Midterm 59-230/2
Oct. 18, 2013

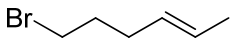
Student Name: **Student ID:**

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	**Total**
/15	/10	/7.5	/11	/7	/5	/9	/12	/8	/5	/7	/13	**/109.5**

Easier Questions (76.5/93)

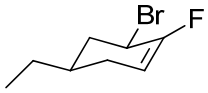
1) Name according to IUPAC the following molecules (include R/S and Z/E assignments where necessary (no cis and trans!)).

a. (4 marks)



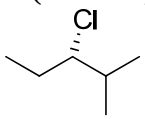
(E)-6-bromohex-2-ene or (E)-6-bromo-2-hexene

b. (7 marks)



(4R,6R)-6-bromo-4-ethyl-1-fluorocyclohex-1-ene
or (4R,6R)-6-bromo-4-ethyl-1-fluoro-1-cyclohexene

c. (4 marks)

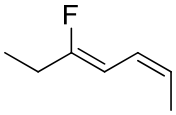


(S)-3-chloro-2-methylpentane

2) Draw the molecular structures for the following names.

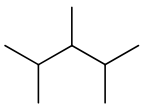
a. (6 marks)

-1 for each mistake



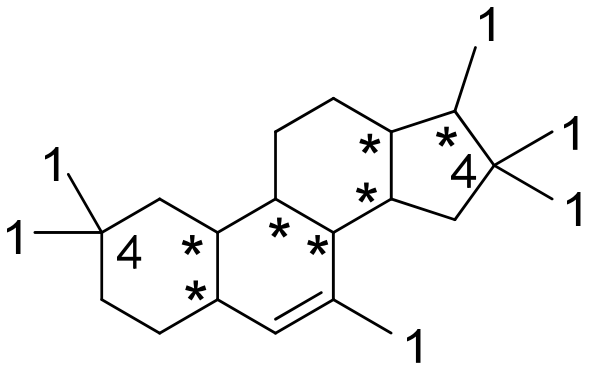
(2Z,4Z)-5-fluorohepta-2,4-diene

b. (4 marks)



2,3,4-trimethylpentane

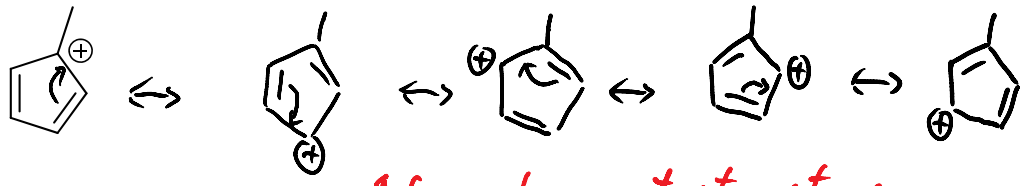
3) Assign all of primary carbons with a **1**, all quaternary carbons with a **4**, and all chiral carbons with an * in the molecule shown below (no information on stereochemistry is provided) (7.5 marks, 0.5 each)



-0.5 for 2 incorrect assignments

4) Draw all resonance structures (conjugated forms) that move (delocalize) the charge of each of the two molecules and use curved arrows to indicate the movement of electrons and the appropriate arrow between each resonance structure (include all lone pairs!).

a. (6 marks) 1 for correct curved arrows; 1 for correct resonance arrows

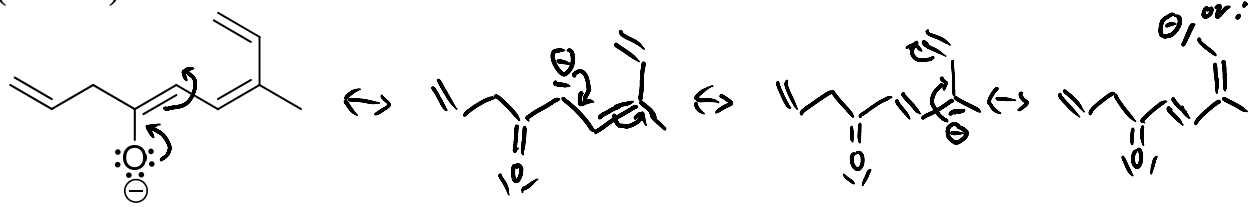


1 for each correct structure

<=> is 0.5 marks

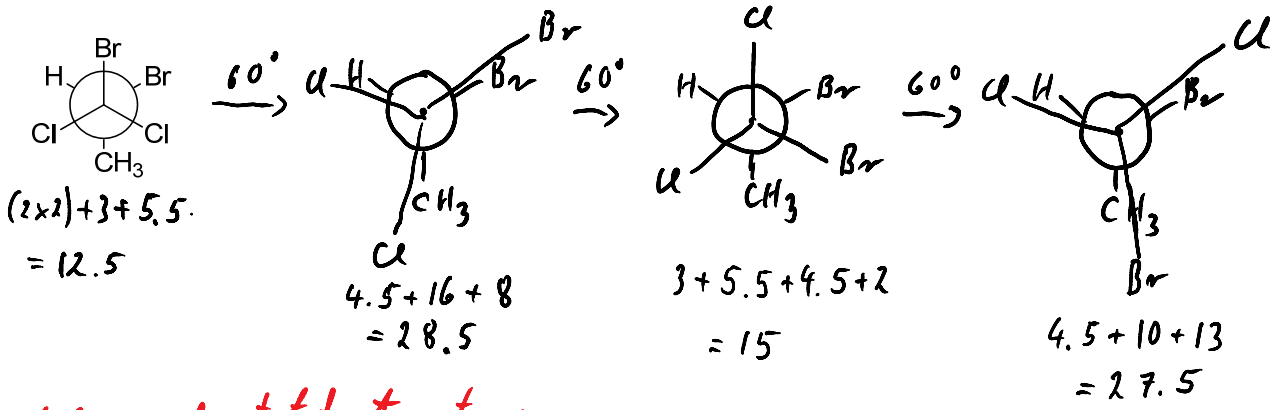
-0.5 for each missing charge, bond, lone pair

b. (5 marks)



marking as above

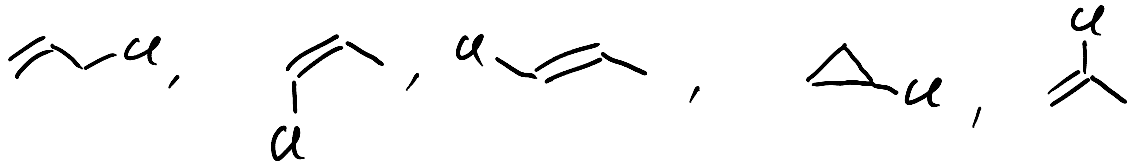
5) Start with the provided conformer as zero rotation angle and then rotate the front carbon clockwise in 60º steps until you reach a rotation angle of 180º. Draw the missing three Newman projections and calculate the strain energies for all four Newman projections based on the strain values provided below. (7 marks)
Use the following strain energies:
eclipsed conformations (in kJ/mol): 4 per H,H interaction; 6 per H,CH_3; 4.5 per H,Cl; 5 per H,Br; 11 per CH_3,CH_3; 8 per Cl,CH_3; 13 per Br,CH_3; 5 per Cl,Cl; 16 per Br,Br; and 10 per Cl,Br interaction;
steric (gauche) interactions in staggered conformations (in kJ/mol): 3.5 per CH_3,CH_3; 2 per Cl,CH_3; 4.5 per Br,CH_3; 1 per Cl,Cl; 5.5 per Br,Br; and 3 per Cl,Br interaction;



1 for each rotated structure

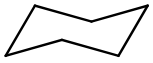
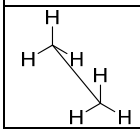
1 for each energy value

6) Draw all isomers of C_3H_5Cl (include all stereoisomers). (5 marks)



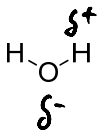
1 mark each

7) Indicate in the table the strain energies of the molecules in the given conformations (cross each box that applies) (9 marks)

molecule	Torsional Strain	Steric Strain	Bond Angle Strain
		X	
	X	not defined both answers correct	X
	X		

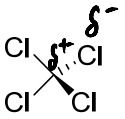
1 mark each

8) Indicate polar bonds (difference in EN 0.4-2.0) by adding δ^+ and δ^- to the polarized atoms of the molecules given below. Also state for each molecule if it is polar or not. (12 marks)



polar

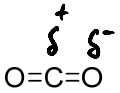
1 for polarization
(0.5 each for δ^+ and δ^-)



non polar

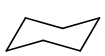
1 for polarity of molecule

polar



non polar

polar

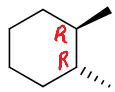


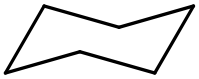
non polar

Intermediate questions (20/93)

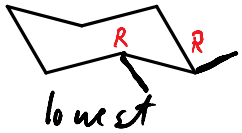
9) Draw the more stable chair conformation for each of the given cyclohexanes. (8 marks)

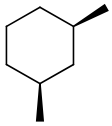
must be correct enantiomer

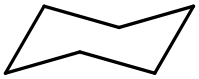




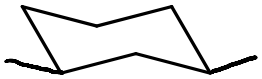
or

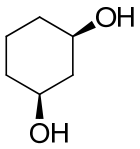


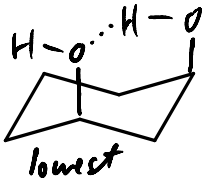




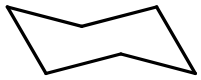
or

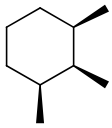


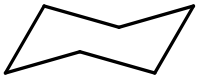




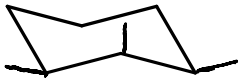
or







or



1 for each lowest energy conformer

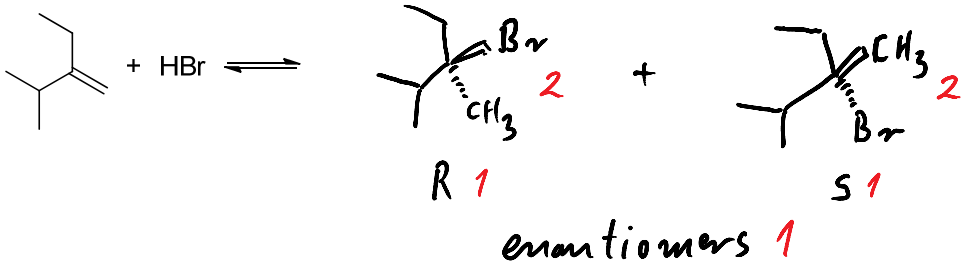
1 for assignment of lowest energy (only required if 2 conformers are given)

10) State whether each of the shown molecules/atoms will typically react as nucleophile or electrophile or both (cross boxes). (5 marks)

	H^+	Br^-	Br_2	$H_2C=CH_2$	H_2O
Nucleophile		X	x accepted	X	X
Electrophile	X		X		X
	1	1	1	1	1

0 points if you state the molecule may react both ways but only one is correct;

11) Draw all products for the addition of HBr to the alkene given below based on Markovnikov's Rules. All stereoisomers must be drawn with wedge-shaped and dotted bonds and include R/S assignment of all chiral carbon atoms. (6 marks)
Also state the relationships between all different stereoisomers (e.g. enantiomers). (1 mark)
1 mark will be subtracted for each incorrect product (product that is not formed).

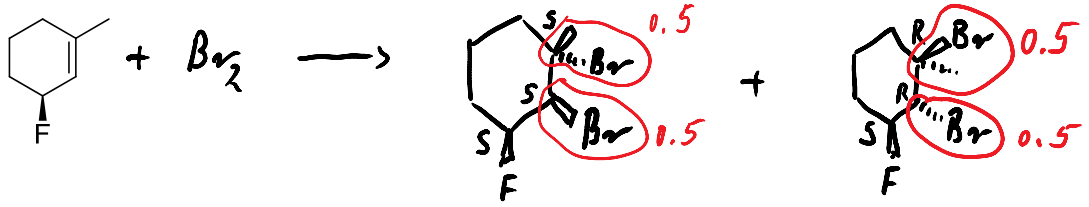


Difficult Question (13/93)

12) a) Draw all products for the addition of Br_2 to the cyclohexene given below. All stereoisomers must be drawn with wedge-shaped and dotted bonds and include R/S assignment of all chiral carbon atoms. (5 marks)

Also state the relationships between all different stereoisomers (e.g. enantiomers). (1 mark)

1 mark will be subtracted for each incorrect product (product that is not formed).

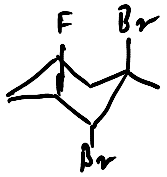


diastereomers 1

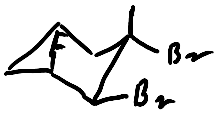
0.5 for each correct R/S

b) Draw both chair conformations for each product and calculated their strain energies based solely on differences in 1,3-diaxial (steric) strain. Use the following 1,3-diaxial (steric) strain energies for **each interaction between two axial ligands**: F with H = 0.25 kJ/mol, Br with H = 1.0 kJ/mol, CH_3 with H = 2.0 kJ/mol, F with Br = 2.5 kJ/mol, F with CH_3 = 3.0 kJ/mol, and Br with CH_3 = 5.0 kJ/mol. Indicate which conformer of each compound has lower potential energy (is more stable). (7 marks)

1 for each correct structure



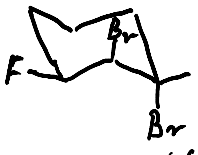
0.25 + 1 + 2.5
= 5.75 0.5
1.0 + 1.0



0.25 + 3.0 + 2.0
= 5.25 0.5

2 × 2.0 = 4.0 0.5

more stable 0.5



1.0 + 1.0
= 4.0 0.5
1.0 + 1.0

more stable 0.5