V. ORGANIC REACTIONS

Zoober: 07 polymers intro

Organic Reactions generally occur more slowly than inorganic reactions. When covalently bonded substances react, they must first break relatively strong existing bonds before making new bonds. For this reason, the use of catalysts is a common practice. The types of organic reactions total that we will be covering are below.

1.) Substitution Reaction

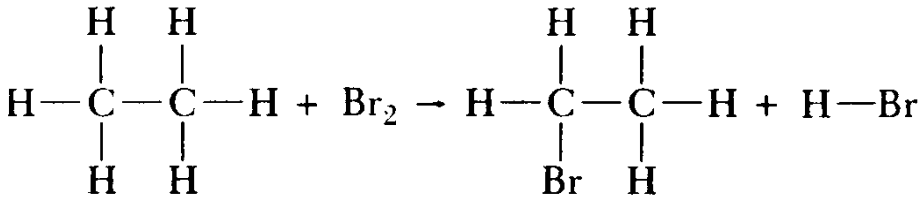
Replaces hydrogen (H) in the molecule with another element, such as a halogen. Other fragments of an alkane (called an alkyl group) can also be substituted for the hydrogen creating branched alkanes.

What to look for: Reactant – one alkane
Products – TWO of them: the substituted hydrocarbon and a small molecule called a **by-product**.

**A HALOCARBON has been made (named for the halogen substitution.)

Example:

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$



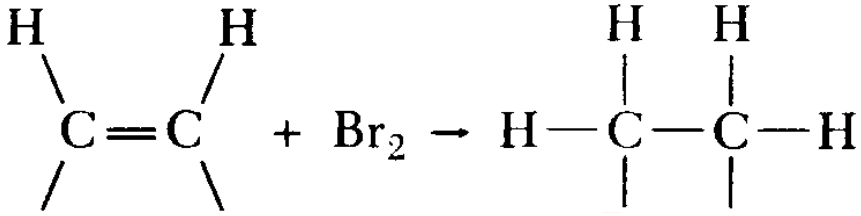
2.) Addition Reaction

Breaking or ADDING across the double or triple bond in the molecule with other elements, such as the halogens, to form a more saturated hydrocarbon (single bonds). Other fragments of an alkane called an alkyl group can also be added across the double or triple bond creating branched alkanes

What to look for: Reactant – DOUBLE OR TRIPLE BOND (Alkene or alkyne)
Product – ONE: the substituted hydrocarbon.

Example:

$$C_5H_{10} + F_2 \rightarrow C_5H_{10}F_2$$



3.) Combustion Reaction

Another name for burning…examples on Reference Table I

What to look for: Reactants – Hydrocarbon or alcohol and O_2
Products – CO_2 and H_2O

Example: $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$

4.) Fermentation

Oldest known Organic Reaction to man!!! Makes buzz in booze

What to look for: Reactants: Glucose ($C_6H_{12}O_6$), sometimes the catalyst zymase is written on top of the arrow
Products: CO_2 + Ethanol (C_2H_5OH)

Example: $C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2C_2H_5OH + 2CO_2(g)$

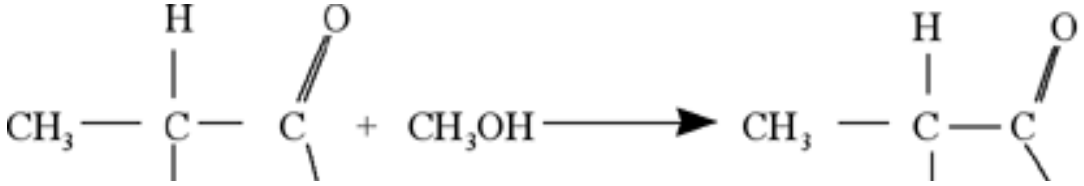
5.) Esterification

How the smell gets into smelly stickers…making fruity & minty compounds – esters – by dehydration synthesis

What to look for: Reactants – Organic Acid (R-COOH) & an Alcohol (R'-OH)
Products – The ester link R-COO-R' and H_2O

Example: $HCOOH + CH_3OH \rightarrow HCOOCH_3 + H_2O$

$CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$



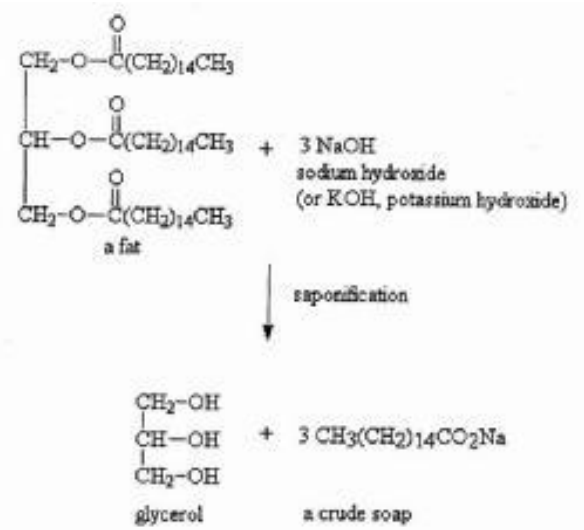
6.) Saponification

2nd oldest reaction to man… First four letters rearranged spells: _____

This is what is made!!! (Reaction is the opposite of esterification)

What to look for: Reactants – Fat (a glycerol ester) + Base (NaOH or KOH)
Products – Glycerol and soap (salt of the Organic Acid)

Example: $(C_{17}H_{35}COO)_3C_3H_5 + 3\ NaOH \rightarrow 3\ C_{17}H_{35}COONa + C_3H_5(OH)_3$



7.) Polymerization – Addition & Condensation

Reaction which makes GIANT molecules called POLYMERS by hooking together small molecules using a catalyst.

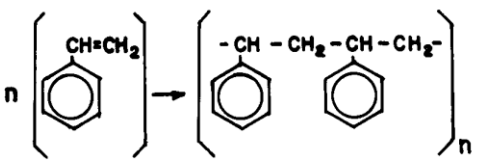
Polymer: "many parts" - extremely large molecules
Man-made: Nylon, polyester, polyethylene, polystyrene
Natural: Linen, silk, cotton, wool, cellulose (paper), protein, starches
Monomer: "one part" – small molecules used to make the polymer, they are the building blocks of the polymer

A. Addition Polymerization: Monomers are connected by breaking one of a double or triple bond to hook together

What to look for: Reactants – double or triple bond: $n\ C_2H_4$ (*n* is a whole number)
Products -(alkane)$_n$-

Example:

n $-CH_2-$ → $(-CH_2-)_n$ (where n = a whole number)



OR

$CH_2{=}CH_2 + CH_2{=}CH_2 + CH_2{=}CH_2 + CH_2{=}CH_2$

$\rightarrow$

$—CH_2CH_2{\cdot}CH_2CH_2—CH_2CH_2—CH_2CH_2—$

B. **Condensation Polymerization**: monomers are connected by removing a water molecule (dehydration synthesis)

What to look for: Reactants: Amino acids or dihydroxy alcohol & double Organic Acid
Products: H_2O & the Polymer

Example: