Chemistry 3351 Organic Chemistry
Tuesday: Oct. 23/ **@ 7:00pm → 9:00**/2nd Exam

Name:_____ (please print, 1pt)

Page	Possible Points	Score
1	1	_____
2	9	_____
3	9	_____
4	9	_____
5	6	_____
6	12	_____
7	10	_____
8	8	_____
9	8	_____
10	8	_____
11	10	_____
12	10	_____
TOTAL	100	_____

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

i) Addition of HCl to 3-methyl-1-pentene gives TWO products. One of these is 2-chloro-3-methylpentane. Identify the other product.

A) 1-Chloro-3-methylpentane

B) 3-Chloro-3-methylpentane

C) 3-Chloro-2-methyl pentane

D) 2-Chloro-2-methylpentane

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

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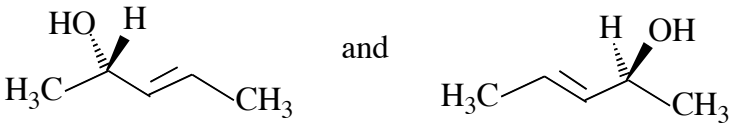
iv) How are these molecules related?



A) Constitutional Isomers

B) Diastereomers

C) Enantiomers

D) Identical

v) Which compound would have the highest heat of combustion (ΔH_{comb}), the energy released as heat when a compound undergoes complete combustion with oxygen under standard conditions?

A) Methylcyclobutane

B) Cyclopentane

C) *cis*-1,2-dimethylcyclopropane

D) *trans*-1,2-dimethylcyclopropane

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 $NaBH_4$, $^{\ominus}OH$

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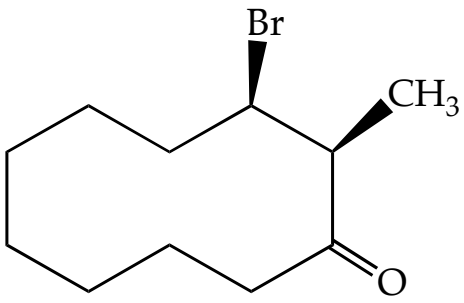
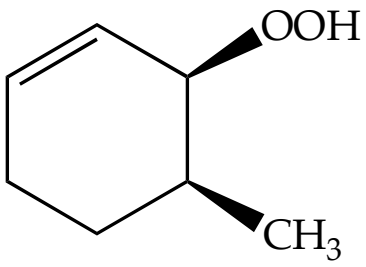
2. (9 pts) For each of the following compounds, assign **R** or **S** at each asymmetric carbon.

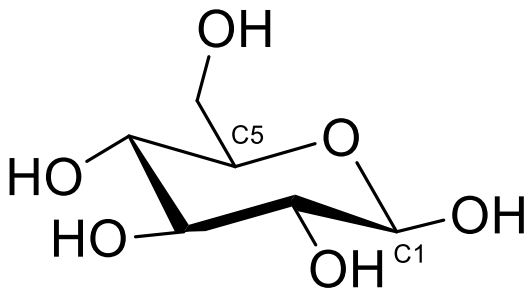
a)



b)



c) Assign C1 and C5 carbons only:



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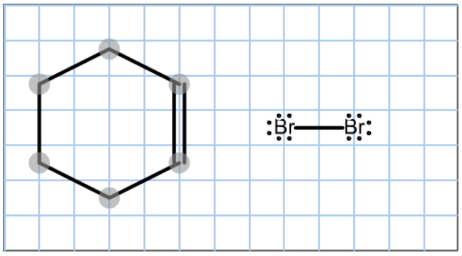
3. (6 pts)

Show the mechanism for the following reaction conducted at – 5 °C in CCl_4:
cyclohexene + bromine yields a dibromocyclohexane
Draw structures – including charges and electrons – and add curved arrows. Details count.

Step 1
Add three curved arrows to the first step.



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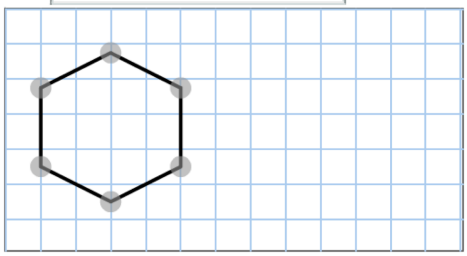
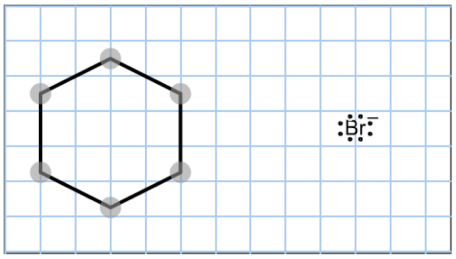
Draw the step 1 products:
1 organic species;
1 inorganic species.



Step 2
• Reproduce the step 1 products.
• Add two curved arrows to show the bromide ion reacting with the organic species.



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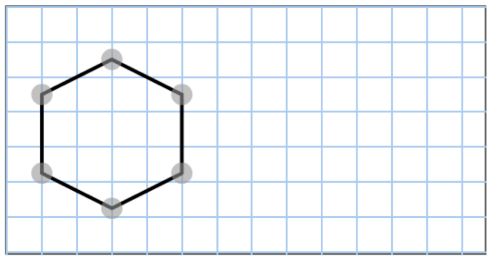
Draw the final product.



4. (12 pts) Give the structure and stereochemistry of all products formed in each of the following reasons.

a) *trans*-2-pentene + Br_2 ⟶

b) *trans*-3-hexene + Br_2 + H_2O (excess solvent) ⟶

c) *cis*-3-hexene+ D_2 $\xrightarrow{Pt/C}$

d) *cis*-3-hexene +BD_3 $\xrightarrow{THF}$ $\xrightarrow{H_2O_2/OH^-}$

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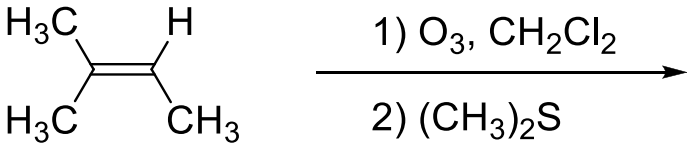
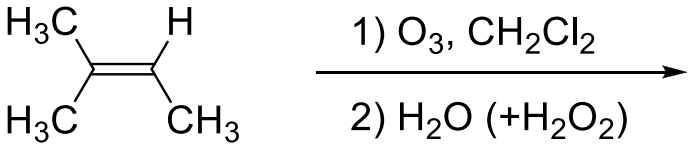
5. (10 pts) Provide the ozonolysis products.

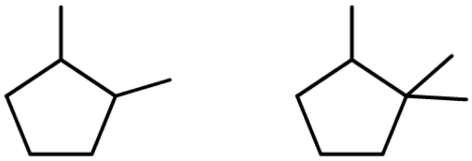
a) 

b) 

6. (8 pts) Identify each pair of compounds as constitutional isomers, stereoisomers, identical molecules, or other.

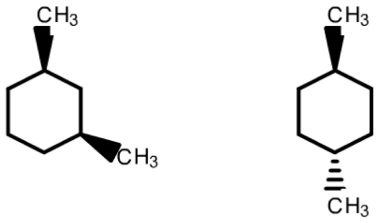
(a)

- other
- stereoisomers
- constitutional isomers
- identical molecules



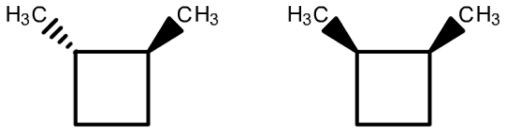
(b)

- other
- identical molecules
- stereoisomers
- constitutional isomers



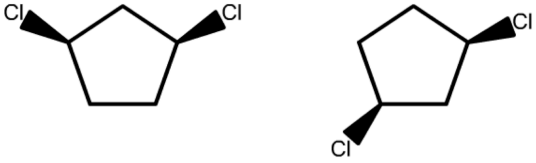
(c)

- stereoisomers
- other
- constitutional isomers
- identical molecules



(d)

- constitutional isomers
- identical molecules
- other
- stereoisomers



7. (8 pts) Draw a mechanism for the two propagation steps in the bromination of methane. The overall reaction is shown here:

$$CH_4 + Br_2 \xrightarrow{h\nu} CH_3Br + HBr$$

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

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8. (8 pts) Draw every stereoisomer for 1-bromo-2-chloro-1,2-difluorocyclopentane. Use wedge-and-dash bonds for the substitutent groups, and be sure that they are drawn on the outside of the ring, adjacent to each other.

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9. (10 pts) How many distinct *meso* compounds are possible for $C_6H_{12}Cl_2$? Draw the structures of each *meso* compound and indicate plane of symmetry.

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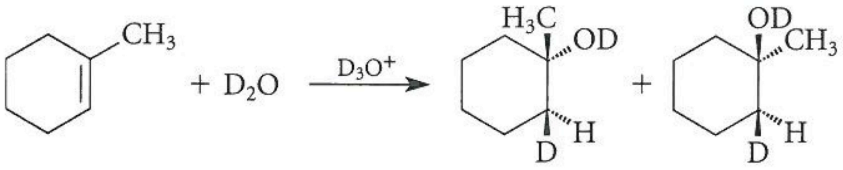
10. (10 pts) When 1-methylcyclohexene undergoes hydration in D_2O, the product is a mixture of diastereomers; the hydration is thus not a stereoselective reactions:



both compounds are racemates

(a) Show why the accepted mechanism of this reaction is consistent with these stereochemical results.

(b) Why must D_2O rather than H_2O be used to investigate the stereoselectivity of this addition reaction?

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