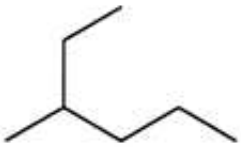
name:

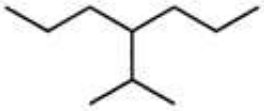
Chemistry 3311-100
Organic Chemistry / Dr. Barney Ellison
Thursday: Feb. 10th **@ 7:00pm → 9:00** / 1st Exam / Math 100

Name: Key (please print)

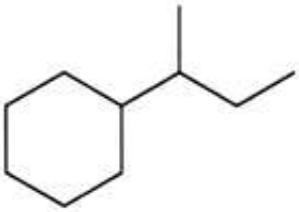
1. (12 pts) Write a correct name for each of the following compounds.

a) 

3-methylhexane

a) 

4-isopropylheptane

a) 

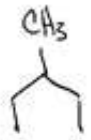
sec-butylcyclohexane

a) 

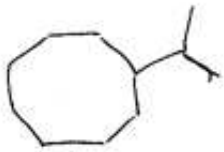
tert-butylcyclopropane

2. (8 pts) Draw a structure correctly representing the following:

a) 3-methylpentane

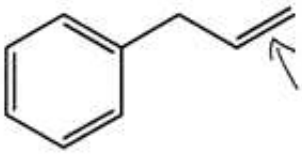


b) isopropylcyclooctane



3. (10 pts) In each of the following, choose the bond which fits.

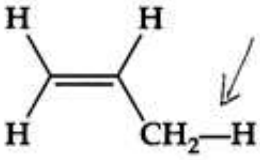
a) shortest C—C bond in:



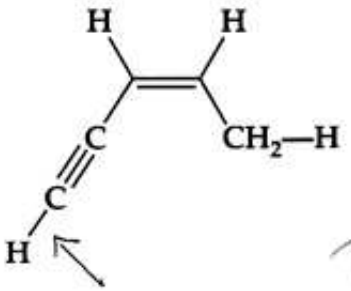
a) longest C—C bond in: H-C≡C-CH_2-CH_3

a) shortest C—C bond in: CH_3-C≡C-CH=CH_2

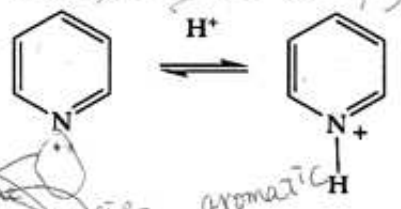
a) longest C—H bond in:



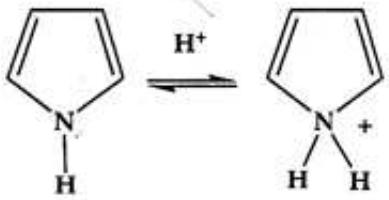
a) shortest C—H bond in:



4. (10 pts) Both pyridine and pyrrole have a lone pair of electrons on nitrogen, which can be protonated in an acid-base reaction. Remembering Hückel's rule, which protonation will be easier? Explain your reasoning.



OR



Both  and  have 6-π electrons and are aromatic.

While pyrrole is aromatic since it has 6π electrons

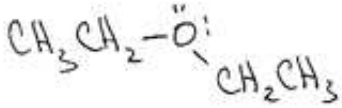
Pyridine easily protonates since both  and  are aromatic.

But if pyrrole is protonated, aromaticity is lost & that costs a lot of energy.

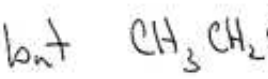
 is hard to protonate

 only has 4 π e's.

5. (10 pts) Although ethyl ether has a substantially higher molecular weight that ethanol, ethanol has a higher boiling point. Explain.



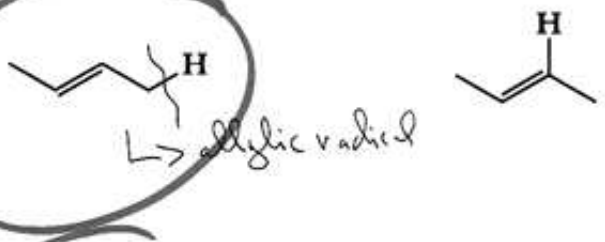
cannot Hydrogen bond

but  can.

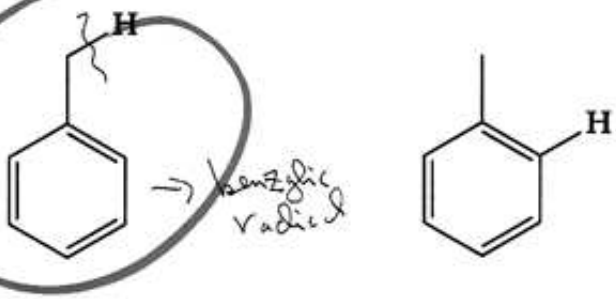
H-bonds in EtOH provide an additional 5 kcal mol^{-1} attractive force between ethanol molecules. The boiling point is raised because these additional attractive forces.

6. (10 pts) Predict which of the two indicated C—H bonds in each of the following compounds would yield a more stable radical upon homolytic cleavage.

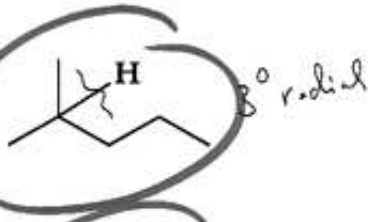
a)

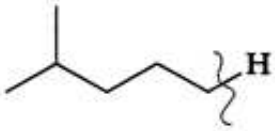


a)

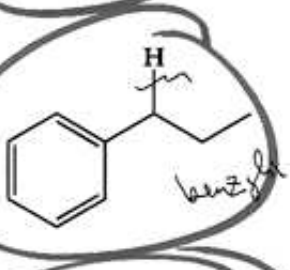


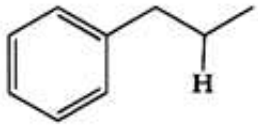
a)



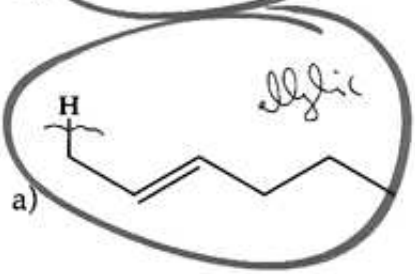


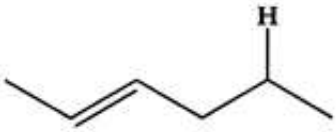
a)





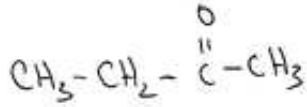
a)





7. (10 pts) For each of the following compounds, how many peaks would you expect to find in the ^1H spectrum? What would expect their splitting and integration to be? How many peaks would you expect to find in the ^{13}C NMR spectrum? What characteristic peaks would you find in the infrared spectrum?

a) 2-butanone



4 C

3H, T

2H, Q

3H, S

The 4 carbons are unique & give rise to 4 different ^{13}C signals. The H1 and H2 protons, being adjacent to -C- groups, appear at $\delta \simeq 2$ ppm. The $-CH_2-$ protons are split into a quartet by $-CH_3$ group. The $-C(=O)-CH_3$ protons are a singlet.

The $-C(=O)-$ at is a strong band in IR about 1700 cm^{-1}.

C ~1700

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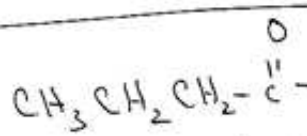
b) butanal



3H, T

2H, M

2H, T

1H S

4C

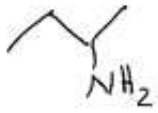
C=O

Again 4 carbons are unique & provide 4 diff ^{13}C signals. The ^1H NMR signal from $-C(=O)-H$ is about $\delta \simeq 9$ ppm & a singlet. The $-CH_2-C(=O)$ protons appear about δ 2 ppm & are a triplet. Remain CH_3CH_2- protons are in aliphatic region & have complex splitting.

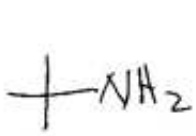
The $-C(=O)-H$ at is strong in IR about 1750 cm^{-1}

c) *s*-butylamine and *t*-butylamine

Again NMR works

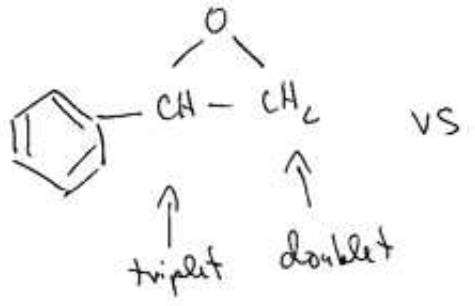


4 diff ^{13}C peaks

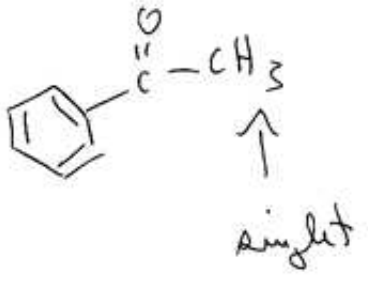


2 diff ^{13}C peaks

d) styrene oxide ($C_6H_5CHCH_2O$) and acetophenone ($C_6H_5COCH_3$)



vs



NMR

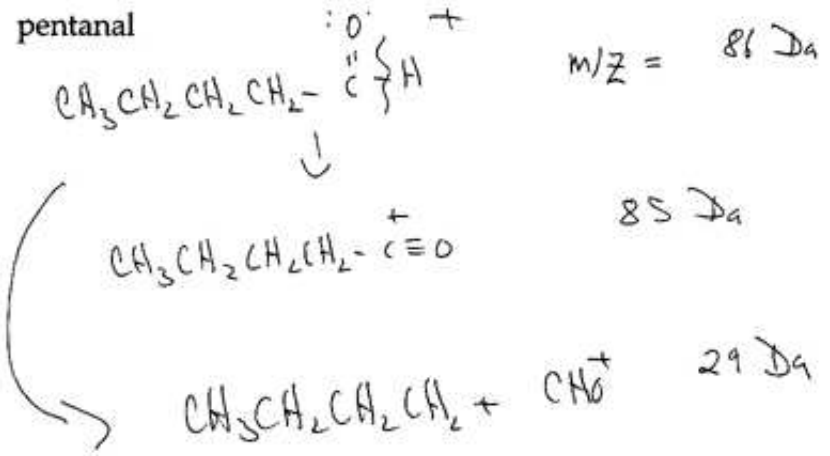
IR

strong C=O band about 1720 cm⁻¹

Wording/structure -2
good method, bad explanation -2
right method only 1/5

9. (10 pts) Predict the mass of the parent ion and the major mass spectral fragments to be expected for each of the following compounds.

a) pentanal



b) acetophenone ($C_6H_5COCH_3$)