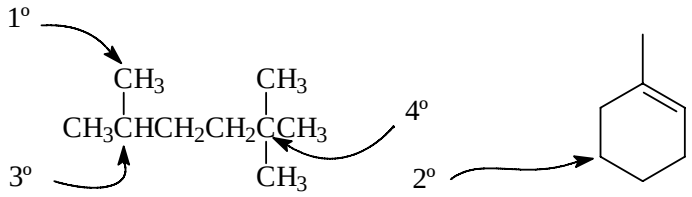
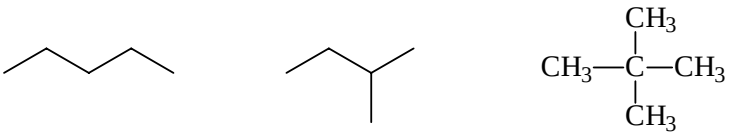
CHM 211 **Name** *Answer Key*

Test 2 (Ch. 3 (exc. 3.1)**, 4, 5)** **60 points** **May 28, 2009**

1. (4) Indicate the degree of substitution (1º, 2º, 3º or 4º) of each carbon atom indicated by an arrow in the structures below:



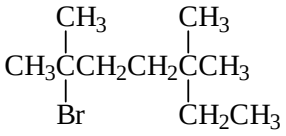
2. (2) Sketch three different isomers of C_5H_{12}. Use the skeletal (line) representation for at least one sketch.



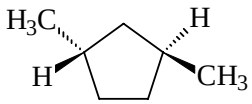
3. (2) Name each of the following groups:

isopropyl ***sec-butyl***

4. (2) Give the correct systematic (IUPAC) name for each of the following structures:



2-bromo-2,5,5-trimethylheptane



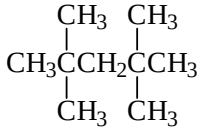
trans-1,3-dimethylcyclopentane

6. (2) Name the two chemical reactions that alkanes undergo.

   a. ***combustion***

   b. ***halogenation***

7. (4) Circle the structure with the higher boiling point within each pair, and state why in a few words.

$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$ or 

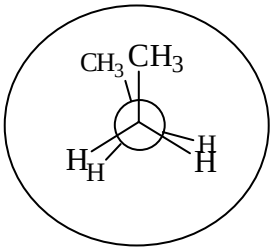
The more elongated the molecule is, the greater the van der Waals forces

$CH_3CH_2OCH_3$ or $CH_3CH_2CH_2OH$

hydrogen bonding

8. (4) Name two major factors that contribute most to the strain energy in cyclopropane and cyclobutane.
   a. ***torsional strain***
   b. ***bond angle strain***

9. (6) Newman projections of three conformations of butane are shown below. Under each sketch, write the name of the conformation. In the blank space to the right, sketch the Newman projection of the lowest energy (most stable) conformation of butane; write its name on the line under it. Circle the sketch of the highest energy (least stable) conformation.



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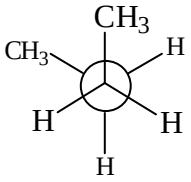
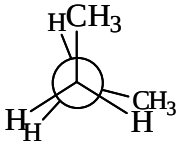
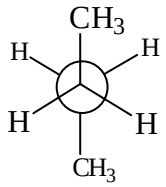


gauche



eclipsed

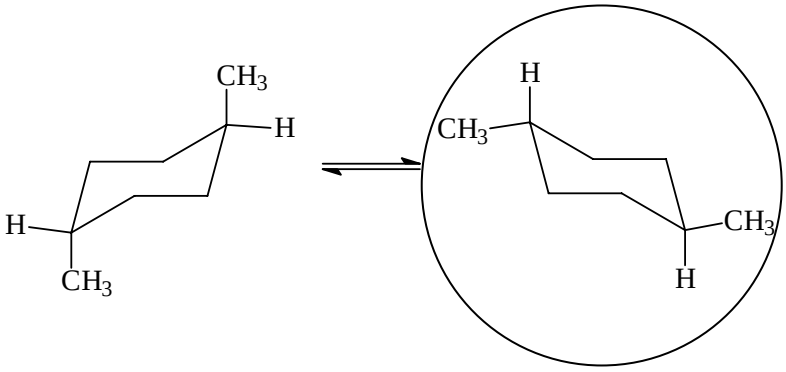


anti

10. (4) Sketch and name the conformation that cyclopentane occupies in order to partially alleviate torsional strain due to eclipsing C-H bonds on adjacent carbon atoms.

envelope conformation

11. (6) Carefully and neatly sketch the two different interconvertible chair conformations of *trans*-1,4-dimethylcyclohexane. Circle the lower energy conformation (if they are equal in energy, write EQUAL).



Circle the best choice in each set of parentheses:

12. (2) When a bond is broken homolytically, (heavy atoms, ions, mu mesons, photons, radicals, liberals, conservatives) are formed.

13. (2) When ions combine to form a covalent bond, it is called (anthropogenic, homogenic, photogenic, heterogenic, cryogenic, thermogenic) bond formation.

14. (2) The following reaction is an example of a(n): (addition, elimination, substitution, rearrangement) reaction.

15. (2) During the chlorination of methane, a small amount of ethane is formed during a (initiation, termination, propagation) step.

16. (4) Circle the species below which should act as nucleophiles.

17. (4) Circle the species below which should act as electrophiles.

18. (4) Referring to an energy vs. reaction progress diagram (right) the difference in energy between reactants and products affects the (equilibrium constant, rate, entropy) of the reaction; the height of the energy barrier between reactants and products affects the (equilibrium constant, rate, entropy) of the reaction.
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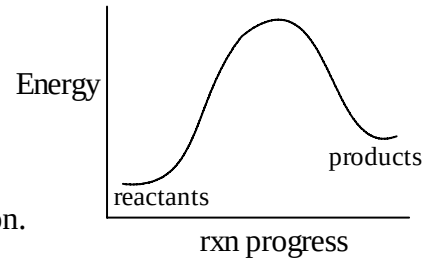
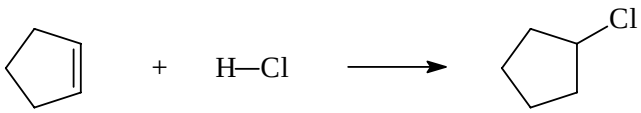


19. (4) Using the table of homolytic bond dissociation energies below, calculate (estimate) the enthalpy of the following ionic reaction (be sure to indicate whether the reaction is endothermic or exothermic; a proper sign of the ΔH_{rxn} will suffice)

C=C	611 kJ/mol
C-C	376 kJ/mol
C-Cl	339 kJ/mol
H-Cl	432 kJ/mol
C-H	390 kJ/mol
Cl-Cl	243 kJ/mol



ΔH = ΣΔH (bonds broken) - ΣΔH (bonds formed)

ΔH = ΔH (C=C) + ΔH (H-Cl) - ΔH (C-C) - ΔH (C-Cl) - ΔH (C-H)

ΔH = 611 + 432– 376 – 339 – 390 = – 62 kJ/mol (exothermic)