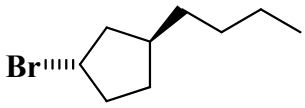
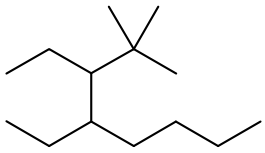
CHEMISTRY 31 **Name:** _____

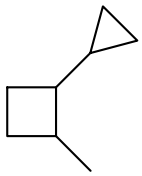
Exam #1

100 pts

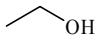
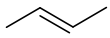
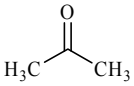
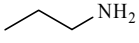
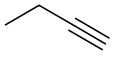
1. (6 pts) Provide the complete IUPAC name for each of the following compounds:



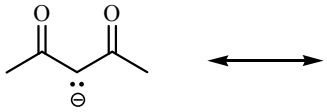


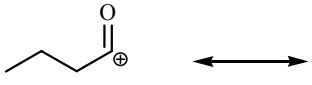


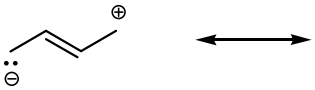
2. (12 pts) For each molecule given below provide the pKa value for the most acidic hydrogen atom and list all functional groups, excluding alkanes.

	pKa	**functional group**
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

3. (12 pts) For each structure shown below a better resonance structure can be drawn. Using curved arrows to illustrate, draw the more stable resonance structure for each compound below. In addition, *briefly* (under ten words) state why your drawing is a better resonance structure.

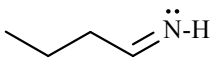
(a) 

(b) 

(c) 

(d) 

4. (10 pts) Consider the molecule shown below to answer the following questions:



(a) How many σ bonds are present in this molecule? _____

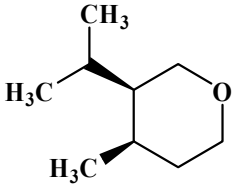
(b) How many π bonds are present in this molecule? _____

(c) What is the approximate H-N-C bond angle in this molecule? _____

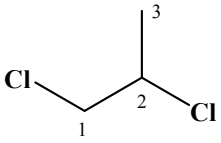
(d) What orbital/orbitals overlap to form the nitrogen – carbon double bond? Be specific.

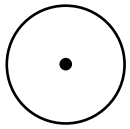
(e) What orbital is the lone pair of electrons in? _____

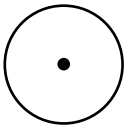
5. (8 pts) Draw the two possible chair conformations for the following molecule. In your drawing clearly show the chair – to – chair inversion process. Using data on the last page, estimate the relative percentages of the two chair conformers.



6. (10 pts) (a) Draw the most and least stable Newman projection of of the compound below when viewed down the C1-C2 bond and calculate the energy of each conformer.



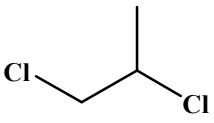


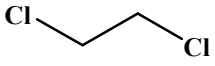


most stable

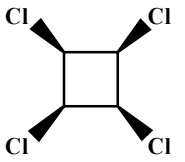
least stable

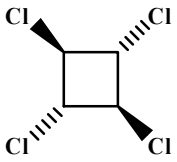
(b) Which compound below do you predict is more polar? Circle your choice and provide a brief (1-2 sentence) explanation.





7. (9 pts) What is the relationship between each pair of compounds shown below, enantiomers, diastereomers, identical, constitutional isomers or different compounds altogether.





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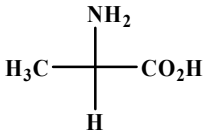
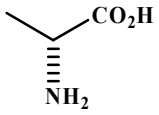
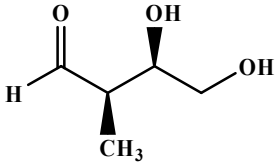
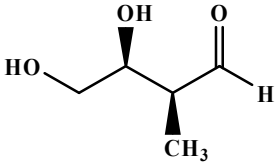




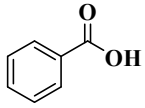
_____





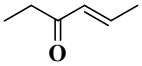
_____

8. (5 pts) For the IR spectrum given below provide the corresponding letter for the molecule that best fits the data from the choices below: (note the cm^{-1} scale lists values at 4000, 3000, 2000, 1500, 1000 and 500 cm^{-1} if you cannot read the values)

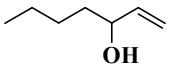


A

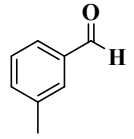
B



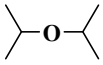
C



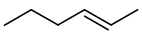
D



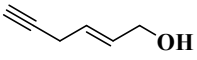
E



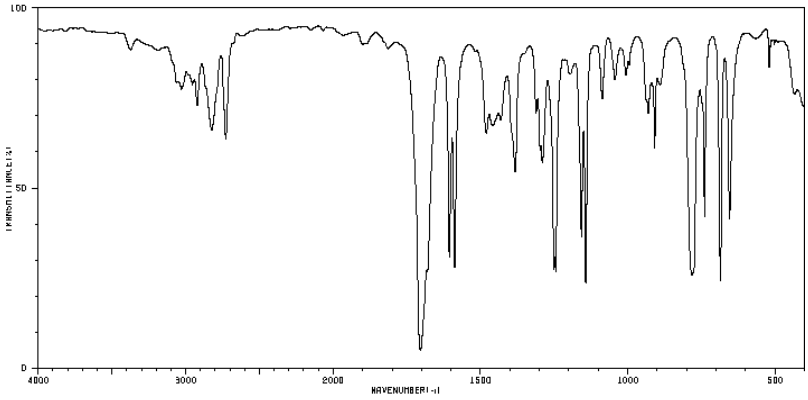
F



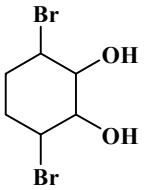
G



H



9. (14 pts) Consider the compound drawn below to answer the following questions:



(a) What is the maximum number of stereoisomers possible? = _____

(b) Draw the stereoisomer with all chiral centers in the R configuration below:

(c) Draw the enantiomer and a diastereomer of your answer in part b below:

Enantiomer Diastereomer

(d) There are two meso forms of this compound, draw them below:

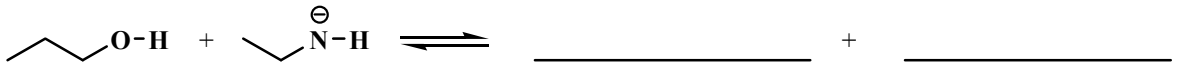
(e) If the specific rotation for your answer in part b is [α] = +76.1° , answer the following: (give a specific value or state 'no way to determine')

The [α] of my enantiomer is = _____

The [α] of my diastereomer is = _____

The [α] of my meso forms, are = _____ and _____

10. (10 pts) If the following two compounds were mixed together, what would be the products if a Bronsted-Lowry acid/base reaction were to occur (be sure to show lone pairs and charges if any)?



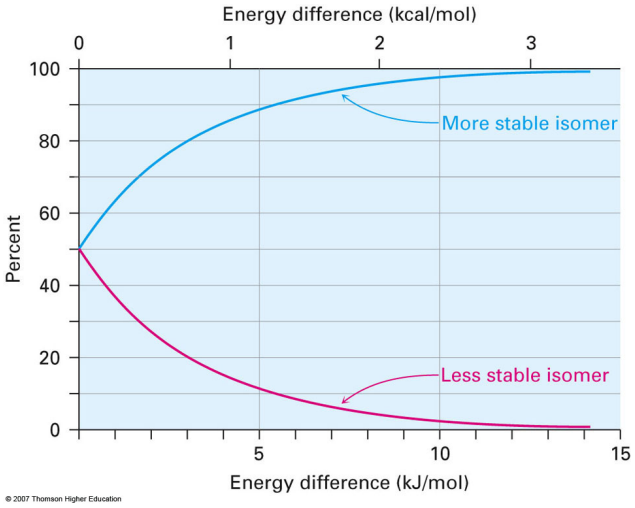
(b) What would be favored, reactants or products? _____

(c) Draw in the curved arrows to show the flow of electrons when going from the reactants to the products on the reaction above.

2. (4 pts) For each compound below provide the number of signals you would expect to see in ^{13}C NMR spectroscopy.

Extra Credit

(5 pts) Which of the following two molecules is a stronger acid (circle your choice)? To receive full points you must provide a clear explanation for your choice. Hint, a picture is worth a thousand words!



Destabilizing Strain Energies

1,3-Diaxial Interactions	Gauche Interactions	Eclipsing Interactions
$CH_3 - H$ = 3.8 kJ/mol	$Cl - Cl$ = 0.25 kJ/mol	$H - H$ = 4.0 kJ/mol
$CH(CH_3)_2 - H$ = 4.6 kJ/mol	$Cl - CH_3$ = 1.0 kJ/mol	$Cl - H$ = 4.8 kJ/mol
$CH(CH_3)_2 - CH_3$ = 8.4 kJ/mol	$CH_3 - CH_3$ = 3.8 kJ/mol	$CH_3 - H$ = 6.0 kJ/mol
	$CH(CH_3)_2 - CH_3$ = 4.6 kJ/mol	$Cl - Cl$ = 5.6 kJ/mol
		$CH_3 - Cl$ = 8.0 kJ/mol

Table 12.1 Characteristic IR Absorptions of Some Functional Groups

Functional Group	Absorption (cm^{-1})	Intensity	Functional Group	Absorption (cm^{-1})	Intensity
Alkane			Amine		
C–H	2850–2960	Medium	N–H	3300–3500	Medium
Alkene			C–N	1030–1230	Medium
=C–H	3020–3100	Medium	Carbonyl compound		
C=C	1640–1680	Medium	C=O	1670–1780	Strong
Alkyne			Carboxylic acid		
≡C–H	3300	Strong	O–H	2500–3100	Strong, broad
C≡C	2100–2260	Medium	Nitrile		
Alkyl halide			C≡N	2210–2260	Medium
C–Cl	600–800	Strong	Nitro		
C–Br	500–600	Strong	NO_2	1540	Strong
Alcohol					
O–H	3400–3650	Strong, broad			
C–O	1050–1150	Strong			
Arene					
C–H	3030	Weak			
Aromatic ring	1660–2000	Weak			
	1450–1600	Medium			