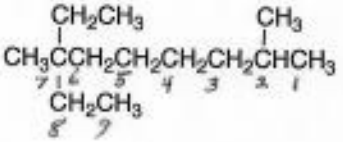
Name: Solutions

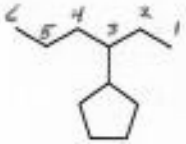
1. Provide the correct name for each of the following compounds using IUPAC nomenclature. Indicate the stereochemistry (i.e., which geometrical isomer) of the last compound. [24 pts; 4 pts each]

IUPAC Name

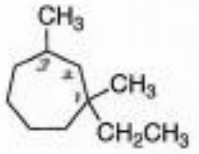
$CH_3(CH_2)_8CH_3$ ⇨ decane or n-decane



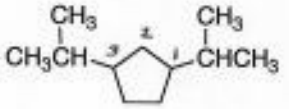
⇨ 7-ethyl-2,7-dimethylnonane



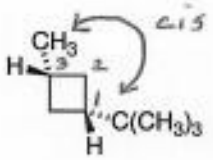
⇨ 3-cyclopentylhexane



⇨ 1-ethyl-1,3-dimethylcycloheptane



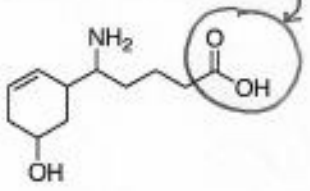
⇨ 1,3-diisopropylcyclopentane



⇨ cis-1-t-butyl-3-methylcyclobutane

2. a. Circle the carboxylic acid functional group on the compound below. [3 pts]

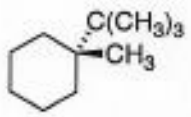
b. Indicate the number of different functional groups present in the compound below in the box provided. [3 pts]



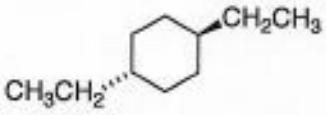
number of different functional groups = 4

alcohol - OH
alkene - C=C
amine - NH_2
carboxylic acid - CO_2H

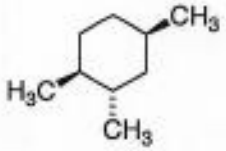
3. Draw the chair conformation that is *lowest* in energy for each compound in the box provided. [12 pts; 4 pts each]



larger tBu group equatorial

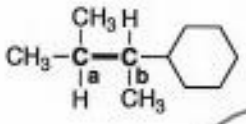


both Et groups equatorial



two Me groups equatorial

4. a. Draw Newman projections for the three staggered conformations of the compound below looking down the $\mathbf{C_a}$-$\mathbf{C_b}$ bond using the templates below. [6 pts; 2 pts each]

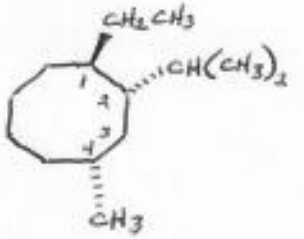


b. Circle the conformation in part (a) above that is lowest in energy. [3 pts]

5. Draw the structures of the following compounds in the boxes provided. [8 pts; 4 pts each]

bicyclo[4.4.0]decane ⟹

trans,cis-1-ethyl-2-isopropyl-4-methylcyclooctane ⟹

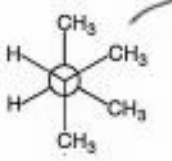


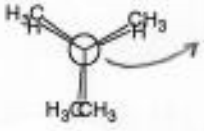
6. Indicate the number of secondary (2°) and quaternary (4°) carbon atoms present in the substituted norbornane below. [4 pts; 2 pts each]

# of secondary (2°) carbon atoms = 4

# of quaterary (4°) carbon atoms = 2

7. a. Newman projections for two conformations of 2,3-dimethylbutane are shown below. Also shown are the strain energies for the different types of gauche and eclipsing interactions. Calculate the difference in energy between the two conformations of 2,3-dimethylbutane. [6 pts]





3 CH_3/CH_3 gauche ⇒ 3(3.8) = 11.4

2 CH_3/H eclipsing + 1 CH_3/CH_3 eclipsing ⇒ 2(5.4) + 1(13.0) = 23.8

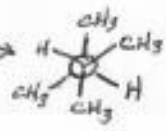
difference ⇒ 23.8 − 11.4 = 12.4

Type of Interaction	Strain Energy (kJ/mol)
CH_3/CH_3 gauche	3.8
H/H eclipsing	4.2
CH_3/H eclipsing	5.4
CH_3/CH_3 eclipsing	13.0

difference in energy = 12.4 kJ/mol

b. Does the staggered conformation shown in part (a) represent the conformation of 2,3-dimethylbutane having the lowest possible energy? Circle your answer. [3 pts]

Yes (No)

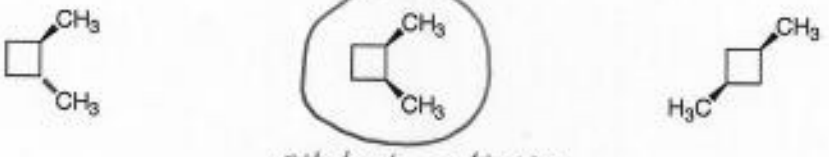


lowest E

8. Circle the structure or conformation that has the greatest total amount of strain (torsional, angle, ring, steric, etc.) in each set (a-c) below. [12 pts 4 pts each]

a. 

b. 

c. 

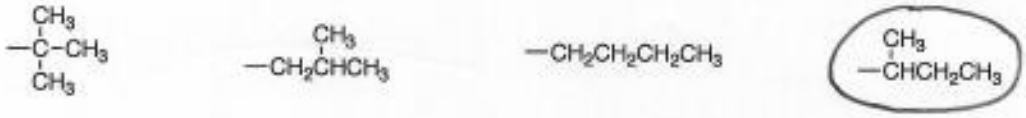
CH_3 / CH_3 eclipsing

11. Which one of the following is named as a spirocyclic compound? Circle your answer. [4 pts]

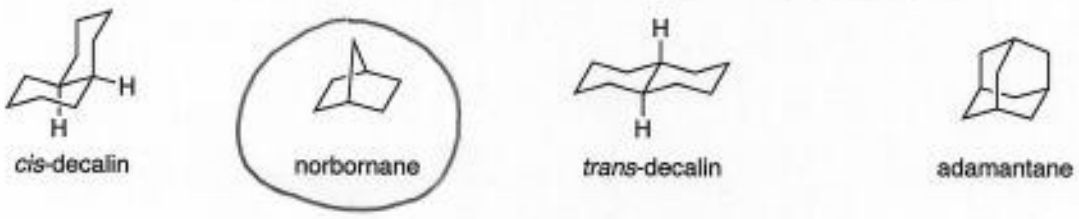
9. The lowest energy conformation of cyclopentane is the envelope conformation, where four carbon atoms are coplanar and one carbon atom sits above the plane of the other four carbon atoms forming the flap of the envelope. Which factor contributes the most toward explaining why one carbon atom twists out of the plane of the other four carbon atoms? Circle your answer. [4 pts]

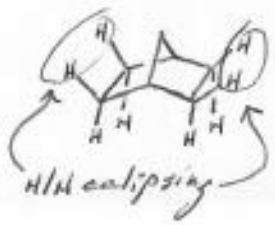
a. Reduction in torsional strain. b. Reduction in angle strain. c. Reduction in 1-3-diaxial interactions

10. Which one of the following is a *sec*-butyl group? Circle your answer. [4 pts]



12. Circle the polycyclic ring system below that contains the greatest amount of *ring strain*. [4 pts]





H/H eclipsing

Score: _____/100