Nomenclature & Formula Writing 9

Introduction to Alkanes

Information

Up to this point, the nomenclature you have been studying in this series of activities has been for what are known as **inorganic** compounds; that is, by definition, they do not contain carbon (although a few exceptions, like carbon dioxide, exist).

Organic compounds, on the other hand, are characterized by the fact that they contain one or more carbon atoms connected to each other to form the **backbone** of a molecule. The term "organic" finds its roots in the fact that these compounds were first identified as those that make up the components of living organisms (tissues, enzymes, etc.).

The **International Union of Pure and Applied Chemistry**, or IUPAC, is the world authority for determining the conventions for chemical nomenclature. Much like with inorganic nomenclature, the names of organic compounds are based on a systematic convention. For **alkanes**, organic molecules with all **single bonds** connecting the carbon atoms to one another, the convention is very straightforward. This activity introduces the naming convention for **normal** alkanes (where each carbon atom is never connected to more than two others) and normal **alcohols** (in which normal alkanes find a **hydroxyl** group (OH^-) attached to one end).

Organic compounds are sometimes generically referred to as **hydrocarbons**, due to their containing primarily carbon and hydrogen (this term is especially applicable to the petroleum industry, where most of the compounds are of this type). Despite the name, hydrocarbons sometimes contain oxygen, sulfur, or other elements, which have a wide range of effects on their properties.

This activity deals only with hydrocarbons containing carbon, hydrogen, and oxygen.

Alkane Nomenclature & Formula Writing

In an alkane, carbon atoms are sp^3 **hybridized**. The details of what this means will be discussed in a later activity, but for now, know that it means that each carbon atom in the alkane forms four bonds – two with other carbon atoms (or just one if the carbon atom happens to be at the end of the chain), and the other bonds are formed with hydrogen atoms. *Every normal alkane is composed only of a carbon backbone and hydrogen atoms.* Therefore, the chemical formulas for alkanes always take the form of C_nH_{2n+2}, where *n* is equal to the number of carbon atoms in the chain.

For example, an alkane with 6 carbon atoms in its backbone has the chemical formula C_6H_{14}.

Determining the name of an alkane is as simple as counting the number of carbon atoms in the backbone, applying a proper prefix, and adding the suffix *–ane*. The prefixes are determined based on the number of carbon atoms present in the backbone:

1	meth-	4	but-	7	hept-
2	eth-	5	pent-	8	oct-
3	prop-	6	hex-	9	non-

10 dec-

You should note that alkanes with a number of carbons greater than 4 use the Latin prefixes similar to those used for inorganic molecular compounds. The first four (*meth-*, *eth-*, *prop-*, and *but-* are holdovers from the common names of these compounds before the pattern now addressed by the systematic names was discovered).

Although you have not yet had any exposure to the structures of molecules (an understanding of how atoms actually connect to one another), the structure of the alkane heptanes shown in Figure 1 will help to clarify the points discussed above:

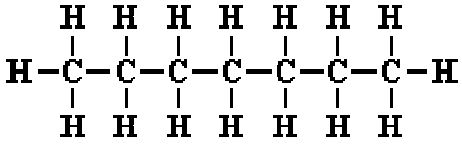

Figure 1

Notice that each of the carbons at the end of the chain have three hydrogen atoms attached to them, and the others each have two hydrogen atoms attached.

Alcohol Nomenclature & Formula Writing

Alcohols are similar to alkanes, the difference being that a hydroxyl (-OH) **functional group** is attached to the chain. For this exercise, we will explore only **normal alcohols**, alcohols on which the hydroxyl functional group is attached at the end of the carbon chain.

Alcohols have chemical formulas of the form $C_nH_{2n+1}OH$.

Alcohols are named simply by starting with the base name of the alkane, removing the *–e* at the end of the name, and replacing it with *-ol*.

Key Questions

1. Write the names and formulas of each of the alkanes containing from 1 to 10 carbon atoms on its backbone.

2. Write the names and formulas of each of the alcohols containing from 1 to 10 carbon atoms on its backbone.

3. Using the diagram in figure 1 as a guide, draw the structures of the alkanes containing 1, 3, 6, and 10 carbon atoms on its backbone.

4. Using the diagram in figure 1 as a guide, draw the structures of the alcohols containing 2, 5, and 8 carbon atoms on its backbone.