

Chapter 7 – Alkenes: Structure and Reactivity

Solutions to Problems

- 7.1 Because two hydrogens must be removed from a saturated compound to introduce an unsaturation, a compound's degree of unsaturation refers to the number of pairs of hydrogens by which its formula differs from that of the corresponding saturated compound. For example, a saturated alkane with four carbons has the formula C_4H_{10} . The compound in (a), C_4H_8 , which has two fewer (or one pair fewer) hydrogens, may have a double bond or a ring. C_4H_{14} thus has a degree of unsaturation of 1.

Compound	Degree of Unsaturation	Structures		
(a) C_4H_8	1	$CH_3CH=CHCH_3$	$CH_3CH_2CH=CH_2$	$(CH_3)_2C=CH_2$
				
(b) C_4H_6	2	$CH_2=CHCH=CH_2$	$CH_3CH=C=CH_2$	$CH_3C\equiv CCH_3$
		$CH_3CH_2C\equiv CH$		
				
(c) C_3H_4	2	$H_2C=C=CH_2$	$CH_3C\equiv CH$	

- 7.2 Unlike the hydrocarbons in the previous problems, the compounds in this problem contain additional elements. Review the rules for these elements.
- Subtract one hydrogen for each nitrogen present to find the formula of the equivalent hydrocarbon – C_6H_4 . Compared to the alkane C_6H_{14} , the compound of formula C_6H_4 has 10 fewer hydrogens, or 5 fewer hydrogen pairs, and has a degree of unsaturation of 5.
 - $C_6H_5NO_2$ also has 5 degrees of unsaturation because oxygen does not affect the equivalent hydrocarbon formula of a compound.
 - A halogen atom is equivalent to a hydrogen atom in calculating the equivalent hydrocarbon formula. For $C_8H_5Cl_3$, the equivalent hydrocarbon formula is C_8H_{12} , and the degree of unsaturation is 3.
 - $C_9H_{16}Br_2$ – one degree of unsaturation.
 - $C_{10}H_{12}N_2O_3$ – 6 degrees of unsaturation.
 - $C_{20}H_{30}ClN$ – 5 degrees of unsaturation.

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