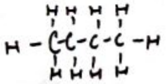
ORGANIC CHEM
basics

SAFETY

- → HAZARD → potential of a substance or activity to do harm
- → RISK → chance that a substance or activity will cause harm.
- → Safe or not depends on
  - → hazards of chemicals
  - → scale of experiment
  - → containment regime (eg. fume cupboard)
- → Risk reduced by
  - → less material / lower conc.
  - → use electric heating mantle not Bunsen burner
  - → protective clothing
  - → fume cupboard
  - → change materials used.

DRAWINGS

- → Displayed formula
  - → show everything



- → Structural formula
  - → show arrangement $CH_3CH_2CH_2CH_3$
- → molecular formula
  - → show ratio C_4H_{10}
- → Skeletal formula
  - → show shape & functional grp.

FUNCTIONAL GRP

- → chemically reactive sequence of atoms
- → gives a molecule specific chemical & physical properties (eg, polarising)
- → more functional grp, more reactions can take part

NAMING

- → LONGEST C chain
- → Carboxyl group must be C1
- → principal functional group must have smallest C.
- → functional groups in alphabetical order
- → in cyclo, no need number for branching.

ISOMERISM

- → ability of a compound with given molecular formula to exist with diff. arrangements of its constituent atoms.
- →

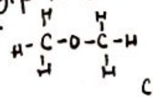
ISOMERISM → STRUCTURAL – Branch / positional / functional grp

STRUCTURAL: compounds w/ same molecular formula but diff arrangements

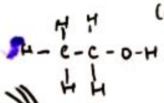
ISOMERISM → STEREOISOMERISM – Geometrical / Optical

STEREOISOMERISM: compounds w/ same molecular formula & molecules hv same atoms bonded to each other but diff arrangement of atoms in space.

- → Functional grp isomerism
  - → atoms of functional grp in diff arrangement. eg.



C_2H_6O (ether)



C_2H_6O (alcohol)

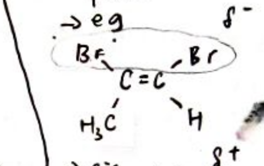
- → big diff in physical & chemical properties
  - ↳ functional grps responsible for chemical & physical properties.

HOMOLOGUES

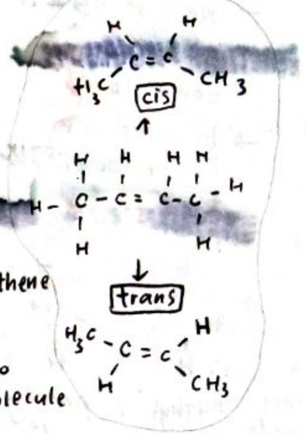
- → Homologue → type of molecule that differ from another by a whole no. of CH_2 "units".
- → members of same homologous series
  - → general formula
  - → same functional group
  - → differ from next by CH_2
  - → change their physical properties going ↓ series

GEOMETRICAL ISOMERISM

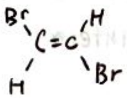
- → result of rotational restriction of C=C
- → results in attached atoms being locked in place
- → each C in C=C is attached to diff atom or group of atom
- → cis -
  - → same side
  - → polar
  - → eg



  - → cis - 1,2-dibromoethene



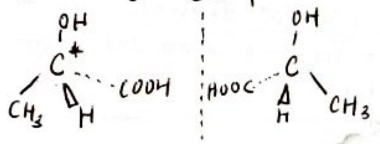
- → trans -
  - → non polar due to symmetry of molecule
  - → eg



trans-1,2-dibromoethene.

OPTICAL ISOMERISM

- → exist in molecules w/ asymmetric carbon atom
  - ↳ C atom bonded to 4 diff atoms / grps (chiral centre)
  - ↳ chiral molecule
- → atoms can be arranged in 2 ways
  - ↳ each are mirror image of the other
  - ↳ non-superimposable → chirality
- → eg. 2-hydroxypropanoic acid

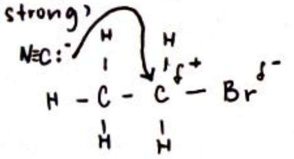


- → Have identical physical properties
- → Difference → properties towards plane-polarized light.
- → when beam of plane-polarized light (monochromatic) passes through solution of optical isomers, plane of polarization rotates.

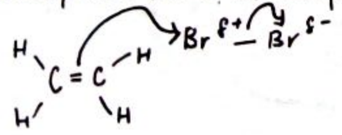
ORGANIC CHEM
Basics
(CONTINUED)

- optical isomers cause exactly same extent of rotation, but in opposite directions
- (+) form rotates light to the right (clockwise)
  (-) form " left (anticlockwise)
- optical isomers ⇒ optically active
- Eqimolar mixture does not rotate light at all as equal and opposite rotations cancel.
  - ↳ ∴ racemic mixture.

REACTION MECHANISMS

- NUCLEOPHILES
  - ⇒ a species w/ a pair of e^- which seeks a +ve charge to form a covalent bond
- eg. $:H^-$ hydride ion (strong), $:OH^-$ hydroxide, $:NH_3$ ammonia, $H_2\ddot{O}$ water (weak)
- 

  - → $^{\delta-}$Br atom polarizes the C-Br bond.
  - → C atom ⇒ electron deficient
  - → C atom ⇒ site of attack for nucleophile
    - ↳ nucleophile attack

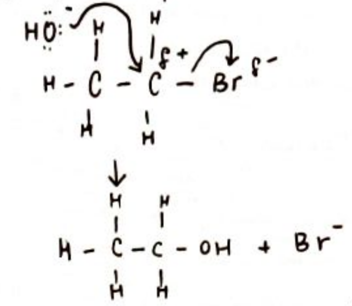
- ELECTROPHILES
  - ⇒ molecule / ions that are attracted to areas of -ve charge and can accept a pair of e^- to form covalent bond
- eg. H_2 , NO_2^+
- electrophiles react w/ compounds that have double bonds.
- 

  - → electrophiles attracted to areas of -ve charge but lack e^- to form bond
  - → molecule which it is attracted to contains area of high e^- density.
  - → electrons in this area can form bond w/ electrophile.

TYPES OF REACTIONS

- substitution
- addition
- elimination ↘ aka dehydration → reaction w/ O or loss of H
- oxidation ↗
- → reduction
- → hydrolysis (ester)
- → polymerization. (large no of molecules joined to make long chain molecule)

H
(alkanes)
NUCLEOPHILIC SUBSTITUTION REACTION

- when nucleophiles involved
- 

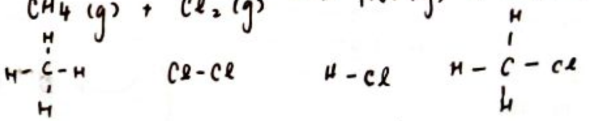
- → Br^- also nucleophile, but OH^- anion stronger than Br^- ∴ can displace
- → stronger nucleophile displace weaker nucleophile.

BOND BREAKING

- Homolytic fission
  - ⇒ splitting of covalent bond where each atom in bond gains one e^- from bond
  - → e^- in each atom is unpaired.
  - → forms radicals
    - ↳ very reactive ∴ can undergo reaction with chemically inert compounds.
    - ↳ short lived → intermediates
- Heterolytic fission
  - → all products have paired e- so NOT free radicals
  - → carbocation, carbanion.

HOMOLYTIC FREE RADICAL SUBSTITUTION (alkanes)

- $CH_4 (g) + Cl_2 (g) \longrightarrow HCl (g) + CH_3Cl (g)$

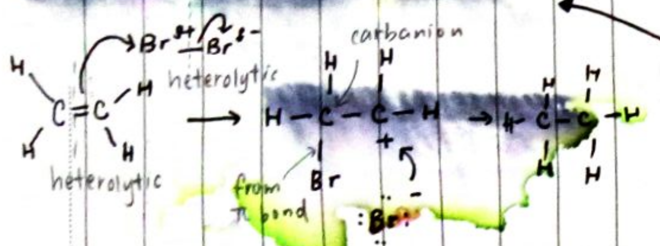


- → substitution reaction , conditions : presence of UV light
- Step 1 : initiation
  - $Cl_2 \rightarrow 2Cl^{\cdot}$ → radicals created (UV light)
- Step 2 : propagation
  - $Cl^{\cdot} + CH_4 \rightarrow CH_3^{\cdot} + HCl$ → radicals used then regenerated
  - $CH_3^{\cdot} + Cl_2 \longrightarrow CH_3Cl + Cl^{\cdot}$

  Cl˙ takes H from CH_4, CH_4 becomes radical, attacks Cl_2 to form more Cl˙ →
- Step 3 :
  - $Cl^{\cdot} + Cl^{\cdot} \rightarrow Cl_2$
  - $Cl^{\cdot} + CH_3^{\cdot} \rightarrow CH_3Cl$
  - $CH_3^{\cdot} + CH_3^{\cdot} \rightarrow C_2H_6$
  - } → radicals removed, possible products.

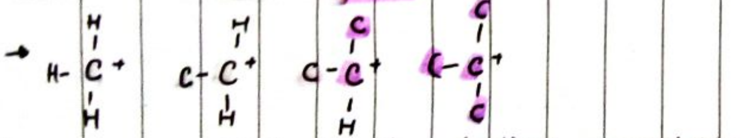
ORGANIC CHEM basics
(CONTINUED)

HETEROLYTIC ELECTROPHILIC ADDITION
(akenes)



- → as bromine molecule approaches ethene, it becomes polarized.
- → nearest Br becomes slightly +ve futher Br slightly -ve.
- → Br δ+ behaves as electrophile ∴ reacts w/ carbon double bond to form carbocation intermediate.
- → bromide ion attacks intermediate to form 1,2-bromoethane.

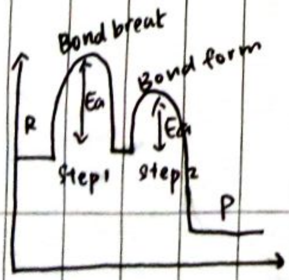
UNSYMMETRICAL ALKENES



least stable methyl < primary 1° < secondary 2° < tertiary 3° most stable

→ more stable intermediate = major product.

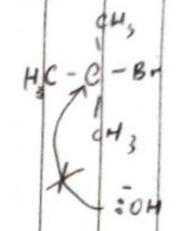
* Alkanes ⇒ substitution (nucleophiles, radicals)
Alkenes ⇒ addition (electrophiles)



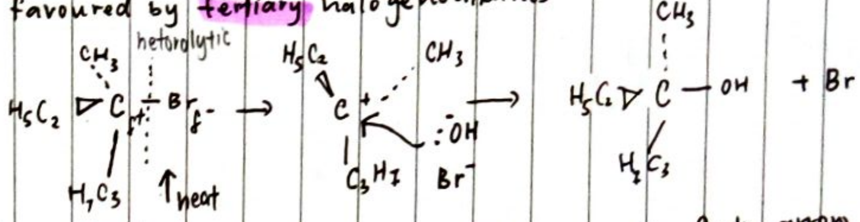
SUBSTITUTION IN HALOGENOALKANES

rate depends on substrate

due to bulky alkyl groups, :OH⁻ cannot attack +ve carbon like in SN₂



- ➡ S_N1
- → favoured by tertiary halogenoalkanes ONLY 3° & 2°
- →



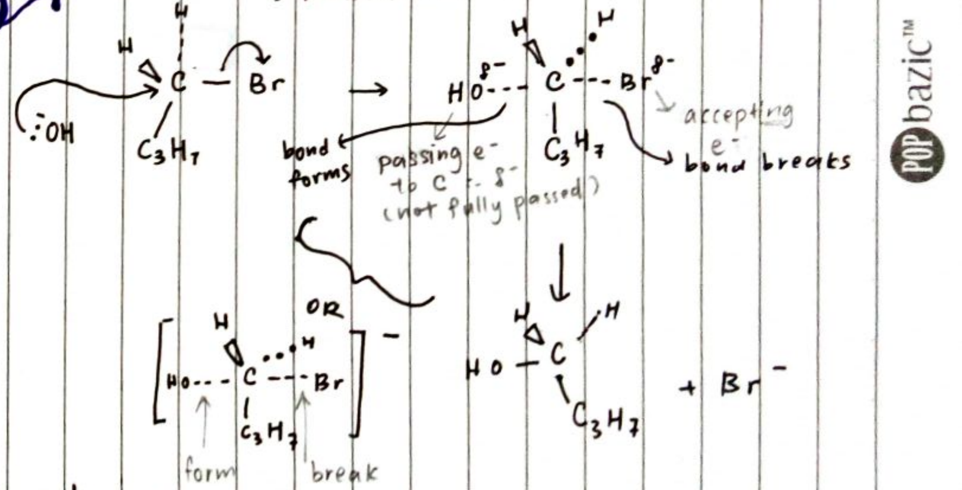
step 1
→ loss of X^- ion & forms intermediate carbocation

→ carbocation reacts rapidly w/ nucleophiles

* Curly arrow from lone pair e⁻ NOT charge
* can form optical isomers

➡ S_N2 → for 1°, 2°
→ rate depends on - nucleophile & - substrate

- → one step process
- → loss of X^- & gain of OH^- simultaneous.
  - ↳ transition state.



- Tertiary carbocation ~~is most stable as~~ it has least number of hydrogens atoms bonded to it, so it is most stable
- This is due to more electron releasing methyl groups ~~are~~ bonded to C^+.
- This reduces charge density on C^+.