

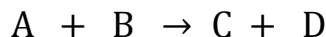
SCH 4U

PART 1: TYPES of ORGANIC REACTIONS

① ADDITION REACTIONS -- Add atoms to a double bond or triple bond



② SUBSTITUTION REACTIONS -- Usually alcohols, alkyl halides, aromatic compounds



③ ELIMINATION REACTIONS



- Single bonds form double bonds
- Reactant heated in presence of a strong acid catalyst (eg. H_2SO_4)

④ OXIDATION/REDUCTION REACTIONS

A. OXIDATION

From reactants to products, carbon has MORE bonds to oxygen & FEWER bonds to hydrogen. Reactions involve an “oxidizing agent”, represented by [O].

- **alcohol** + oxidizing agent \rightarrow aldehyde or ketone
- **aldehyde** + oxidizing agent \rightarrow carboxylic acid

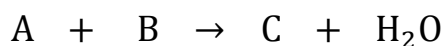
B. REDUCTION – [also addition reactions OR hydrogenation reactions]

From reactants to products, carbon has FEWER bonds to oxygen & MORE bonds to hydrogen. Reactions involve a “reducing agent”, represented by [H].

- **aldehyde or ketone** + reducing agent \rightarrow alcohols
- **alkenes or alkynes** + reducing agent \rightarrow alkanes

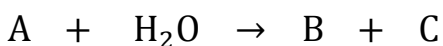
⑤ ESTERIFICATION

A. CONDENSATION



Carb. acid + alcohol \rightarrow ester + water

B. HYDROLYSIS



Ester + water \rightarrow carb. Acid + alcohol

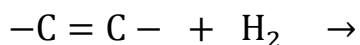
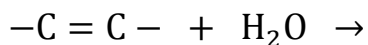
EXAMPLES:

1. ethene combined with hydrobromic acid.
2. 1-butyne with limited bromine
3. 1-propanol with hydrochloric acid
4. 2-bromobutane and ammonia
5. benzene with nitrous acid
6. 2-propanol with sulfuric acid catalyst
7. bromoethane with heat and a catalyst
8. 2-methyl-1-propanol + [O]
9. propyne + [H]
10. 3-nitropentanal + [O]
11. 2-methylcyclopentanone + [H]
11. ethanoic acid + 3-methyl butanol
12. tert-butyl cyclopentanoate + water

PART 2: REACTIONS OF FUNCTIONAL GROUPS

① ALKENES & ALKYNES

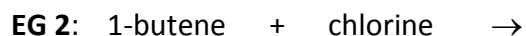
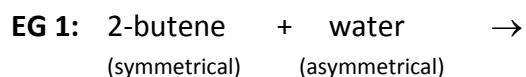
- **ADDITION REACTIONS** are common due to reactive double/triple bonds



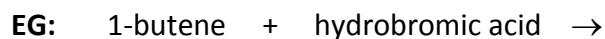
ALKENES

- **symmetrical** – identical groups on each side of double bond
- **asymmetrical** – different groups on each side of double bond
- **ADDITION SUBSTANCE**
 - symmetrical – eg. Cl_2 -- $[Cl - Cl]$
 - asymmetrical -- eg. H_2O -- $[H - OH]$

IF either alkene or addition substance is symmetrical → ONLY 1 product



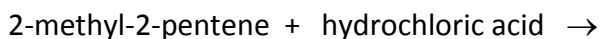
IF both reactants are asymmetrical → MORE THAN 1 product



MARKOVNIKOV'S RULE:

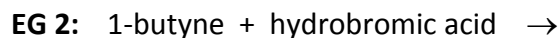
- Major & minor products are formed.
- **MAJOR PRODUCT:** The H of the **added substance** goes to the carbon with the **greater number of H atoms**; the rest of the added substance goes to the carbon with the fewer H atoms. This is a case of "The rich get richer!"

EG: Draw and label only the major product for the reaction:



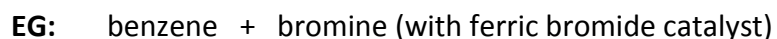
ALKYNES

- If addition substance is limited, alkyne \rightarrow alkene
- If addition substance is unlimited, alkyne \rightarrow alkene \rightarrow alkane
- Follows Markovnikov's rule for asymmetrical reactants



AROMATIC COMPOUNDS

- ONLY Substitution reactions, NOT addition reactions



② ALCOHOLS

[A] *SUBSTITUTION REACTIONS (with HX)*

EG: ethanol with hydrochloric acid

[B] *ELIMINATION REACTIONS (forms alkenes)*

- Heated with strong acid catalyst

EG: ethanol $\xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$

[C] *OXIDATION REACTIONS (forms aldehyde or ketone)*

- 1° alcohol + oxidizing agent → aldehyde + oxidizing agent → carb. acid
- 2° alcohol + oxidizing agent → ketone
- 3° alcohol + oxidizing agent → NR

EXAMPLES: Complete each reaction.

1. 2-butanol + [O]

2. 2-propanol $\xrightarrow[\Delta]{\text{H}_2\text{SO}_4}$

3. 2-propanol + hydrobromic acid

③ ALDEHYDES & KETONES

[A] OXIDATION REACTIONS -- only aldehydes, NOT ketones

- Aldehyde + oxidizing agent \rightarrow carb acid

[B] REDUCTION REACTIONS -- aldehydes and ketones

- Aldehyde + reducing agent \rightarrow 1° alcohol
- Ketone + reducing agent \rightarrow 2° alcohol

EXAMPLES: Complete each reaction.

1. ethanal + [H]

2. propanone + [O]

3. butanone + [H]

4. pentanal + [O]

④ CARBOXYLIC ACIDS

[A] NEUTRALIZATION REACTIONS:

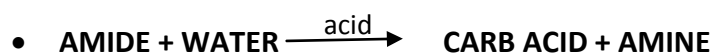
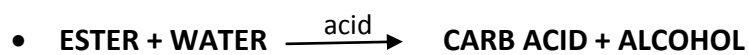
- CARB ACID with a BASE → SALT & WATER

[B] ESTERIFICATION REACTIONS (*special type of CONDENSATION REACTION*)

- CARB ACID WITH ALCOHOL → ESTER & WATER

⑤ ESTERS & AMIDES -- undergo hydrolysis reactions

[A] ACID HYDROLYSIS



[B] BASIC HYDROLYSIS

