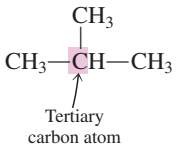
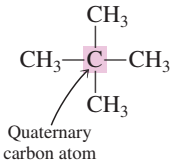
The notations 1°, 2°, 3°, and 4° are often used as designations for the terms *primary, secondary, tertiary,* and *quaternary.* Thus we can write

1° carbon atom
2° carbon atom
3° carbon atom
4° carbon atom

A **tertiary carbon atom** *is a carbon atom in an organic molecule that is bonded to three other carbon atoms.* The molecule 2-methylpropane contains a tertiary carbon atom.



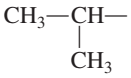
A **quaternary carbon atom** *is a carbon atom in an organic molecule that is bonded to four other carbon atoms.* The molecule 2,2-dimethylpropane contains a quaternary carbon atom.



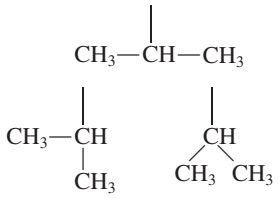
12.11 BRANCHED-CHAIN ALKYL GROUPS

To this point in the chapter, all alkyl groups encountered in structures have been continuous-chain alkyl groups (Table 12.3), the simplest type of alkyl group. Just as there are continuous-chain and branched-chain alkanes, there are continuous-chain and branched-chain alkyl groups. Four branched-chain alkyl groups, shown in Figure 12.5, are so common that you should know their names and structures.

For the two groups whose names contain the prefix *iso-* the common structural feature is an end-of-chain arrangement that contains two methyl groups.



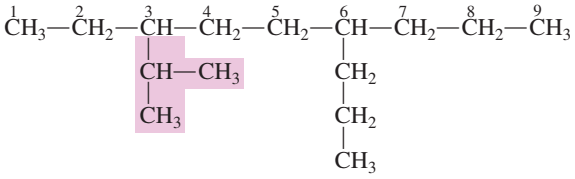
You need to be able to recognize various conformations of branched-chain alkyl groups. For example, these structures all represent an isopropyl group:



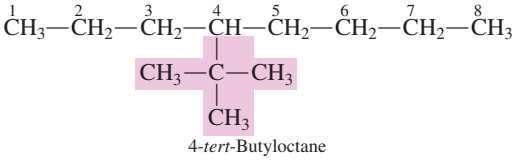
In each case, you have a chain of three carbon atoms with an attachment point (the long bond) involving the middle carbon atom of the chain.

For the *sec*-butyl group, the point of attachment of the group to the main carbon chain involves a *secondary* carbon atom. For the *tert*-butyl group, the point of attachment of the group to the main carbon chain involves a *tertiary* carbon atom.

Two examples of alkanes containing branched-chain alkyl groups follow.



3-Isopropyl-6-propylnonane



4-*tert*-Butyloctane

Figure 12.5 The four most common branched-chain alkyl groups and their IUPAC names.