

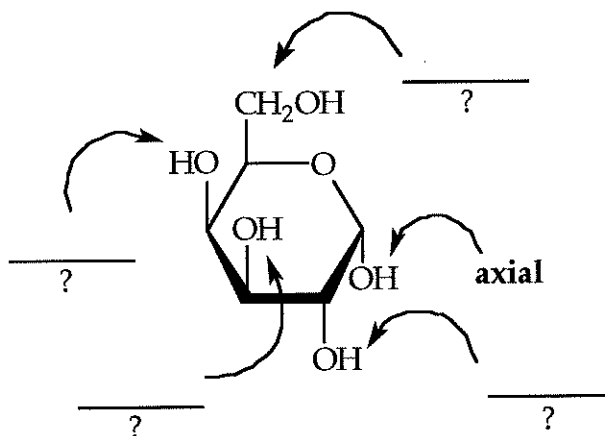
- (4) 1. An acyclic alkane whose molar mass is 310 g/mol must have the molecular formula C\_\_H\_\_ (a **generic formula is unacceptable**).
- (4) 2. Upon combustion, a hydrocarbon yields 0.261 moles of CO<sub>2</sub> and 0.196 moles of H<sub>2</sub>O. The empirical formula of the hydrocarbon is:  
a) C<sub>4</sub>H<sub>9</sub>    b) C<sub>4</sub>H<sub>3</sub>    c) C<sub>3</sub>H<sub>4</sub>    d) C<sub>2</sub>H<sub>5</sub>    e) C<sub>2</sub>H<sub>3</sub>
- (4) 3. Which one of the following represents a pair of **structural (constitutional)** isomers?  
a) 2-chloro-2-methylpropane versus tert-butyl chloride  
b) isobutyl chloride versus isobutyl bromide  
c) CH<sub>2</sub>=CHCH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> versus ethylcyclopropane  
d) cyclooctane versus n-octane  
e) None of the above pairs illustrates structural isomerism
- (4) 4. The number of **tertiary carbon** atoms present in a 2,3,4-trimethylpentane molecule is \_\_\_\_\_.  
a) two    b) three    c) five    d) eight    e) none
- (4) 5. The IUPAC name of the C<sub>7</sub>H<sub>15</sub>Cl structural isomer that is **not** a **secondary** alkyl chloride is:  
a) 2-chloroheptane    b) 3-chloroheptane    c) 4-chloroheptane  
d) 2-chloro-2,3-dimethylpentane    e) 2-chloro-3,3-dimethylpentane
- (4) 6. There are \_\_\_\_ structurally isomeric compounds of formula C<sub>3</sub>H<sub>6</sub>BrCl.  
a) six    b) five    c) four    d) three    e) two
- (4) 7. In the **most stable** chair conformation of **cis**-1-tert-butyl-4-methylcyclohexane, the methyl group is oriented \_\_\_\_, and the tert-butyl group is oriented \_\_\_\_, respectively.  
a) axial, equatorial    b) equatorial, axial  
c) equatorial, equatorial    d) axial, axial

(4) 8. Which of the following dimethylcyclohexanes **cannot** exist in an **equatorial, equatorial** chair conformation?

- i) 1,1-dimethylcyclohexane      ii) trans-1,2-dimethylcyclohexane  
 iii) cis-1,2-dimethylcyclohexane    iv) cis-1,3-dimethylcyclohexane

- a) i only    b) i & ii    c) i & iii    d) i & iv    e) ii & iv

(4) 9.  $\alpha$ -D-Galactopyranose, a carbohydrate present in milk sugar, exists in a chair conformation analagous to that of cyclohexane. In the illustration shown below, use the reference position indicated to determine whether the remaining substituents are located at **axial** or **equatorial** bond positions:



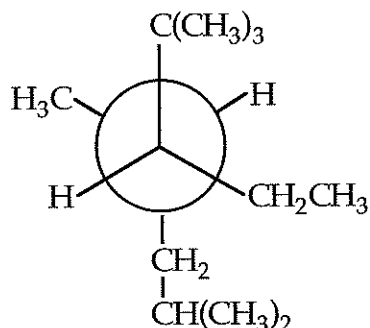
(12) 10. Match the relative yields in Column A with the appropriate monochlorination product of 2,2,4,6,6-pentamethylheptane shown in Column B. Relative rates of reaction per hydrogen atom for chlorination at 25°C are 5.0:3.8:1.0 for 3° vs 2° vs 1° hydrogens, respectively.

Column A

Column B

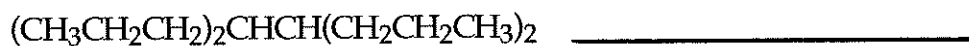
7.3%	1-chloro-2,2,4,6,6-pentamethylheptane	_____
12.1%	3-chloro-2,2,4,6,6-pentamethylheptane	_____
36.9%	4-chloro-2,2,4,6,6-pentamethylheptane	_____
43.7%	(CH <sub>3</sub> ) <sub>3</sub> CCH <sub>2</sub> CH(CH <sub>2</sub> Cl)CH <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub>	_____

11. Consider the Newman projection shown below:



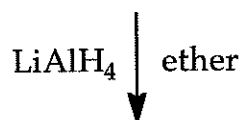
- (3) a) The correct IUPAC name of the above hydrocarbon is:  
\_\_\_\_\_
- (3) b) In the conformation shown, the front carbon is number \_\_\_\_ and the rear carbon is number \_\_\_\_.
- (3) c) In the conformation shown, the name of the alkyl substituent that is **anti** to the tert-butyl (or 1,1-dimethylethyl) group is:  
\_\_\_\_\_

(8) 12. Name the following compounds according to IUPAC rules:

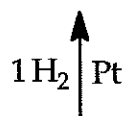


- (22) 13. Provide the correct structures for each of the missing starting materials in the following syntheses of **2,4-dimethylpentane**:

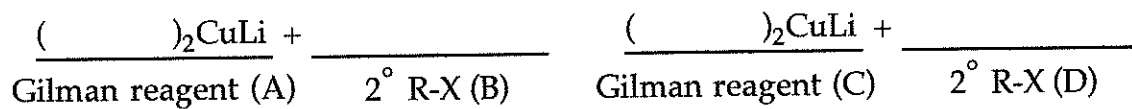
\_\_\_\_\_ or \_\_\_\_\_ or \_\_\_\_\_  
structural isomers



**2,4-dimethylpentane**



\_\_\_\_\_ or \_\_\_\_\_  
structural isomers



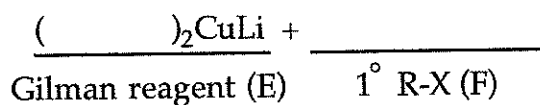
**2,4-dimethylpentane**

+

LiX

+

alkylcopper byproducts



14. Compound X contains 16.86% carbon, 2.11% hydrogen, 56.13% bromine, and 24.90% chlorine by mass.
- (4) a) If the molar mass of compound X is 284.71 g/mol, what is the molecular formula of compound X? Show all work in the space provided below.
- (9) b) The hydrogen atoms in a molecule of compound X exist in **two** distinct environments. Draw three different structural formulas for compound X that are consistent with all the data.

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