Try This Activity: Butane Behaviour

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- The volume of the butane gas is greater than the liquid as evidenced by the expansion of the plastic bag. The liquid butane feels very cold compared to the gas. Both the liquid and gas are colourless.
- A layer of yellow flame slowly burns down into the beaker. The bottom of the beaker feels cold. A tissue wiped on the insider of the beaker turns black.

(a) The butane gas occupies a larger volume than its liquid. As long as the bag is sealed, the amount of butane remains constant.
(b) The energy comes from the person's hand. The surface of the hand becomes cold, implying that energy is being removed (transferred to the butane).
(c) It suggests that butane is heavier or more dense than the surrounding air. This also explains why the butane gas remains largely in the open beaker when it forms from its liquid. The flame appears to be burning where the top of the butane is in contact with the air.
(d) The energy appears to come from the glass at the bottom of the beaker because the bottom was cold.
(e) The dark substance is probably carbon (soot).

11.1 ORGANIC COMPOUNDS

PRACTICE

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Understanding Concepts

1. The current definition of organic compounds includes almost all compounds of carbon. The original definition of organic compounds included only compounds formed by living things.
2. The major sources of hydrocarbons are fossil fuels.
3. Most scientists believe that fossil fuels are the remains of living things, acted on by heat and pressure and preserved underground through geologic time.
4. The primary use of hydrocarbons is as fuel for heat and electricity generation. Secondary uses include as source material for the production of plastics, pharmaceuticals, solvents, and many other industrial products.

Making Connections

5. The secondary uses of petrochemicals are extremely important to our society, but involve less than 5% of the raw material use. Fossil fuels are not renewable, and there are other ways to generate heat and electricity. We should be finding ways to conserve this resource for more critical uses.
6. Developing nations will probably not be happy with agreements that limit the growth in their use of hydrocarbons — arguing that the developed nations had no such restrictions when they were developing. Developed nations such as Canada use far more hydrocarbons per person than developing nations, and benefit from that usage; any system that starts from current usage and imposes reductions could doom developing countries to poverty, relative to the developed nations. Also, wealth allows flexibility — countries such as Canada should be able to convert more easily to alternative sources of energy, and so should be less harmed by any international limitations on fossil fuel use.

Reflecting

7. Biology relies heavily on a knowledge of organic chemistry, because nearly all molecules in living things are organic.

PRACTICE

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Understanding Concepts

8. Classification systems allow knowledge to be organized for easy reference and recall.
9. Hydrocarbons are substances with molecules composed solely of carbon and hydrogen atoms.
10. The two classes of hydrocarbons are aliphatic and aromatic compounds.
11. Hydrocarbon molecules are nonpolar. Only London forces act between such molecules.

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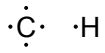
12. Carbon atoms can form up to four bonds, hydrogen atoms only one.



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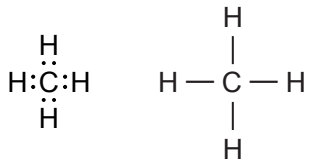
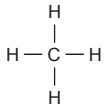
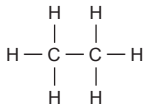


14.

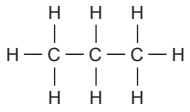
(a) methane



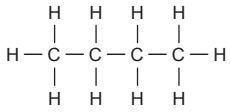
(b) ethane



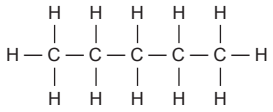
(c) propane



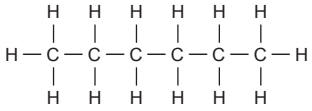
(d) butane



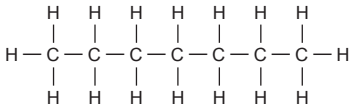
(e) pentane



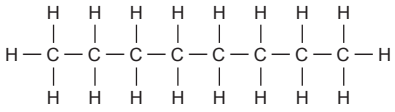
(f) hexane



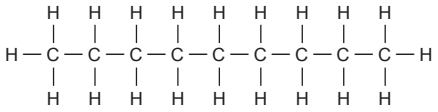
(g) heptane



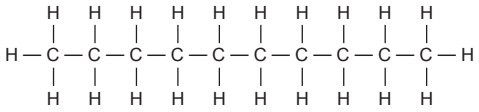
(h) octane



(i) nonane



(j) decane



15. $C_{30}H_{62}$ or $C_{30}H_{62(s)}$
16. All alkane names end in the sufix “ane.” This is for identification. It’s possible that “-ane” comes from “one.”

SECTION 11.1 QUESTIONS

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Understanding Concepts

1. (a) inorganic
   (b) organic
   (c) inorganic
   (d) organic
   (e) organic
2. The prevailing origin theory is that organic molecules in formerly living things, buried in sediment and drawn or pushed deep into the crust by geologic forces, are chemically transformed into hydrocarbons (fossil fuels) in the hot, high-pressure conditions.
3. Most organic compounds come from living things or are synthesized from petrochemicals.
4. Methane, propane, and butane are three common fuels.

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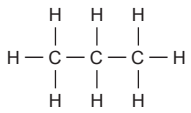
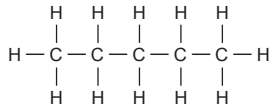
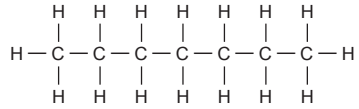
5 (a) C_3H_8



(b) C_5H_{12}



(c) C_7H_{16}



6. (a) ethane
   (b) butane
   (c) hexane
   (d) nonane
7. $C_{45}H_{92}$ is an alkane, since it fits the formula C_nH_{n+2}.

Applying Inquiry Skills

8. (a) Assume one mole (44.01 g) of the molecular compound.

$m_C = 81.68\% \times 44.01\text{ g} = 35.95\text{ g}$ $\quad M_C = 12.01\text{ g/mol}$

$m_H = 18.32\% \times 44.01\text{ g} = 8.063\text{ g}$ $\quad M_H = 1.01\text{ g/mol}$

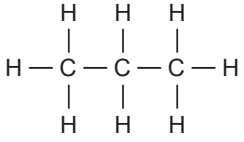
$$n_C = 35.95\ \cancel{\text{g}} \times \frac{1\text{ mol}}{12.01\ \cancel{\text{g}}}$$

$$n_C = 2.993\text{ mol}$$

$$n_H = 8.063\ \cancel{\text{g}} \times \frac{1\text{ mol}}{1.01\ \cancel{\text{g}}}$$

$$n_H = 7.98\text{ mol}$$

The molecular formula of the compound is C_3H_8, so it is propane.
The structure is



Making Connections

9. To the best of our current knowledge, fossil fuels require many millions of years to form, so even though more are presumably forming as we answer this question, from our point of view they are still a finite resource.

Reflecting

10. Without fossil fuels, if we were still capable of and interested in making detergents, plastics, and fabrics, the only abundant source of organic matter would be biological material, i.e., living things. Perhaps carbon could be extracted from rocks, such as limestone, and hydrogen from water. Energy sources might include solar, wind, water, nuclear, or geothermal (which is also nuclear) energy.

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