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Octane

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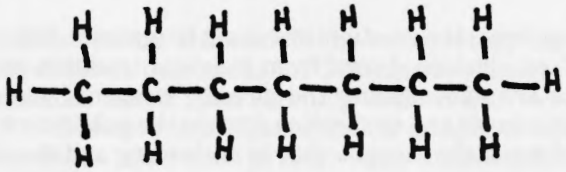
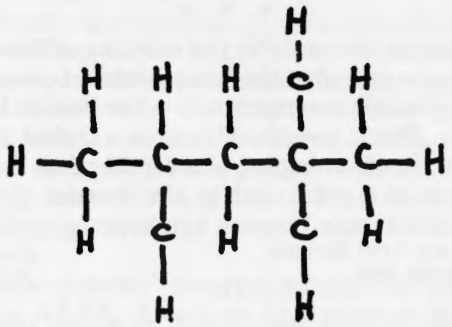
The octane rating of a gasoline is an indication of how a gas burns. Straight-chain hydrocarbon molecules (Fig. 1) are unsuitable for use in automobiles because they burn too rapidly causing the engine to knock and ping.



n-heptane (C_7H_{16})

Fig. 1. n-heptane has an octane rating of 0.

Such effects are not only harmful to engines but also indicate inefficient fuel consumption. Straight-chain hydrocarbons have low octane ratings. Branch-chain hydrocarbons (Fig. 2) burn with slow, smooth, efficient expansion and have high octane ratings.



Isooctane (C_8H_{18})

Fig. 2. Isooctane has an octane rating of 100.

The octane rating of straight-chain hydrocarbons can be improved by a process called "cracking and reforming." In this process, straight chain molecules are converted to branch-chain configurations. The octane rating of a gasoline may also be improved by using additives that control the burning rate of gas. The most common additive is tetraethyl lead. Three ml of tetraethyl lead added to a gallon of n-heptane increases the octane rating approximately 40%. If tetraethyl lead is not added, the percentage of branched hydrocarbon molecules in a gallon of gas must be increased. Cracking and reforming straight molecules into branched molecules makes unleaded gasoline more expensive.