3.2 ACTIVITY: BUILDING MOLECULAR MODELS

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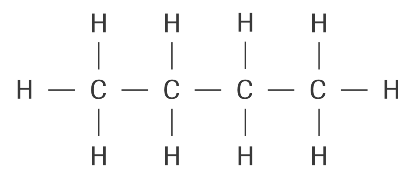
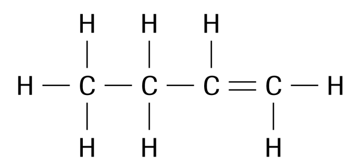
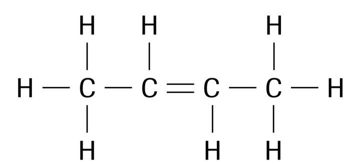
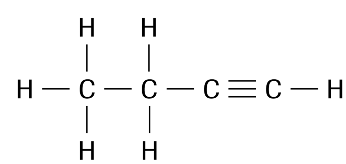
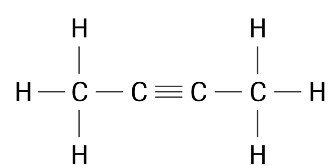
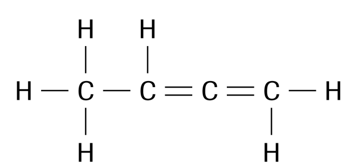
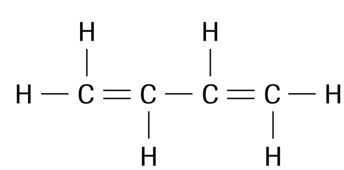
Observations

Sample Observation Table

Procedural step	Name	Formula	Structural formula
2.	butane	C_4H_{10}	
3.	1-butene	C_4H_8	
	2-butene		
4.	1-butyne	C_4H_6	
	2-butyne		
	1,2-butadiene		
	1,3-butadiene		

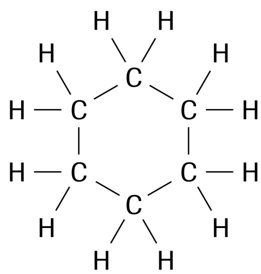
[Students are not expected to be able to name the alkenes with two double bonds because this nomenclature was not taught in the section.]

Synthesis

(c) (i) one (ii) three (iii) three
(d) (i) There is no functional group for which we need to indicate a location.
(ii) The carbon chain should be numbered in the opposite direction to give the lowest number: 2-hexene.
(iii) There can be no triple bond formed by a single carbon atom.
(e) A wooden stick is used to form the first bond in a multiple bond; the second or third bonds are formed by a spring, which more readily comes undone.

Extension

(f)



Isomer: 1-hexene

3.3 FRACTIONAL DISTILLATION AND CRACKING

TRY THIS ACTIVITY: THE GREAT MARBLE RACE

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(a) The marbles travelled more slowly in the oils designed for summer, and more quickly in the oils designed for winter. We could conclude that the "summer" oils are thicker (more viscous) than the "winter" oils. When each oil was cooled in the ice bath, the marbles travelled more slowly in them than before cooling. Similarly, the marbles travelled more quickly in the warmed oils. Cooler oils appear to be more viscous than warmer oils.

An explanation for these observations is that the forces of attraction between the molecules in the summer oils were stronger than the forces of attraction between molecules in the winter oils. Also, when cooled, the molecules moved more slowly and were closer together, with stronger forces of attraction. The reverse is true for the warmed oils.

(b) In cold winter temperatures, motor oils become more viscous. Therefore, a less viscous oil is needed in winter in order to have the same viscosity as the summer oils.

SECTION 3.3 QUESTIONS

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Understanding Concepts

1. Petroleum is a complex mixture of hydrocarbon molecules, formed from prehistoric plants and animals. This mixture contains gases, liquids, and dissolved solids composed of many different hydrocarbon molecules, some of which may be up to 40 carbon atoms long. Some components are used as fuels for heat and cooking, dry-cleaning solvents, gasoline, kerosene and diesel fuel, furnace oil, heavy greases, waxes, cosmetics, polishes, and asphalt and tar for roofs and roads.
2. (a) The small hydrocarbons molecules, such as methane, ethane, propane, and butane, exist as gases. Larger hydrocarbons are liquids, and the largest molecules, with boiling points over 400°C, exist as solids. The smaller the molecule is, the lower the boiling point it has.
(b) In fractional distillation, the entire mixture of hydrocarbons is first heated to very high temperatures—high enough to evaporate nearly all of the hydrocarbons, small and large. Then, the hot gases are allowed to rise in a tall fractionation tower. The upper parts of the tower are cooler than the lower parts. Each gas condenses at its own boiling point. As the hot gases travel up through the lower, warmer sections, the larger molecules