12.8 Reactions of Alkanes

The only major reactants of alkans are with oxygen and halogens. They do not react with acids, bases or most other commen reagents.

COMBUSTION is an oxidation reaction that takes place in a controlled manner in an engine or furnace. The products of combustion are carbon dioxide and water, plus a large amount of heat….may even be a flame.

A balanced equation for the complete combustion of ethane with oxygen:

HALOGENATION is the replacement of an alkane Hydrogen by a chlorine or bromine in a process initiated by light. It often yields a mixture of products through several reactions that happen one after the other.

Problem: Write the structures of all possible products with one and two chlorine atoms that form in the reaction of propane with Cl_2.

An alkane with a halogen is a HALOALKANE

Some common solvents in lab:

- CH_3Cl = methyl chloride = chloromethane (used to decaffeinate coffee)
- CH_2Cl_2 = methylenechloride = dichloromethane
- $ChCl_3$ = chloroform = trichloromethane
- CCl_4 = carbon tetrachloride = tetrachloromethane

The ones with a single halogen are VERY reactive!

FYI: CCl_4 has a density of 1.58 g/ml
CCl3 has a density of 1.48 g/ml
The Chlorine (which is heavy) and the Cl:H ratio make this heavier than water!!

FYI: Haloalkanes have a density of about 1.3 to 1.6 g/ml. The C1 haloalkanes are non-flammable, and they are heavy because Chlorine is heavy. You have to take into account the halogen : carbon ratio.

12.9 Cycloalkanes

CYCLOALKANES contain rings of carbon atoms, with a basic structure of C_nH_{2n}. In order to form the closed ring, you need an additional C-C bond and the LOSS of two H atoms. The two simplest cycloalkanes are CYCLOPROPANE and CYCLOBUTANE. Cyclopropane has three Cs, and very acute bond angles (60-degrees). Cyclobutane has four Cs, and about 90-degree bond angles. Because both of these are in an "uncomfortable" state, they readily open up if something with an extra e- comes along. Think of it as sitting cross legged and wanting to straighten out your legs!

Conversely, CYCLOPENTANE and CYCLOHEXANE both have ideal bond angles, and are thus very stable. Note that when drawn "from the side" cyclohexane has several configurations, all a result of the "pucker".

Cyclic and acyclic alkanes are similar in many of their properties.

When cyclohexane is changing around its shape, this is no problem for it at all, b/c all the constituents are Hs. If you put on a methyl group or two, then they are going to prefer equatorial positions…they will not like being next to each other.

12.10 Drawing & Naming Cycloalkanes

For cycloalkanes we don't use the condensed structure, just the skeletal structure.

CH2= methylene
CH = methene

Ex: Methylcyclohexane

NAMING PROCESS:

Step 1: Find the parent. It is a *cyclo*_____ *ane*

Step 2: Count the Carbons in the cycloalkane, and add this to the name: *cyclohexane*
NOTE: having a cycloalkane trumps the longest chain rule!

Step 3: Identify and add the number of the subs
Start numbering at the group that has alphabetical authority
Proceed around the ring in the direction that gives the lowest count.