Physical properties of Alkyl halides:

i) In pure form alkyl halides are colourless but when it is exposed in sunlight bromides and iodides may develop colour.

ii) most of the volatile alkyl halide have sweet smell.

iii) Alkyl halides are polar in nature still it is insoluble in water because neither it can form hydrogen bond with water nor it can break hydrogen bond of H2O.

iv) Alkyl halide can dissolve in organic solvents

v) As the molecular mass of alkyl halide increases (due to increase in no. of Carbon atom or due to increase in atomic mass of halogen atom) density of halide increases.

vi) chlorides and bromides of C_1 to C_2 are in Gaseous State but onwards are liquid & Solids.

vii) As molecular mass of halide increases in their straight chain, vanderwaal force or dipole-dipole increases due to that boiling point of the compound increases, but as the branching start in larger molecule vanderwaal force decreases and thats why boiling point also decreases.

In case of aromatic halides parapostion are more symmetrical so the the boiling point in para derivatives are more than their ortho & meta derivatives.

Teacher's Signature : _____

Chemical properties of Alkyl halides or Haloalkanes:→

Haloalkane shows three types of chemical reactions which are as follows:-

i) Nucleophilic substitution reaction. (SN reaction)
ii) Elimination reaction. (E reactions)
iii) Reaction with metals.

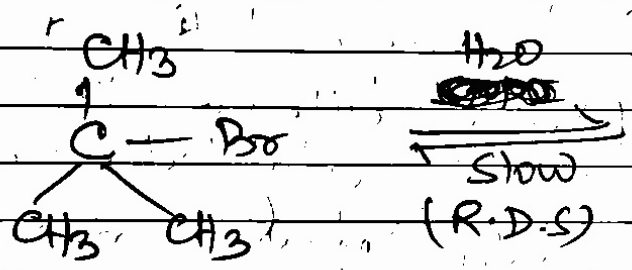
1. Nucleophilic substitution reactions:- (SN Reaction)

Nucleophilic substitution reactions are those reactions in which one nucleophile displaces other nucleophile and shift itself there. On the basis of order of reaction it is of two types i.e i) S_N1 or nucleophilic substitution reaction having order one ii) S_N2 or nucleophilic substitution reaction having order two. One more special type of nucleophilic substitution reaction is called S_Ni reaction or Nucleophilic substitution reaction intramolecular.

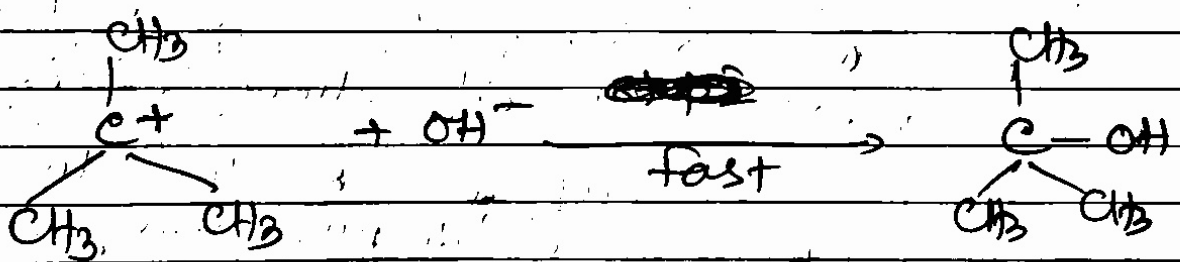
1. S_N1 :→ In nucleophilic substitution reaction having order one, the substrate is alkyl halide and there must be a weak nucleophile which can attack on substrate. In S_N1 reaction concentration of substrate only changes with respect to time, or substrate only is responsible for the rate of reaction not the reagent. That why order of reaction is only one.

S_N1 reaction complete in two steps in the first step carbocation is formed, during this step, the rate of reaction is slow and this step is rate determining step (the step in which rate is determined by substrate only [participated] hence order = 1) During this step carbocation is formed so for alkyl halide $3^0 > 2^0 > 1^0$ preferred for the reaction, because 3^0 carbocation is more stable (due to +I effect & hyper-conjugation), than 2^0 carbocation & than 1^0 carbocation:

Step I



Step II



In S_N1 reaction medium must be polar protic medium as H_2O. In first step breaking of C–Br bond take place due to solvation of halide ion with protons of protic solvent (H_2O or NH_3 or CH_3-CH_2-OH (Alcohol) etc
Rate of reaction ∝ stability of carbocation.
So 3^0 Alkyl halide > 2^0 Alkyl halide > 1^0 Alkyl halide.

Teacher's Signature :

Note: In protic solvent H is bonded with F|O|N which can solvate to cation & anion both.

Allylic and benzylic halide show high reactivity towards S_N1 reaction, and the carbocation thus formed is stabilised by resonance. Better leaving group in alkyl halide $I^- > Br^- > Cl^-$.

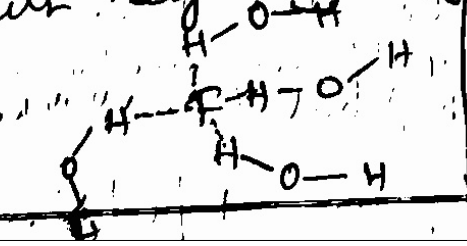
Whenever nucleophilic attack on substrate is from front then retention take place but as nucleophile attack from backside inversion take place. If the alkyl halide (substrate) is optically active or the alkyl halide contain chiral carbon then it will show racemisation. In S_N1 reaction carbocation is formed in first-step where nucleophilic attack may be by front or back any one, so it show optical activity which dextro and laevo both formations are possible and leave in equal manner so it show racemisation

Solvation effect :→ Solvent are of two types

i. Protic solvent (which can donate H^+ ion easily).

ii) Aprotic solvent: (which can not give H^+ ion)

In protic solvent H is bonded with F|O|N with Co-valent bond. As NH_3, H_2O, R-OH etc. when it solvate any anion then H is bonded to electronegative element by hydrogen bond.



When an anion is more solvated then its nucleophilicity decreases

Solvation in halide:

$F^- > Cl^- > Br^- > I^-$

most solvated due to small size

least solvated due to larger size