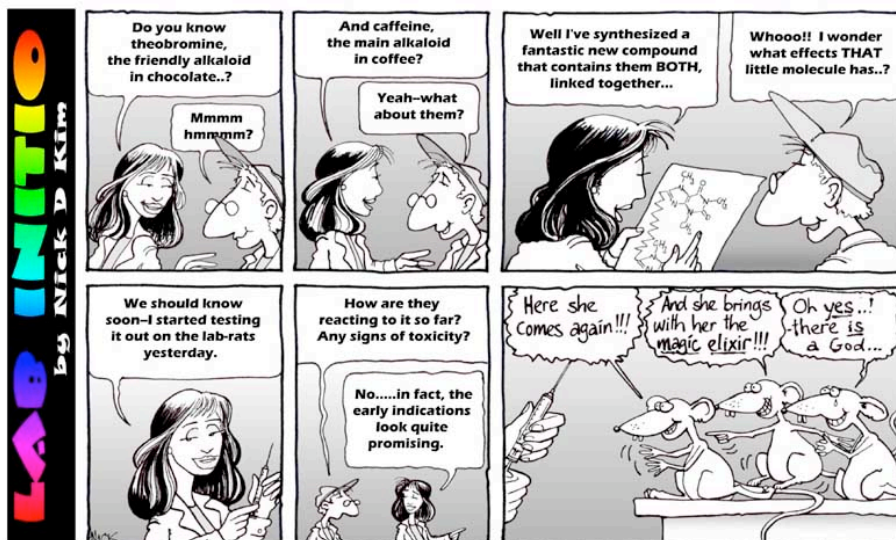
**KEY**

Please read through each question carefully and answer in the spaces provided.

A good strategy is to go through the test and answer all the questions you can do easily. Then go back and tackle the more difficult problems.

Please make sure your structures are drawn clearly and indicate any necessary stereochemistry with bold or dashed bonds.

Finally, think about what you know. Reason and common sense can often help you out.

You may use the back of the pages for scratch paper.

Problem 1 12 pts \_\_\_\_\_

Problem 6 20 pts \_\_\_\_\_

Problem 2 12 pts \_\_\_\_\_

Problem 7 8 pts \_\_\_\_\_

Problem 3 10 pts \_\_\_\_\_

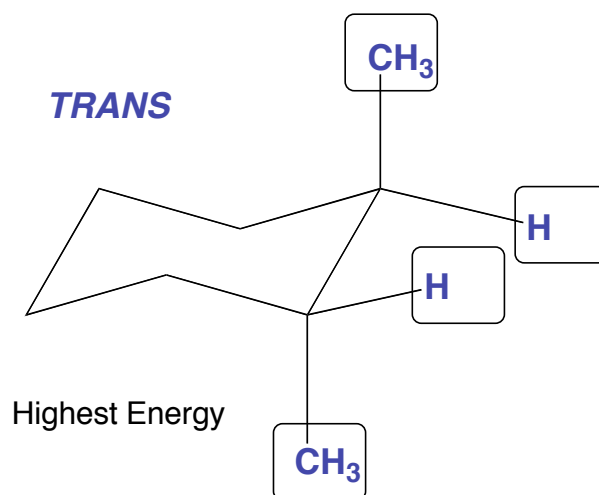
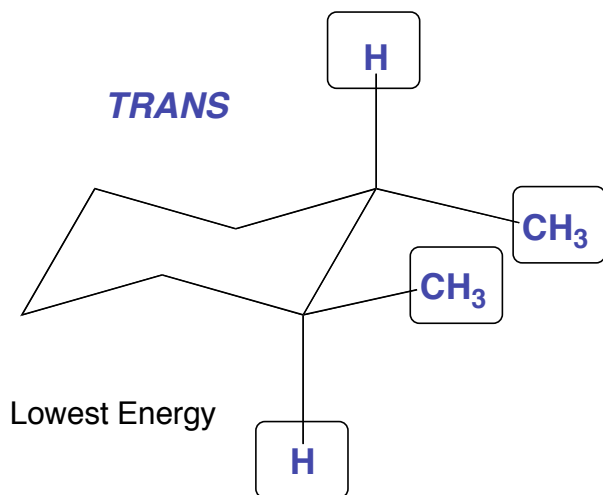
Problem 8 4 pts \_\_\_\_\_

Problem 4 18 pts \_\_\_\_\_

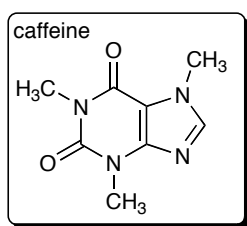
Problem 5 16 pts \_\_\_\_\_

TOTAL 100 pts \_\_\_\_\_

1. 1,2-Dimethylcyclohexane can exist in either the cis-form or the trans-form. Furthermore, the two chair conformations for both isomers may be at different energies. Fill in the CH<sub>3</sub> and H in the boxes below for the most stable stereoisomer in the most stable conformation and the least stable structure in the highest energy conformation. Label each structure as being either cis or trans. (12 pts)



2. Answer the following questions about the natural compound caffeine. (12 pts)



a) How many electrons reside in pi-bonds? (do not count lone pairs)

8

b) How many sp<sup>2</sup> atoms are present?

8

c) What is the hybridization of the oxygens in this molecule?

sp<sup>2</sup>

d) How many sigma bonds are present?

25

e) How many primary (1°) hydrogens are present?

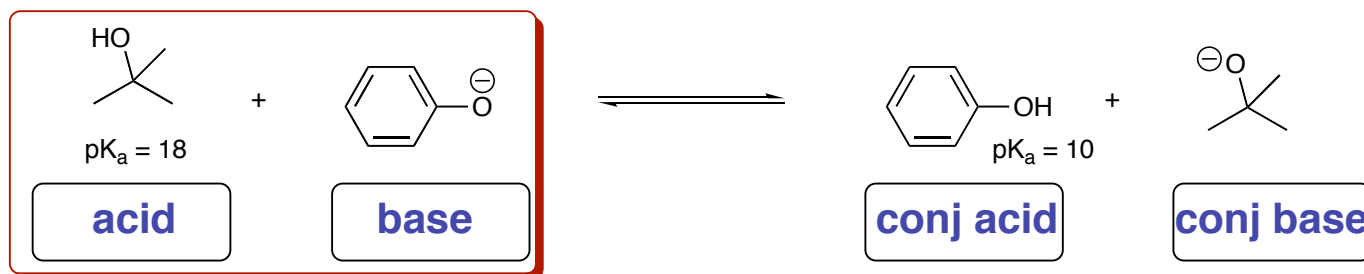
0

f) How many lone pairs are present in the molecule?

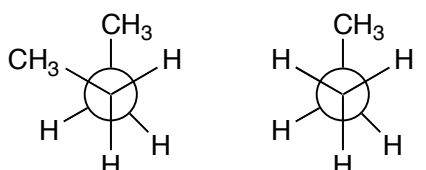
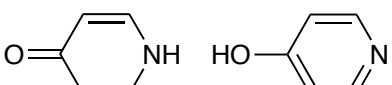
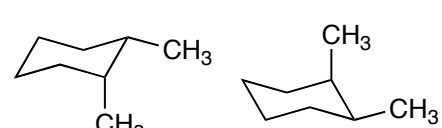
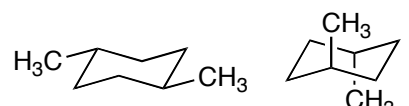
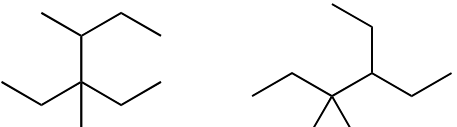

8

9 was also accepted as an answer for the 3 methyl groups. Note, they are not attached to any carbons, so technically these are not considered primary.

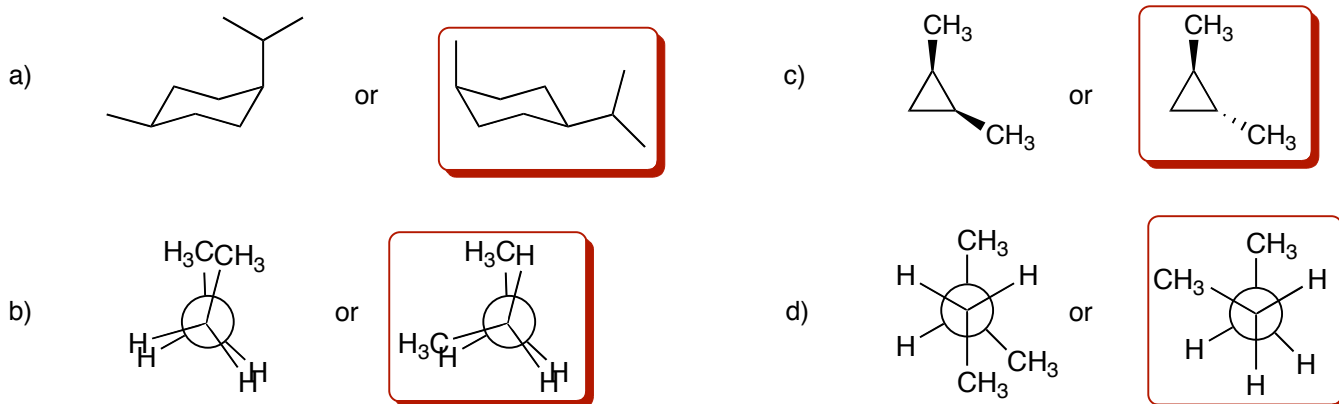
3. In the following acid/base reaction, write the role of each species in the box below (acid, base, conjugate acid, conjugate base). Indicate which side the reaction favors by circling that side of the equation. (10 pts)



4. Identify the relationship between the following pairs of molecules as Identical, Resonance Forms, Constitutional Isomers, Conformers or completely Different compounds. (check the appropriate box). (18 pts)

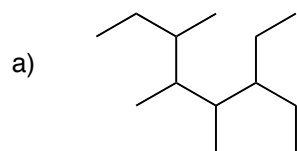
	identical	resonance forms	constitutional isomers	conformers	different
a) 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) 	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) 	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
e) 	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) 	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. For each of the following pairs of conformers or isomers, circle the one that would be MOST stable (lower energy). (16 pts)



note: These are different molecules, but the one on the right would have less overall steric interactions.

6. Draw the structure or provide a name for the following. (20 pts)

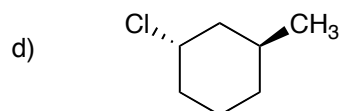
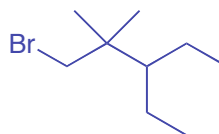


**3-ethyl-4,5,6-trimethyloctane**

b) *cis*-1,3-dichlorocyclopentane

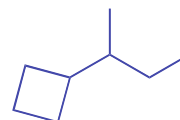


c) 1-bromo-3-ethyl-2,2-dimethylpentane

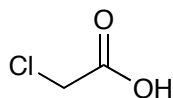


**trans-1-chloro-3-methylcyclohexane**

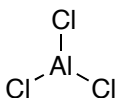
e) (1-methylpropyl)cyclobutane



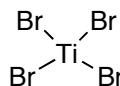
7. For each of the following, indicate whether it could act as a Brønsted or a Lewis acid (circle one for each). (8 pts)



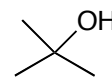
Lewis **Brønsted**



Lewis **Brønsted**

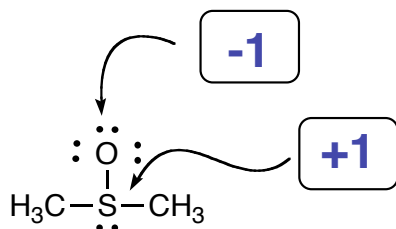


Lewis **Brønsted**



Lewis **Brønsted**

8. For the following compound indicate the formal charges for the Sulfur and Oxygen atoms. A portion of the periodic table is provided for your convenience. (4 pts)



IIIA	IVA	VA	VIA	VIIA
5 B	6 C	7 N	8 O	9 F
13 Al	14 Si	15 P	16 S	17 Cl
21 Sc	22 Ti	23 V	24 Cr	25 Mn