1								

1 ⓪ ⓪ ⓪ ⓪ ⓪ ⓪ ⓪ ⓪
① ① ① ① ① ① ① ①
② ② ② ② ② ② ② ②
③ ③ ③ ③ ③ ③ ③ ③
④ ④ ④ ④ ④ ④ ④ ④
⑤ ⑤ ⑤ ⑤ ⑤ ⑤ ⑤ ⑤
⑥ ⑥ ⑥ ⑥ ⑥ ⑥ ⑥ ⑥
⑦ ⑦ ⑦ ⑦ ⑦ ⑦ ⑦ ⑦
⑧ ⑧ ⑧ ⑧ ⑧ ⑧ ⑧ ⑧
⑨ ⑨ ⑨ ⑨ ⑨ ⑨ ⑨ ⑨

CEM 351 –Quiz 1

Fall 2025

NAME	KEY

Score		
0	5	5

● ⓪ ⓪
① ① ①
② ② ②
③ ③ ③
④ ④ ④
⑤ ● ●
⑥ ⑥ ⑥
⑦ ⑦ ⑦
⑧ ⑧ ⑧
⑨ ⑨ ⑨

READ THIS!

Bubble in your PID in the space above. Write your answer for each question in the space provided.

LEAVE THIS COVER SHEET ATTACHED TO THE Quiz!

1. _____/17
2. _____/18
3. _____/11
4. _____/9

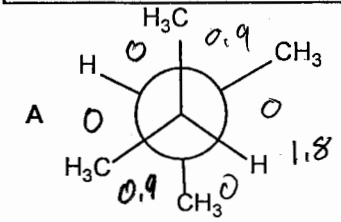
[redacted]

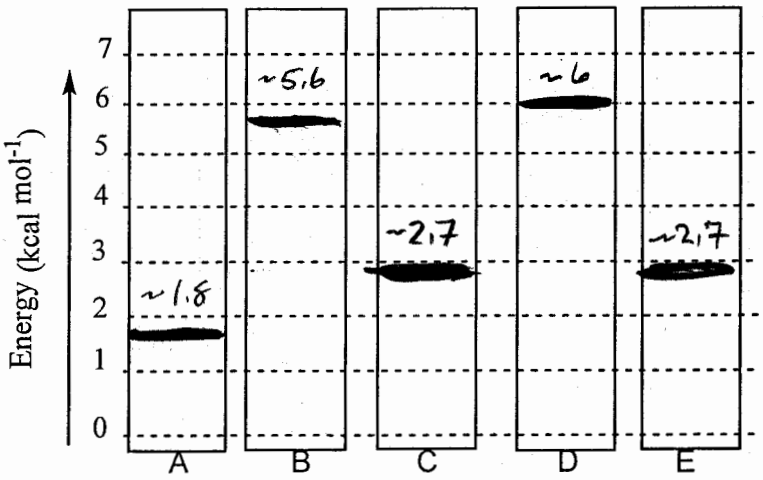
TOTAL:_____/ 50 + 5 pts bonus

, were built in to the problem totals

1) Given the following data, plot the relative energies for the Newman Projection conformations.
Rotate the BACK carbon of Compound A CLOCKWISE in 60° increments and
Plot the relative energy of each Newman projection conformation. (5 pts)

CH_3/CH_3 (gauche): 0.9 kcal mol^{-1}	CH_3/CH_3 (eclipsed): 3.0 kcal mol^{-1}
H/H (gauche): 0 kcal mol^{-1}	CH_3/H (eclipsed): 1.3 kcal mol^{-1}
CH_3/H (gauche): 0 kcal mol^{-1}	H/H (eclipsed): 1.0 kcal mol^{-1}

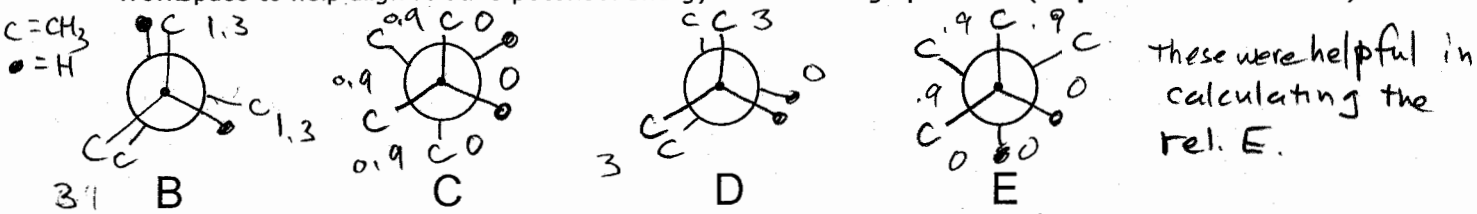




Plotted Relative Energy levels need to be drawn clearly with a bold line!

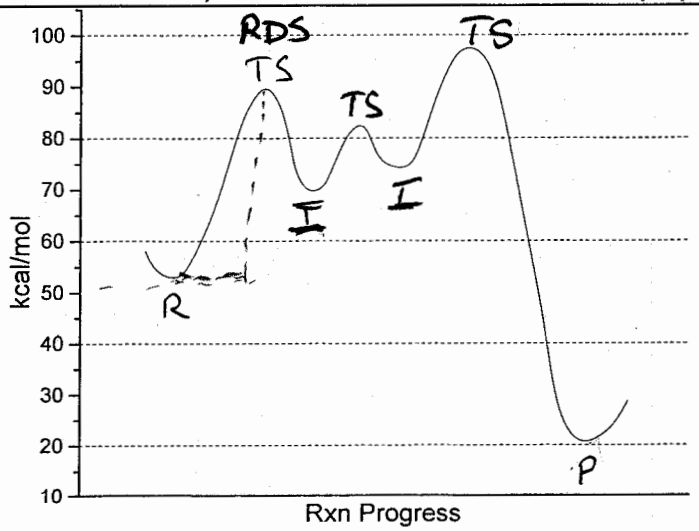
(----▬▬▬----)

Workspace to help align relative potential energy lines on the graph above (**no points for structures**)



these were helpful in calculating the rel. E.

2) Use the letter I to label where (I)ntermediates occur, TS to label where Transition States are, R to indicate where the reaction starts, and P for where the reaction ends. (12 pts)



a) How many steps are in this reaction? (1 pt)

[3] = TS

b) Label the Rate Determining Transition State with the letters ***RDS*** (1 pt)

c) The activation energy (Ea) is estimated at

approximately [40] ± 5 kcal/mol (1 pt)

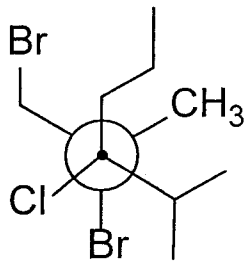
d) The ΔH° for the overall reaction is

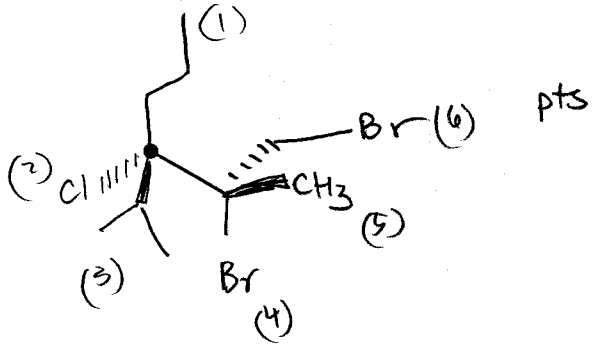
> (<) = to [∅] (2 pts) ← or = −30 kcal/mol

(CIRCLE SYMBOL/FILL IN BOX)

since no units were provided, we were looking for this!

3) Based on the Newman Projection, draw the perspective drawing on the template provided. The (•) represents the front carbon. Use wedged (—) and dashed (·····) lines at the proper angles to demonstrate that you are drawing tetrahedral geometry. (6 pts)





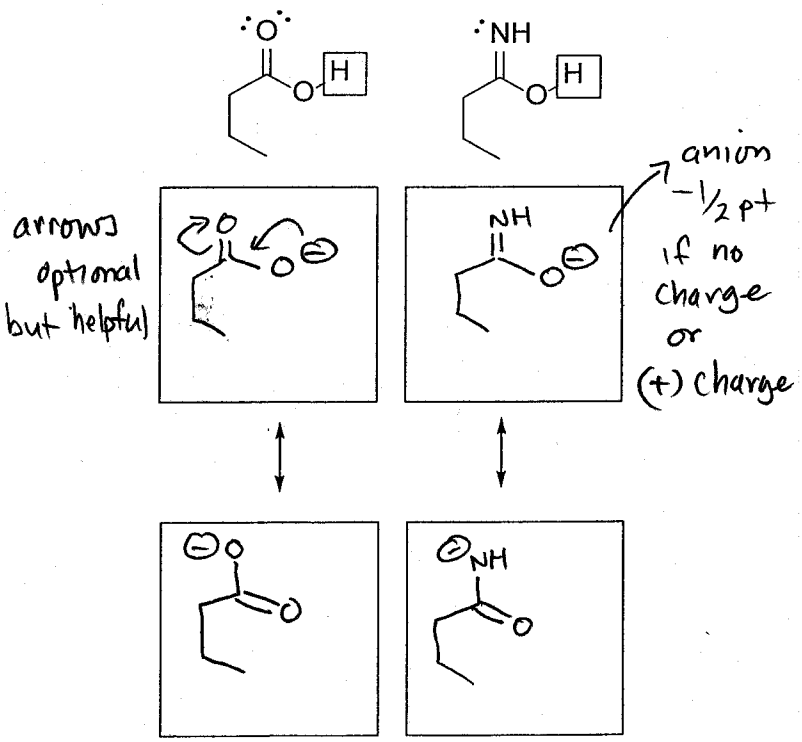
pts

4) a-d (7 pts)

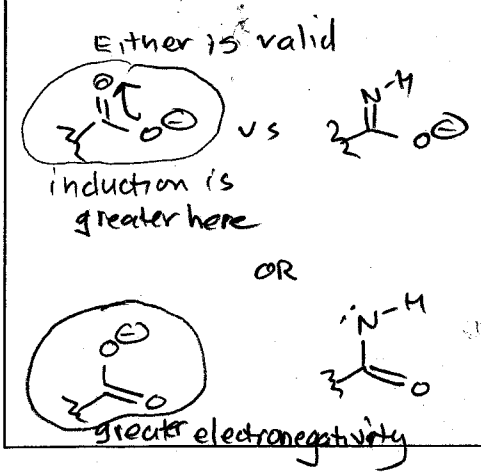
a) Circle the compound that has the most acidic proton (boxed). (1 pts)

b) Draw the conjugate base of <u>each</u> acid in the box below it. (2 pts)

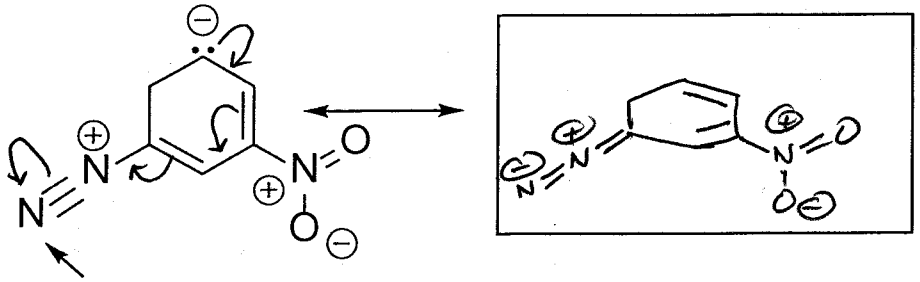
c) If the conjugate base can form a resonance structure, draw a resonance structure in the box below it. If no resonance structure of the conjugate base can be drawn, then draw an X in the box. (2 pts)



d) (2 pts) Explain in 1-2 sentences what difference most influenced the difference in acidity, the Atom, Resonance, Induction, or Orbitals (ARIO):
<u>NO CREDIT IF YOU MERELY COPY A WORD FROM THE ARIO SERIES</u> IN THE SPACE BELOW. YOU MUST DESCRIBE IN A <u>BRIEF</u> SENTENCE <u>or with a PICTURE</u> BELOW HOW THE EFFECT YOU CHOSE ACCOUNTED FOR THE ACIDITY DIFFERENCE.

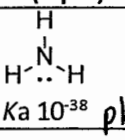
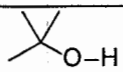
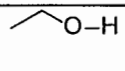
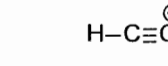
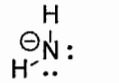
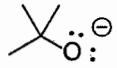


5) Draw a resonance structure where the N-atom (indicated with arrow) gains a formal charge and the carbanion (C^- atom) loses its formal charge. (<u>5 pts</u>)



weakest base is associated with the strongest acid

6) Given the following pK_a (or K_a) values (LOOK closely) for the following acids, CLEARLY CIRCLE the weakest conjugate base among (A – D) below. (2 pts)

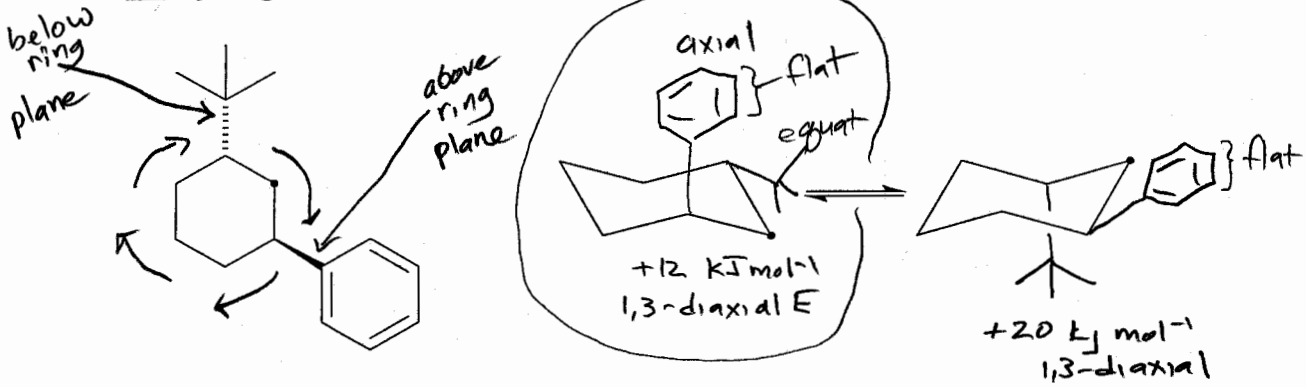
H–C≡C–H			
p*K*a = 25	*K*a 10^{-38} pka 38	p*K*a = 18	*K*a 10^{-16} pKa 16
A 	B 	C 	D 

Strongest acid

weakest base doesn't hold H⊕ as well as other C.Bs.

7) Convert the "flat" perspective representation of the cyclohexane molecule (at left) to the chair conformation templates (at right). ONLY DRAW THE ATOMS/GROUPS AND BONDS THAT ARE SHOWN (4 pts)

Diaxial Strain Energies between the substituent and two axial H's
tert-Butyl adds 20 kJ/mol
Phenyl ring adds 12 kJ/mol

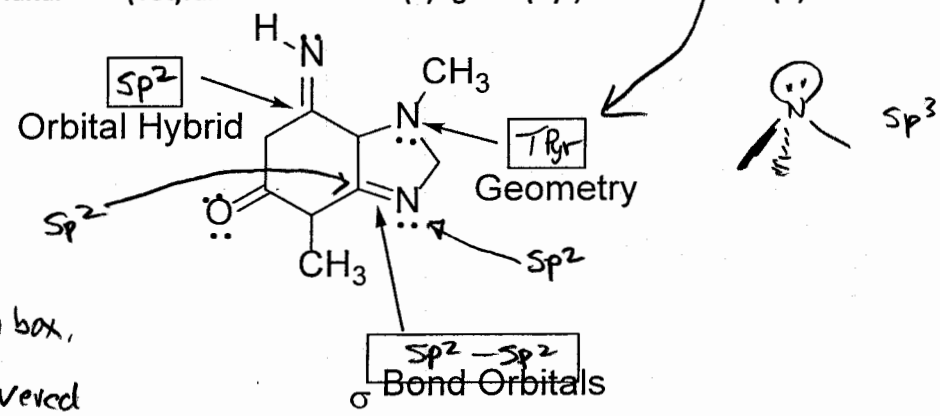


LOOK: DRAW OUT THE PHENYL RING, DO NOT USE 'Ph' ABBREVIATION
ERASE ANY EXTRA BONDS THAT ARE NOT NEEDED (SEE NOTE ABOVE)

8) Using the data above, calculate which ring has the MOST STABLE (i.e., lowest energy) conformation above
CIRCLE THE MOST STABLE CONFORMATION ABOVE (1 pts)

9) Identify either the orbital hybridization, overlapping orbital used to construct the sigma (σ) bond, or molecular geometry of the items indicated in the molecule below using the appropriate letters in the parentheses below: (4 pts)

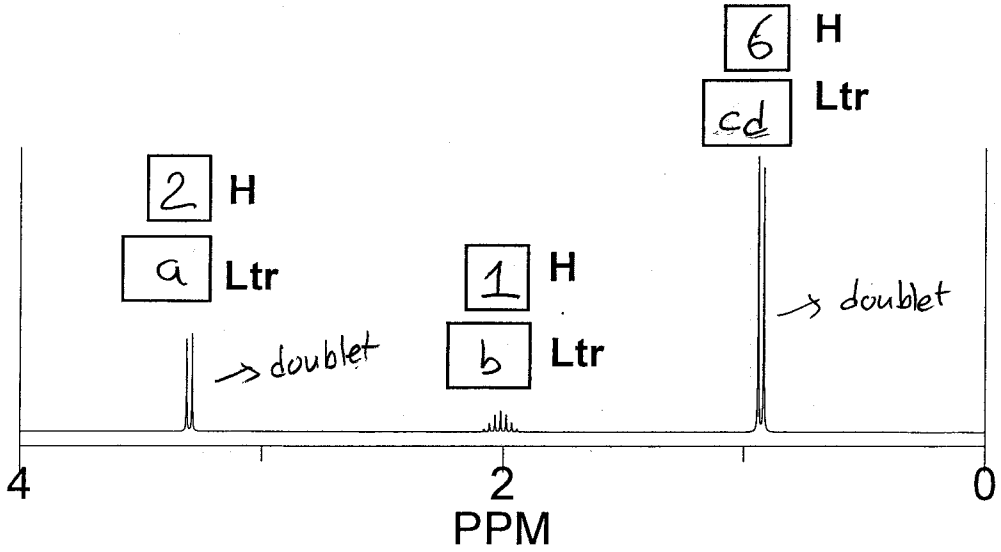
for MOLECULAR GEOMETRY use the following:
(L)inear (T)rigonal (P)lanar (Tet)rahedral (T)rigonal (Pyr)amid (B)ent



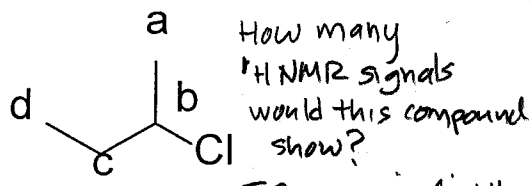
These instructions were important to read to understand what was needed in each box.

An inclass worksheet covered these concepts.

10) The ^{1}H NMR spectrum below belongs to one of the two compounds listed below it.
In the box next to 'H' write the number of hydrogens represented by the peak area
In the box next to 'Ltr' write the letter or letters listed on the structure whose hydrogens yield the given chemical shift. (7 pts)

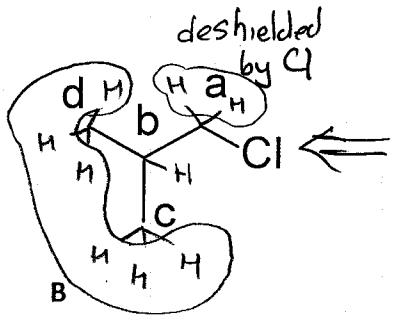


There ar 2 doublets present. Compound B is the only one where an N+1 = 2 is applicable to 2 different proton types



A

How many ^{1}H NMR signals would this compound show?
If you identified 4, thats correct



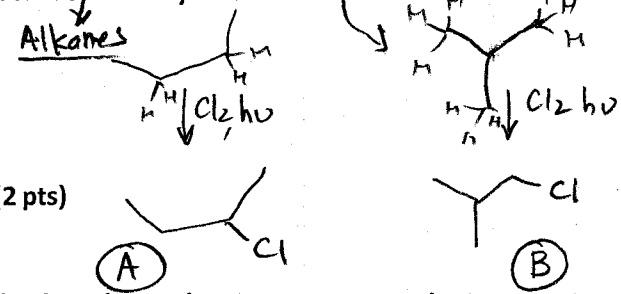
B

one of these 2 compounds belonged to the ^{1}H NMR spectrum above

11) Both monochlorinated compounds A and B above come from a reaction 1:1 mixture of alkanes reacting with Cl_2 gas and light ($h\nu$) via a radical reaction.

Given that the product ratio of monochlorination is directed by the slowest step (i.e., the rate determining step) involving the removal of a hydrogen atom (H•) from the alkanes followed by the transfer of a Cl• radical from Cl–Cl in the faster step to the alkyl radical, estimate the approximate relative abundances of each monochlorinated product above if given the following data about the rate of H• removal by Cl•.

Cl• removes a 1° H• at a relative rate of 1 molecule / sec
Cl• removes a 2° H• at a relative rate of 4 molecules / sec
Cl• removes a 3° H• at a relative rate of 5 molecules / sec



Calculate the relative abundances of Compounds A and B (2 pts)

A Rel. Abundance (not as percentage)	B Rel. Abundance (not as percentage)
4 equiv H × 4 mol/s (rate) = 16 molecules	9 equiv H × 1 mol/sec = 9 molecules

16 to 9