

First Name \_\_\_\_\_

Last Name \_\_\_\_\_

Student ID \_\_\_\_\_

Signature \_\_\_\_\_

## Chemistry 161, A1

Midterm Examination - 05 November 2004

© 2004 H. Taube

## Instructions

Closed book exam; no calculators.

Physical models permitted.

Only answers on the front side of each page will be marked, unless requested otherwise.

Write in pen (to permit potential remarking).

Time allowed: 50 min.

There are 16 questions on 7 pages.

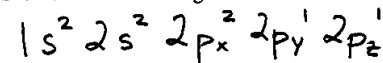
## Potentially Useful Data

## Mini Periodic Table

H, He, Li, Be, B, C, N, O, F, ..., Cl, ..., Br, ..., I

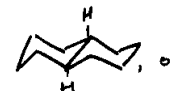
Approx. pK <sub>a</sub> Values	
"acid"	pK <sub>a</sub>
H <sub>2</sub> SO <sub>4</sub>	-3
H <sub>3</sub> O <sup>+</sup>	-2
CH <sub>3</sub> CO <sub>2</sub> H	5
NH <sub>4</sub> <sup>+</sup>	9
phenol, C <sub>6</sub> H <sub>5</sub> OH	10
1,3-dicarbonyl	9 - 13
Methanol, CH <sub>3</sub> OH	16
H <sub>2</sub> O	16
Ethanol, CH <sub>3</sub> CH <sub>2</sub> OH	16
Acetone, CH <sub>3</sub> COCH <sub>3</sub>	20
terminal alkyne	25
NH <sub>3</sub>	33

Page #	Maximum	Score			
1	11				
2	11				
3	11				
4	11				
5	7				
6	9				
7	10				
Total	70				

01. Show the electron configuration for the O atom, incl. spatial orientation (1s, 2s, 2p<sub>x</sub>, 2p<sub>y</sub>, 2p<sub>z</sub>)

02. Explain the following terms by description, example, sketch ....

a) conformationally rigid molecule (example, please &amp; brief comment)



trans-decalin, or

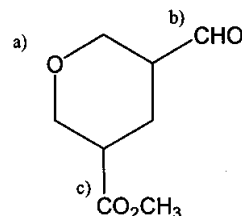
Steroids

} restricted conformational mobility;  
ring-flip cannot occur, etc. ...

b) racemate

equal (50:50) mixture of enantiomers  
(mirror images of chiral compds.)

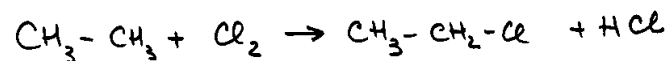
03. Consider



Identify the functional groups (pay attention to the letters).

a) ether      b) aldehyde      c) esterd) What is the number of  $\pi$  bonds? 2e) What is the number of sp<sup>2</sup> hybridized carbon atoms? 2

04. a.) Write a chemical equation for the mono-chlorination of ethane.

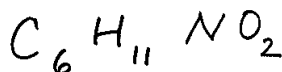
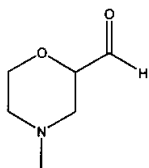


b.) What type of reaction mechanism is involved? homolytic (or radical)

c.) Show the first step of this reaction using proper "curved arrows".



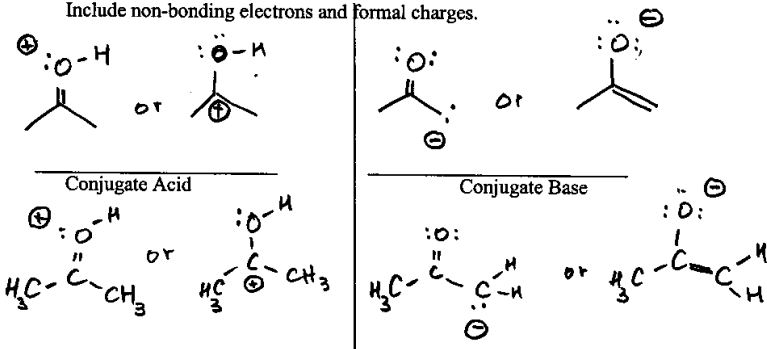
05. Determine the molecular formula for the following bond-line structure.



07. Acetone,  $\text{CH}_3\text{COCH}_3$ , is a ketone and can act as Bronsted-Lowry acid or base.

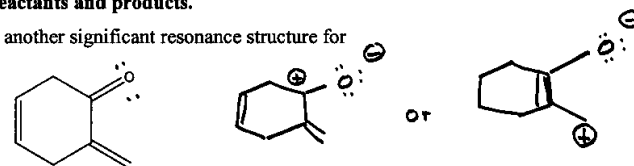
Show the conjugate acid and conjugate base of acetone.

Include non-bonding electrons and formal charges.

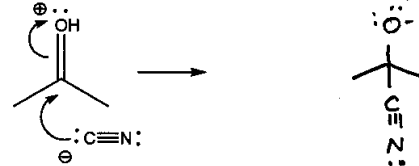


06. For all questions below, show all missing nonbonding electrons and formal charges in both reactants and products.

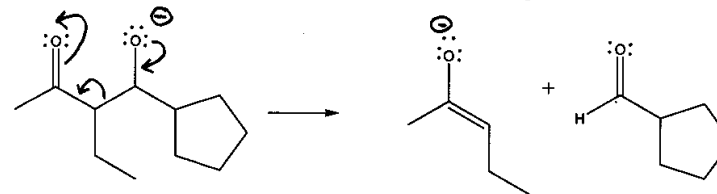
a. Write another significant resonance structure for



b. What is the result of the a reaction indicated by the "curved arrows"?



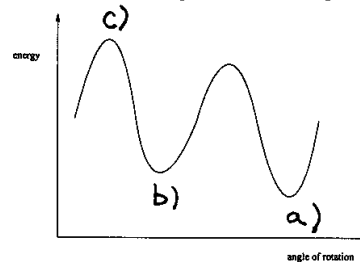
c. Place appropriate "curved arrows" to effect the following reaction.



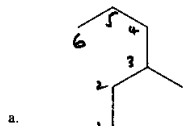
08. The following indicates an energy diagram related to the conformations of butane.

(rotation around the C2 - C3 bond). On the diagram, point out where the 2 methyl groups

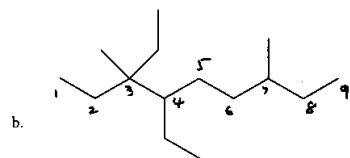
a.) are anti, b.) have a gauche relationship, c.) are eclipsed. Use the letters.



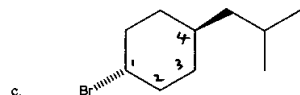
09. Provide names for the following. Ignore R/S designations..



3-methylhexane



3,4-diethyl-3,7-dimethylnonane



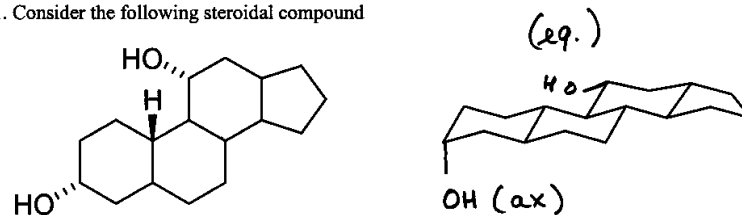
trans-1-bromo-4-isobutylcyclohexane

10. Rank the following groups according to the CIP priority rules (Cahn - Ingold - Prelog).



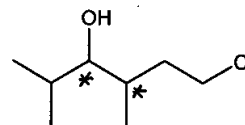
Use the letters; highest priority first: b c a d

11. Consider the following steroidal compound

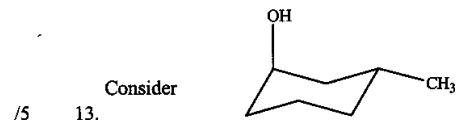


Place the -OH groups on the structure to the right and indicate whether they are equatorial (eq) or axial (ax).

12. On the following, indicate all stereogenic centers by locating stars (\*) at the proper places.

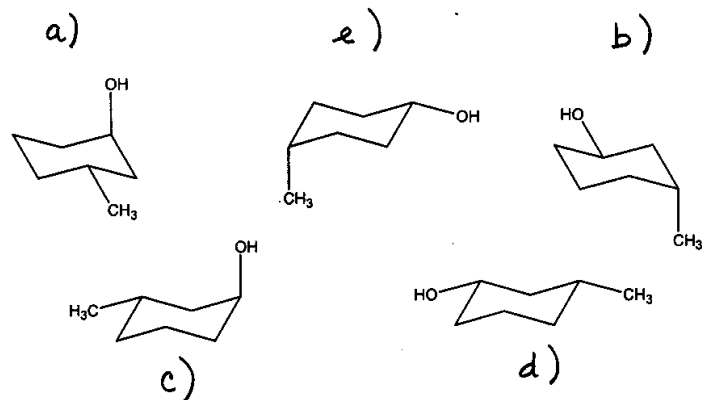


Total number of stereogenic centers: 2

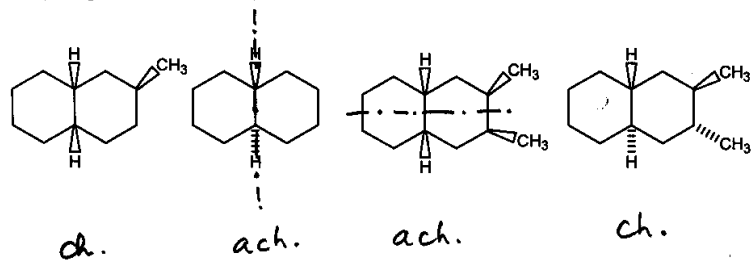


Compare each of the following with the above and indicate whether it is:

- a) identical conformer, b) different conformer, c) enantiomer, d) diastereomer, e) constitutional isomer, f) not an isomer. Use the letters.

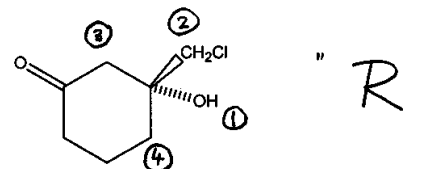


14. Consider the following decalin structures and write underneath whether they are chiral (ch.) or achiral (ach.). Also indicate a plane of symmetry where appropriate.  
(wrong answers: -0.5 each)

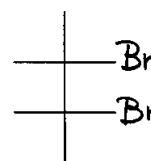


15. Determine whether the following has R or S configuration.

Priority assignments **must** be shown.

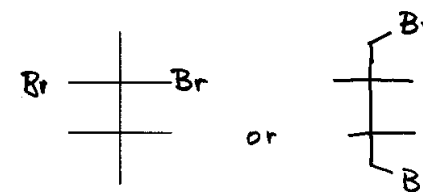
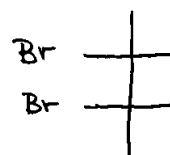


16. Many isomers of dibromobutane are possible. Using the Fischer templates below, show the structures requested underneath. You need to show only the **Br (bromine)** atoms.  
(There might be several possibilities.)



a.) meso-2,3-dibromobutane

or



b.) an achiral dibromobutane other than a.)

