Chemistry 3351 Organic Chemistry
Thursday: Oct. 21st / @ **7:00pm → 9:00** / 2nd Exam

Name: Habset Yin (please print)

Page	Possible Points	Score
2	9	
3	9	
4	10	
5	12	
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8	9	
9	10	
10	10	
11	10	
12	10	
TOTAL	109	

1. (3 pts each) *Clickers* in action:

i) Predict the major product in the reaction of 3-methyl-1-butene with 1 M HNO_3.

A) 3-Methyl-butan-1-ol

B) 3-Methyl-butan-2-ol

C) 2-Methyl-butan-2-ol

D) 3-Methyl-butan-1-ol

ii) Predict the major product in the reaction of 3-methyl-2-pentene with Cl_2 in H_2O as the solvent.

A) 2-Chloro-3-methyl-pentan-3-ol

B) 3-Chloro-3-methyl-pentan-2-ol

C) 4-Chloro-3-methyl-pentan-3-ol

D) 3-Chloro-3-methyl-pentan-4-ol

iii) Predict the product in the reaction between 3-methyl-2-pentene and Cl_2 in CCl_4 as the solvent.

A) 2, 3-Dichloro-2-methylpentane

B) 2, 3-Dichloro-3-methylpentane

C) 2, 2-Dichloro-3-methylpentane

D) 3, 3-Dichloro-2-methylpentane

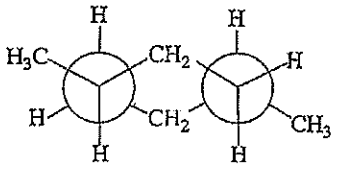
iv) Consider the reaction of 1-butene with Br_2 in aqueous solution and identify the nucleophilic species that leads to the major product in this reaction.

A) Br_2

B) $Br^{\ominus}$

C) $HO^{\ominus}$

D) H_2O

v) The IUPAC name of the compound  is:

A) *cis*-1, 3-dimethylcyclohexane.

B) *trans*-1, 3-dimethylcyclohexane.

C) *cis*-1, 4-dimethylcyclohexane.

D) *trans*-1, 4-dimethylcyclohexane.

vi) Which reaction conditions would you select to synthesize 3-methylpentan-2-ol from 3-methylpent-2-ene?

A) H_2O, concentrated H_2SO_4

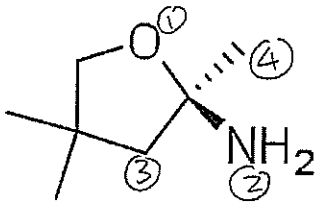
B) Br_2, H_2O

C) BH_3, THF; followed by H_2O_2/ $^{\ominus}OH$

D) $Hg(OAc)_2$, THF-H_2O; followed by $NaBH_4$, $^{\ominus}OH$

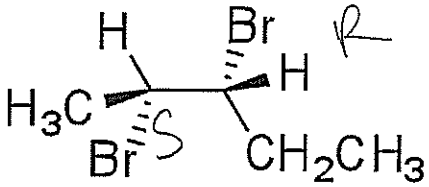
2. (10 pts) For each of the following compounds, assign **R** or **S** at each asymmetric carbon.

a)



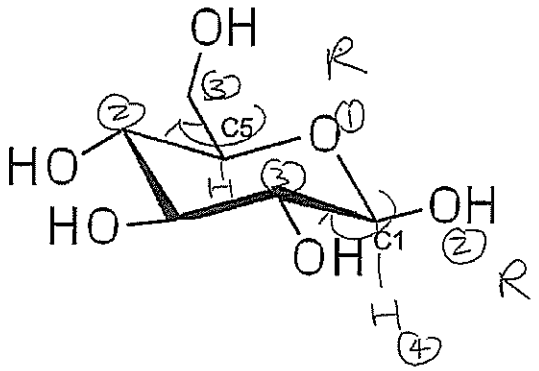
R

b)



R

c) Assign C1 and C5 carbons only:

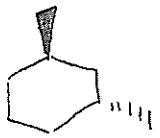


R

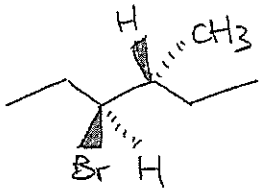
R

3. (12 pts) Draw structures for each of the following compounds.

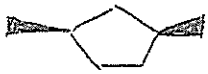
a) (1*R*, 3*R*)-1, 3-dimethylcyclohexane



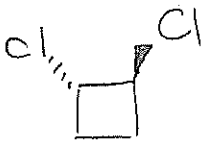
b) (3*S*, 4*R*)-3-bromo-4-methylhexane



c) The *meso* isomer of 1, 3-dimethylcyclopentane

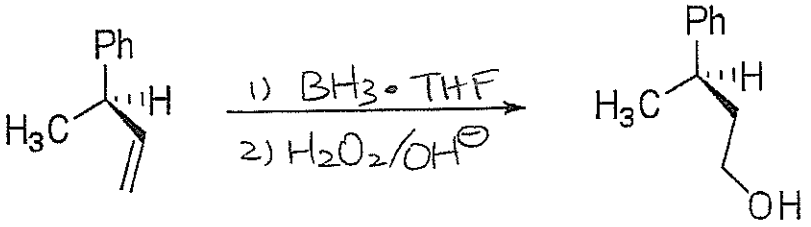


d) An optically active isomer of 1, 2-dichlorocyclobutane

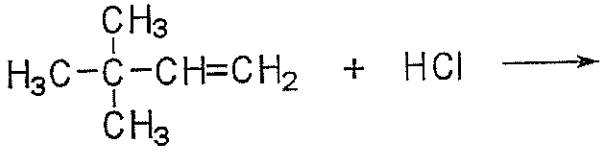


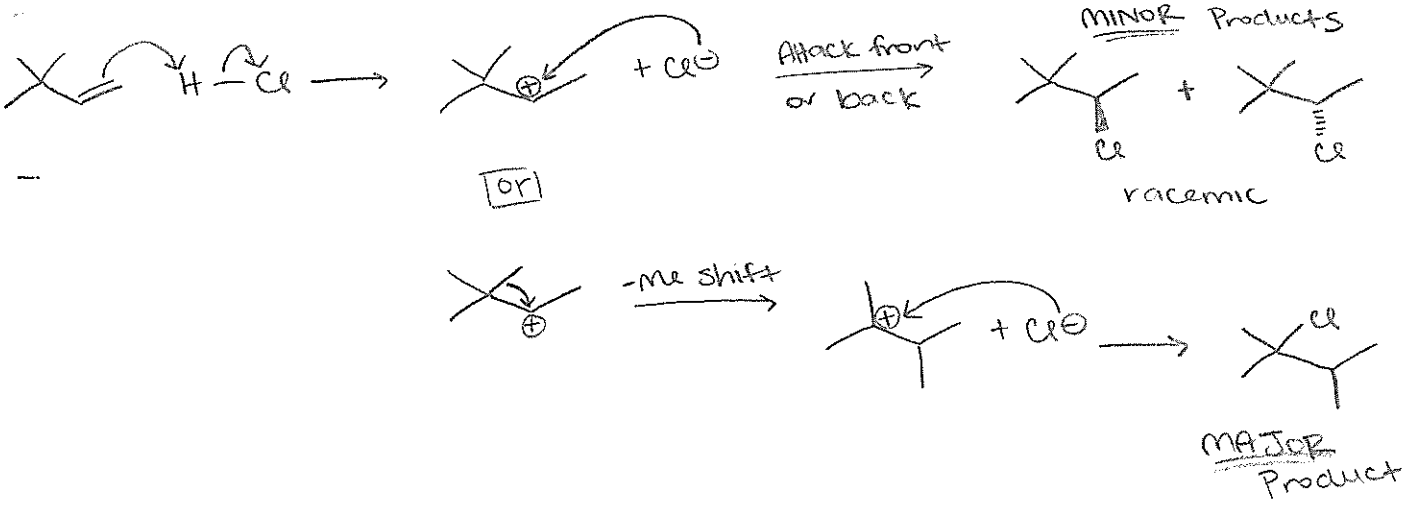
4. (10 pts)

a) Show how the following conversions might be accomplished.

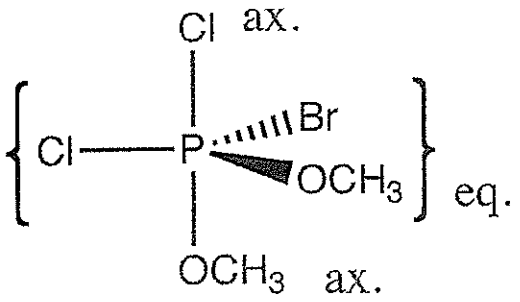


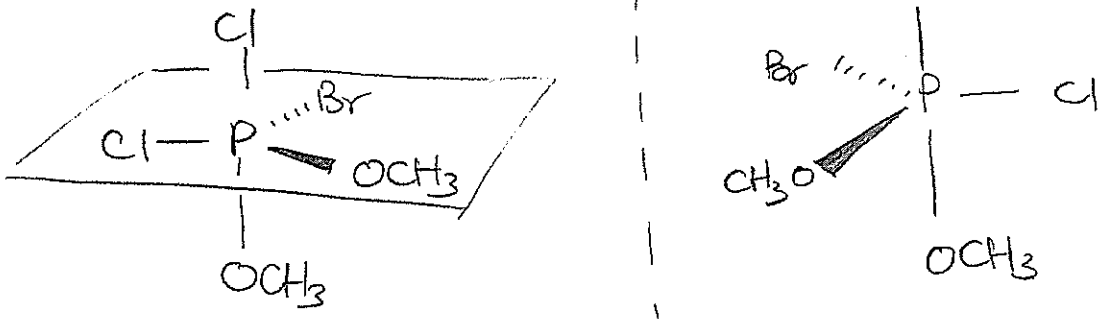
b) Show the products of these addition reactions. Show the mechanism for the addition step(s).





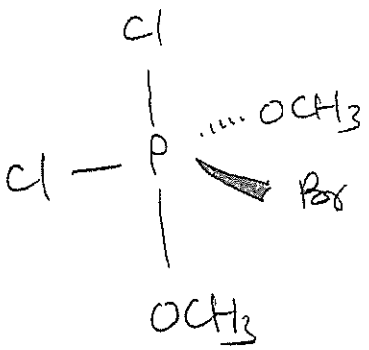
5. (10 pts) In a structure containing a pentacoordinate phosphorus atom, the bonds to three of the groups bound to phosphorus (equatorial) lie in a plane containing the phosphorus atom and the bonds to other two groups (axial) are perpendicular to this plan. Is this compound chiral? Explain.





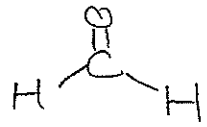
rotate 180°C

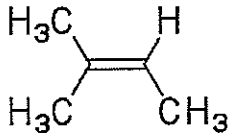
because the two mirror-image structures are not congruent, the compound is chiral.

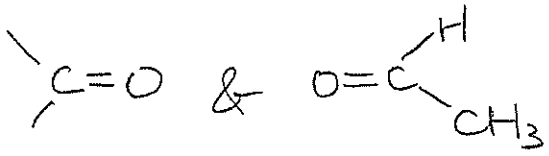


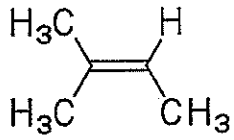
6. (12 pts) Provide the ozonolysis products.

a) $CH_3(CH_2)_5CH{=}CH_2$ $\xrightarrow[2)\ (CH_3)_2S]{1)\ O_3,\ CH_2Cl_2}$

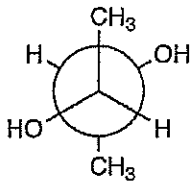
$CH_3(CH_2)_5CHO$ & 

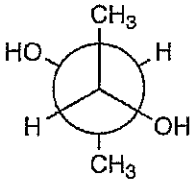
b)  $\xrightarrow[2)\ (CH_3)_2S]{1)\ O_3,\ CH_2Cl_2}$



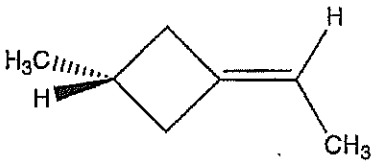
c)  $\xrightarrow[2)\ H_2O\ (+H_2O_2)]{1)\ O_3,\ CH_2Cl_2}$

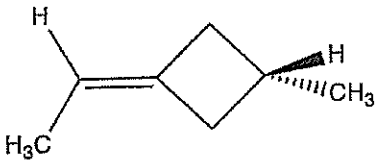
7. (10 pts) Determine the relationship (i.e. identical, enantiomers, diastereomers, constitutional isomers) between each of the following pairs of molecules.

a) 

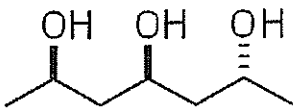
and 

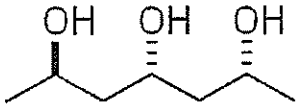
identical

b) 

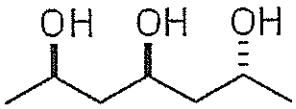
and 

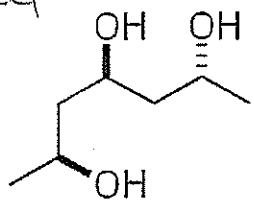
enantiomers

c) 

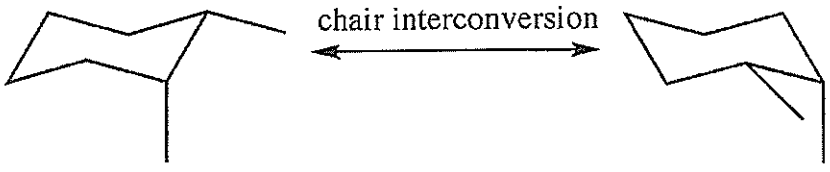
and 

identical

d) 

and 

diastereomers

e) 

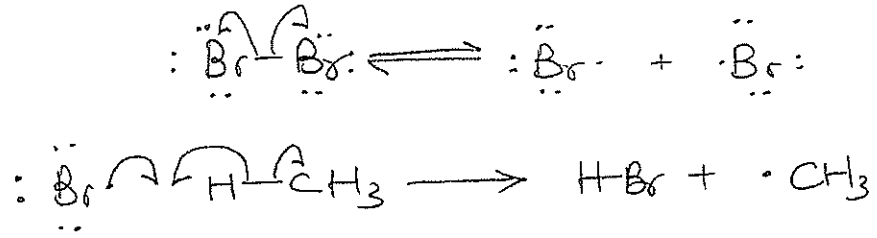
(conformational) enantiomers

8. (10 pts) Draw a mechanism for the two propagation steps in the bromination of methane. The overall reaction is shown here:

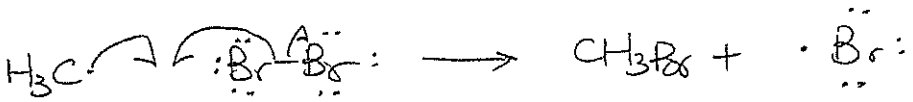
$$CH_4 + Br_2 \longrightarrow CH_3Br + HBr$$

For full credit, include all curved arrows, unpaired electrons, lone pairs of electrons, and any non-zero formal charges.

First propagation step:



Second propagation step:



Calculate the overall enthalpy change for this bromination. The bond dissociation energies you will need are given below. Draw a box around your answer.

C-H in methane: 104 kcal/mol; Br-Br: 46 kcal/mol; H-Br: 88 kcal/mol

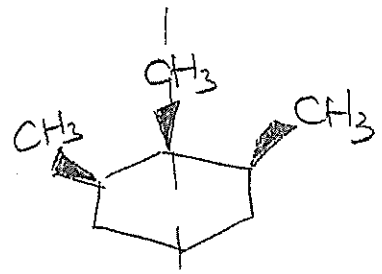
C-Br in CH_3Br: 70 kcal/mol

$+104 - 88 = 16$

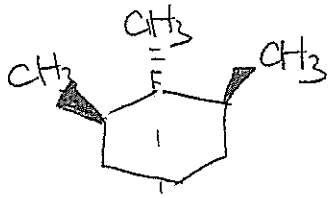
$+46 - 70 = -24$

$\Delta H_{rxn} = -8$ (kcal/mol)

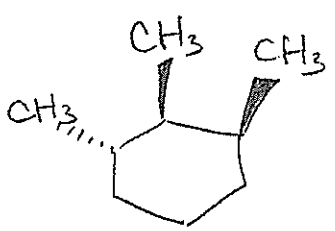
9. (10 pts) Give the structure of every stereoisomer of 1,2,3-trimethylcyclohexane. Label the enantiomeric pairs and show the plane of symmetry in each achiral stereoisomer.

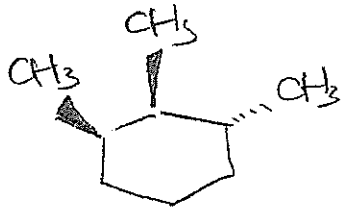


(meso)



(meso)

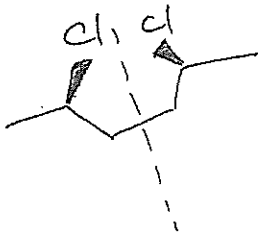




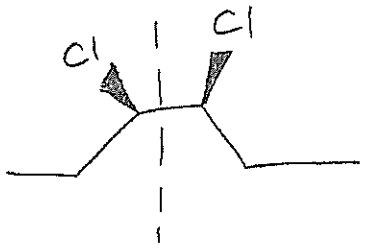
enantiomers

10. (10 pts) Draw the structures of all compounds with the formula $C_6H_{12}Cl_2$ that can exist as meso compound. Indicate how many meso compounds are possible for each structure.

(1)



(2)



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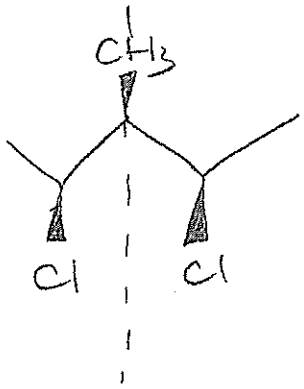

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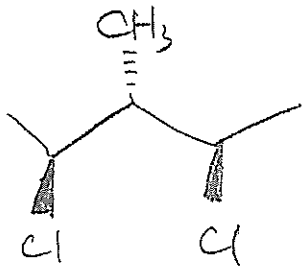

(5)