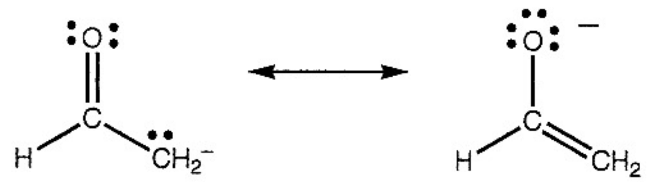
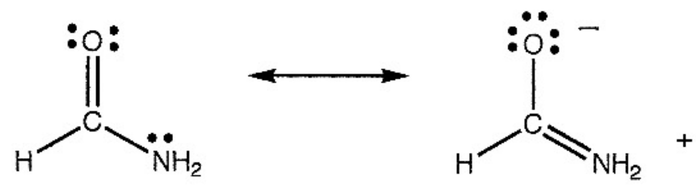
Chemistry 3311-100
Organic Chemistry/Dr. Barney Ellison
Thursday: Feb. 14^{th} @ **7:00pm → 9:00**/1^{st} Exam/ Math 100

Name: Key (please print)

1. (10 pts) For each of the following resonance hybrids, rank the contributing structures in order of their relative importance:

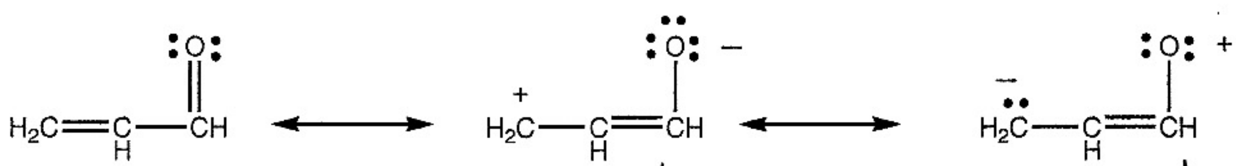
a) 

less more

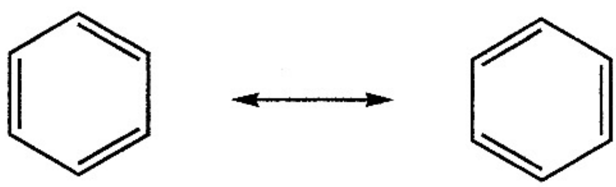
b) 

more less

c)



most ok worst

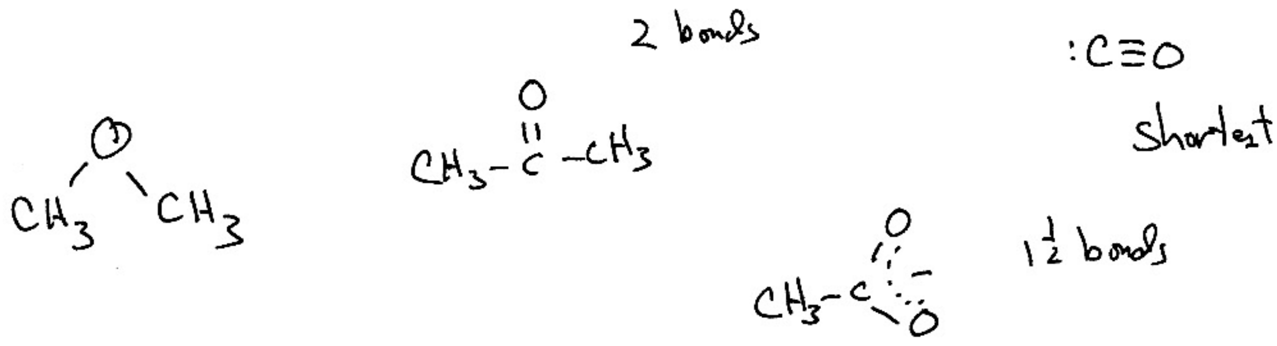
d) 

equal

2. (20 pts)

Arrange the following compounds in order of increasing C-O bond length.

a) CH_3OCH_3 b) CH_3COCH_3 c) $CH_3CO_2^-$ d) CO



longest

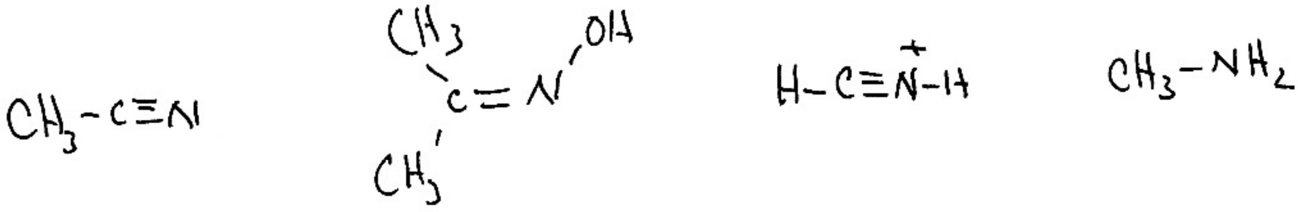
A C B D

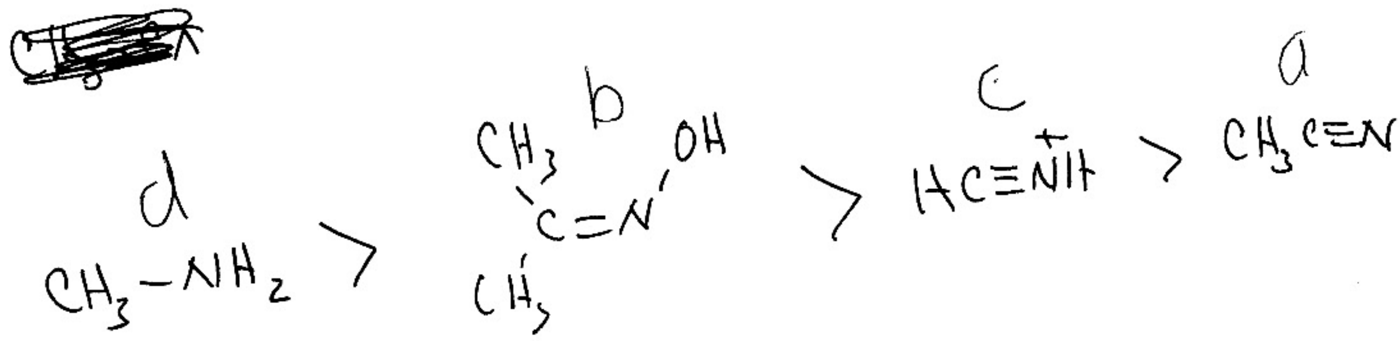
CH_3-O-CH_3 > $CH_3CO_2^-$ > $CH_3\overset{O}{\overset{\|}{C}}CH_3$ > CO

longest shortest

Arrange the following compounds in order of increasing C-N bond length.

a) CH_3CN　　b) $(CH_3)_2C{=}NOH$　　c) $HCNH^+$　　d) CH_3NH_2

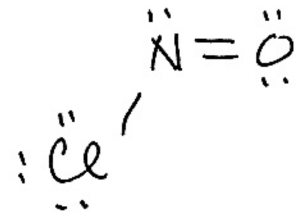




3. (10 pts) Write out Kekulé structures for the following species. Be sure to indicate lone pairs of electrons.

Here is the Kekulé for water: 

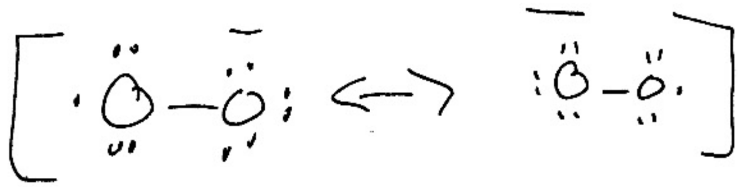
a) CℓNO



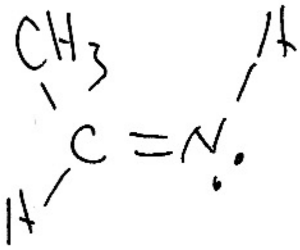
b) CH_2CCH_2

$CH_2=C=CH_2$

c) O_2^-



d) CH_3CHNH



4. (10 pts)

a) One acid has a pK_a of 2 and the other has a pK_a of 8. What is the ratio of the K_a's ?

$K_a(acid_1) = 10^{-2}$

$K_a(acid_2) = 10^{-8}$

$\frac{K_a(acid_1)}{K_a(acid_2)} = \frac{10^{-2}}{10^{-8}} = 10^{6}$

Acid$_1$ is a million times stronger than acid$_2$

b) Calculate the K_a for each of the following acids given the pK_a's. Rank the compounds in order of increasing acidity.

i) aspirin, $pK_a = 3.48$

ii) Vitamin C, $pK_a = 4.17$

iii) formic acid, $pK_a = 3.75$

iv) oxalic acid, $pK_a = 1.19$

$K_a(aspirin) = 10^{-3.48}$

$K_a(vitamin\ C) = 10^{-4.17}$

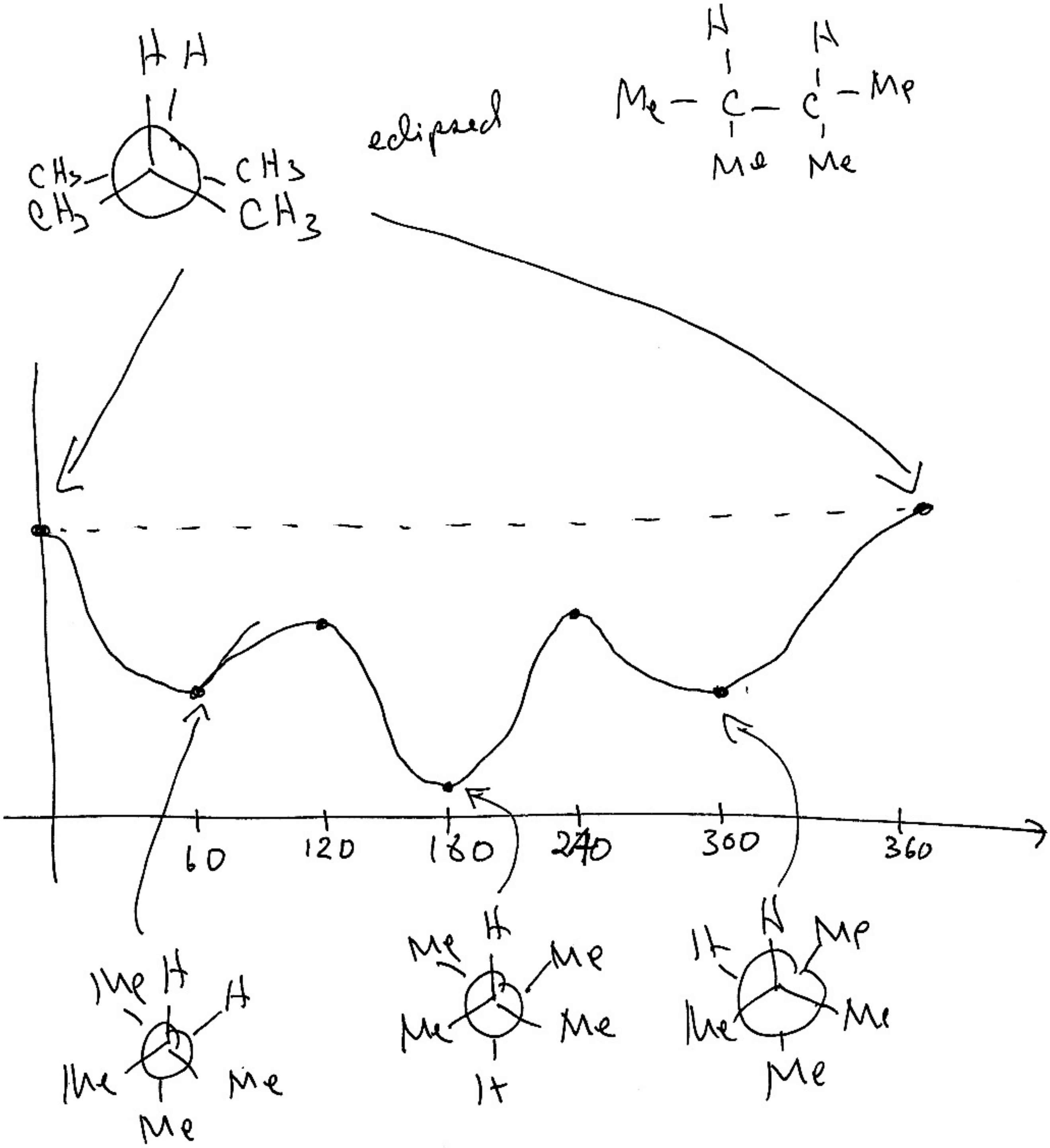
$K_a(HCOOH) = 10^{-3.75}$

$K_a(oxalic\ acid) = 10^{-1.19}$

Oxalic acid > aspirin > formic > Vitamin C

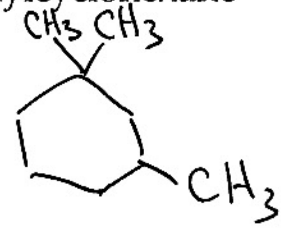
Stronger ⟷ weaker

5. (10 pts) Using Newman projections, draw a potential energy diagram for rotation about the C_2—C_3 bond of 2,3-dimethylbutane.

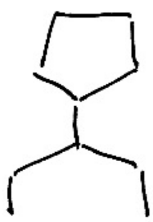


6. (10 pts) Using simple geometric figures and line structures, depict the following compounds.

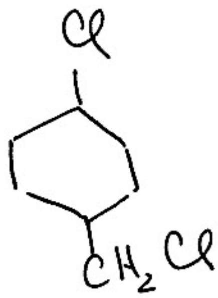
a) 1, 1, 3-trimethylcyclohexane



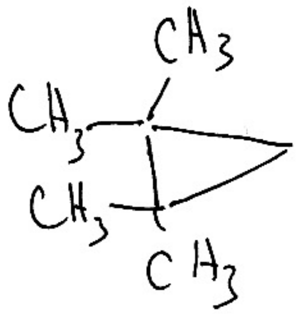
b) 3-cyclopentylpentane



c) 1-chloro-4-chloromethylcyclohexane

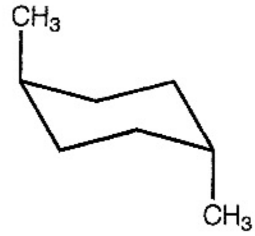


d) 1, 1, 2, 2,-tetramethylcyclopropane



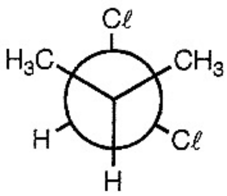
7. (10 pts) Which of the following pairs are structural isomers? Conformational isomers? Neither ?

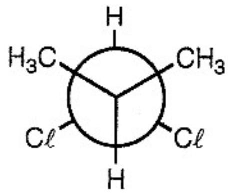
a)



Conformational isomers

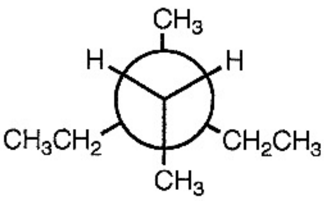
b)

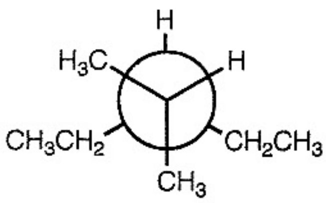




conformational isomers

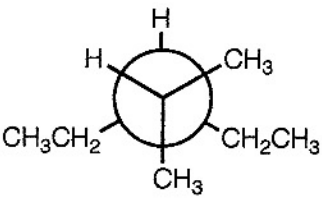
c)

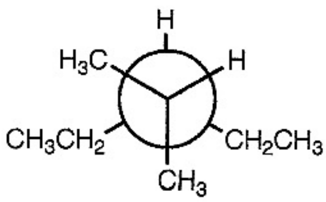




Structural isomers.

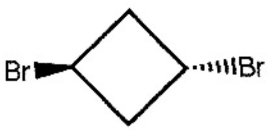
d)

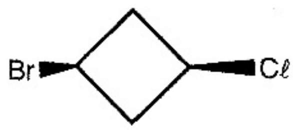




conformatial isomers

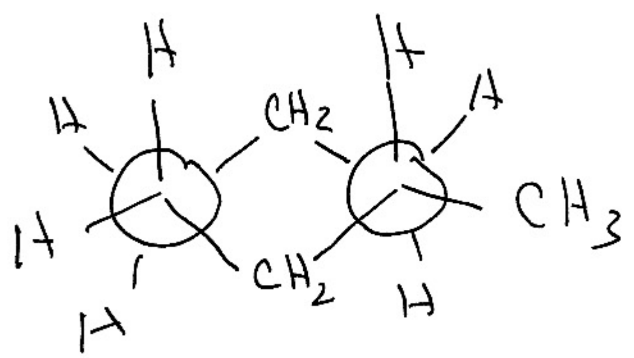
e)

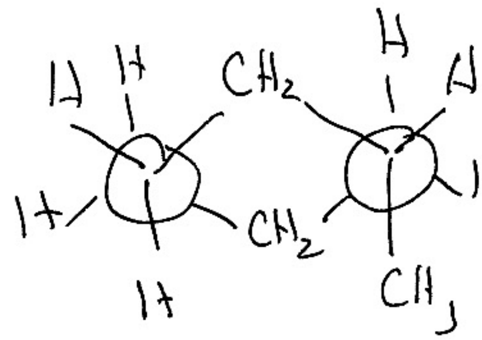




not isomers

8. (10 pts) Draw a Newman projection for the C_1—C_2 bond of methylcyclohexane with the methyl group in the equatorial position. Compare this with the ring flipped so the methyl group is in the axial position. Which conformation is more stable? Why?

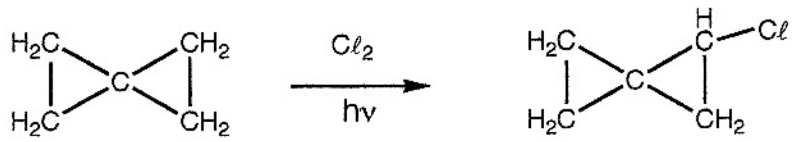




CH3 group is anti to the ring ⇒ most stable

gauche to ring.
less stable

9. (10 pts) The reaction of the unusual hydrocarbon, spiropentane with chlorine and light is a nice method to prepare chlorospiropentane.



a) Why is this reaction so useful?

b) Draw me the reaction mechanism. Assume that you have a large excess of spiropentane.

A) Notice that all H atoms are equilivant. So monosubstitution only makes one product. It is easy to separate a chlorinated product from the low-boiling spiropentane.

B) $Cl_2 + h\nu \rightarrow 2\ Cl\cdot$