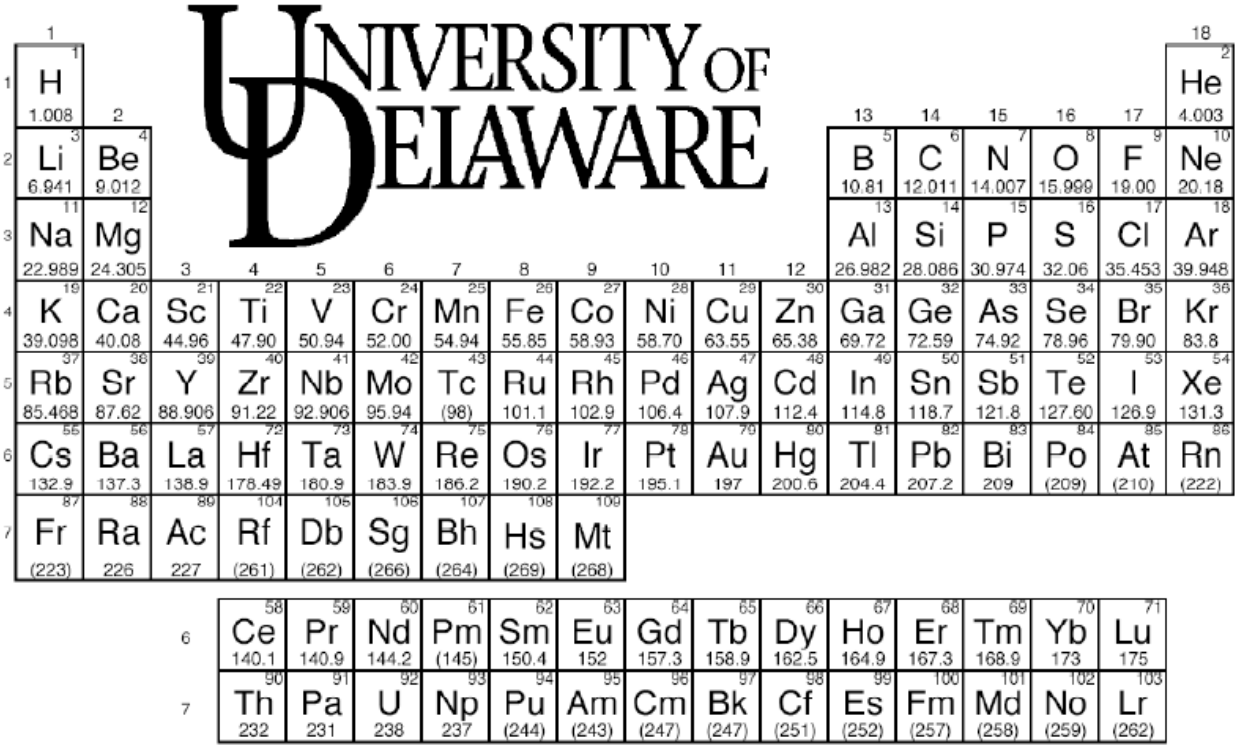
Name:_____

(Print your name clearly!)

Sametz: CHEM 321 2010
Organic Chemistry Final Exam

All answers should be written CLEARLY in the space provided. (If it's not clear, it's wrong).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H 1.008																	He 4.003
2	Li 6.941	Be 9.012											B 10.81	C 12.011	N 14.007	O 15.999	F 19.00	Ne 20.18
3	Na 22.989	Mg 24.305											Al 26.982	Si 28.086	P 30.974	S 32.06	Cl 35.453	Ar 39.948
4	K 39.098	Ca 40.08	Sc 44.96	Ti 47.90	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.70	Cu 63.55	Zn 65.38	Ga 69.72	Ge 72.59	As 74.92	Se 78.96	Br 79.90	Kr 83.8
5	Rb 85.468	Sr 87.62	Y 88.906	Zr 91.22	Nb 92.906	Mo 95.94	Tc (98)	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.4	In 114.8	Sn 118.7	Sb 121.8	Te 127.60	I 126.9	Xe 131.3
6	Cs 132.9	Ba 137.3	La 138.9	Hf 178.49	Ta 180.9	W 183.9	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197	Hg 200.6	Tl 204.4	Pb 207.2	Bi 209	Po (209)	At (210)	Rn (222)
7	Fr (223)	Ra 226	Ac 227	Rf (261)	Db (262)	Sg (266)	Bh (264)	Hs (269)	Mt (268)									

	58	59	60	61	62	63	64	65	66	67	68	69	70	71
6	Ce 140.1	Pr 140.9	Nd 144.2	Pm (145)	Sm 150.4	Eu 152	Gd 157.3	Tb 158.9	Dy 162.5	Ho 164.9	Er 167.3	Tm 168.9	Yb 173	Lu 175
7	Th 232	Pa 231	U 238	Np 237	Pu (244)	Am (243)	Cm (247)	Bk (247)	Cf (251)	Es (252)	Fm (257)	Md (258)	No (259)	Lr (262)

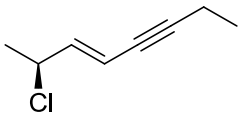
You may raise your hand to ask a question if you are unsure what a question is asking of you.

1. (3 points) Multiple Choice: which of the following compounds in its most stable conformation has all carbons in the same plane?

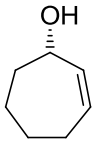
a) cyclobutane
b) cyclohexane
c) cyclopentane
d) cyclopropane
e) none of the above

2. (6 points) Provide IUPAC names for the following compounds:

a)

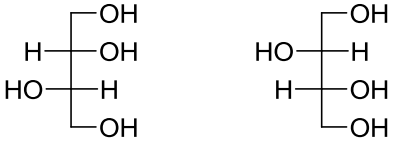


b)



3. (12 points) For each of the following pairs of structures, indicate if they represent a pair of diastereomic, enantiomeric, or identical chemical compounds:

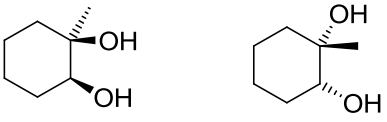
a)



b)

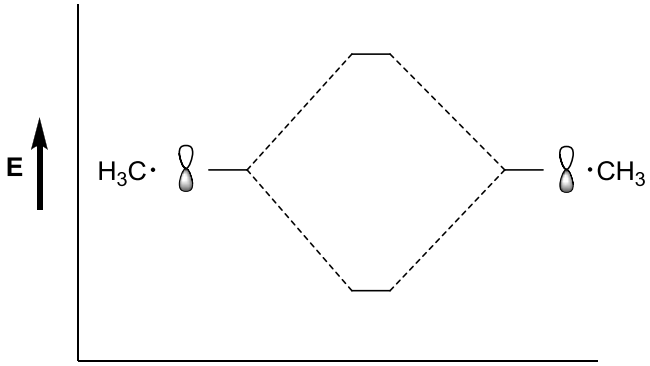
c)

d)

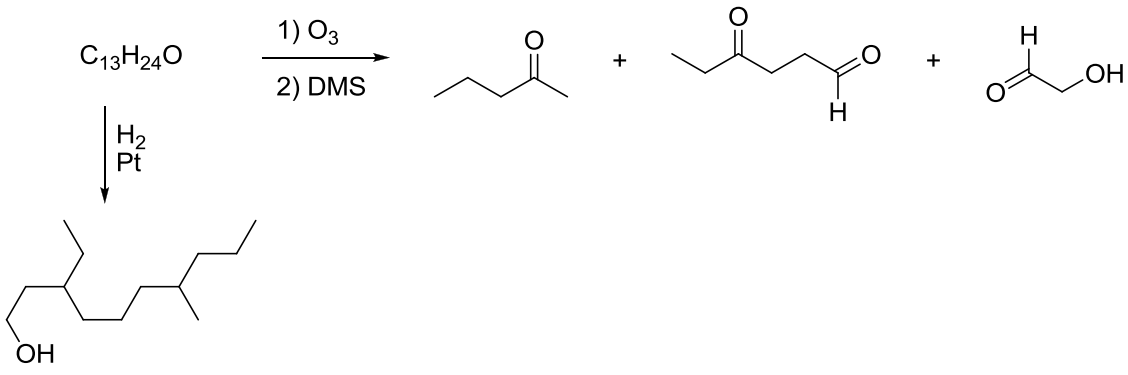


4. (6 points) Rank the following compounds in order of decreasing reactivity to S_N2 substitution, 1-4 (1 = most reactive, 4 = least reactive).

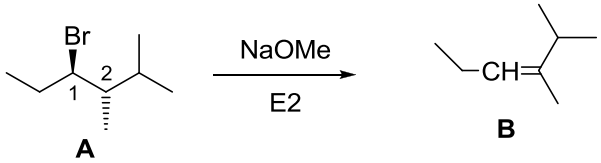
5. (10 points) Complete the following diagram, showing how two p orbitals overlap to form a π bond. Sketch the resulting molecular orbitals next to their associated energy levels (with correct shading of lobes to indicate the relative sign of the wavefunction), and label them (π or π^*). Also add the correct number of electrons to the atomic and molecular orbitals (using the arrow convention).



6. (8 points) A compound with the formula $C_{13}H_{24}O$ undergoes the following two reactions. Based on the products of these two reactions, determine what the structure of the compound is.



7. (12 points) Consider the following reaction:



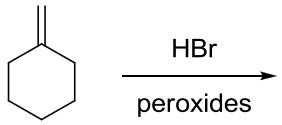
a) Draw a Newman projection for **A**, looking down the C1-C2 bond, for the lowest-energy conformation.

b) Draw another Newman projection for **A**, looking down the C1-C2 bond, that would be the reactive conformer (i.e. that the E2 reaction proceeds via).

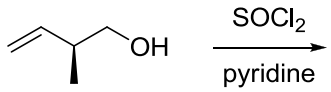
c) Based on your answer to b), redraw compound **B** to show which stereoisomer (*E*- or *Z*-) would result from this reaction.

8. (48 points) Give the major organic product(s) for the following reactions, including stereochemistry if applicable.

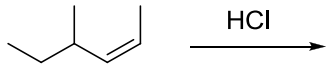
a)



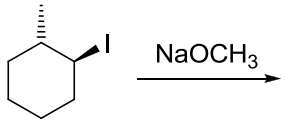
b)



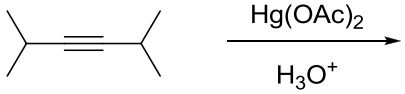
c)



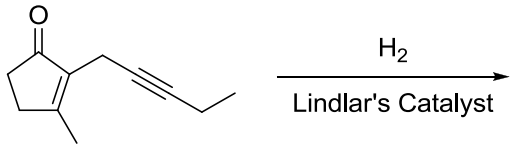
d)



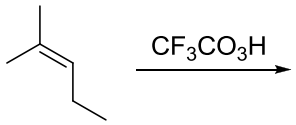
e)



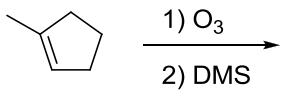
f)



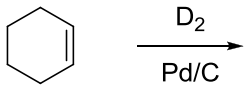
g)


CF_3CO_3H

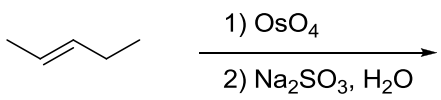
h)


1) O_3
2) DMS

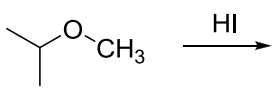
i)


D_2
Pd/C

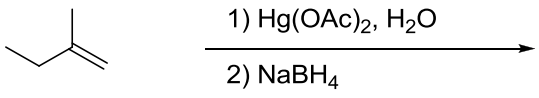
j)


1) OsO_4
2) Na_2SO_3, H_2O

k)

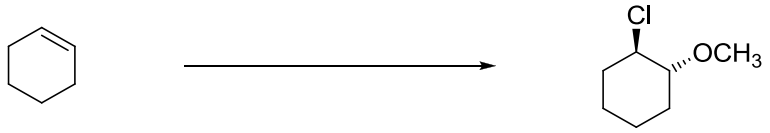

O
CH_3
HI

l)

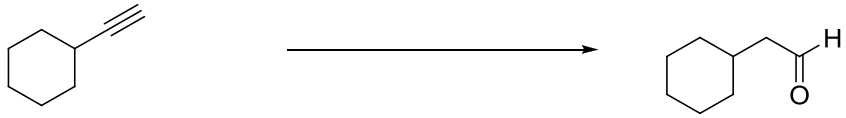

1) $Hg(OAc)_2$, H_2O
2) $NaBH_4$

9. (21 points) Give the reaction conditions required to effect the following transformations:

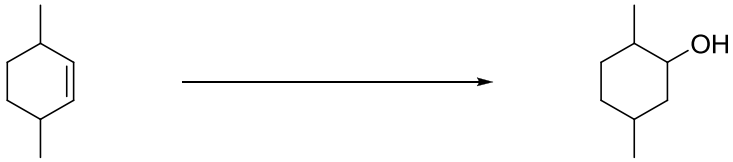
a)



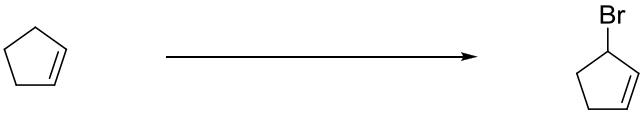
b)



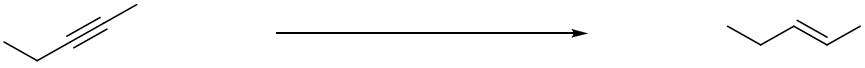
c)



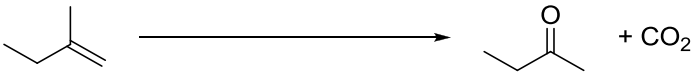
d)



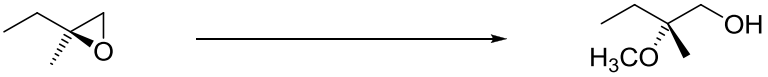
e)



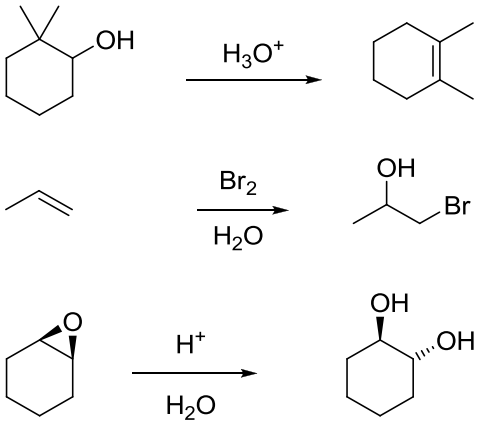
f)



g)

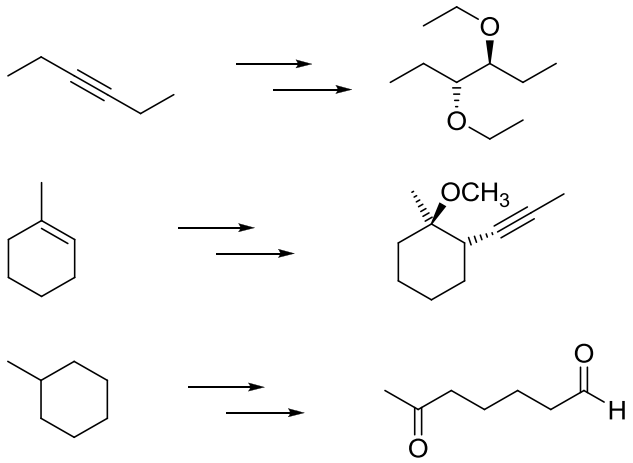


10. (12 points) Reaction Mechanisms: Choose TWO of the following THREE reactions and show a reaction mechanism that accounts for the formation of the product. CLEARLY INDICATE which two you wish graded for credit; otherwise, if you show work on all three, only the first two will be graded.



11. (12 points) Multistep Synthesis: Choose ONE of the following THREE synthesis problems. Provide a synthesis for the compound on the right from the indicated starting material on the left. Although multiple solutions may be possible, each synthesis could be accomplished in no more than three steps .Retrosynthetic analysis counts for part credit (use the correct arrows if you do this), but for full credit write the complete sequence of forward reactions with specific reagents.

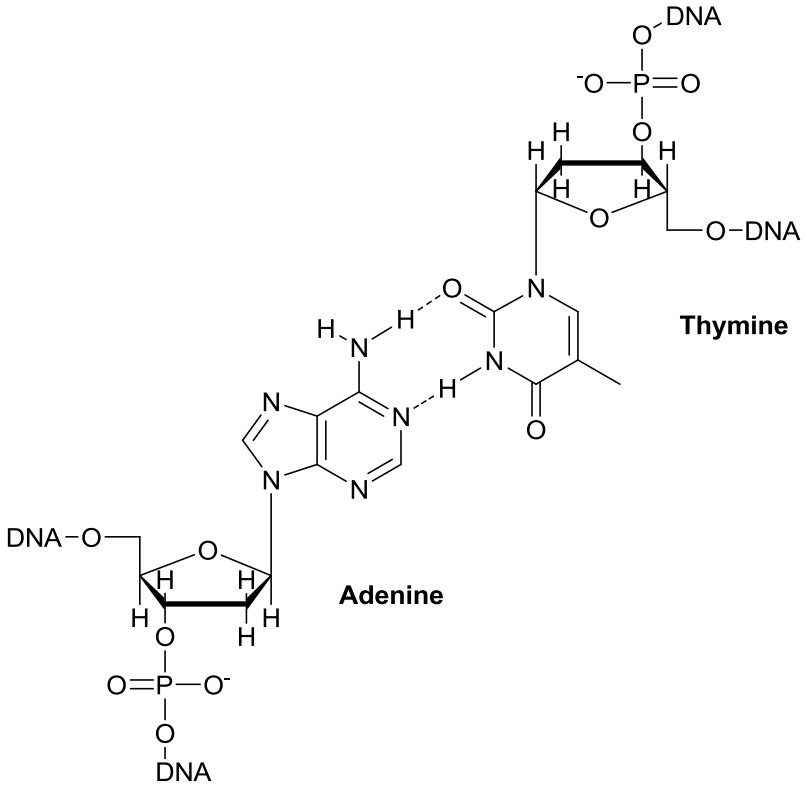
CLEARLY INDICATE which two you wish graded for credit; otherwise, if you show work on all three, only the first two will be graded.



(extra space for Question 11)

Extra Credit: A recent, controversial paper submitted to the journal *Science* reported the discovery of a bacterium that could substitute arsenic for another element in biomolecules such as DNA. The following questions involve the chemistry of DNA.

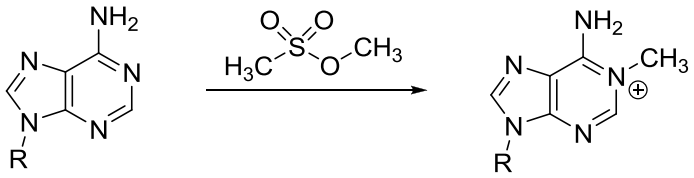
12. DNA consists of two strands of repeating nucleotide units (adenine, cytosine, guanine, thymine). The two strands are held together by hydrogen bonds. An adenine-thymine "base pair" with its associated hydrogen bonds is shown below.



a) (2 points) As soon as I heard on the radio that the discovery involved incorporation of arsenic into the structure of DNA, I had a good idea that, if this were true, it had to be replacing phosphorous or nitrogen. Why would these two elements have been the most likely candidates?

b) (3 points) I also immediately concluded that, if this were true, the arsenic would be replacing phosphorous and not nitrogen. Why would it be implausible that the nitrogen in DNA could be replaced by arsenic?

13. Alkylating agents can be carcinogenic, because they can react with DNA bases. For example, methyl methanesulfonate can react with adenine as follows:



a) (4 points) Show a mechanism for this reaction.

b) (3 points) Would such alkylations stabilize, or destabilize, the DNA double helix? Why?