Lesson 9 Chemical reactions with alkanes, haloalkanes and alkenes.

Click to revise reaction pathways

Saturated hydrocarbon = a compound that has single carbon to carbon bonds (C-C) and is composed of hydrogen and carbon atoms only.
Unsaturated hydrocarbon = a compound that has one or more double carbon to carbon bonds (C=C) or even a triple carbon to carbon bond and is composed of hydrogen and carbon atoms only.

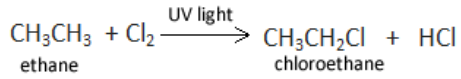
All alkanes and alkenes undergo complete combustion with oxygen to produce carbon dioxide and water. They may also undergo incomplete combustion where the products are carbon monoxide and water or even solid carbon and water. At SLC hydrocarbons will undergo combustion in oxygen to produce $CO_2(g)$ and $H_2O(l)$. Consider the following reactions at SLC.

a) $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$ (complete combustion)

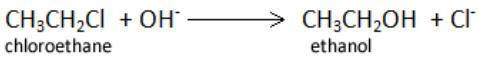
b) $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ (complete combustion)

c) $2C_2H_6(g) + 5O_2(g) \rightarrow 4CO(g) + 6H_2O(l)$ (incomplete combustion)

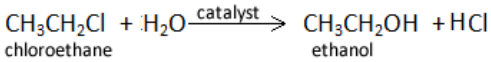
Alkanes undergo reactions known as ***substitution reactions*** where a hydrogen is substituted for a chlorine or some other halogen. This usually occurs in the presence of UV light.



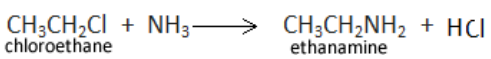
Haloalkanes can then be used in further substitution reactions to produce other beneficial compounds.
Chloroethane, for example, can undergo a substitution reaction with NaOH to produce ethanol

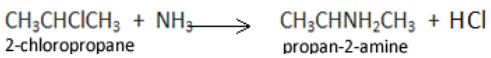


Ethanol can also be produced via a substitution reaction between chloroethane and water in the presence of a catalyst.



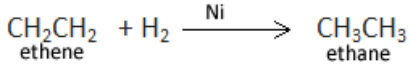
Amines can also be formed through substitution reactions with haloalkanes via reactions with ammonia.

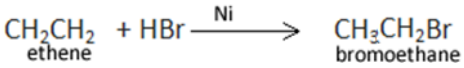


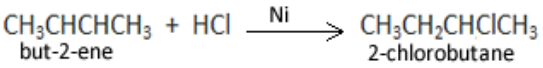


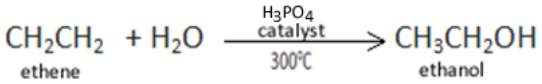
Addition reactions.

As the name implies addition reactions involve the addition of a small molecule across the double bond of an alkene.





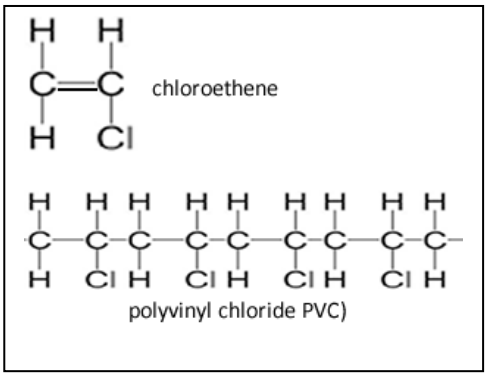




The reaction above, where water is used as a reactant is sometimes referred to as a ***hydration*** reaction.

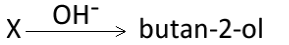
Alkenes can also undergo addition reactions to form long chain polymers. This type of reaction is known as ***addition polymerisation***. Alkenes can attach to each other across the double bond.

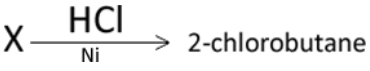
Eg Polyvinyl chloride (PVC) is a durable and versatile plastic. It is made from chloroethene monomers. Monomers are the small molecules that join to form long molecules, generally known as polymers.

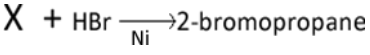


1) Write a balanced chemical equation for the combustion reaction of octane.

2) For each of the reactions below identify X

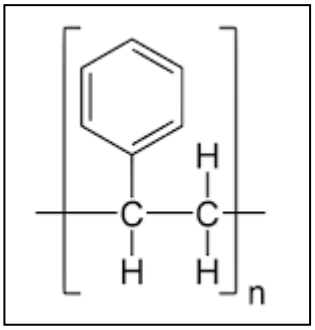
   a) 

   b) 

   c) 

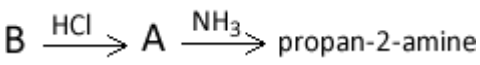
3) trans-Pent-2-ene reacts with Cl_2 in an addition reaction.
   Name all the possible isomers formed and give their structural formulae.

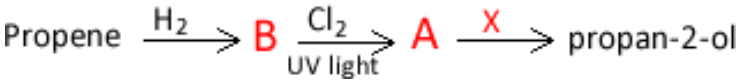
4) Styrene is a plastic commonly used for packaging and plastic cutlery. The repeating unit in the polymer chain is shown on the right.
   Draw the monomer of this polymer.



   What type of reaction forms this plastic?

4) Identify each species involved in the reaction pathways shown below. Identify the type of reaction that takes place at each step.

a) 

b) 

5) Name all the possible isomers that form from the addition reactions taking place below.

a) propene + HCl →

b) buta-1,3-diene + Br_2 →

c) 2-methylbut-1-ene + Cl_2 →

d) propene + H_2O →

6) Draw the polymer that is formed from an addition polymerisation reaction taking place with the following monomers. Draw a short section of the polymer with two repeating units.

a. CH_3CHCH_2

b. $CH_3CH_2CHCHCH_3$