

Key

## Finals Test Prep

1) Define the following:

a) Lewis Acid

electron pair acceptor

b) Lewis Base

electron pair donor

c) Bronsted-Lowry Acid

proton donor

d) Bronsted-Lowry Base

proton acceptor

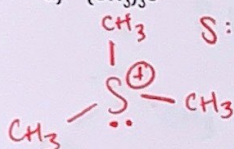
e) Nucleophile

seeks a (+) center

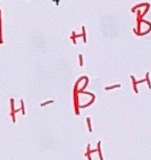
f) Electrophile

seek electrons

2) Assign formal charges to the central atoms in the following organic compounds:

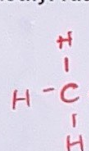
a)  $(\text{CH}_3)_3\text{S}^+$ 

$$\text{S: } 6 - 3 - 2 = \boxed{+1}$$

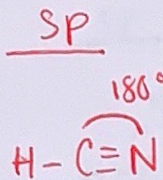
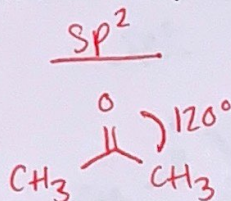
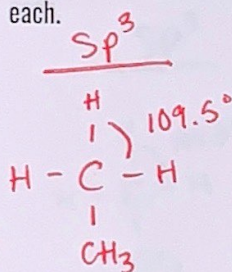
b)  $\text{BH}_4^-$ 

$$\text{B: } 3 - 4 - 0 = \boxed{-1}$$

c) Methyl radical



$$\text{C: } 4 - 3 - 1 = \boxed{0}$$

3) Show an example of  $\text{sp}^3$ ,  $\text{sp}^2$ , and  $\text{sp}$ -hybridized compounds. Determine the bond angles present in each.

4) What is the optimum structure that minimizes electron repulsion (trigonal planar, tetrahedral, octahedral, etc)?

tetrahedral  $\rightarrow 109.5^\circ$ 

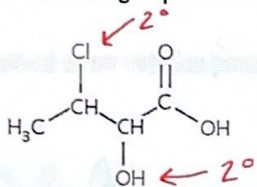
5) Can you rotate bonds? Explain.

$\sigma$  bonds (single) can be rotated freely, but  $\pi$  bonds cannot. You would have to break a double or triple bond to rotate it.

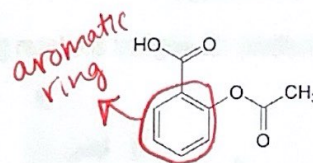
- 6) What would it mean for a compound to have a zero dipole moment? Can this happen in a compound that has polar bonds? *zero dipole moment = nonpolar compound*

*Depending on how the polar bonds in a molecule are arranged, they could cancel each other out, so yes.*

- 7) Identify the functional groups in the following compounds.

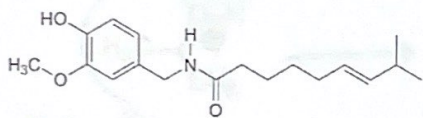


*Alkyl halide, alcohol  
≠ carboxylic acid*



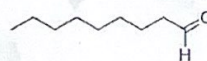
acetylsalicylic acid (aspirin)

*ester ≠ carboxylic acid*

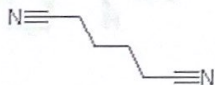


capsiacin

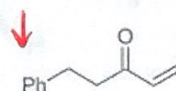
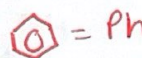
*phenol, ether ≠ amide*



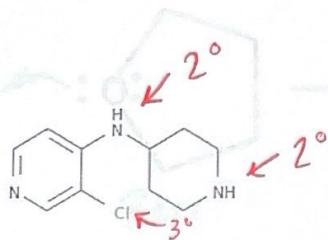
*aldehyde*



*Nitriles*

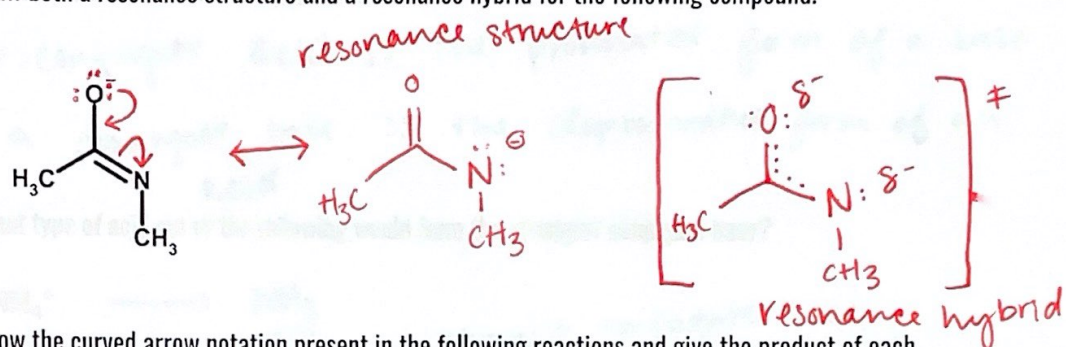


*Ketone*

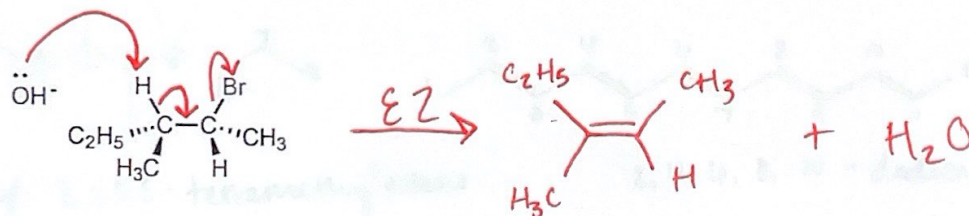
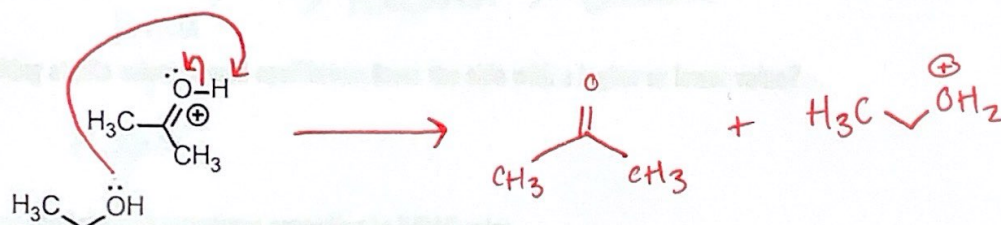
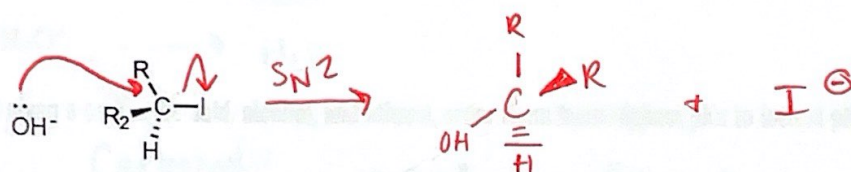


*alkyl halide  
≠ amines*

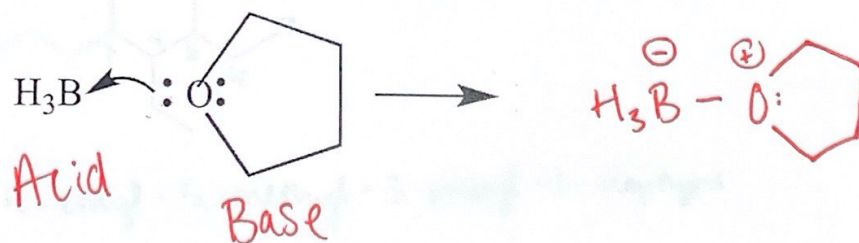
- 8) Draw both a resonance structure and a resonance hybrid for the following compound.



- 9) Show the curved arrow notation present in the following reactions and give the product of each.



- 10) For the following two reactants, determine which is the acid and base, and give the Lewis acid/base complex.



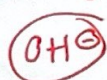
11) What is a conjugate acid? Conjugate base?

A conjugated acid is the protonated form of a base

& a conjugate base is the deprotonated form of an acid.

12) What type of acid out of the following would form the strongest conjugate base?

weakest acid



strongest conj. base



13) If given a carboxylic acid, alcohol, and ethane, order them from highest pKa to lowest pKa.

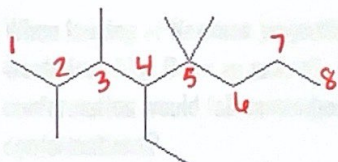
Carboxylic Acid > Alcohol > Ethane

14) Looking at pKa values, would equilibrium favor the side with a higher or lower value?

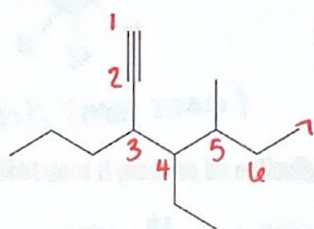
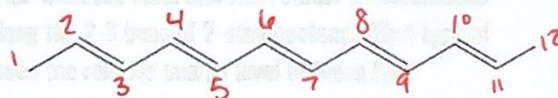
Higher

15) Name the following structures according to IUPAC rules.

2, 4, 6, 8, 10 - dodeca - pentadiene



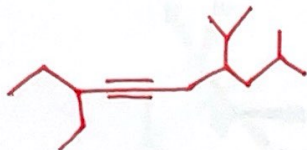
4-ethyl-2,3,5,5-tetramethyloctane



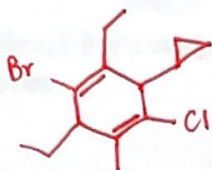
4-ethyl-5-methyl-3-propyl-1-heptyne

16) Draw the following structures using their IUPAC name.

a) 3-ethyl-7-isopropyl-9-methyl-4-decyne



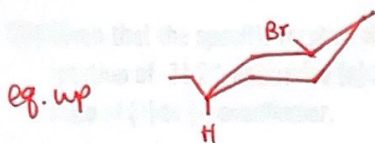
b) 1-bromo-4-chloro-2,6-diethyl-3-cyclopropyl-5-methyl-1,4-cyclohexa-diene



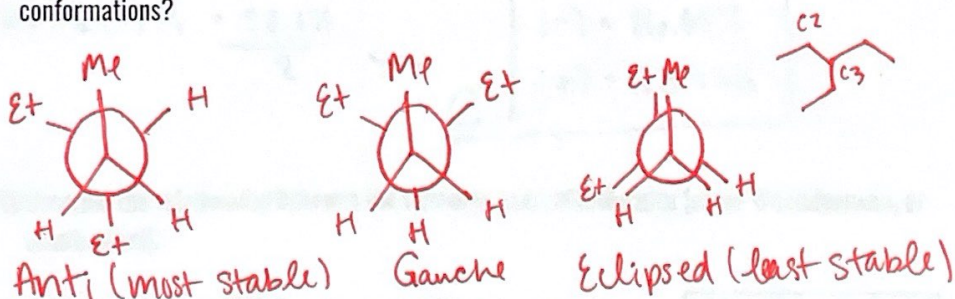
17) Which cyclic alkane is the most stable?

Cyclohexane, bond angles are  $\sim 109^\circ$ .

18) Draw the most stable conformation of cis-1-ethyl-5-bromocyclohexane.



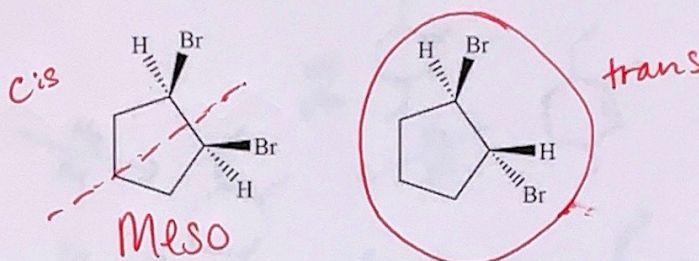
19) When looking at Newman projections, describe what the most and least stable conformations would look like. Draw an example of each along the 2-3 bond of 3-ethylpentane. What type of conformation would fall somewhere in between the relative energy level of these two conformations?



20) What does it mean to be optically active? What does it mean for a molecule to be meso?

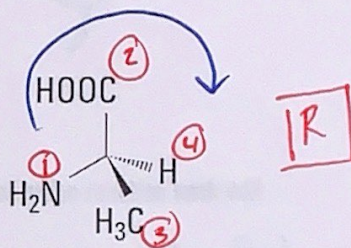
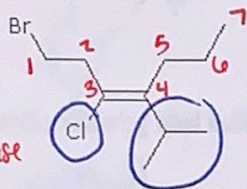
An optically active molecule has one or more chiral centers  $\nexists$  no internal plane of symmetry.  
If it has both chiral center(s)  $\nexists$  an internal plane of symmetry, it is meso. Meso compounds are achiral.

21) Which of the following molecules would be optically active?



22) Determine the E, Z, R or S configurations of the following compounds (if applicable), and name them, if you can.

E = opposite  
Z = same  
R = clockwise  
S = counter clockwise



(Z)-1-bromo-3-chloro-4-isopropyl-3-heptene

23) Given that the specific rotation of a solution is  $7.6^\circ$ , and the (-) pure enantiomer has a specific rotation of  $-11.2^\circ$ , determine (a) the enantiomer in excess, (b) the enantiomeric excess, and (c) the ratio of (+) to (-) enantiomer.

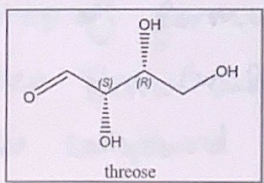
A. (+) enantiomer in excess

$$ee = \left( \frac{7.6}{11.2} \right) \times 100\% \rightarrow B. ee = 67.9\%$$

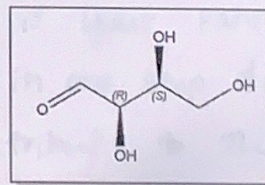
$$100 - 67.9\% = \frac{32.1\%}{2} \rightarrow$$

(-) = 16.05%
(+) = 83.95%

24) Describe the relationship between the following pairs of molecules (same, diastereomers, or enantiomers).



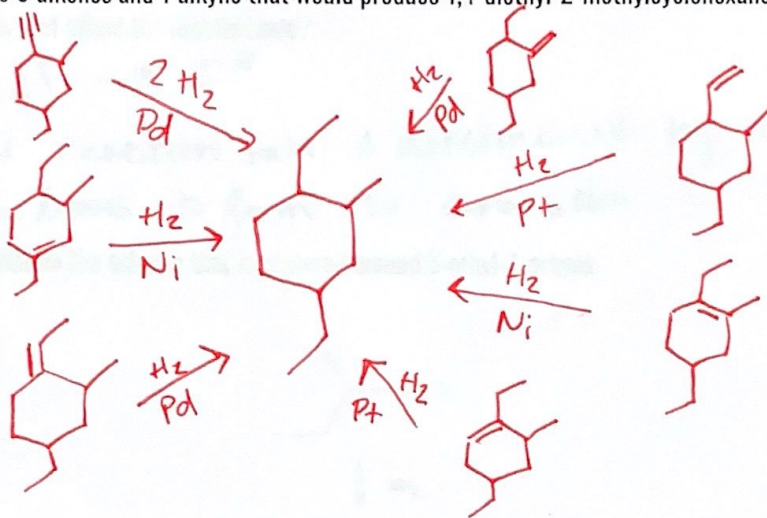
enantiomers



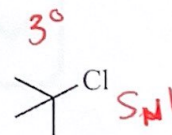
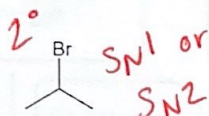
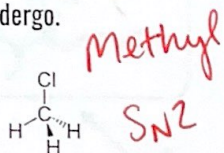
diaster.  $\rightarrow$  (S) (S)  $\leftarrow$  enant.  
(R) (R)  $\leftarrow$

## Hydrogenation

25) Give 6 alkenes and 1 alkyne that would produce 1,4-diethyl-2-methylcyclohexane.



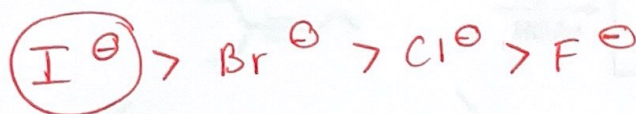
26) Looking at the following alkyl halides, determine what type of substitution reaction each will undergo.



27) Which nucleophilic halogen will react the fastest with a sterically hindered alkyl halide in methanol?

$\text{MeOH} \rightarrow$  polar protic

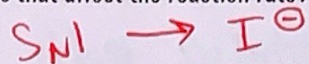
$\rightarrow \text{SN}_1$



28) Explain the difference between unimolecular and bimolecular in substitution and elimination reactions.

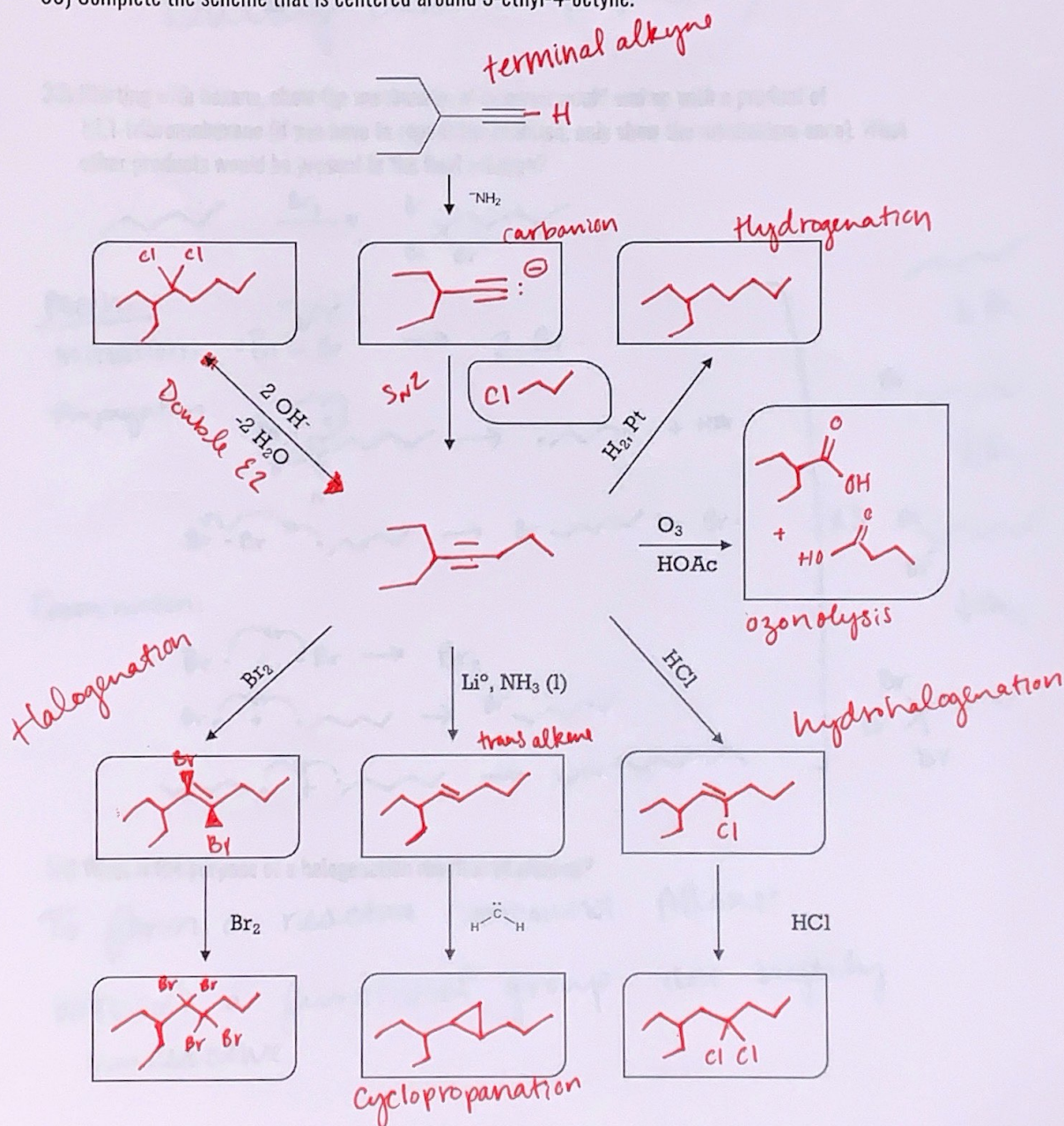
Unimolecular reaction rates are based solely on the organic compound reacting. The base or nucleophile has no effect. This is because the slow step of forming the carbocation is your rate-determining step. Bimolecular reactions happen in one step & both the compound & nucleophile contribute to the rate.

29) When looking at a tertiary alkyl halide, which halogen would be the best leaving group, and how does that affect the reaction rate?



The reaction rate is determined by how fast the LG leaves to form the carbocation

30) Complete the scheme that is centered around 3-ethyl-4-octyne.





- 31) What type of alkene will produce the least amount of heat in a hydrogenation reaction (tetrasubstituted, trisubstituted, etc.)?

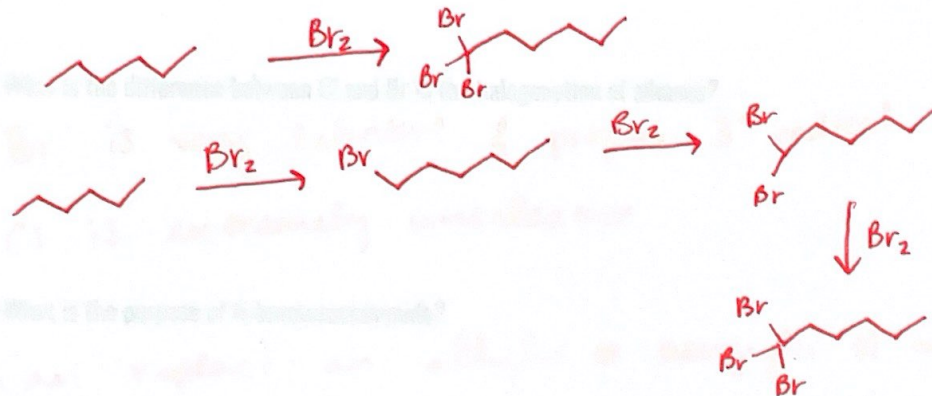
Tetrasubstituted

- 32) What kind of base can you use to get a less stable alkene from an elimination reaction?

Bulky base

"Hoffman's Rule"

- 33) Starting with hexane, show the reaction of how you would end up with a product of 1,1,1-tribromohexane. What are a few other products that would be present in the final solution?

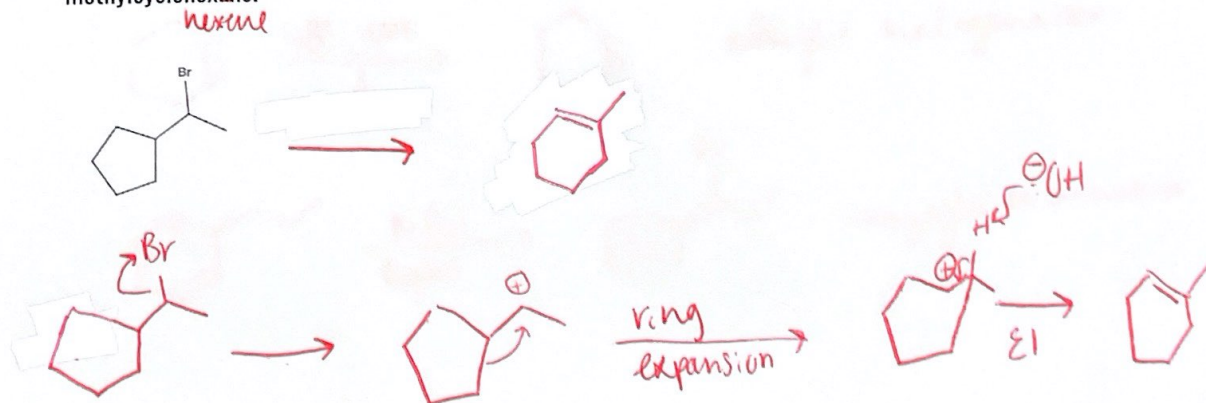


- 34) What is the purpose of a halogenation reaction of alkanes?

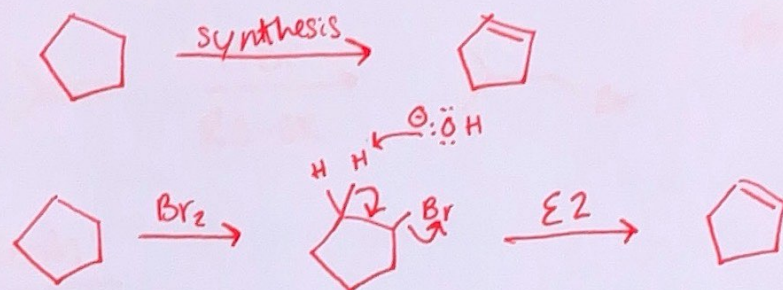
To form a reactive compound.

Alkanes w/o a functional group are highly unreactive

- 35) Provide the mechanism for a reaction that starts with the following and ends with methylcyclohexane.



36) Provide a reasonable synthesis for cyclopentene from cyclopentane.

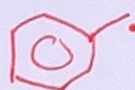
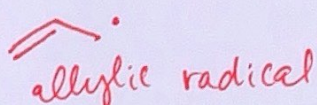


37) What is the difference between Cl and Br in the halogenation of alkanes?

Br is very selective & prefers 3° radical  
Cl is extremely unselective

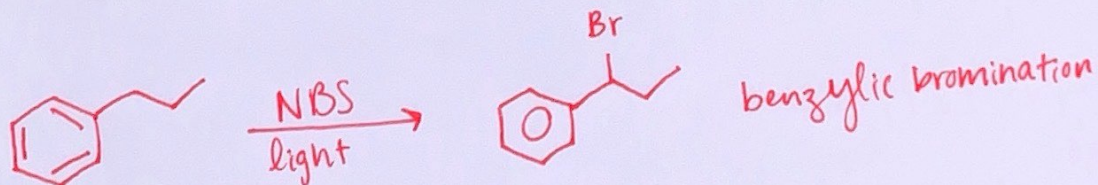
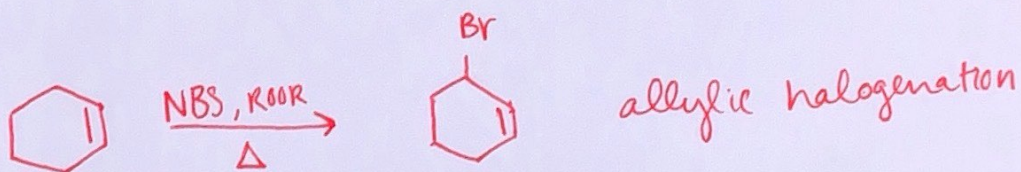
38) What is the purpose of N-bromosuccinimide?

Can replace an allylic or benzylic H w/ a Br

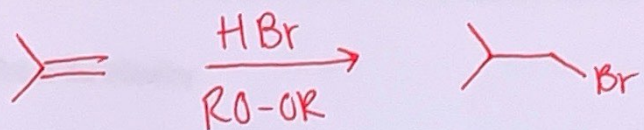


\*resonance stabilized radicals\*

39) Show both an allylic and benzylic halogenation reaction.



40) Show the mechanism of anti-Markovnikov halogenation of alkenes.



Anti-Markovnikov

Mech:

