.

Mechanism: The rxn breaks the carbon-carbon double bond and add halogen atom to one carbon and hydrogen atom to other.

Markovnikov's Rule:- It occurs when there is unequal distribution of alkene. This rule states that "hydrogen atom adds to a carbon with more hydrogen atoms" (rich get richer) CH_3-CH_2 alkyl halide. → (-)ive part will attach to low hydrogen)

$$R-CH=CH_2 + HX \longrightarrow \underset{X}{\overset{R}{[CH]}} - CH_3$$

$$CH_2=CH_2 + HCl \longrightarrow CH_2Cl - CH_3$$

(ethyl chloride)

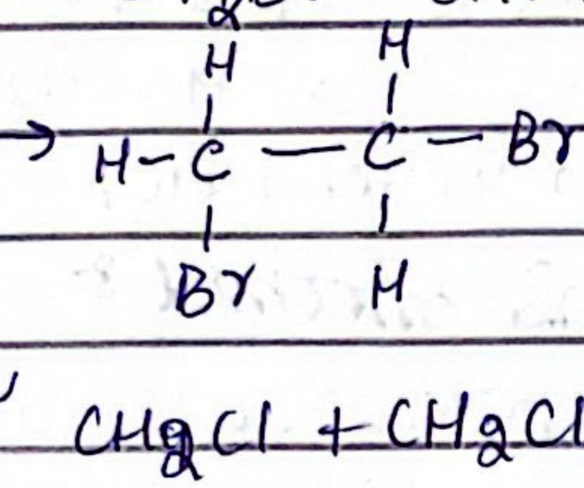
Addition of Halogens:-

(b) Reaction of alkanes with halogens (Cl_2 and Br_2) in a inert solution like CCl_4 at room temperature to form

vicinal dihalides (halogens on adjacent carbons).

Reactions :-

$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} CH_2Br - CH_2Br$$



$$CH_2 = CH_2 + Cl_2 \longrightarrow CH_2Cl + CH_2Cl$$

Why does fluorine not react with alkenes to form vicinal dihalides?

Fluorine is too reactive and causes explosives rxn and it cannot control the reaction, making it unsuitable for forming vicinal dihalide.

Why Iodine does not react with alkene to form VDhalide?

Because C-I bond is weak and unstable, and iodine is low react that's why it is not energetically favourable due to the endothermic nature of the process.

Reactions of alkyl halide :-

These reactions undergo two reactions :-

(1) Nucleophilic Substitution Reaction :- In these rxns, the halogen atom in alkyl halide (R-X) is replaced by nucleophile.

R-X

↳ **Nucleophile :-** A negatively charged species or a natural specie with a lone pair of electrons.

OH^-, NH_3, CN^-, SCN^-, $H_2\ddot{O}:$, HS^-

Good leaving groups :-

Is a molecule orion that can easily detach from the

Substrate during chemical rxn.

→ They are weak bases and more stable with a negative charge.

example :-

$CH_3CH_2-\underline{Cl} + OH^- \longrightarrow CH_3CH_2-OH + \underline{Cl^-}, Br^-, I^-, HSO_4^-$

Bad leaving groups :- is a molecule or ion that cannot easily detach from substrate because it is unstable or reactive after detachable.

→ They do not stabilize the (neg) charge, less eletronegative or small in size. OH^-, NH_4^-, RO^-

e.g;

$CH_3-CH_2-OH + OH^- \longrightarrow$ NO rxn

(1) Reaction with NaOH :-

$R-X + NaOH \longrightarrow R-OH + NaX$

e.g; $CH_3-Cl + NaOH \longrightarrow CH_3-OH + NaCl$ **(Alcohol)**

(2) Reaction with KCN :-

$R-X + KCN \longrightarrow R-CN + KX$

e.g; $CH_3-Cl + KCN \longrightarrow CH_3-CN + KCl$ **(Nitrile)**

Reaction with NH_3 :-

(3) $R-X + NH_3 \longrightarrow R-NH_2 + HX$

e.g; $CH_3-Cl + NH_3 \longrightarrow CH_3-NH_2 + HCl$ **(Primary Amine)**

(4) Rxn with $AgNO_3$ / Detection test for Halogen :-

$R-X + AgNO_3 \longrightarrow R-NO_3 + \underline{AgX}$ (precipitate)

e.g; $CH_3-CH_2-Br + AgNO_3 \longrightarrow CH_3-CH_2-NO_3 + AgBr_{(s)}$.

(Nitroalkane)

Identifying Halogens by precipitate :-

White precipitate (AgCl) : Slouble in aqueous NH_3 → Indicate (Cl^-)

Cream precipitate (AgBr) : Partially soluble in aq NH_3 → Indicates (Br^-)

Yellow precipitate (AgI) : Insoluble in aqeous NH_3 → Indicate (I^-)

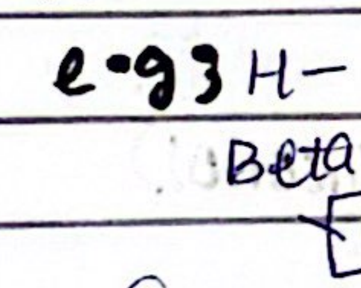
why Silver Nitrate ($AgNO_3$) is used for Halogen detection?

Bcz, it reacts with halide to form insouble silver halides (AgX) with distinct color (white, yellow, cream)..
Mean while, alcohols, nitriles and amines form soluble compounds, so they do not produce visible preticipitate for halogen rxn.

(2) Eliminition Reactions:- In elimination reaction; halogen and a β-hydrogen are removed to form carbon-carbon double bond.

How to identify which bonded H is beta-Hydrogen:-

- In the alkyl halide, the beta-Hydrogen is the hydrogen atom attached to the carbon adjdent or bonded on other carbon ...in which Halogen is attached.

e.g. 

$CH_2 = CH_2 + H_2O + NaBr$

$CH_3 - CH_2 + NaOH$

H Br

Alc NaOH

2. $CH_3-CH_2-Br + NaOH \longrightarrow CH_2=CH_2 + H_2O + NaBr$
(Bromoethane)

2. $CH_3-CH(Br)-CH_3 - KOH \longrightarrow CH_3-CH=CH_2 + KBr + H_2O$

Important Note:-

During elimination reaction, when forming a double bond, we need to check if the carbon involved in the double bond has alkyl group(CH_3) attached to it.

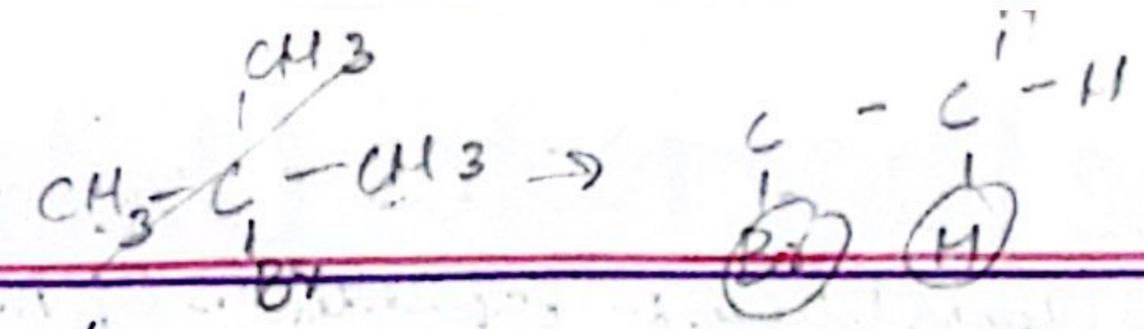
E-Reaction for practice:-

3. $CH_3-CH_2-CH=CH_2-Br + NaOH \longrightarrow CH_3-CH_2-CH=CH_2 + H_2O + NaBr$

H Br

4. $CH_3-CH_2-CH_2-CH_2-Br + KOH \longrightarrow CH_3-CH_2-CH=CH_2 + H_2O + KBr$
(2-Bromobutane)

$CH_3-CH(Br)-KOH$



5. $(CH_3)_3C - Br + KOH \longrightarrow (CH_3)_2C = CH_2 + H_2O + KBr$

(2-Bromo-2-Methylpropane

6. $CH_3 - CH_2 - Br + NaOH \longrightarrow CH_2 = CH_2 + H_2O + NaBr$

(ethly bromide)

7. $CH_3 - CH_2 - OH \xrightarrow[heat]{H_2SO_4} CH_2 = CH_2 + H_2O$ (ethanol)

8. $CH_3 - CH_2 - CH(Br) - CH(CH_3) - CH_3 + KOH \longrightarrow CH_3 - CH_2 - CH = CH - CH_3 + H_2O + KBr$

(3-Bromo-2-Methylpentane)

9. $CH_3 - CH_2 - CH_2 - Cl + KOH \longrightarrow CH_3 - CH = CH_2 + H_2O + KBr$

(2-chloropropane)

10. $CH_3 - CH(Br) - CH_2 - CH_2 - CH_3 + NaOH \longrightarrow CH_3 - CH = CH - CH_2 - CH_3 + H_2O + NaBr$

(2-Bromopentane)

11. $C_6H_{11}OH \xrightarrow[Heat]{H_2SO_4} C_6H_{10} + H_2O$ (cyclonexanol).

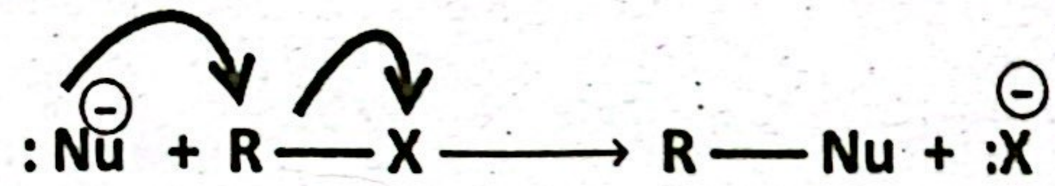
Zaitsev's Rule :- During elimination rxn, the more substituted alkene (refers to the number of alkyl group CH_3, CH_2 groups) attached to the carbon atoms in a double bond.

$CH_3 - CH = CH_2$

(ii) What are Nucleophilic substitution reactions or SN reaction?

Thee reactions where halogen of alkyl halide is substituted or replaced by attacking nucleophile is known as nucleophilic substitution (S_N) reactions.

Example:



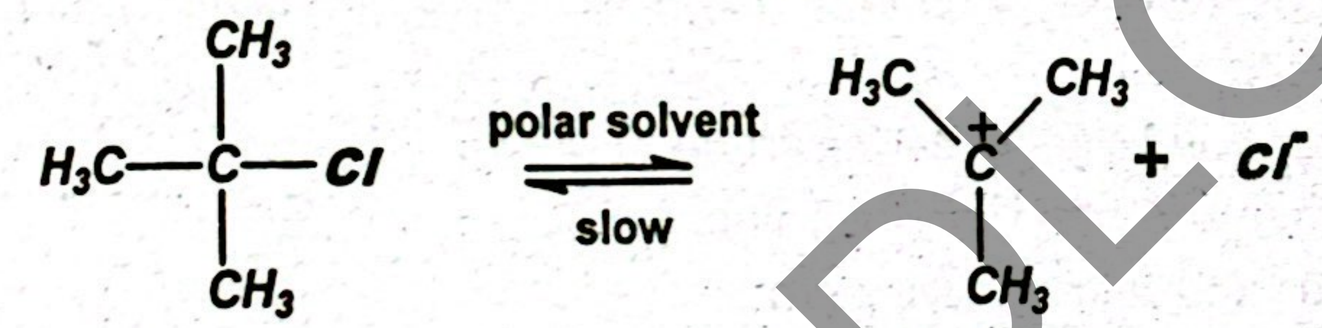
Attacking nucleophile Substrate Leaving Nucleophile

(iii) Tertiary alkyl halides show S_N1 reactions mostly, why?

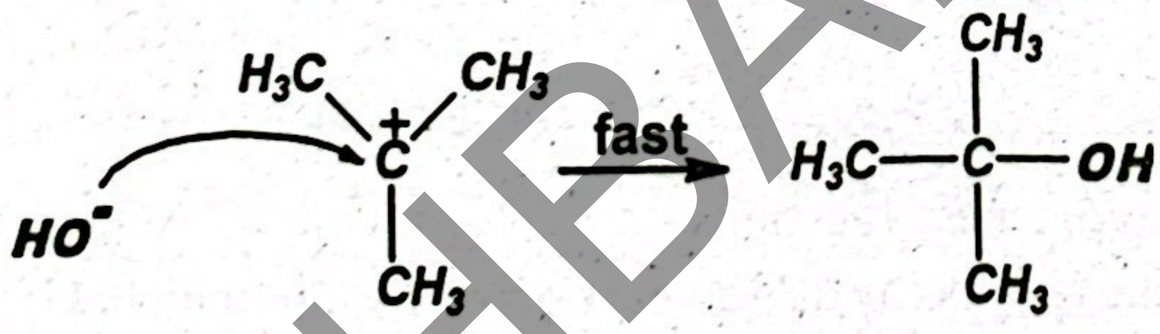
In tertiary alkyl halides, the nucleophile cannot directly attack on the electrophilic carbon of alkyl halides. Because, bulky alkyl groups are present on the electrophilic carbon and there is hindrance (steric hindrance) to attack.

Hence, in step I, the tertiary alkyl halides are ionized to give carbocation which is planar.

Then in step II, the nucleophile attacks to give products. This two-step mechanism is S_N1 mechanism.



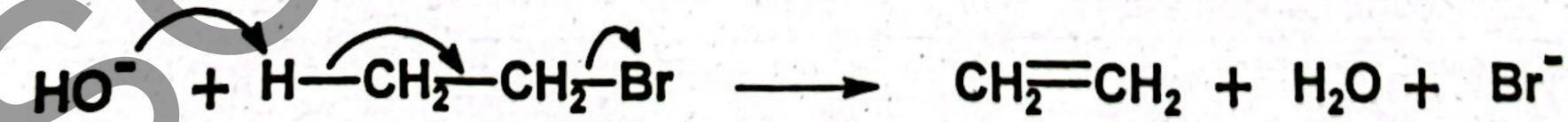
Carbocation



(iv) What are elimination reactions?

The chemical reaction in which two groups (halogen and β-hydrogen form alkyl halide) are eliminated from two adjacent carbon atoms to form carbon carbon double bond is called elimination reaction.

Since β-hydrogen is necessary for eliminations, it is also called β-elimination.



Base Bromoethane Ethene

(v) Which factor decides the reactivity of alkyl halides?

There are two main factors which control the reactivity of halogenoalkanes:

1. Bond polarity of C-X bond 2. Bond energy of C-X bond

- On the basis of bond polarity reactivity of alkyl halides decreases in the following order.

$$R—F > R—Cl > R—Br > R—I$$

- However, actually reactivity of alkyl halides depends upon the strength of $C-X$ bond.
- $C-F$ bond is the strongest while $C-I$ bond is the weakest.
- So, the overall order of reactivity of alkyl halides is:

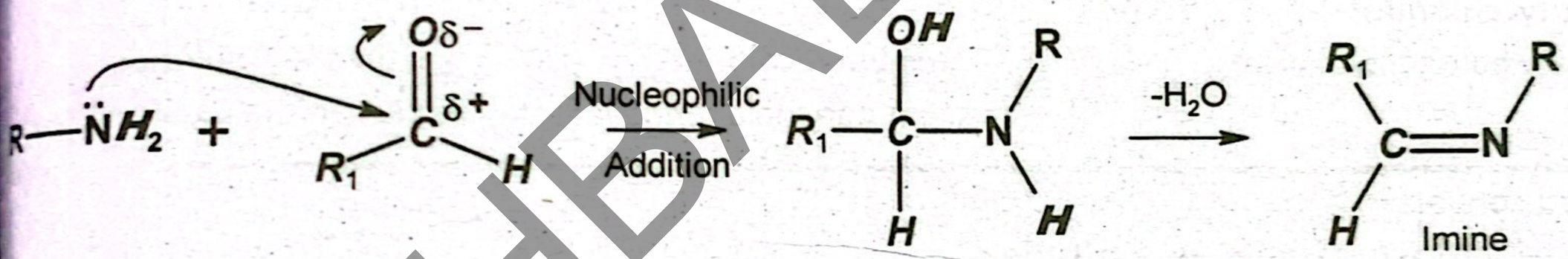
$$R-I > R-Br > R-Cl > R-F$$

(vi) What are the diazonium salt?

When amines react with nitrous acid, diazonium compounds are formed.

$$R—NH_2 + HNO_2 \longrightarrow R—\overset{+}{N}\equiv N + HO^- + H_2O$$

(vii) How can nucleophilic addition of a primary amine giving an imine?



(viii) Amines are more basic than analogous alcohols why?

Amines may act as bases towards acids. They are more basic than alcohols and ethers. It is because they have single electron pair on nitrogen atom which is readily donated. On the other hand, in alcohols, there are two lone pairs of electrons on oxygen atom. These two electrons compete with each other during donation. Hence, neither of these two is readily donated, so alcohols are weaker bases than amines.

6. How will you convert ethyl chloride to the

(i) ethyl cyanide

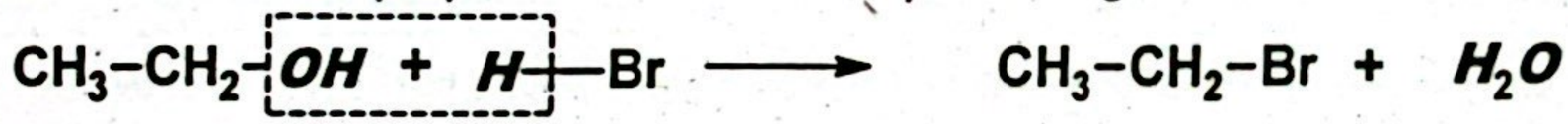
$$CH_3-CH_2-Cl + KCN \longrightarrow CH_3-CH_2-CN + KCl$$

(ii) ethanol

$$CH_3-CH_2-Cl + NaOH \xrightarrow{aq.} CH_3-CH_2-OH + NaCl$$

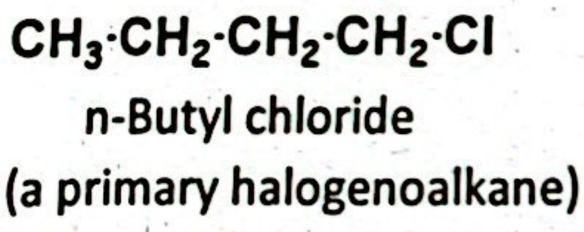
8. Design a synthetic route for the preparation of bromoethane. What starting materials would you use?

Bromoethane can be prepared from alcohols by following methods

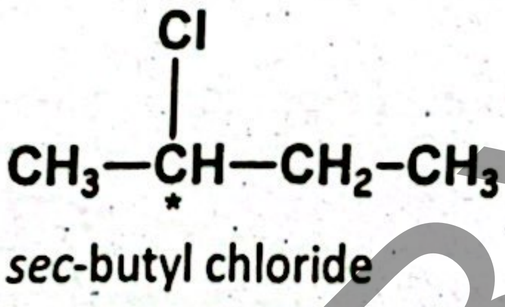


or

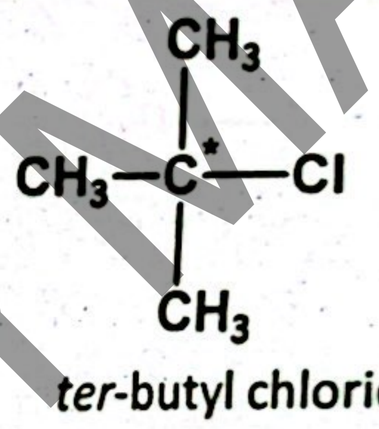
9. Write the structural formulae of a primary, secondary and a tertiary halogenoalkane that have molecular formula C_4H_9Cl.



n-Butyl chloride
(a primary halogenoalkane)



sec-butyl chloride
(a secondary halogenoalkane)

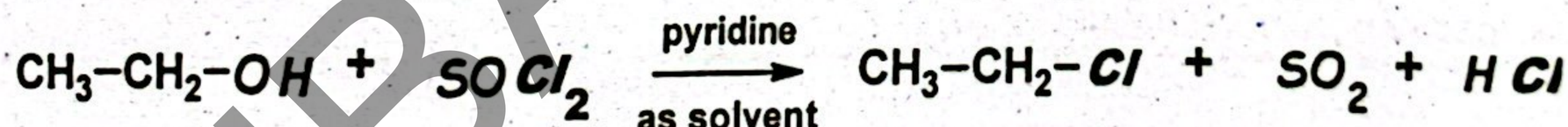


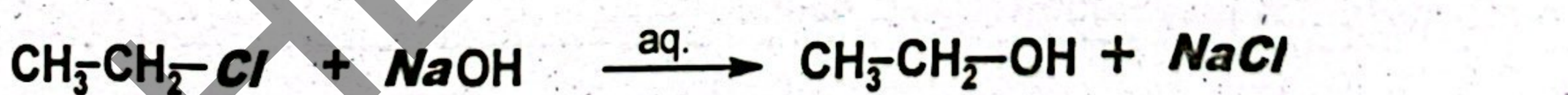
ter-butyl chloride
(a tertiary halogenoalkane)

10. How can you convert?

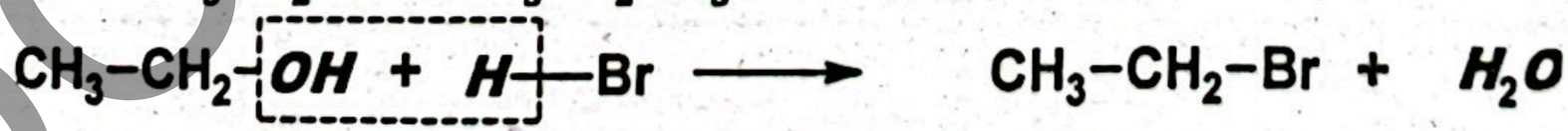
(i) CH_3CH_2OH → chloroethane → a nitrile

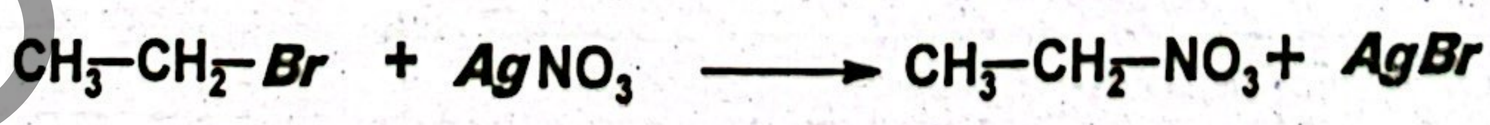
(ii) CH_3CH_2OH → CH_3CH_2Cl → CH_3CH_2OH





(iii) CH_3CH_2OH → CH_3CH_2Br → $CH_3CH_2NO_3$





11. Which is an isomer of 2-chloropropane? Propane or 1-chloropropane or both, give reason.

1-Chorlopropane is the isomer of 2-chlropropane. Both are position isomers of each other because the position of functional group (Cl) is different

12. Give chemical reactions to produce the following starting with a halogenoalkane.

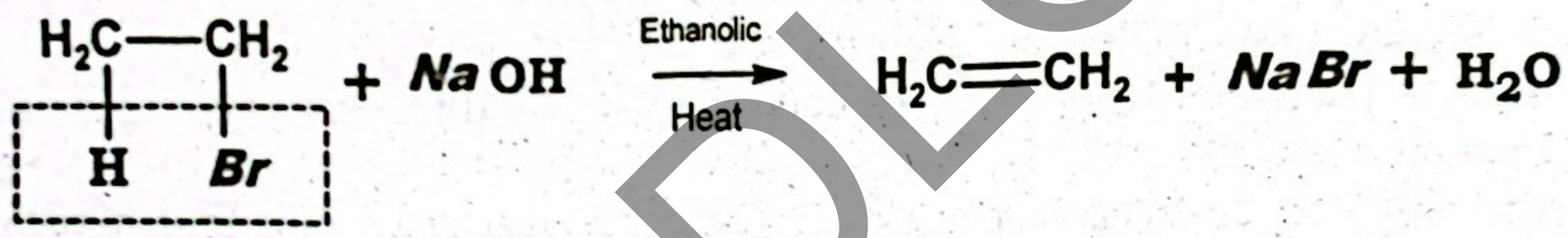
(i) A nitrile

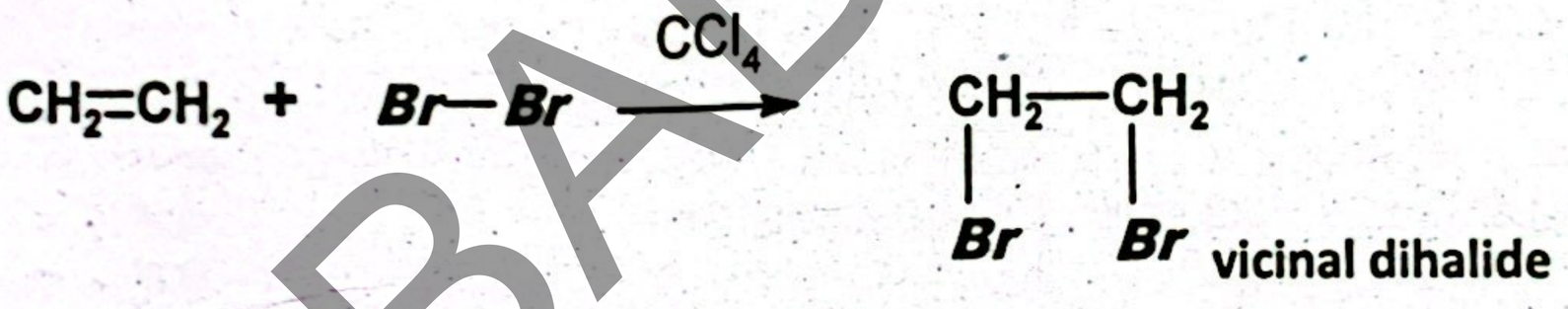
$$R{-}X + KCN \longrightarrow R{-}CN + KX$$

(ii) An amide

$$R{-}X + NH_3 \longrightarrow R{-}NH_2 + HX$$

(iii) A vicinal dihalide





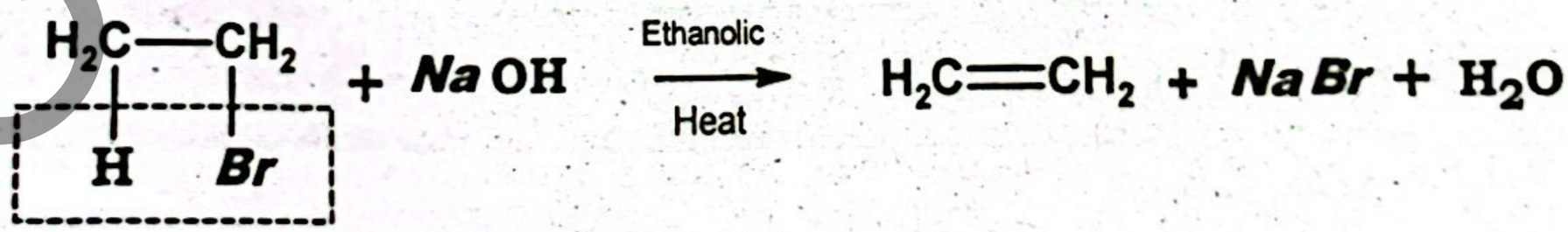
(iv) An amine

$$R{-}X + NH_3 \longrightarrow R{-}NH_2 + HX$$

(v) A nitrate

$$R{-}X + AgNO_3 \longrightarrow R{-}NO_3 + AgX$$

(vi) An alkene



. Give short answer.

(i) What are primary, secondary and tertiary alkyl halides?

$CH_3CH_2CH_2\boxed{CH_3-Cl}$ trihaloalkane

Primary alkyl halides:- Alkyl halide in which it's halogen is attached with primary (1 alkyl group) carbon.

example:

CH_3-Cl
n-Methyl-chloroside
chloromethane

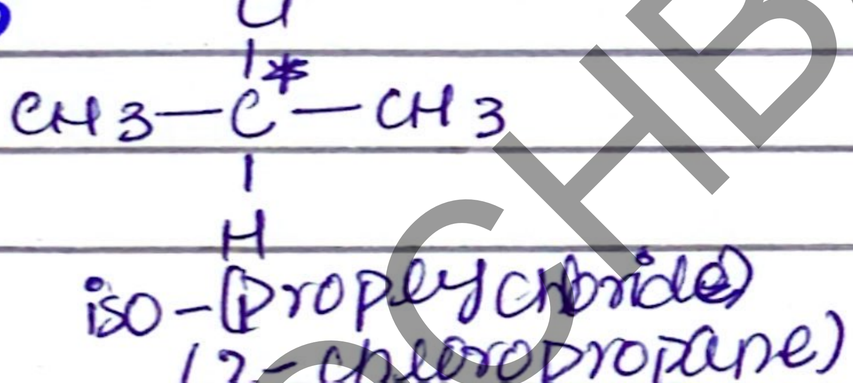
$CH_3CH_2\boxed{CH_3-Cl}$
n-Propyl-chloride
(Chloropropane)

$CH_3(CH_2)_3\boxed{CH_3-Br}$
n-Pentyl-bromide
(Bromopentane)

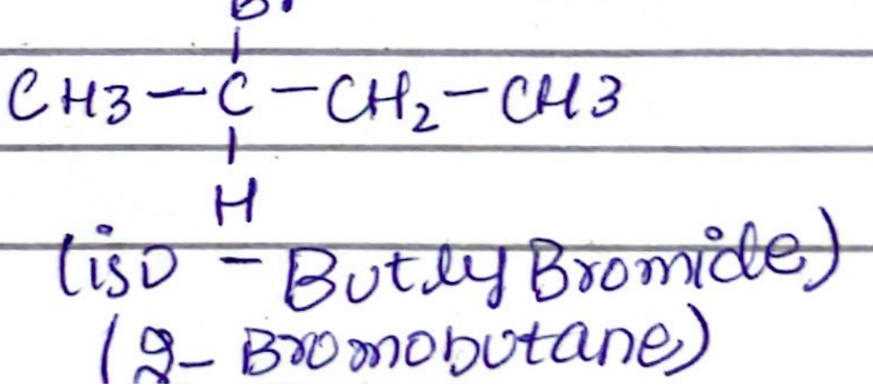
Secondary Alkyl halides:-

Alkyl halide in which it's halogen is attacheel with secondary carbon (two alkyl groups).

e.g:



iso-(Propyl chloride)
(2-chloropropane)

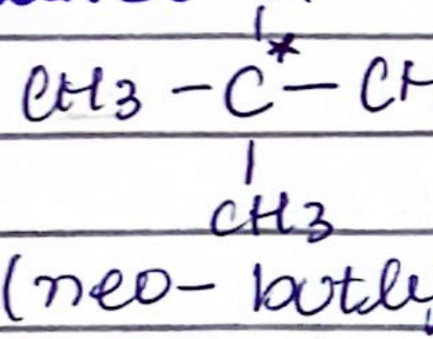


(iso-Butyl Bromide)
(2-Bromobutane)

Good

Tertiary alkyl halide: Alkyl halide in which it's alkyl halogen atom is attached with tertiary carbon (3-alkyl group)

Butane:

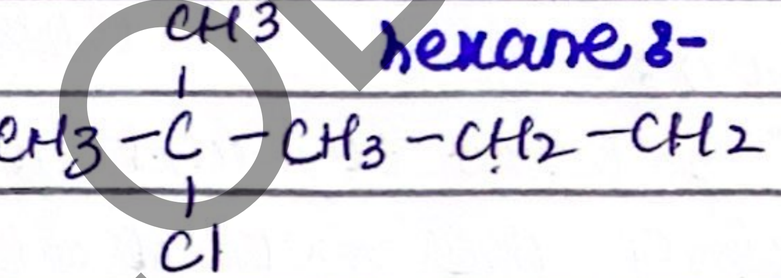


(neo-butylchloride)

2-Methyl-2-chaloropropane

2°

Hexane:-

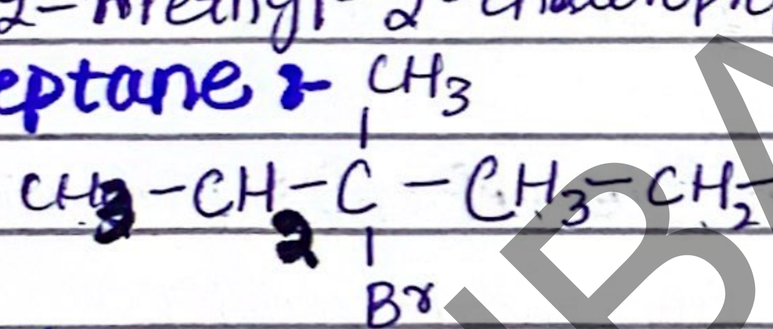


(t-hexyl chloride)

2-Methyl-2chlorohexane

3°

Heptane:-



(t-heptylbromide)

(3-Methyl-3-bromoheptane) (3-bromo-3-Methyl heptane)

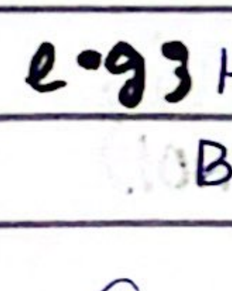
5. What are β-elimination reactions? Explain them with detail.

(2) Elimination Reactions :-

In elimination reaction, halogen and a β-hydrogen are removed to form carbon-carbon double bond.

How to identify which bonded H is beta-Hydrogen :-

- In the alkyl halide, the beta-Hydrogen is the hydrogen atom attached to the carbon adjacent or bonded on other carbon in which Halogen is attached.

e.g. 

Beta Halide

$CH_3-CH_2-Br + NaOH \longrightarrow CH_2=CH_2 + NaBr + H_2O$

1. $CH_3-CH_2-Br + NaOH \longrightarrow CH_2=CH_2 + H_2O + NaBr$

(Bromoethane)

2. $CH_3-CH(Br)-CH_3 + KOH \longrightarrow CH_3-CH=CH_2 + KBr + H_2O$

Important Note :-

During elimination reaction, when forming a double bond, we need to check if the carbon involved in the double bond has alkyl group (CH_3) attached to it.

E-Reaction for practice :-

3. $CH_3-CH_2-CH=CH_2-Br + NaOH \longrightarrow CH_3-CH_2-CH=CH_2 + H_2O + NaBr$

4. $CH_3-CH_2-CH_2-CH_2-Br + KOH \longrightarrow CH_3-CH_2-CH=CH_2 + H_2O + KBr$

(2-Bromobutane)

$CH_3-CH(Br)-KOH$

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4. Give two methods for the preparation of alkyl halides

Preparation of alkyl halide :-

From Alcohol :- Alcohol can be converted into alkyl halides using various reagents, as shown ;

(1) Reaction with HCl in the presence of Anhydrous $ZnCl_2$:-

⇒ $CH_3CH_2OH + HCl \xrightarrow[ZnCl_2]{anhydrous} CH_3CH_2-Cl + H_2O$ (Chloroethane)

In other forms :-

$CH_3-CH_2-CH_2-OH + HCl \xrightarrow{ZnCl_2} CH_3CH_2CH_2-OH + H_2O$ (Chlorobutane)

$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OH + HCl \xrightarrow{ZnCl_2} CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl + H_2O$ (2-Methyl-2 chloro propan

$CH_3-\underset{CH_3}{CH}-OH + HCl \xrightarrow{ZnCl_2} CH_3-\underset{CH_3}{CH}-Cl + H_2O$ (2-Methyl-2-chloroethane

2) :-

(2) Reaction with Thionyl chloride ($SOCl_2$) :-

$$CH_3CH_2OH + SOCl_2 \xrightarrow{\text{pyridine}} CH_3CH_2Cl + HCl + SO_2$$

(Chloroethane) (Sulphur dioxide)

Explanation :-
This reaction form SO_2 and HCl as by product which as escapes gases making the method more efficient and clean.

other forms :

$$CH_3-CH(CH_3)-CH_2-OH + SOCl_2 \longrightarrow CH_3-CH(CH_3)-Cl + HCl + SO_2$$

(3) Reaction with Phosphorous Tribromide (PBr_3) :- | Trihalide

$$CH_3CH_2-OH + PBr_2 \longrightarrow CH_3CH_2Br + H_3PO_3$$

(Bromoethane) (Phosphoric acid)
(ethyl bromide)

explanation :-
PBr_2 react with 3 moles of ethanol to replace the hydroxyl group (OH) of alcohol with a bromine atom forms alkyl halides.

(4) Reaction with Phosphorous Trichloride (PCl_3) :-

$$CH_3CH_2OH + PCl_3 \longrightarrow CH_3CH_2-Cl + H_3PO_3 + HCl$$

(5) Reaction with Phosphorous Pentachloride (PCl_5) :-

$$CH_3CH_2OH + PCl_5 \longrightarrow CH_3CH_2Cl + POCl_3 + HCl$$

SLO :-
What is the difference b/w $SOCl_2$ and PCl_5 for converting alcohol Reaction with ?

Alcohol reaction with $SOCl_2$ form SO_2 and HCl gases, as by product, which can easily escape into the air make rxn more efficient. Mean while alcohol rxn with PCl_5 form $POCl_3$ and HCl as by product but HCl remain in the reaction mixture.

Exam Questions :-

$$CH_3CH_2OH + HCl \xrightarrow{ZnCl_2} ? \quad (CH_3CH_2Cl + H_2O)$$

$$CH_3CH_2OH + SOCl_2 \xrightarrow{\text{pyridine}} ? \quad (CH_3CH_2Cl + HCl + SO_2)$$

(6) Reaction with Phosphorous triiodide :-

$$CH_3CH_2OH + PI_3 \longrightarrow CH_3CH_2I + H_3PO_3$$

Good

② **From Alkanes:-** Alkyl halides can be prepared by substituting a hydrogen atom in an alkane with a halogen atom. This rxn occurs in the presence of sunlight and UV light.

- $CH_3 - CH_3 + Cl_2 \xrightarrow{h\nu} CH_3CH_2Cl + HCl$
- $CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl + HCl$

Drawback of this method:-

This reaction is not pure because alkanes produce a mixture of alkyl halides (like CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4). instead of forming only a specific alkyl halide.

③ **From alkenes:-** Alkyl halides can be prepared by reacting alkenes with halogens or halogen acid. There are two methods.

(a) Hydrohalogenation:-

Definition:- Addition of hydrogen halide to an alkene.

Mechanism: The rxn breaks the carbon-carbon double bond and add halogen atom to one carbon and hydrogen atom to other.

Markovnikov's Rule:- It occurs when there is unequal distribution of alkene. This rule states that "hydrogen atom adds to a carbon with more hydrogen atoms" (rich get richer) CH_2-CH_2 alkyl halide. → (-)ive part will attach to low hydrogen)

$$R-CH=CH_2 + HX \longrightarrow R-\underset{\underset{X}{|}}{CH}-CH_3$$

$$CH_2=CH_2 + HCl \longrightarrow CH_2Cl-CH_3$$

(ethyl chloride)

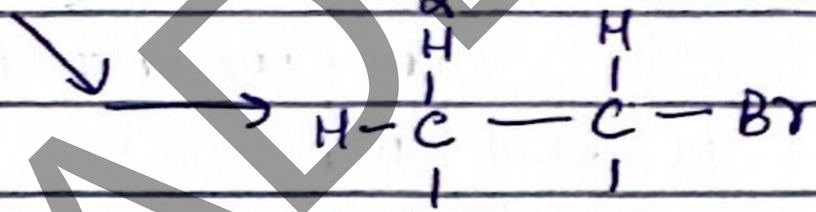
Addition of Halogens:-

(b) Reaction of alkanes with halogens (Cl_2 and Br_2) in a inert solution like CCl_4 at room temperature to form

vicinal dihalides (halogens on adjacent carbons).

Reactions :-

$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} CH_2Br - CH_2Br$$



$$CH_2 = CH_2 + Cl_2 \longrightarrow CH_2Cl + CH_2Cl$$

donation. Hence, neither of these two is re

Discuss the reactivity of alkyl halides.

The reactivity of alkyl halides is influenced by two main factors:

1. **Bond Polarity (C–X Bond Polarity)**
    - Halogens are more electronegative than carbon, making the C–X bond polar.
    - Carbon gets a partial positive charge and becomes susceptible to nucleophilic attack.
    - **Reactivity order based on bond polarity:**

R–F > R–Cl > R–Br > R–I

2. **Bond Energy (C–X Bond Strength)**

- The strength of the C–X bond determines how easily it can be broken.
- **C–F bond is the strongest**, making alkyl fluorides least reactive.
- **C–I bond is the weakest**, making alkyl iodides the most reactive.
- **Overall reactivity order:**

R–I > R–Br > R–Cl > R–F