Year -12 Topic Notes (Chemistry)
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Products of Reactions involving Hydrocarbons

Inquiry question: *What are the products of reactions of hydrocarbons and how do they react?*

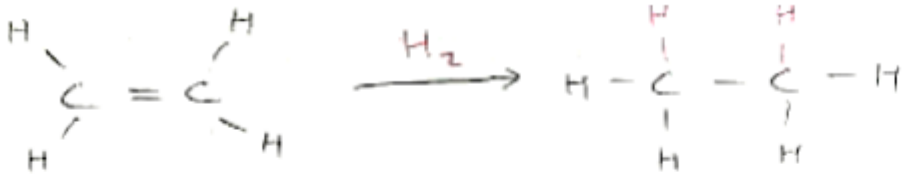
Students:

- *investigate, write equations and construct models to represent the reactions of unsaturated hydrocarbons when added to a range of chemicals, including but not limited to:*

– hydrogen (H_2)

Hydrogenation is an addition reaction where hydrogen gas (H_2) reacts with unsaturated hydrocarbons such as alkenes and alkynes to form one combined product. The hydrogen reacts with and beaks the C=C bond and as a result, one hydrogen atom is added to each carbon atom. The alkene is converted to an alkane.

See the example below for the hydrogenation of ethene:



– halogens (X_2)

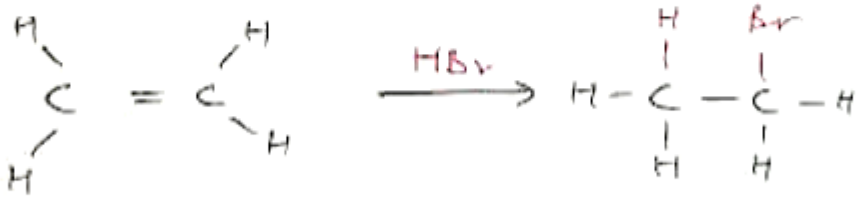
Halogenation is another addition reaction where diatomic halogen molecules (X_2) reacts with the C=C bond resulting in one halogen atom being added to each carbon atom. The alkene is converted to a haloalkane.

See the example below for the halogenation of ethene:

– hydrogen halides (HX)

Hydrohalogenation is an addition reaction where a hydrogen halide molecule (HX) breaks the C=C bond resulting in a hydrogen atom being added to one carbon atom and a halogen atom being added to the other carbon atom. The alkene is converted to a haloalkane.

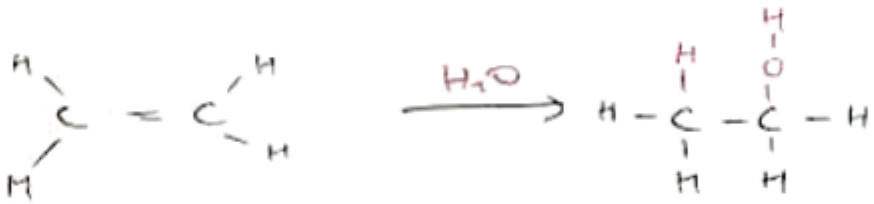
See the example below for the hydrohalogenation of ethene:



– water (H_2O) (ACSCH136)

Hydration is also an addition reaction where a hydroxyl group (OH) is added to one carbon atom of C=C bond and a hydrogen atom is added to the other carbon atom. The alkene is converted to a saturated alcohol.

See the example below for the hydration of ethene:



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The second type of unsaturated hydrocarbons are alkynes. Alkynes have triple carbon bonds whilst alkenes have double carbon bonds. Hence alkynes will have double the number of addition chemical reactions than alkenes.

Q. Write out the chemical equations for the halogenation of ethyne. (Hint: there will be two chemical equations)

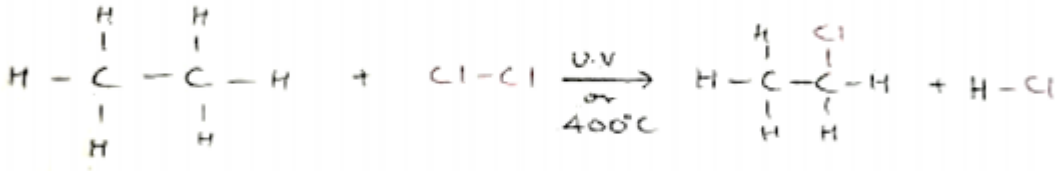
• *investigate, write equations and construct models to represent the reactions of saturated hydrocarbons when substituted with halogens*

Saturated hydrocarbons are considered chemically unreactive as they don't readily undergo many chemical reactions. Since alkanes contain only single bonds, they don't undergo addition reactions like alkenes and alkynes. Instead, alkanes undergo substitution reaction under the presence of high temperatures or ultraviolet radiation to break the C-H bond.

Under these conditions, the covalent bonds in the diatomic halogen molecule (X_2) is broken creating a free halogen free radical which reacts with a hydrogen atom in the alkane. As a result, we get a radical hydrocarbon molecule with a missing hydrogen atom and a hydrogen halide.

The radical hydrocarbon then reacts with a free halogen radical to form an alkyl halide.

See the example below for the halogenation of ethane:



SOLUTION: