Multiple Choice. Choose the best answer for the following questions. (40 pts)

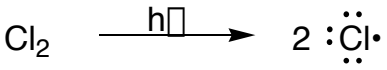
1. Calculate the degrees of unsaturation for a compound with a molecular formula of $C_{11}H_{12}ClNO_2$.

a. 4
b. 5
c. 6
d. 7

2. The rate of a reaction is dependent upon which of the follow?

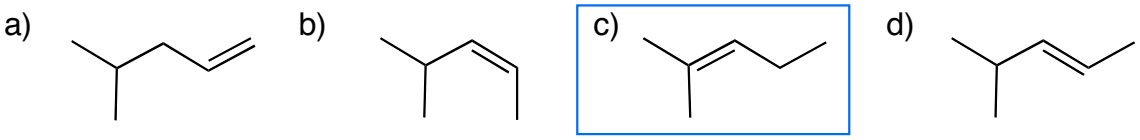
a. $\Delta G°$
b. $\Delta H°$
c. $\Delta S°$
d. $\Delta G^{\ddagger}$

3. The reaction below can be characterized as:

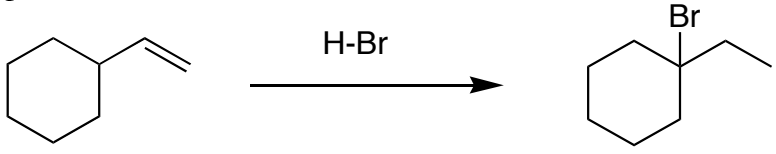


a. heterolytic
b. homolytic
c. heterogenic
d. electrophilic

4. Which of the following isomeric alkenes would be the most stable?



5. The product from the reaction below is the result of a:

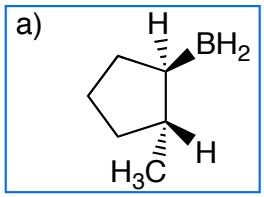


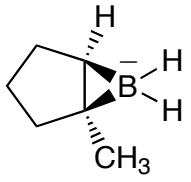
a. 1,2-methyl shift
b. carbene
c. bromonium ion
d. 1,2-hydride shift

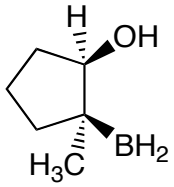
6. Stablization of a carbocation by alkyl groups involves hyperconjugation between:

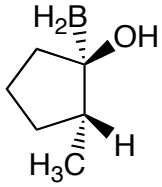
a. a filled C-H σ-bond with a vacant σ*-orbital
b. a vacant σ*-orbital with the vacant p-orbial
c. a filled C-H σ-bond with a vacant p-orbital
d. a filled C-H σ-bond with a filled π-orbital

7. Which of the following is an intermediate for the hydroboration of 1-methylcyclopentene?

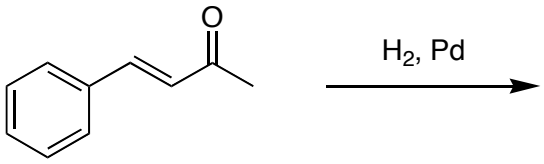
a) 

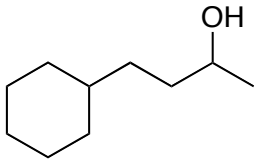
b) 

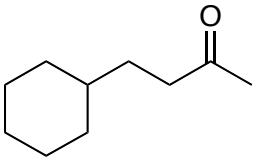
c) 

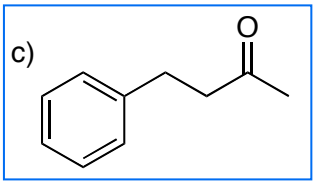
d) 

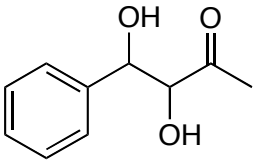
8. Which is the correct product for the following reaction?



a) 

b) 

c) 

d) 

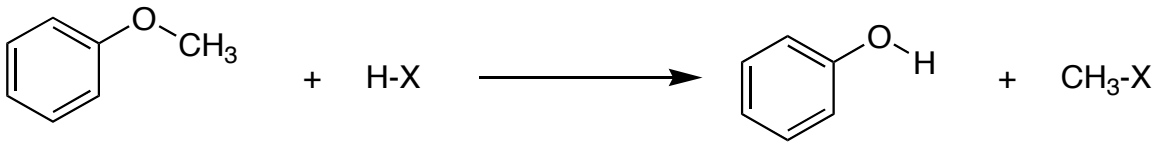
9. Which of the following is a propagation step for the free radical chlorination of methane?

a) Cl-Cl + hν → 2 Cl•
b) H_3C• + Cl• → H_3C-Cl
c) H_3C• + Cl_2 → H_3C-Cl + Cl•
d) 2 H_3C• → H_3C-CH_3

10. Which of the following will react with an alkene to give a product in a single step?

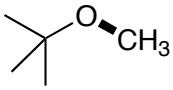
a) NBS, H_2O, DMSO
b) carbene
c) H_3O^+
d) Cl_2

11. Consider the following reaction:

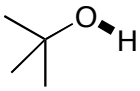


a) Using the following information, determine which reagent (HX) is most favorable for the desired reaction. Assume that entropy is constant for the three reactions (show your work): (8 pts)

Enthalpies for the highlighted bonds:



□H° = 340 KJ/mol



□H° = 440 KJ/mol

H–Cl	□H° = 430 KJ/mol	H_3C–Cl	□H° = 350 KJ/mol
H–Br	□H° = 370 KJ/mol	H_3C–Br	□H° = 300 KJ/mol
H–I	□H° = 300 KJ/mol	H_3C–I	□H° = 240 KJ/mol

For H-Cl: DH° = 340 + 430 – 440 –350 = -20 KJ/mol

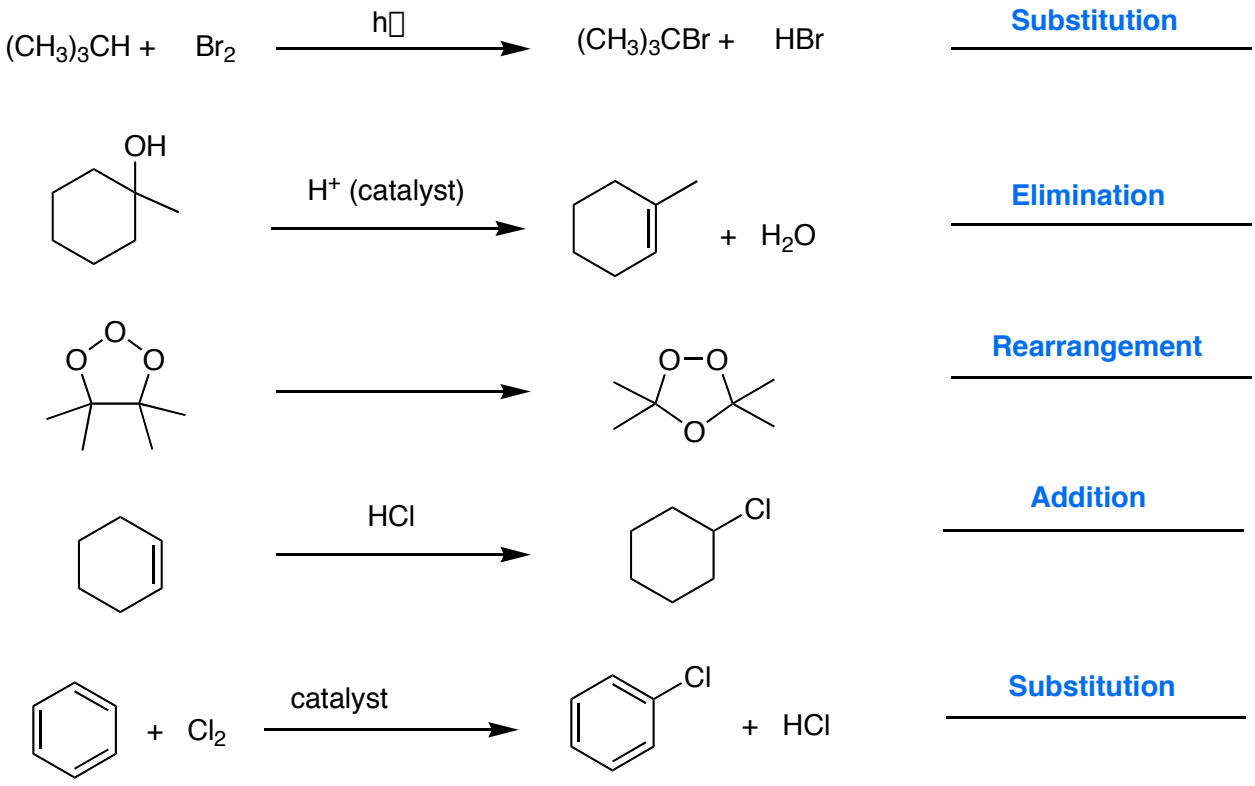
For H-Br: DH° = 340 + 370 – 440 – 300 = -30 KJ/mol

For H-I: DH° = 340 + 300 – 440 – 240 = -40 KJ/mol

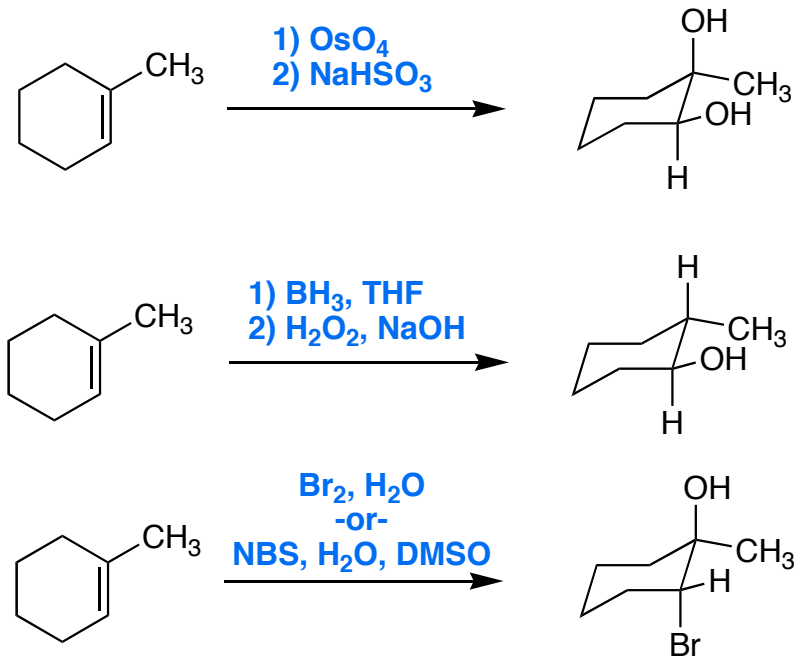
All reactions are exergonic. HI has the most favorable free energy change for the reaction.

b) According to the Hammond postulate, the transition state of the reaction would most resemble _____**Reactants (negative free energy change)**_____. (2 pts)

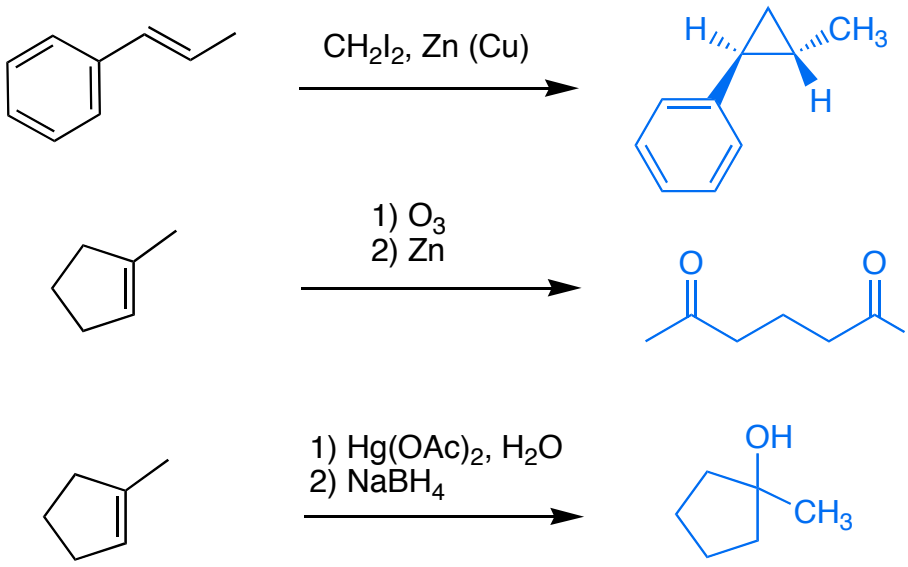
12. Classify the reactions below as either an addition, elimination, substitution or rearrangement : (10 pts)



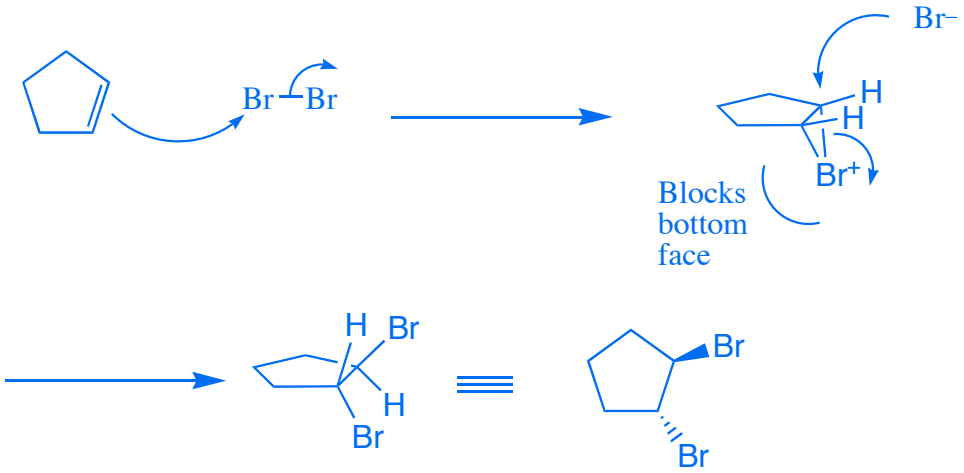
12. Give all reagents required for the following reactions. (15 pts)



13. Give the product of each reaction below. Indicate stereochemistry if it is important. (15 pts)



14. Draw a complete mechanism for the reaction of Br_2 with cyclopentene. Your mechanism should clearly account for any stereochemical preference the reaction may show. (10 Pts)



Anti (trans) addition of Br_2

Problem 1-10:_____ (40 pts)

11:_____ (10 pts)

12:_____ (25 pts)

13:_____ (15 pts)

14:_____ (10 pts)

Total out of 100: _____