Name _____

Date _____ Period _____

Constructing Models of Organic Compounds

PROBLEM

How are molecular model kits used to study organic molecules?

INTRODUCTION

Molecules are three dimensional structures. Organic molecules are the most varied and complex of all molecules. Molecules with the same simple formula often have different shapes. Molecular models can be used to study their shapes. In this laboratory exercise, you will use a molecular model kit to construct models of organic molecules and you will draw diagrams illustrating their structures.

MATERIALS (per group)

Molecular model kit

PROCEDURE

1. Examine the contents of the molecular model kit. Each kit should contain colored spheres to represent atoms and sticks or springs to represent bonds. Table I shows the characteristics of each of the types of spheres.

2. To begin constructing a model, select the spheres needed to represent each of the atoms shown by the formula. For example, if the formula were C_2H_4O, you would select two black spheres, four yellow spheres, and one red sphere.

3. After selecting the spheres, attach them together using the sticks. Each stick represents a single bond. Use long sticks to represent bonds between two carbons, and short sticks to represent other bonds. See Figure 1-a below.

4. The holes in the spheres represent bonding sites. Attach the spheres together in such a way that all the holes are filled. If all the holes are not filled when all the spheres are in place, use springs to make double or triple bonds. See Figure 1-a below.

Table I. Characteristics of spheres representing atoms

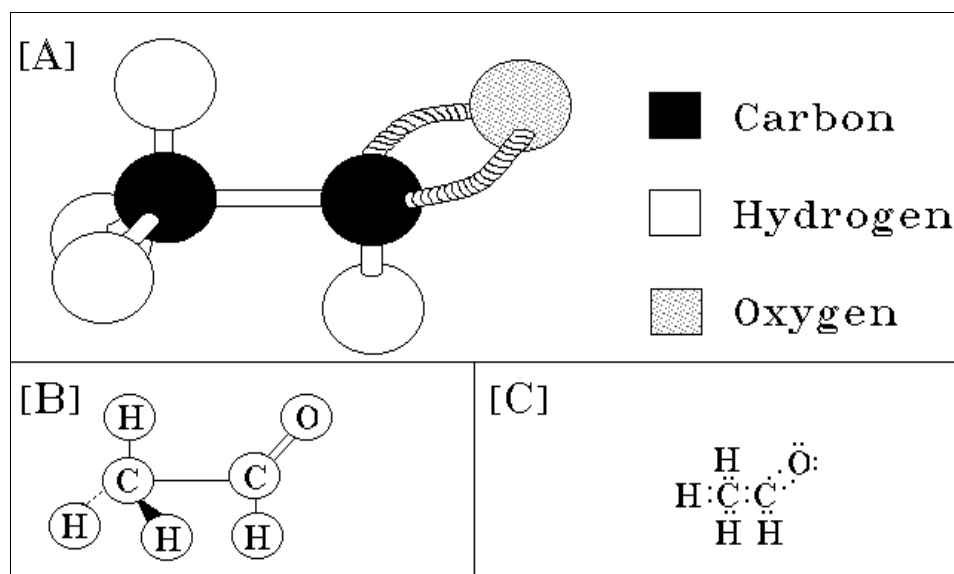| Element	Color	Holes
Carbon	Black	4
Hydrogen	Yellow	1
Oxygen	Red	2
Nitrogen	Blue	5
Chlorine	Green	1
Bromine	Orange	1
Iodine	Purple	1

Figure 1. *The structure of C_2H_4O: (a) a molecular model; (b) a molecular diagram; (c) an electron dot diagram.*

5. Construct models of each of the following, keeping the atoms in the same order as shown by the graphic formulas for models 4-10: (1) methane [CH_4]; (2) ethene [C_2H_4]; (3) chloroethane [C_2H_7Cl]; (4)methanal [HCHO]; (5) propanone [CH_3COCH_3]; (6)methanoic acid [HCOOH]; (7) ethanol [CH_3CH_2OH]; (8) methoxymethane [CH_3OCH_3] ; (9) methyl methanoate [$HCOOCH_3$]; and (10) ethyne[C_2H_2].

6. Based on the model, draw a molecular diagram of each compound on a separate sheet of paper. Draw a circle for each atom labeled with its symbol and a line for each bond. For bonds going behind the plane of the paper draw a dotted line. For bonds in the plane of the paper draw a single line. For bonds coming out of the plane of the paper, draw a heavy line in perspective. See Figure 1-b on the previous page.

7. On a separate sheet of paper, draw the electron dot diagram for each compound. See Figure 1-c on the previous page. Each bond represents a shared pair of electrons. Outer shells should be complete.

OBSERVATIONS

DRAWINGS: (On separate sheet)

1. Which of the compounds above has double bonds? _____

2. Which of the compounds above has triple bonds? _____

3. How many other atoms can carbon combine with at once (*HINT:* Look at methane.)? _____
    _____

CONCLUSIONS

1. Why does the black sphere have four holes (*HINT:* Refer to the periodic table.)? _____
    _____
    _____
    _____

2. What is the purpose of using molecular models? _____
    _____
    _____
    _____

3. The formula for ethanol is C_2H_6O. The formula for methoxymethane is the same.

    [a] Draw all the isomers of C_2H_6O.

    [b] How could the molecular model kit be used to help identify all the arrangements of
         C_2H_6O? _____
         _____
         _____

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(1) methane [CH$_4$]	(2) ethene [C$_2$H$_4$]
(3) chloroethane [C$_2$H$_7$Cl]	(4) methanal [HCHO]
(5) propanone [CH$_3$COCH$_3$]	(6) methanoic acid [HCOOH]
(7) ethanol [CH$_3$CH$_2$OH]	(8) methoxymethane [CH$_3$OCH$_3$]
(9) methyl methanoate [HCOOCH$_3$]	(10) ethyne [C$_2$H$_2$]