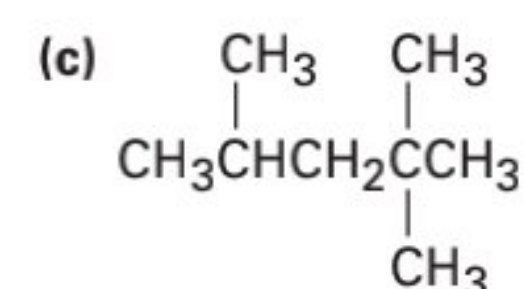
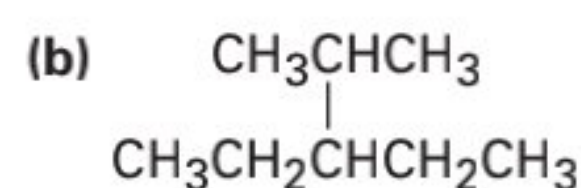
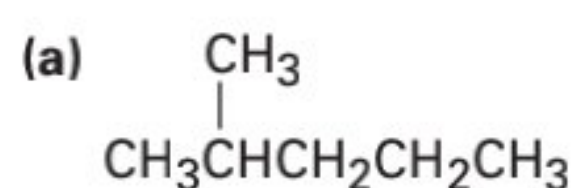


- Problem 2.4** Draw structures for the five isomers of C_6H_{14} .
- Problem 2.5** Draw structures that meet the following descriptions:
 (a) Three isomers with the formula C_8H_{18}
 (b) Two isomers with the formula $C_4H_8O_2$
- Problem 2.6** Draw the eight possible five-carbon alkyl groups (pentyl isomers).
- Problem 2.7** Draw alkanes that meet the following descriptions:
 (a) An alkane with two tertiary carbons
 (b) An alkane that contains an isopropyl group
 (c) An alkane that has one quaternary and one secondary carbon
- Problem 2.8** Identify the carbon atoms in the following molecules as primary, secondary, tertiary, or quaternary:



2.3 Naming Branched-Chain Alkanes

In earlier times, when few pure organic chemicals were known, new compounds were named at the whim of their discoverer. Thus, urea ($\text{CH}_4\text{N}_2\text{O}$) is a crystalline substance isolated from urine, and morphine ($\text{C}_{17}\text{H}_{19}\text{NO}_3$) is an analgesic (painkiller) named after Morpheus, the Greek god of dreams. As the science of organic chemistry slowly grew in the 19th century, so too did the number of known compounds and the need for a systematic method of naming them. The system of naming (*nomenclature*) we'll use in this book is that devised by the International Union of Pure and Applied Chemistry (IUPAC, usually spoken as **eye-you-pac**).

A chemical name typically has four parts in the IUPAC system of nomenclature: prefix, parent, locant, and suffix. The prefix specifies the location and identity of various substituent groups in the molecule, the parent selects a main part of the molecule and tells how many carbon atoms are in that part, the locant gives the location of the primary functional group, and the suffix identifies the primary functional group.



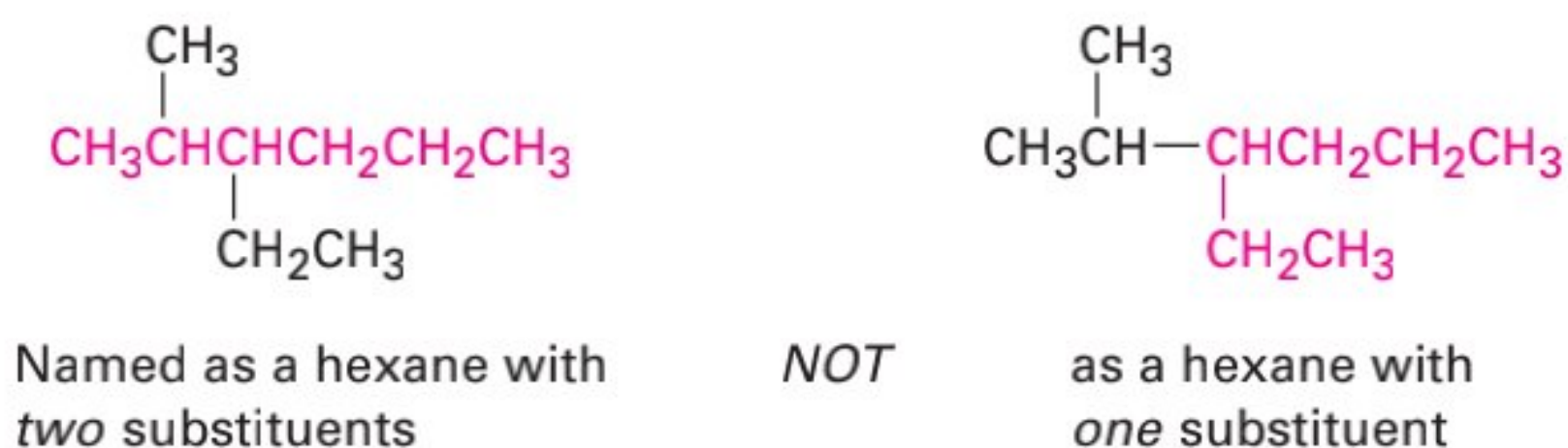
As we cover new functional groups in later chapters, the applicable IUPAC rules of nomenclature will be given. In addition, Appendix A gives an overall view of organic nomenclature and shows how compounds that contain more than one functional group are named. For now, let's see how to name branched-chain alkanes. All but the most complex branched-chain alkanes can be named by following four steps.

STEP 1 Find the parent hydrocarbon.

- (a) Find the longest continuous carbon chain in the molecule and use the name of that chain as the parent name. The longest chain may not always be obvious; you may have to “turn corners.”



- (b) If two chains of equal length are present, choose the one with the larger number of branch points as the parent.

**STEP 2 Number the atoms in the main chain.**

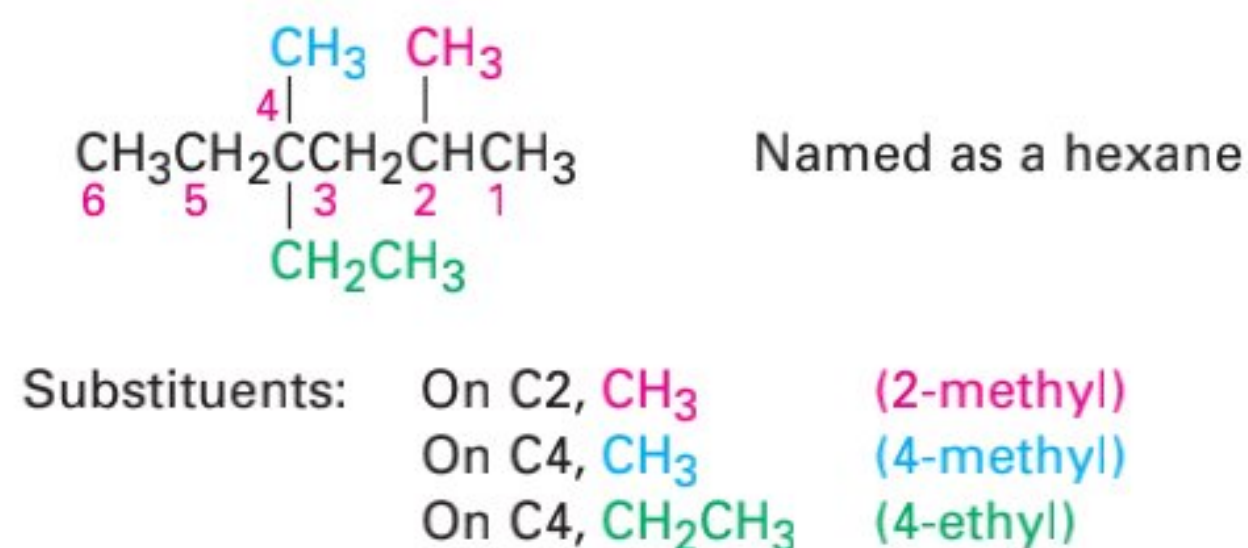
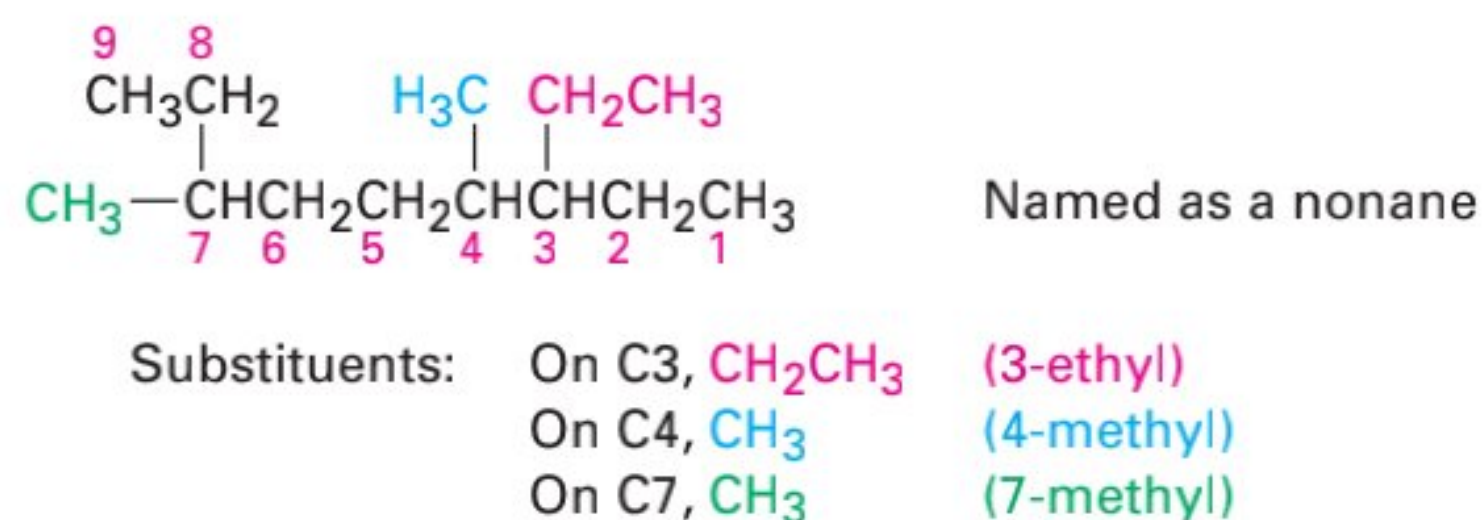
Beginning at the end nearer the first branch point, number each carbon atom in the parent chain.



The first branch occurs at C3 in the proper system of numbering but at C4 in the improper system.

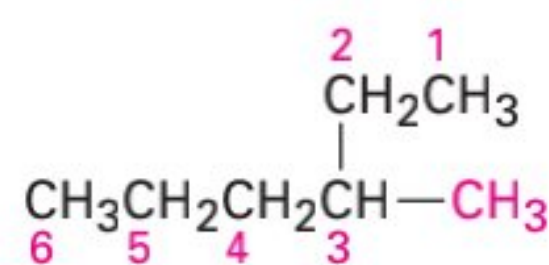
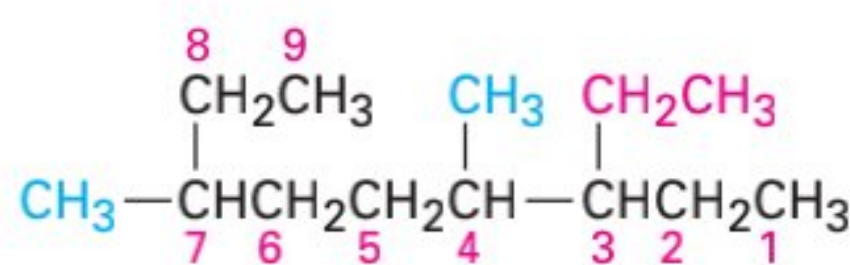
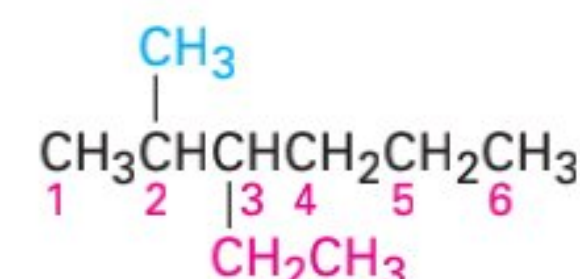
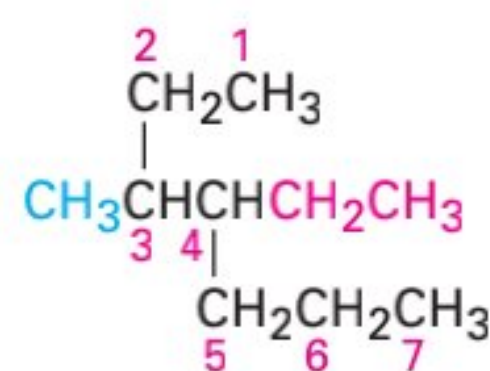
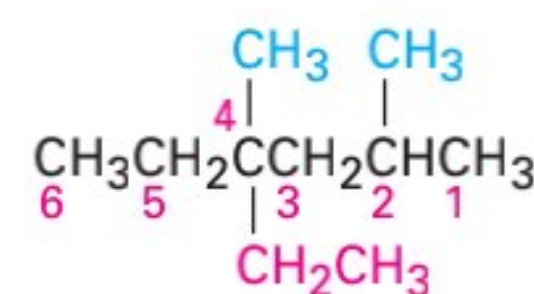
STEP 3 Identify and number the substituents.

Assign a number, called a *locant*, to each substituent to specify its point of attachment to the parent chain. If there are two substituents on the same carbon, assign them both the same number. There must always be as many numbers in the name as there are substituents.

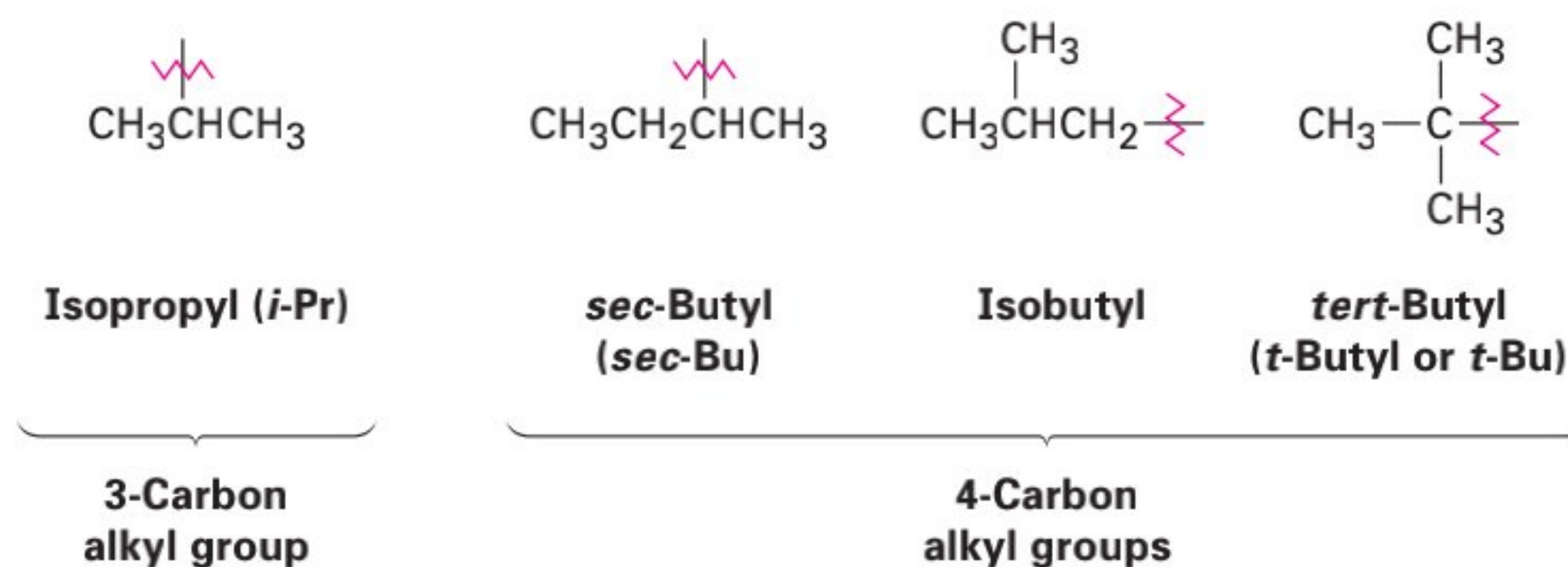


STEP 4 Write the name as a single word.

Use hyphens to separate the various prefixes and commas to separate numbers. If two or more different side chains are present, cite them in alphabetical order. If two or more identical side chains are present, use the appropriate multiplier prefixes *di-*, *tri-*, *tetra-*, and so forth. Don't use these prefixes for alphabetizing, though. Full names for some examples follow:

**3-Methylhexane****3-Ethyl-4,7-dimethylnonane****3-Ethyl-2-methylhexane****4-Ethyl-3-methylheptane****4-Ethyl-2,4-dimethylhexane**

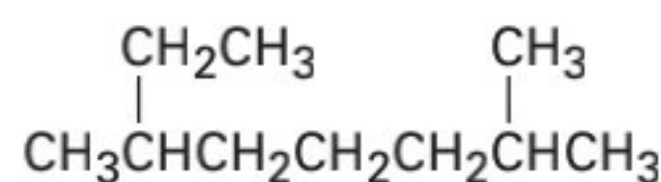
For historical reasons, a few simple branched-chain alkyl groups also have nonsystematic, common names, as noted in Figure 2.3.



When writing the name of an alkane that contains one of these alkyl groups, the nonhyphenated prefix *iso-* is considered part of the alkyl-group name for alphabetizing purposes, but the hyphenated and italicized prefixes *sec-* and *tert-* are not. Thus, isopropyl and isobutyl are listed alphabetically under *i*, but *sec*-butyl and *tert*-butyl are listed under *b*.

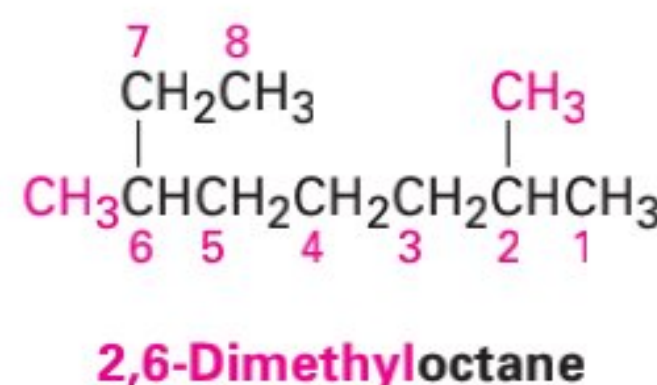
Worked Example 2.2**Naming an Alkane**

What is the IUPAC name of the following alkane?



Strategy The molecule has a chain of eight carbons (octane) with two methyl substituents. Numbering from the end nearer the first methyl substituent indicates that the methyls are at C2 and C6.

Solution

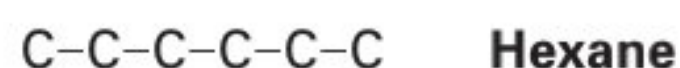


Worked Example 2.3

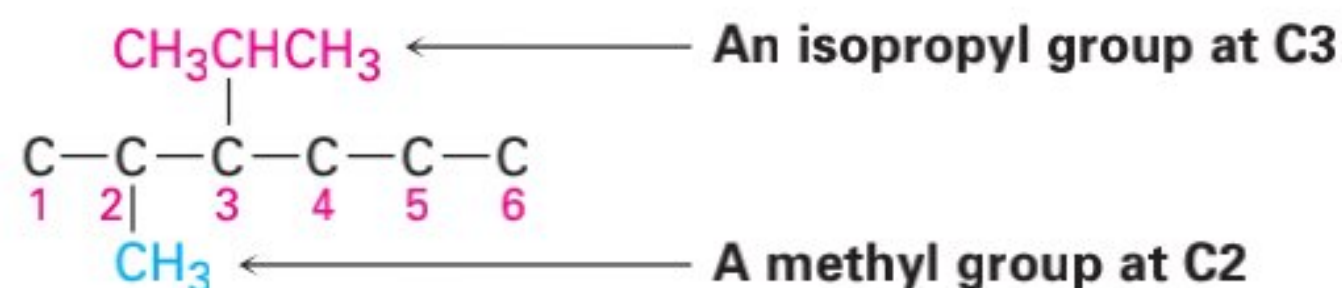
Drawing a Structure from a Name

Draw the structure of 3-isopropyl-2-methylhexane.

Strategy First, look at the parent name (hexane) and draw its carbon structure.

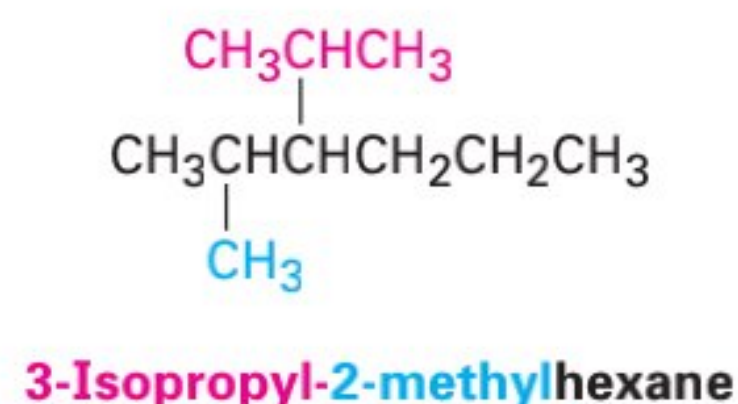


Next, find the substituents (3-isopropyl and 2-methyl), and place them on the proper carbons.



Finally, add hydrogens to complete the structure.

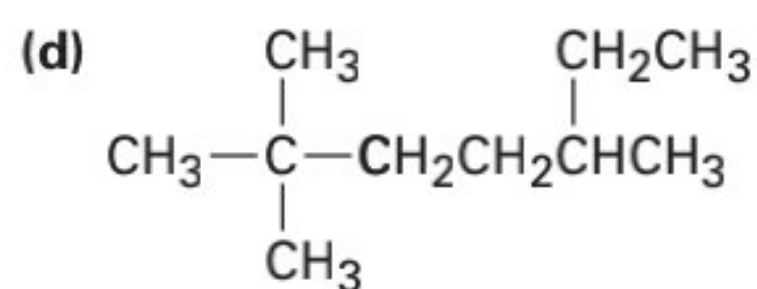
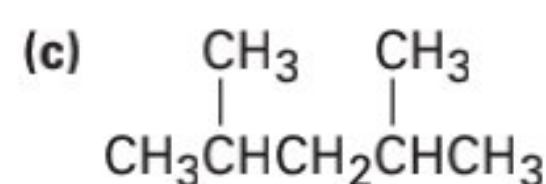
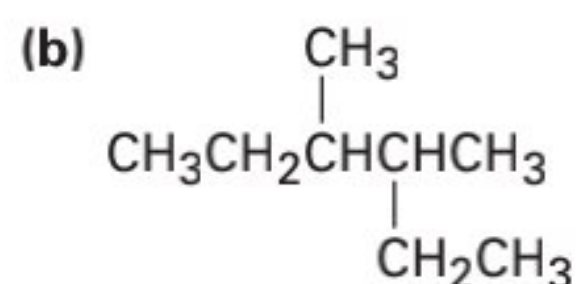
Solution



Problem 2.9

Give IUPAC names for the following alkanes:

(a) The three isomers of C_5H_{12}



Problem 2.10

Draw structures corresponding to the following IUPAC names:

(a) 3,4-Dimethylnonane

(b) 3-Ethyl-4,4-dimethylheptane

(c) 2,2-Dimethyl-4-propyloctane

(d) 2,2,4-Trimethylpentane