

## ORGANIC REACTIONS

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### Lesson Description

In this lesson we:

- Look at the chemical reactions of organic molecules



### Summary

Organic molecules can undergo several important chemical reactions.

#### 1. Substitution

Substitution reactions occur when one or more atom in the organic molecule is substituted with another atom or group of atoms.

Substitution reactions can only occur with single bonds, i.e. a hydrogen in an alkane is replaced with a halogen.

Types of substitution reactions:

Reactants	Product/s	Conditions
Alkanes + halogens (Halogenation)	Haloalkanes + HX	Sunlight or heat
Alcohols + HX	Haloalkane + water	Primary / secondary alcohol need high temperatures
Haloalkanes + water + KOH(aq) / NaOH(aq)	Alcohols + HX	Dissolve haloalkane in ethanol Heat

#### 2. Addition

Addition reactions occur when an atom or group of atoms is added to an organic molecule. These reactions occur when a double or triple between carbon atoms is broken.

Types of addition reactions with alkenes

Name	Reactants	Product	Conditions
Hydrohalogenation	Alkene + HX	Haloalkane (no water)	Room temperature No catalyst
Halogenation	Alkene + halogen	Haloalkane (no water)	Room temperature No catalyst
Hydration	Alkene + H <sub>2</sub> O	Alcohol	Catalyst – H <sub>2</sub> SO <sub>4</sub>
Hydrogenation	Alkene + H <sub>2</sub>	Alkane	Catalyst – Pt, Ni or Pd Dissolve alkene in non-polar solvent (e.g. benzene)

### 3. Elimination

Elimination reactions are reactions in which a smaller molecule is removed from a larger molecule which produces an alkene and another molecule.

Types of elimination reactions

Name	Reactants	Product	Conditions
Dehydrohalogenation	Haloalkanes + conc NaOH / KOH	Alkene + water + halide salt	Strongly heated with reflux Base dissolved in alcohol
Dehydration (alcohols)	Alcohol	Alkene + water	Heated Excess concentrated H <sub>2</sub> SO <sub>4</sub> or H <sub>3</sub> PO <sub>4</sub>
Thermal cracking	Large hydrocarbon	Mixture of products- many alkenes	High temperature and pressure
Catalytic cracking	Large hydrocarbon	Mixture of products – branched alkanes and aromatic hydrocarbons	Lower temperature Catalyst present Low pressure

### 4. Combustion reaction

Alkane + insufficient oxygen → carbon monoxide + water + energy

Alkane + sufficient oxygen → carbon dioxide + water + energy

### 5. Esterification

An ester is prepared by the reaction between an alcohol and a carboxylic acid in the presence of sulphuric acid, which acts as a catalyst. The products are always an ester and water.

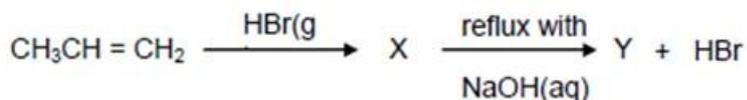


### Test Yourself

Select the most correct answer from the options given. Write down only the correct letter

#### Question 1

A simple reaction scheme is shown below:

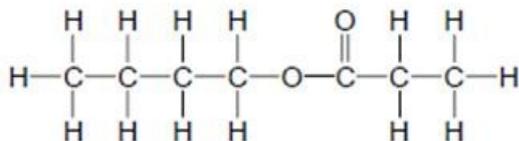


The formula for Y is...

- A. CH<sub>3</sub>CH<sub>2</sub>COOH
- B. CH<sub>3</sub>CHOHCH<sub>3</sub>
- C. CH<sub>3</sub>CHBrCH<sub>2</sub>OH
- D. CH<sub>3</sub>CHOHCH<sub>2</sub>Br

**Question 2**

The structural formula of an ester is shown below



Which ONE of the following pairs of compounds can be used to prepare the above ester?

- A. Propanoic acid and butan-1-ol
- B. Propanoic acid and butan-2-ol
- C. Butanoic acid and propan-1-ol
- D. Butanoic acid and propan-2-ol

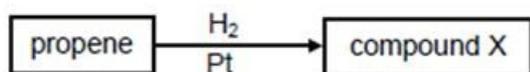
**Question 3**

Which ONE of the following reaction types can be used to prepare ethane from octane?

- A. Addition
- B. Hydrogenation
- C. Cracking
- D. Substitution

**Question 4**

Consider the flow diagram below:



The IUPAC name for compound X is:

- A. Propyne
- B. Propan-1-ol
- C. Propane
- D. Propan-2-ol



