

## Chapter 1

# Introduction to Structural Spectroscopy

**1-1 (a), (b), and (d)** structural isomers; **(c)** and **(e)** stereoisomers

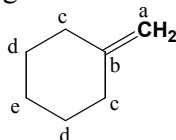
**1-2 (a)**  $C_7H_{12}$ , 87.42% C, 12.58% H;  $C_5H_{11}N$ , 70.53% C, 13.02% H, 16.45% N;  
 $C_8H_{16}$ , 85.63% C, 14.37% H;  $C_7H_{10}O_2$ , 71.98% C, 6.71% H, 21.31% O;  
 $C_7H_{10}O$ , 76.32% C, 9.15% H, 14.53% O

**(b)** 2, 1, 1, 5, 3

**(c)** double bond; amine, cyclopropane; none; phenyl, ester; double bond, hydroxyl

**1-3 1-1(a)**, left: 7 distinct carbons; 4 different pairs of methylene hydrogens, 1 methyl trio of hydrogens, 1 alkenic hydrogen

**1-1(a)**, right: 5 different kinds of carbons in the ratio 2/2/1/1/1. The 3 unique carbons (a, b, e; see structure below) are on the axis of symmetry; the 2 pairs (c, d) are off the axis. There are 4 kinds of hydrogens in the ratio 4/4/2/2. The 2 pairs (a, e) are on the axis, the 2 sets of 4 (c, d) are off it. This analysis assumes rapid ring flipping.



**1-1(d)**, both: there are 7 kinds of carbons in the ratio 2/2/1/1/1/1/1 (ortho and meta carbons on the phenyl ring are doubled); there are 5 kinds of hydrogens in the ratio 3/2/2/2/1.

**1-1(e)**, both: there are 4 kinds of carbons in the ratio 2/2/2/1 (note the mirror plane in the molecule); there are 6 kinds of hydrogens in the ratio 2/2/2/2/1/1 (the hydrogens of the CH<sub>2</sub>CH<sub>2</sub> portion are made up of 2 exo and 2 endo types).

**1-4 (a)**  $C_5H_8O_2$

**(b)**  $C_7H_{13}ON$

