



# ScienceGuyz

## CHEM 2212

### Remembering First Semester Organic Chemistry

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**Introduction:**

Welcome to your second semester of Organic Chemistry! This packet reviews the most important concepts from the first semester that you will likely see again in the course. This is by no means a comprehensive review of every topic in your first semester, but it is a great refresher of some useful naming rules and reactions. We encourage you to try this packet without the video to see what you recall, then check your answers! Happy studying.

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## Nomenclature Rules from Organic 1

### I. To Name a Compound:

1. Determine if a priority group is present. Priority groups are listed at the end of the parent chain name.

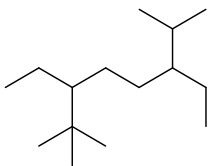
Priority	Functional Group		Substituent Name	Parent Chain Suffix
1	Alcohol	-OH	N/A	-ol
2	Amine	-NR <sub>2</sub>	-amino	-amine
3	Alkene & Alkyne	-C=C / -C≡C	N/A	-ene / -yne
No Priority	Halogen, Alkyl Groups, Ethers	-X, -R, -OR	Variable	N/A

2. Find the longest continual chain of carbons that includes the priority group.
  - i. If there are multiple chains of equal length, choose the chain with the greatest number of substituents.
3. Number the longest chain such that the priority group has the lowest locant.
  - i. The locant of the priority group must be included unless the parent chain is a cyclic ring. In this case, the priority group is assumed to have position 1.
  - ii. If there is no priority group, number the chain such that the substituents receive the lowest possible locant.
  - iii. If you can number in either direction and the locants are the same, pick the direction that gives the first alphabetized substituent the lower locant.
4. Identify and name the substituents with a locant in front, denoting where the substituent falls on the parent chain.
  - i. If there are multiple substituents of the same type, aggregate them together and include a prefix denoting the number, along with their locants (ex. 2,2,3-trimethyl).
5. Assemble the name by alphabetizing the substituents, then adding the parent chain name, then the priority group at the end (if there is one).
  - i. Never alphabetize by prefixes (di, tri, etc.) unless the prefix is inside the parentheses of a complex substituent.
6. Any stereochemistry present (R/S or E/Z) should be placed in front of the name inside parentheses.
  - i. If there is only one stereocenter of a type (ex. one chiral center), no locant is necessary.

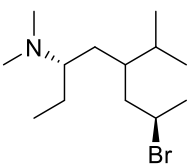
#### IUPAC Name Break Down:

Stereochemistry	Substituents	Parent Chain	Saturation	Priority Group
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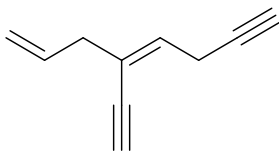
**Example:** Provide the IUPAC name for each of the following compounds.



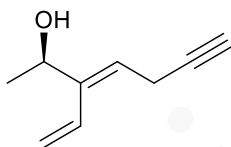
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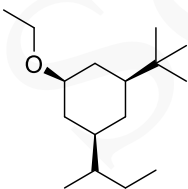
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## Chapter 2: Acids and Bases

### I. Bronsted Acids and Bases:

- Bronsted Acids: proton (hydrogen with no electrons) donors
- Bronsted Bases: proton acceptors
  - Generally, are [neutral with a lone pair of electrons] or are [negatively charged with a lone pair of electrons]
  - Always Bases:** Any time an **alkali** or an **alkali earth** metal is attached to a non-metal, this species will always be the base (ex. NaCl, BrMgCH<sub>3</sub>, etc.)


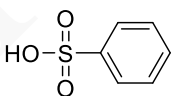
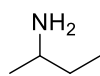


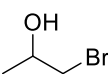
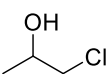
### II. Lewis Acids and Bases:

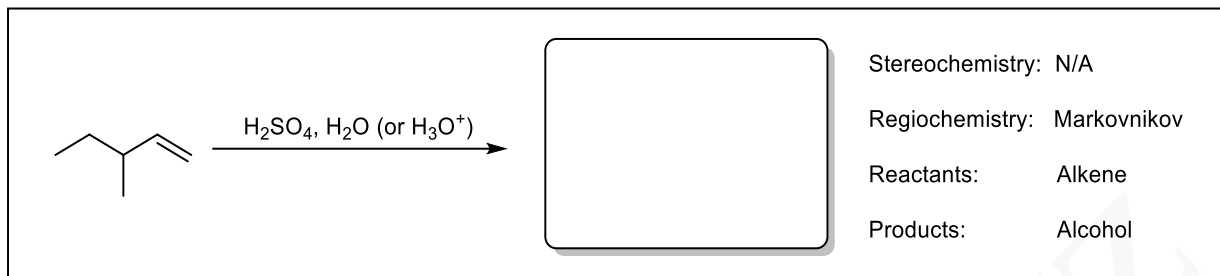
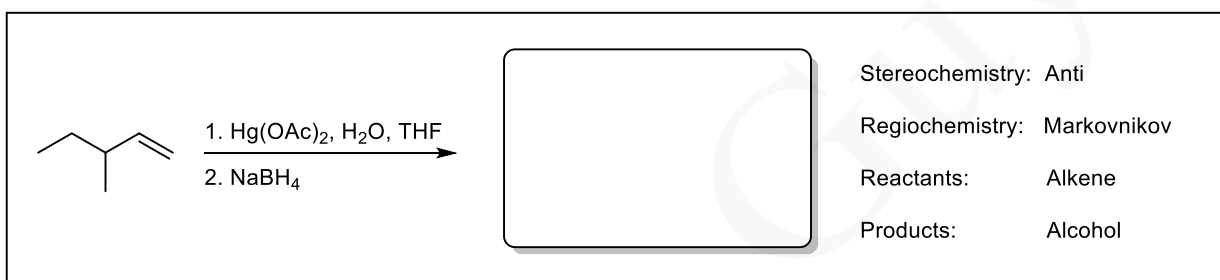
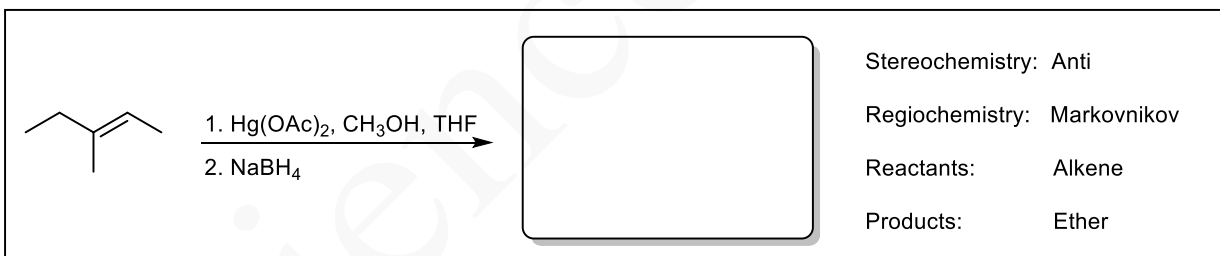
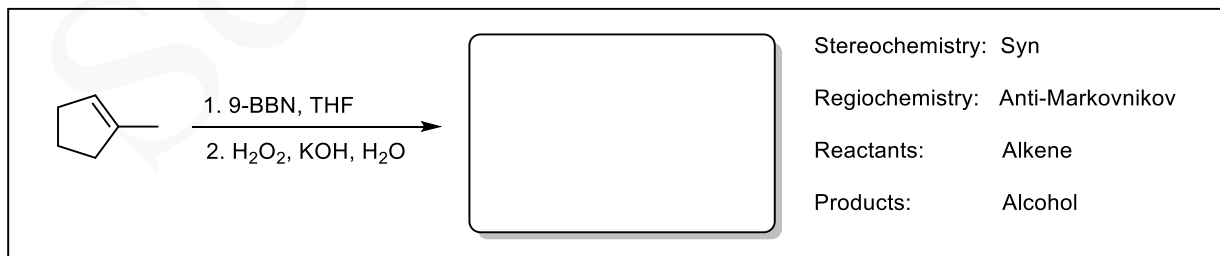
- Lewis Acids: electron acceptors (usually group III making three bonds or transition metals).
  - Uncommon Lewis Acids: TiCl<sub>4</sub>, FeBr<sub>3</sub>, SnCl<sub>2</sub>, AlCl<sub>3</sub>, and BF<sub>3</sub>. Remember that any of the halogens used in the list above, can be exchanged with other halogens.
  - Other neutral Lewis Acids can accept a pair of electrons via a resonance form.
- Lewis Bases: electron donors

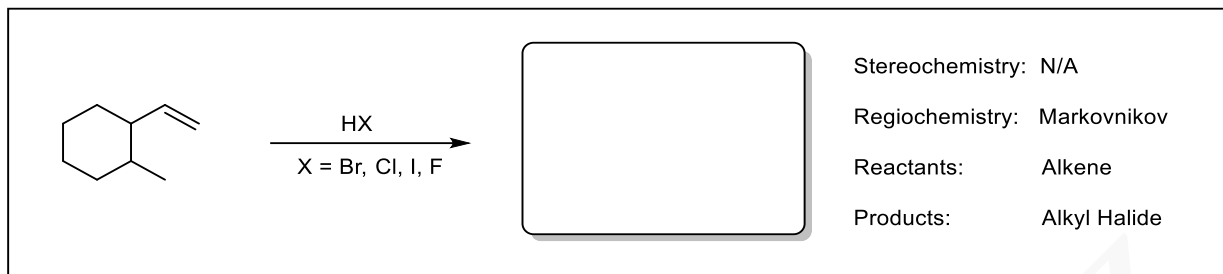
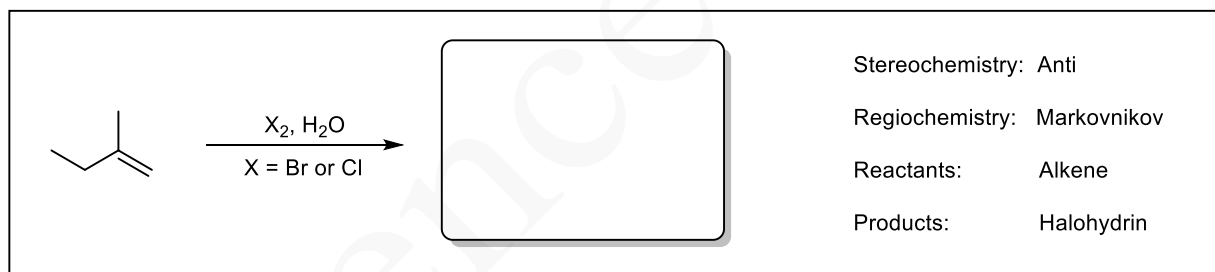
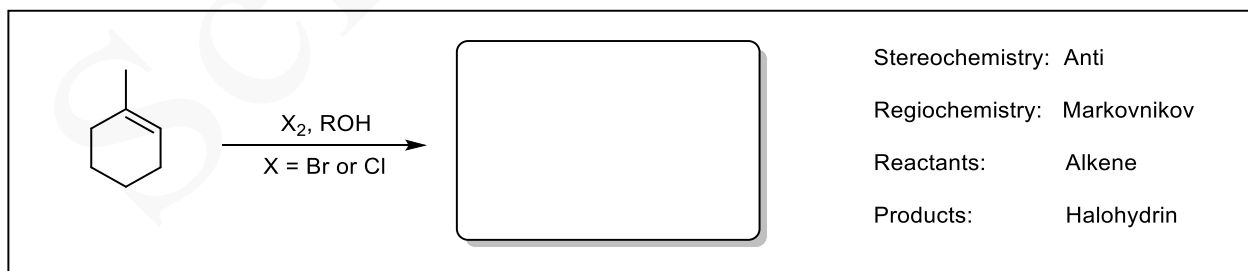
### III. Ranking Acidity: Acidity can depend on several situations depending on the relationship between the atoms bearing the most acidic proton.

The Most Acidic Proton is Located On....	
Identical Atoms	Different Atoms
1. Hybridization: more s character = more acidic	1. Size: larger atom = more acidic
2. Resonance: more resonance = more acidic	2. Electronegativity: more EN = more acidic
3. Inductive Electron Withdrawal: more EN groups close to acidic proton = more acidic	

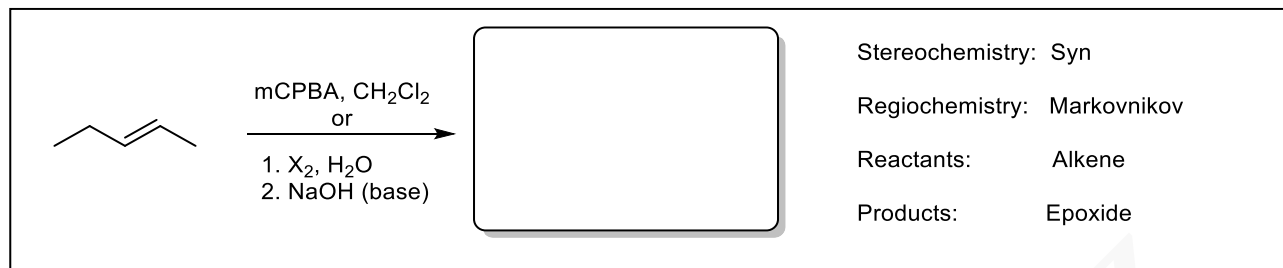
**Example:** Assess the pairs of compounds shown below and select the most acidic.

	vs.		vs.	
<input type="radio"/>		<input type="radio"/>		<input type="radio"/>
	vs.		vs.	
<input type="radio"/>		<input type="radio"/>		
<input type="radio"/>		<input type="radio"/>		<input type="radio"/>

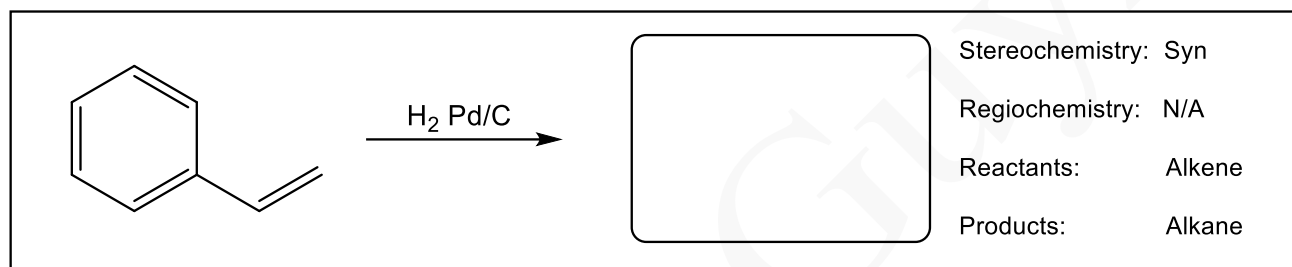
**Chapter 6: Electrophilic Addition Reactions of Alkenes****Acid Catalyzed Hydration (Rearrangement Possible)****Oxymercuration/Demercuration****Modified Oxymercuration/Demercuration****Hydroboration/Oxidation**

**Hydrohalogenation (Rearrangement Possible)****Halogenation****Halohydrin****Modified Halohydrin**

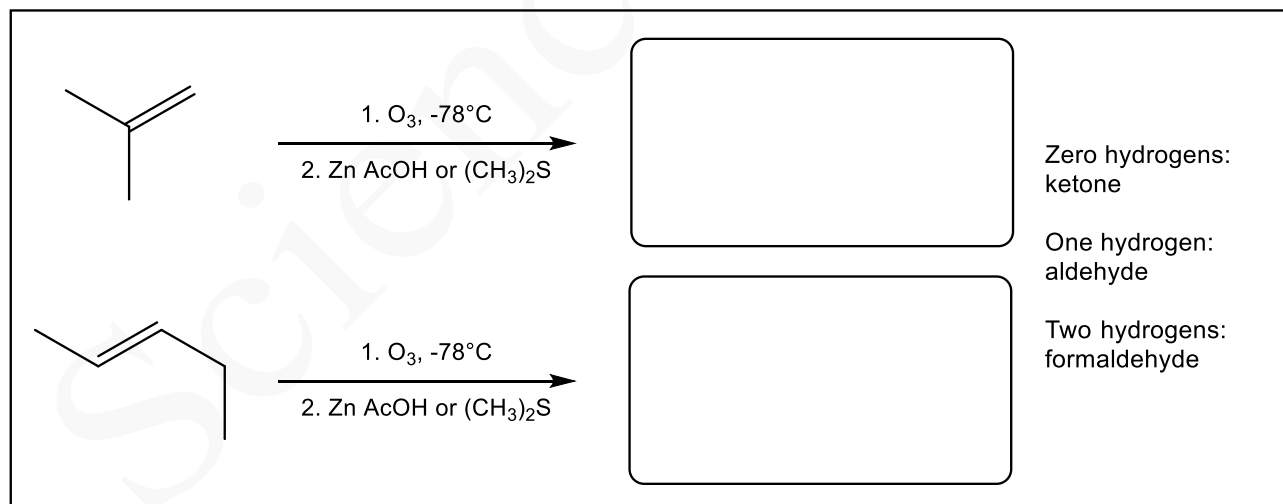
### Peroxyacid Epoxidation



### Catalytic Hydrogenation (does not reduce arene double bonds)

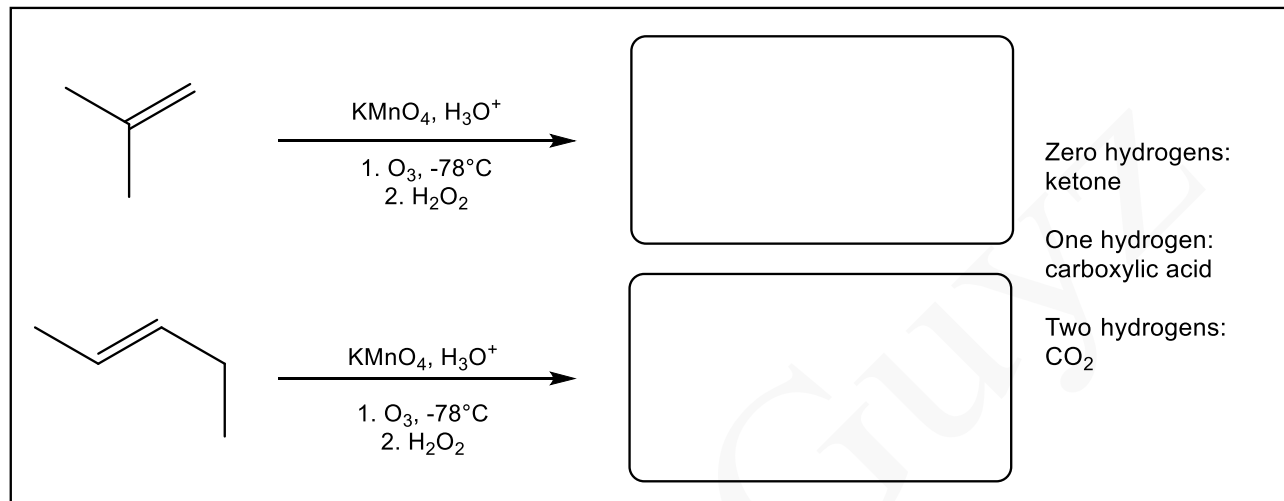


**Ozonolysis (Reductive Workup):** The alkene will cleave down the middle. To determine what products will form, you must see how many hydrogen atoms are attached to the opposing ends of the alkene. Ozonolysis will consume all double bonds in a compound unless they are a part of an arene.



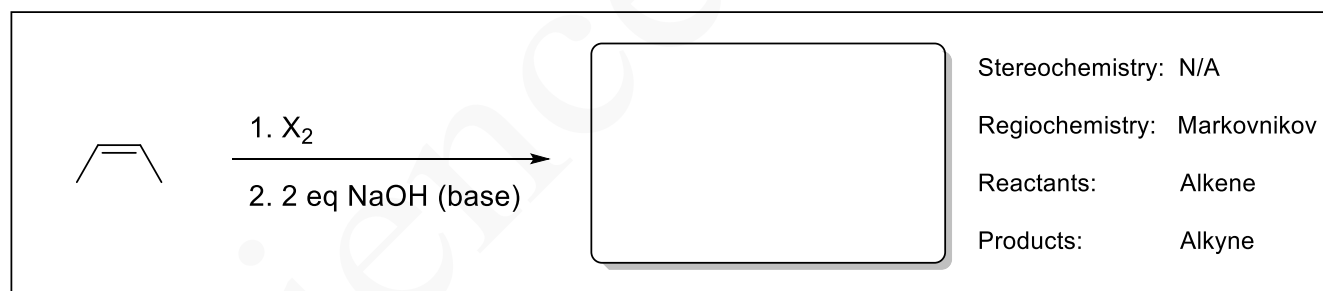


**Ozonolysis (Oxidative Workup)/KMnO<sub>4</sub> Oxidation:** The alkene will cleave down the middle. To determine what products will form, you must see how many hydrogen atoms are attached to the opposing ends of the alkene. KMnO<sub>4</sub> Oxidation will consume all double bonds in a compound unless they are a part of an arene.

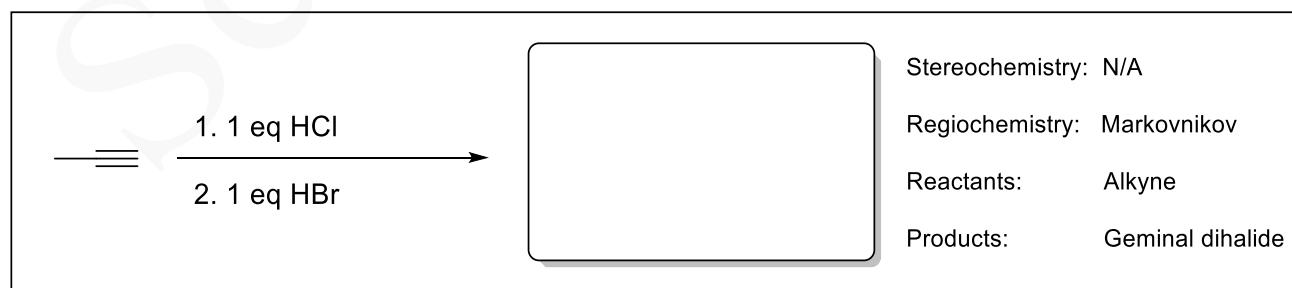


## Chapter 7: Reactions of Alkynes

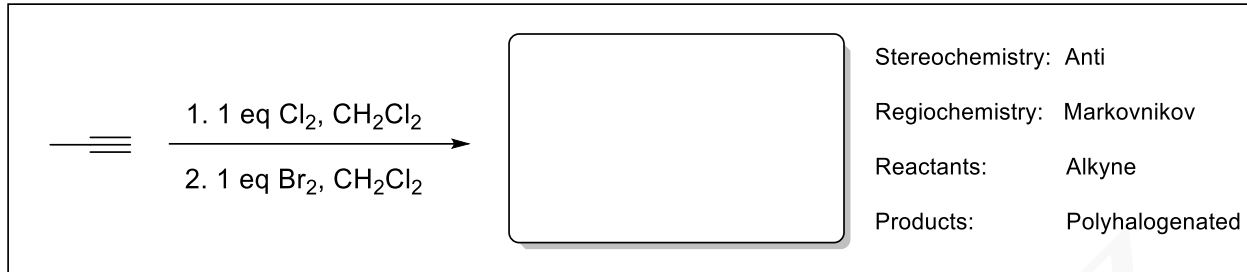
### Formation of the Alkyne from the Alkene



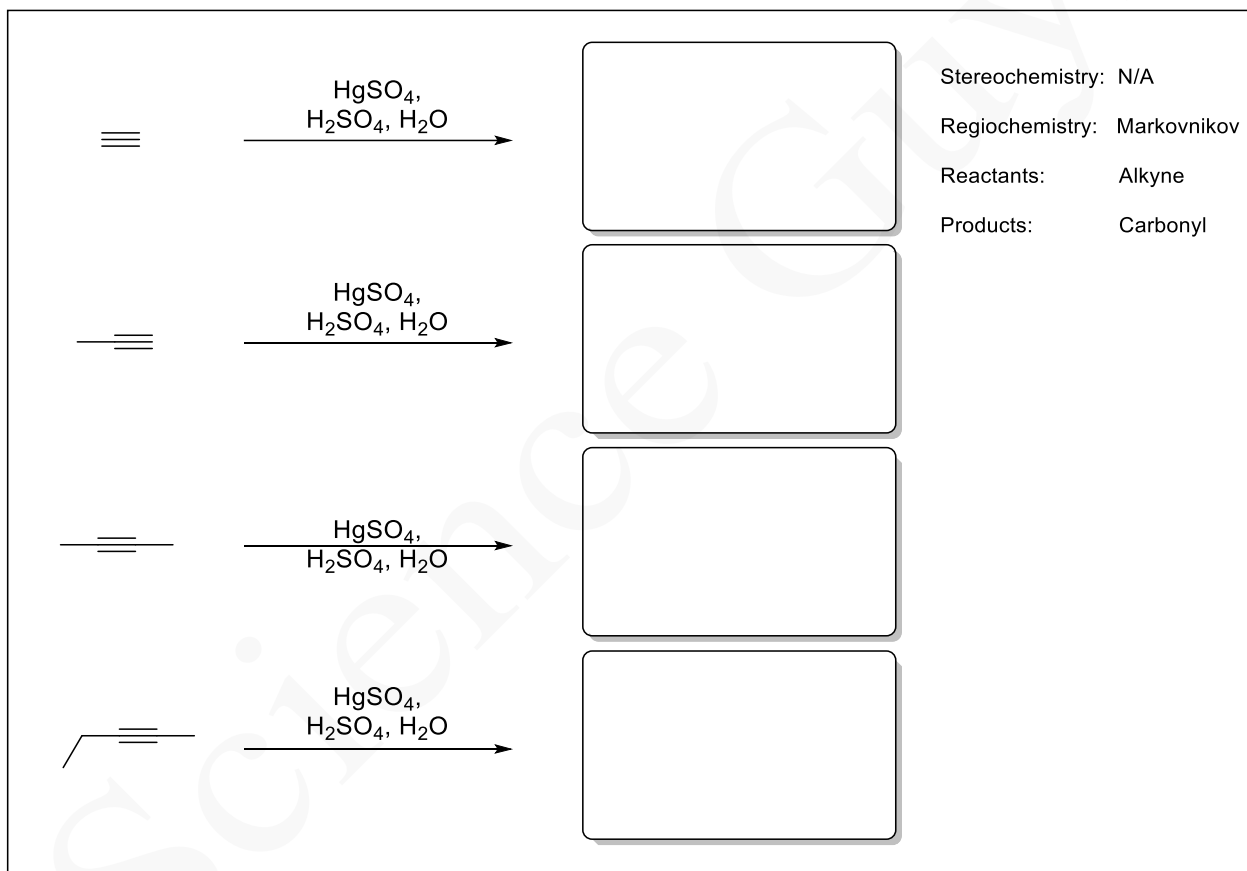
### Hydrohalogenation of the Alkyne





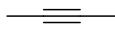
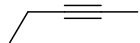
## Halogenation of the Alkyne



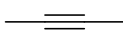
## Mercury Catalyzed Hydration of the Alkyne:



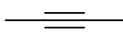
### Hydroboration Oxidation of the Alkyne

	$\xrightarrow[2. \text{H}_2\text{O}_2, \text{NaOH}, \text{H}_2\text{O}]{1. \text{9-BBN, THF}}$	<input type="text"/>	Stereochemistry: N/A Regiochemistry: Anti-Markovnikov Reactants: Alkyne Products: Carbonyl Notes: Terminal alkynes must use 9-BBN
	$\xrightarrow[2. \text{H}_2\text{O}_2, \text{NaOH}, \text{H}_2\text{O}]{1. \text{9-BBN, THF}}$	<input type="text"/>	
	$\xrightarrow[2. \text{H}_2\text{O}_2, \text{NaOH}, \text{H}_2\text{O}]{1. \text{9-BBN or BH}_3, \text{THF}}$	<input type="text"/>	
	$\xrightarrow[2. \text{H}_2\text{O}_2, \text{NaOH}, \text{H}_2\text{O}]{1. \text{9-BBN or BH}_3, \text{THF}}$	<input type="text"/>	

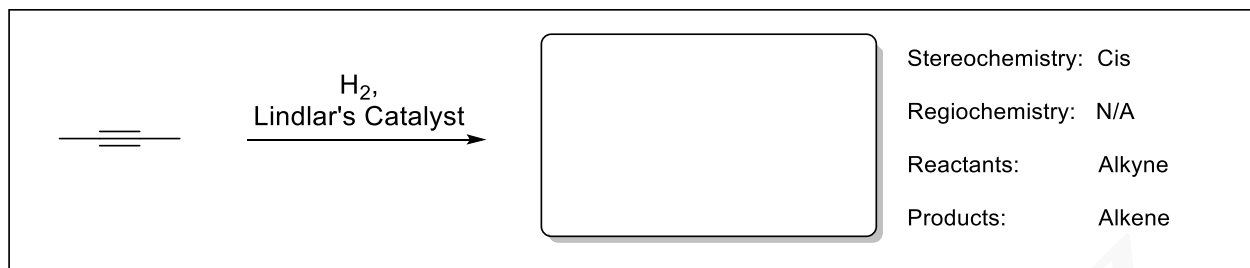
### Catalytic Hydrogenation of Alkynes

	$\xrightarrow{\text{H}_2, \text{Pd/C}}$	<input type="text"/>	Stereochemistry: Syn Regiochemistry: N/A Reactants: Alkyne Products: Alkane
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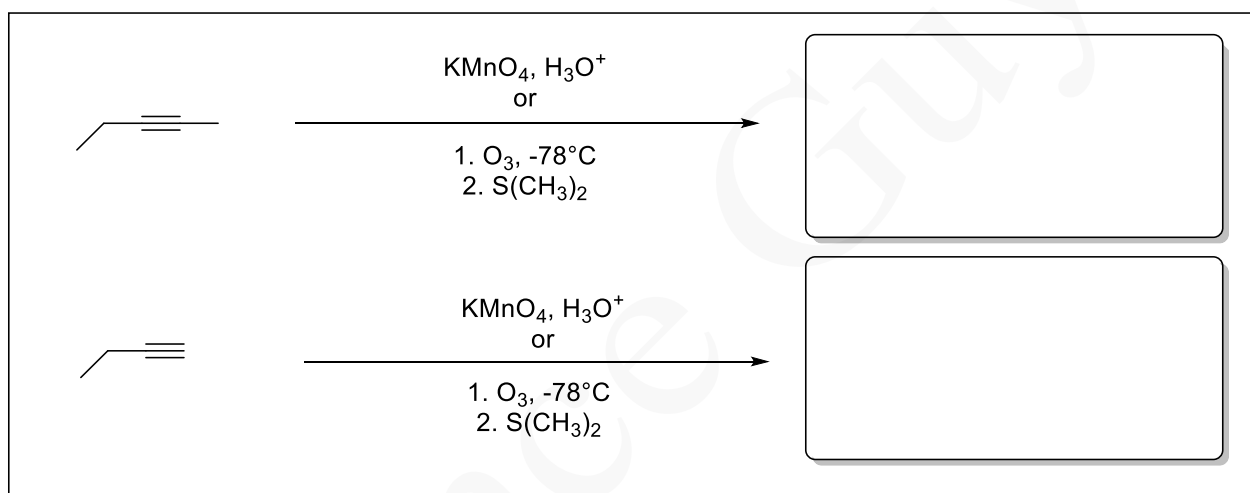
**Dissolving Metal Reduction:** Produces the trans-alkene. Can NOT be used on terminal alkynes.

	$\xrightarrow[\text{NH}_3, -78^\circ\text{C}]{\text{Na or Li}}$	<input type="text"/>	Stereochemistry: Trans Regiochemistry: N/A Reactants: Alkyne Products: Alkene
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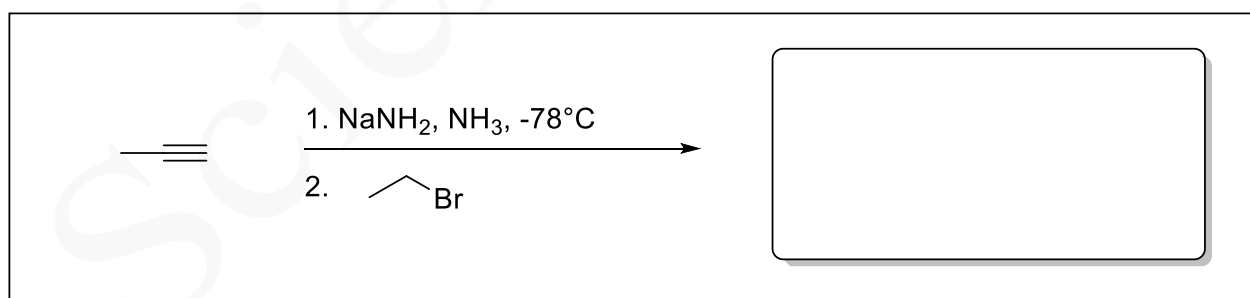
**Lindlar's Reduction:** Produces the cis-alkene.



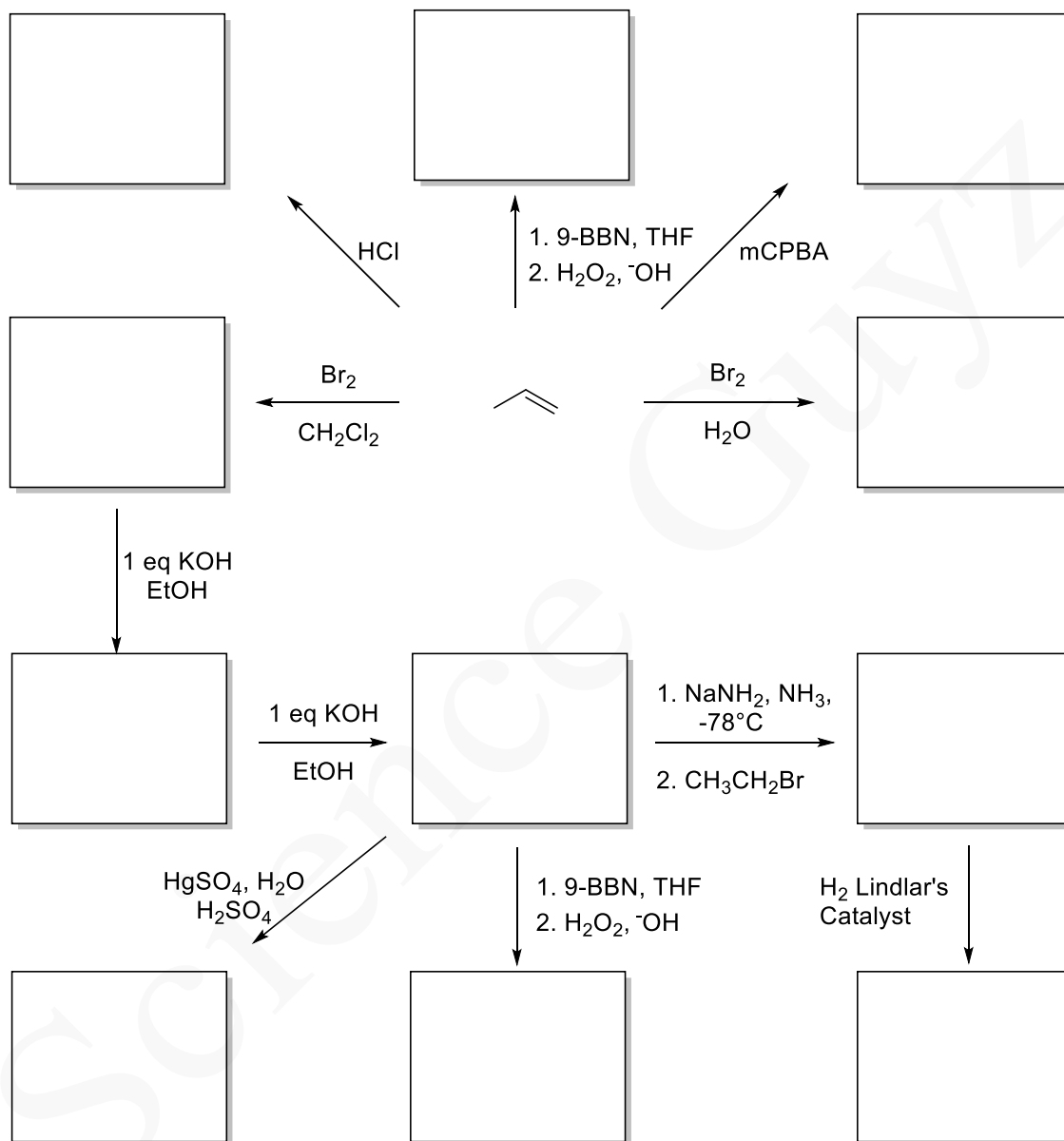
**Oxidative Cleavage of the Alkyne:** Will always cleave down through the triple bond to produce a carboxylic acid (no terminal Hydrogen) or CO<sub>2</sub> (1 terminal hydrogen).



**Alkylation of the Acetylide Anion**

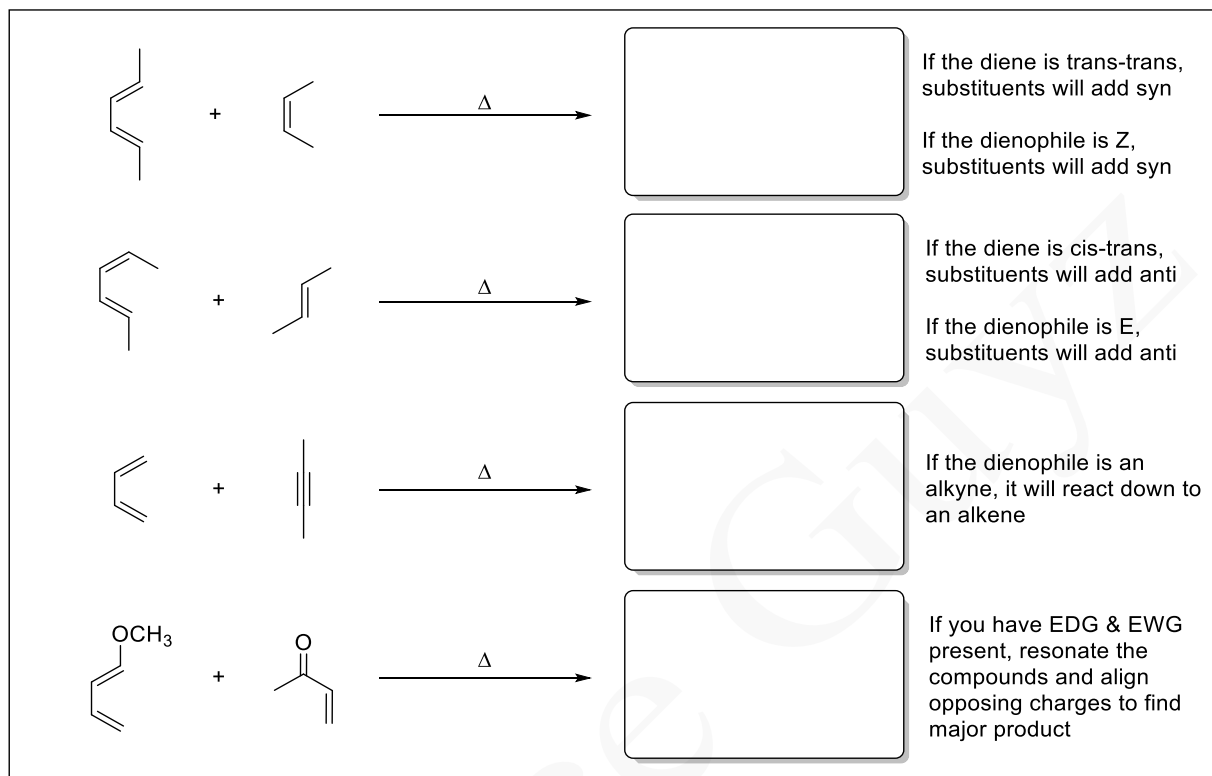


**Example:** Complete the following spiderweb of reactions by providing the product(s) for each of the indicated reactions.

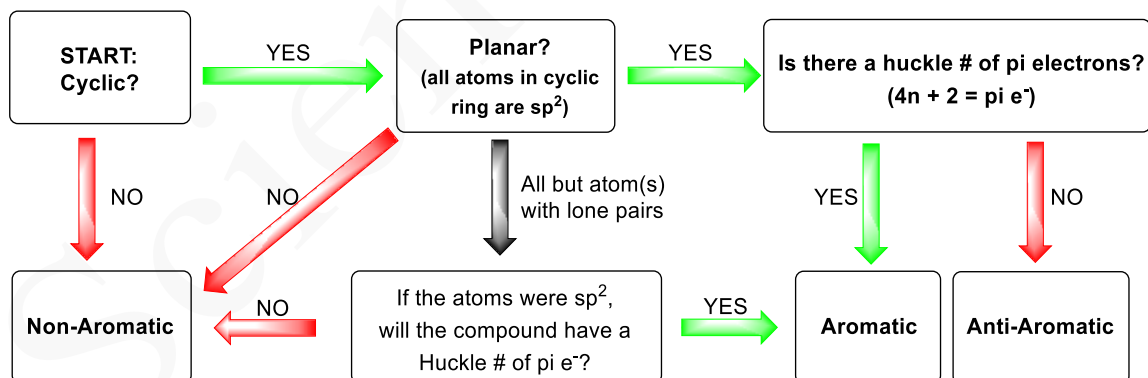


## Chapter 8: Conjugation and Aromaticity

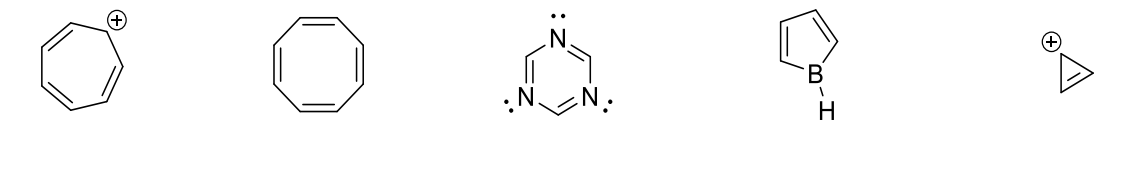
### Diels Alder Cycloaddition

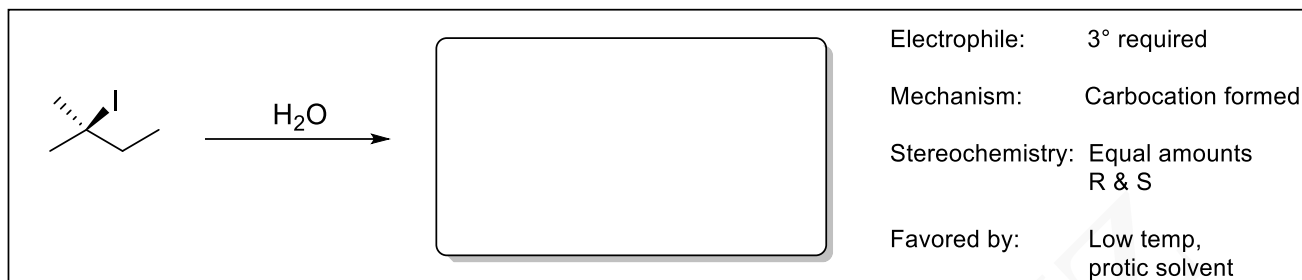


### Aromaticity

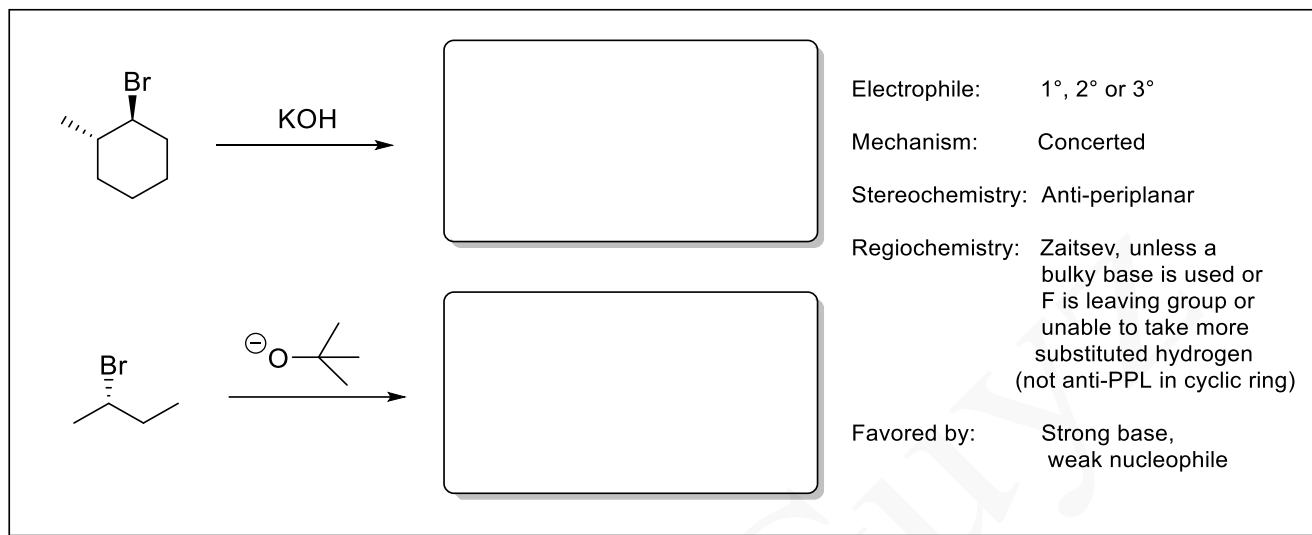


**Example:** Determine whether the compounds below are aromatic, anti-aromatic or non-aromatic.



**Chapter 9: Nucleophilic Substitution and Elimination****S<sub>N</sub>1 Reaction** (Rearrangement possible)**S<sub>N</sub>2 Reaction****E1 Reaction** (Rearrangement possible)

## E2 Reaction

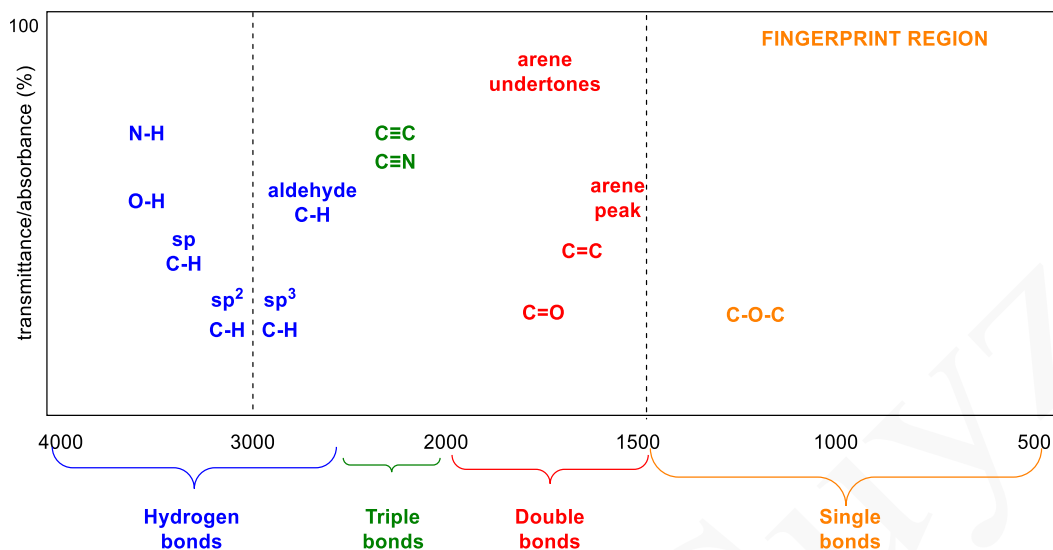


## Picking Major Pathway Chart

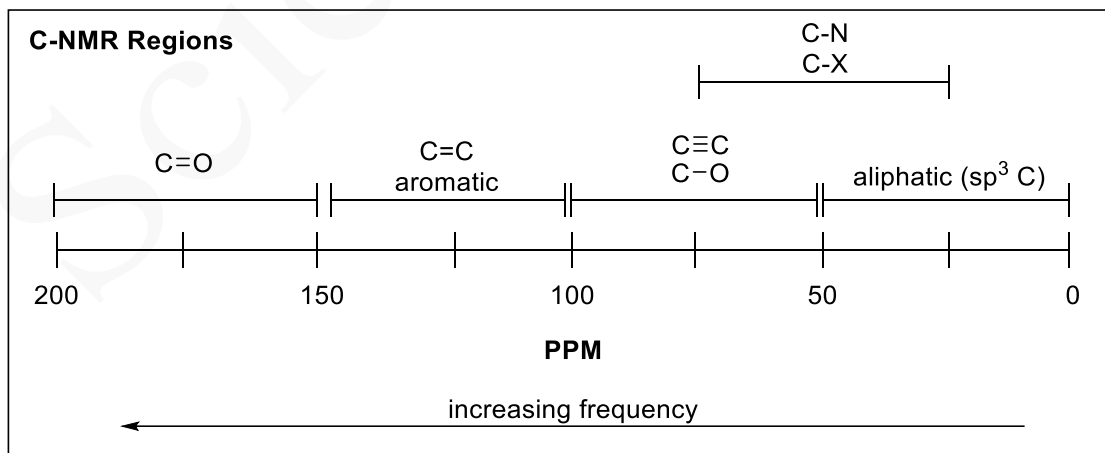
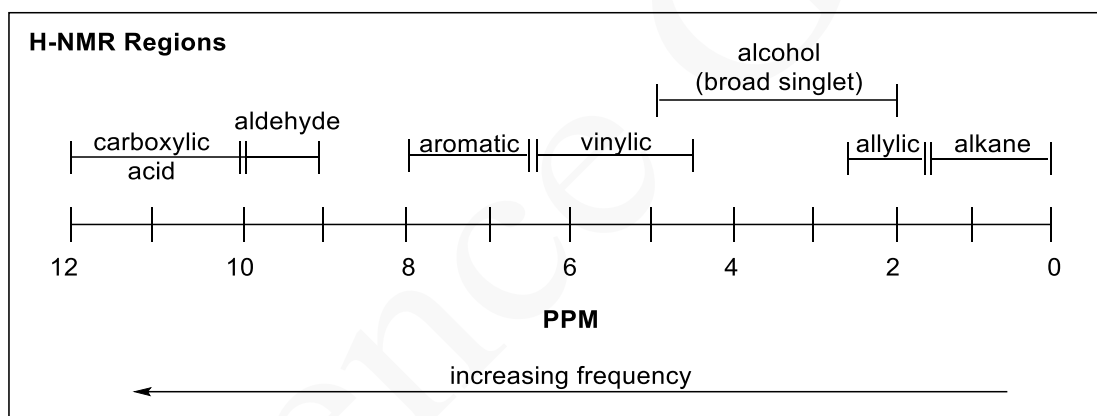
	Strong Nucleophile/ Strong Base	Weak Nucleophile/ Strong Base	Strong Nucleophile/ Weak Base	Weak Nucleophile/ Weak Base				
	NaOH NaOR	NaNH <sub>2</sub> NaH	KOC(CH <sub>3</sub> ) <sub>3</sub> DBU	LDA DBN	KCN LiN <sub>3</sub>	NaSR KOOCR	H <sub>2</sub> O NH <sub>3</sub>	HOCH <sub>3</sub> HSCH <sub>3</sub>
1° Alkyl Halide	S <sub>N</sub> 2	E2 (Δ)	S <sub>N</sub> 2	S <sub>N</sub> 2 (If nucleophile strength is greater than the fluoride ion; if not, no reaction)				
2° Alkyl Halide	E2	E2	S <sub>N</sub> 2	S <sub>N</sub> 2 (If nucleophile strength is greater than the fluoride ion) <b>or</b> E1 (Δ)				
3° Alkyl Halide	E2	E2	S <sub>N</sub> 1 <b>&amp;/or</b> E1 (Δ)	S <sub>N</sub> 1 <b>&amp;/or</b> E1 (Δ)				



### Chapter 13: Infrared Spectroscopy

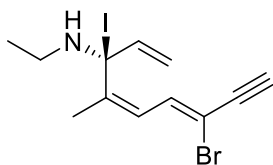
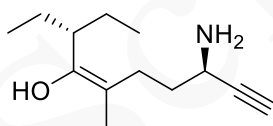
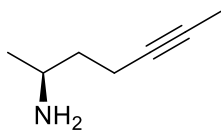
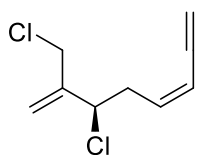
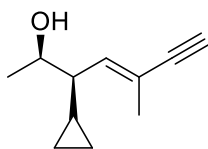
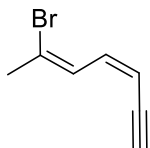


### Chapter 14: Nuclear Magnetic Resonance

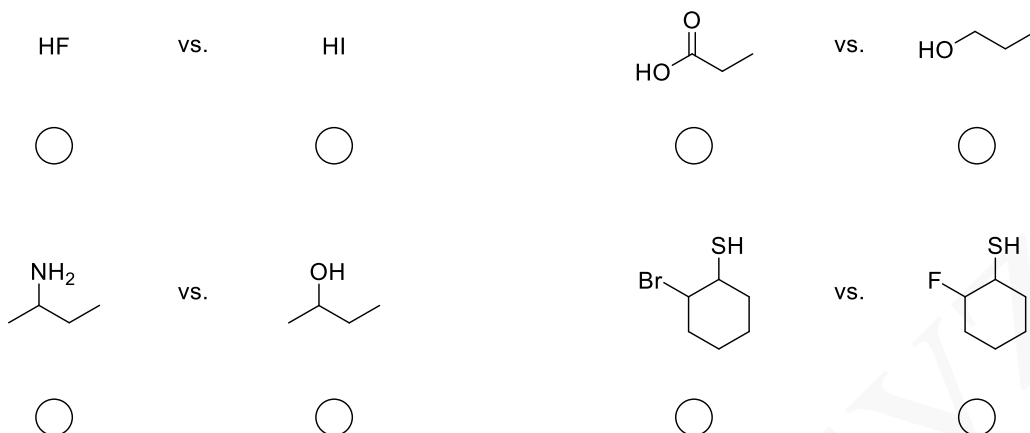


**Practice Problems** – test your understanding and try these problems out on your own! An answer key will be posted to the Science Guyz website.

1. Provide the IUPAC name for each of the following compounds.



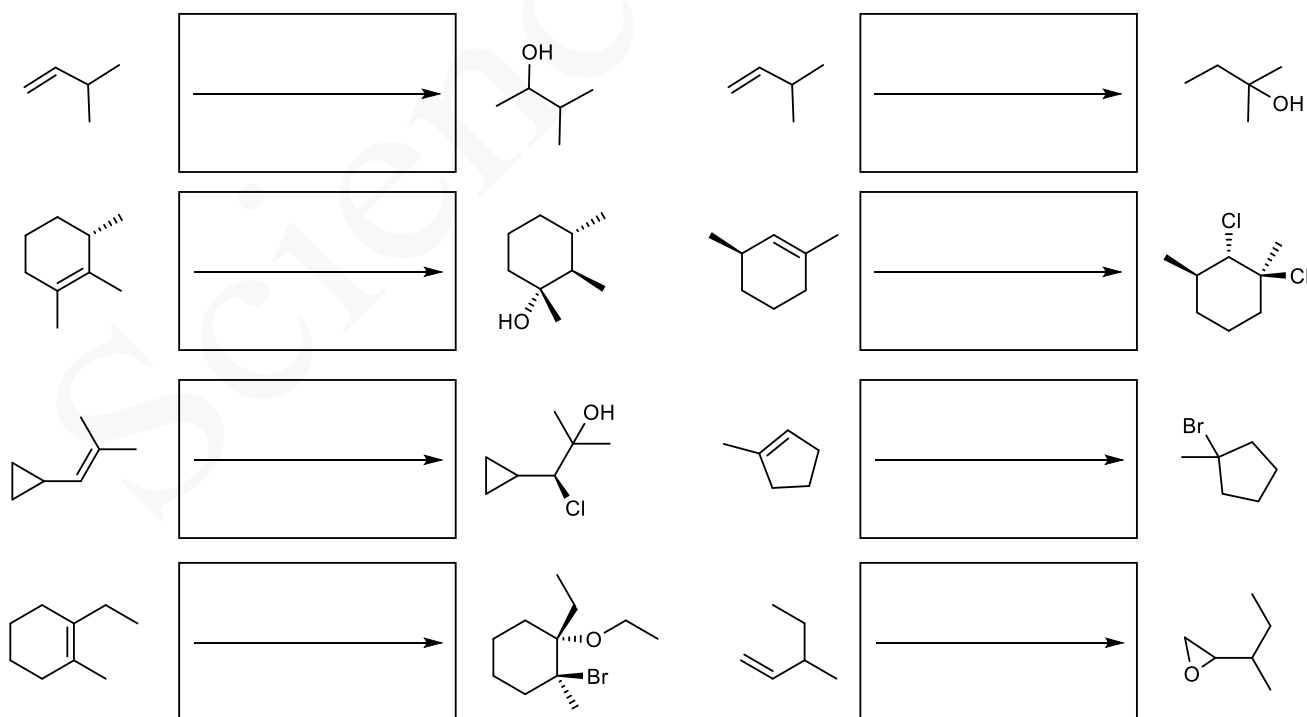
2. Select the more acidic compound out of the pairs of molecules below.



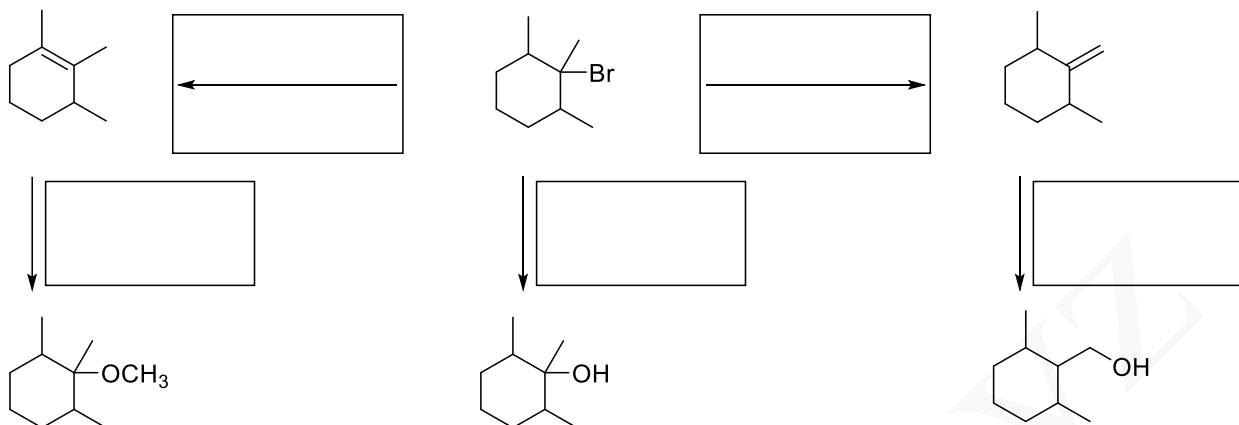
3. Select the stronger base out of the pairs of molecules below.



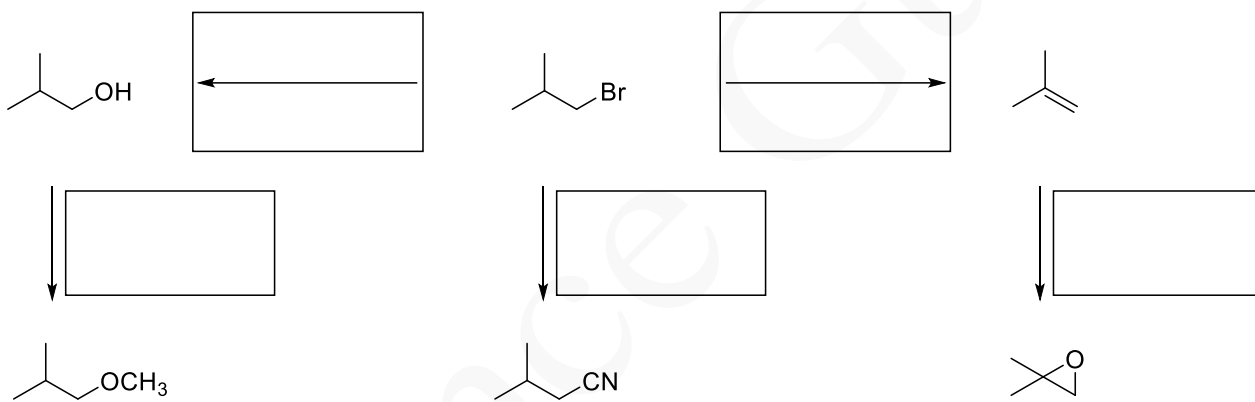
4. Provide the missing reagent(s) for the following transformations.



5. Provide the missing reagent(s) for the reactions shown below.



6. Provide the missing reagent(s) for the reactions shown below.



7. Propose a synthesis for the following transformation.

