The reaction does not stop at this stage, however, because the chlorinated methane product can react with additional chlorine to produce polychlorinated products.

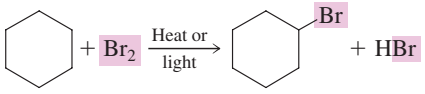
$$CH_3Cl + Cl_2 \xrightarrow[\text{light}]{\text{Heat or}} CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow[\text{light}]{\text{Heat or}} CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow[\text{light}]{\text{Heat or}} CCl_4 + HCl$$

By controlling the reaction conditions and the ratio of chlorine to methane, it is possible to *favor* formation of one or another of the possible chlorinated methane products.

The chemical properties of cycloalkanes are similar to those of alkanes. Cycloalkanes readily undergo combustion as well as chlorination and bromination. With unsubstituted cycloalkanes, monohalogenation produces a single product because all hydrogen atoms present in the cycloalkane are equivalent to one another.



The Chemistry at a Glance feature on page 349 summarizes the physical properties and chemical reactions of alkanes and cycloalkanes.

12.18 NOMENCLATURE AND PROPERTIES OF HALOGENATED ALKANES

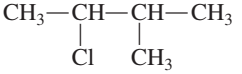
A **halogenated alkane** *is an alkane derivative in which one or more halogen atoms are present.* Similarly, a **halogenated cycloalkane** *is a cycloalkane derivative in which one or more halogen atoms are present.* Produced by halogenation reactions (Section 12.17), these two types of compounds represent the first class of hydrocarbon derivatives (Section 12.3) that we formally consider in this text.

Nomenclature of Halogenated Alkanes

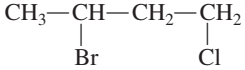
The IUPAC rules for naming halogenated alkanes are similar to those for naming branched alkanes, with the following modifications:

1. Halogen atoms, treated as substituents on a carbon chain, are called *fluoro-*, *chloro-*, *bromo-*, and *iodo-*.
2. When a carbon chain bears both a halogen and an alkyl substituent, the two substituents are considered of equal rank in determining the numbering system for the chain. The chain is numbered from the end closer to a substituent, whether it be a *halo-* or an alkyl group.
3. Alphabetical priority determines the order in which all substituents present are listed.

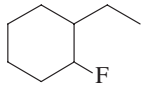
The following names are derived using these rule adjustments.



2-Chloro-3-methylbutane



3-Bromo-1-chlorobutane



1-Ethyl-2-fluorocyclohexane

Simple halogenated alkanes can also be named as *alkyl halides.* These non-IUPAC names have two parts. The first part is the name of the hydrocarbon portion of the molecule (the alkyl group). The second part (as a separate word) identifies the halogen portion, which is named as if it were an ion (chloride, bromide, and so on), even though no ions are present

The contrast between IUPAC and common names for halogenated hydrocarbons is as follows:

IUPAC (one word)

haloalkane

chloromethane

Common (two words)

alkyl halide

methyl chloride