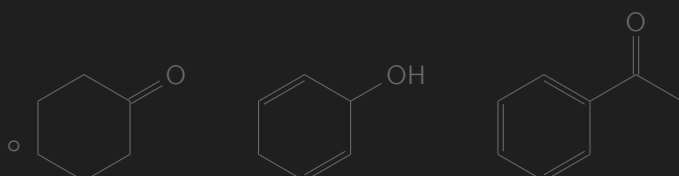
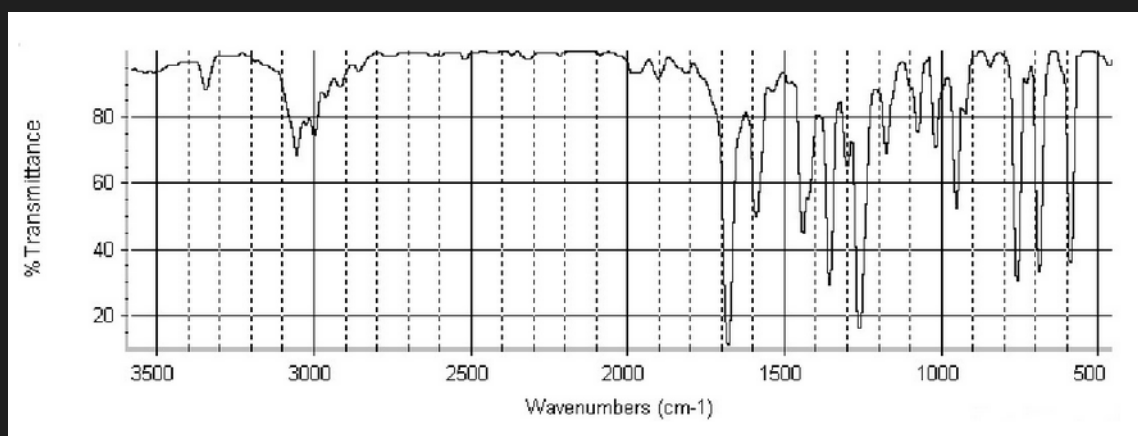


# Mini Quizzes

<b>Week 5 — Chapter 17</b>	2
<b>Week 3/4 — Chapter 16</b>	4
<b>Week 2 — Chapter 15</b>	6
<b>Week 1 — Chapter 14</b>	8

## Week 5 – Chapter 17

- Which of the following molecules has a characteristic broad stretch at  $3300\text{ cm}^{-1}$ ?
  - $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$
  - $(\text{CH}_3)_2\text{CHCCCH}_3$
  - $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_3$
  - $(\text{CH}_3)_2\text{CHCH}=\text{CH}_2$
  - C–H (sp-s; alkyne C-H), O–H, and N–H can be found in  $\tilde{\nu}$  of approximately 3300.
  - The key point here is the broad stretch, which is very characteristic of O–H.
- Which of the following structures is consistent with the IR spectra shown below?

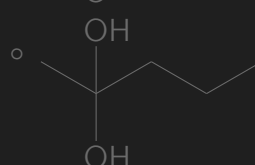
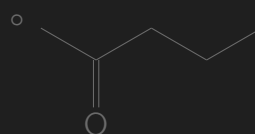
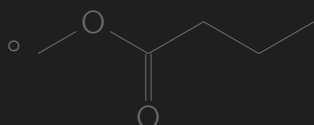
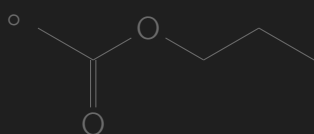


- The large and sharp peaks at around 1700 indicate some kind of carbonyl, and there is no large broad shape indicating OH, so either first or third option.
  - The peak around 3000–3100 indicates that some kind of C–H bond is present, specifically an  $sp^2$  hybridized carbon.
- The two most abundant isotopes of boron are  $^{10}\text{B}$  and  $^{11}\text{B}$ , with  $^{11}\text{B}$  being about 4 times more abundant. In the mass spectrum of trimethylborate  $(\text{CH}_3\text{O})_3\text{B}$ .
    - the peaks at  $m/z$  103 and  $m/z$  104 have equivalent intensities
    - the peak at  $m/z$  103 has an intensity which is 4 times that of the  $m/z$  104 peak
    - the peak at  $m/z$  103 has an intensity which is 1/4 the intensity of the peak at  $m/z$  104
    - none of the above
    - $^{11}\text{B}$  would have a peak that is one mass unit higher than  $^{10}\text{B}$ , so that makes it 103 and 104 respectively.

- The more abundant peak would have a higher relative intensity.
4. The mass spectrum of which compound has  $M^+$  and  $M+2$  peaks of approximately equal intensity?
- 3-bromopentane
  - 3-pentanol
  - pentane
  - 3-chloropentane
  - $M + 2$  peaks help determine any halides that are present.
    - Chlorine has 3:1 ratio due to natural occurrence of isotopes.
    - Bromine has 1:1 ratio due to natural occurrence of isotopes.

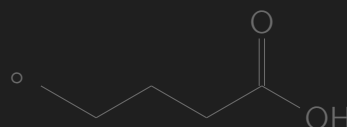
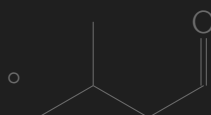
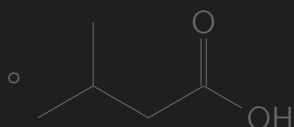
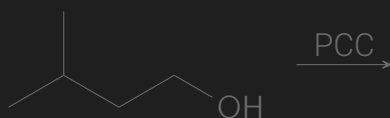
## Week 3/4 – Chapter 16

1. What is the major product for the following reaction.



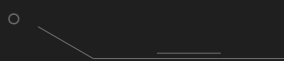
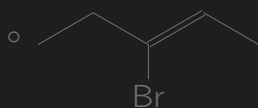
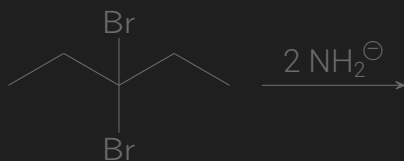
- $\text{CrO}_3$  is an oxidizing agent, which means electron density will be pulled away from the carbon to form a double bonded oxygen.
- Oxygen does not insert itself into the chain.

2. Give the major product for the following oxidation.



- PCC is a mild oxidizing agent that is commonly used for selective oxidation of alcohols to aldehydes or ketones.
- In this case we started with a terminal enol, which would produce an aldehyde.
- The carbonyl group is not affected, it should not change.

3. What is the major product from the following reaction?

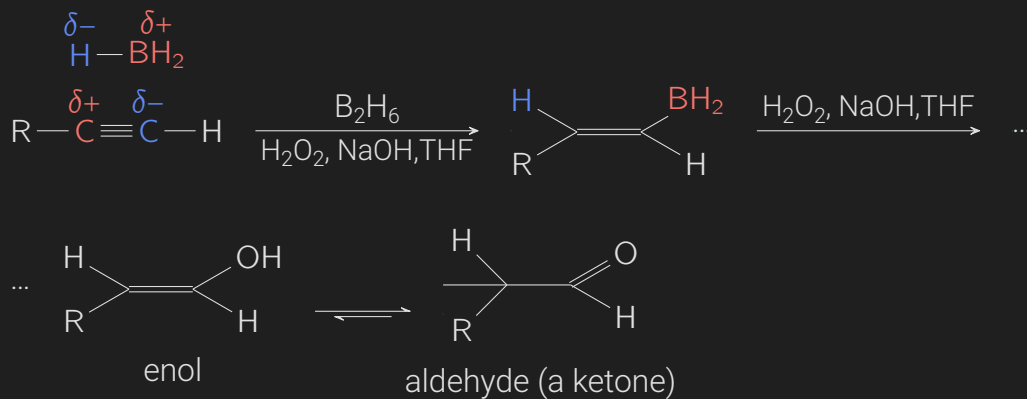


- This looks like dihaloalkane elimination. I took this quiz a week early, so this explanation might not be the best, but looks like  $\text{NH}_2^-$  is acting as a reducing agent(?); causing the elimination of bromine, leaving the carbon to form a triple bond.

4. The major product of a hydroboration oxidation reaction on a terminal alkyne is

- a carboxylic acid
- alkane
- ketone
- aldehyde

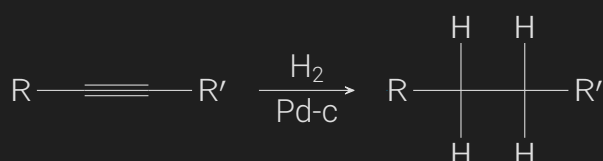
- Example of an alkyne undergoing a hydroboration-oxidation reaction:



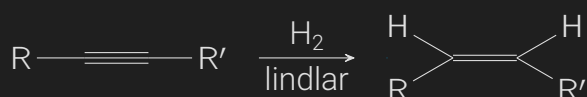
## Week 2 – Chapter 15

1. The reagent needed to convert 2-butyne to cis-2-butene is

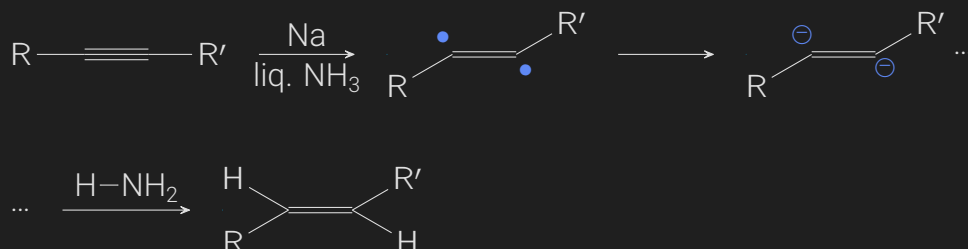
- $\text{H}_2/\text{Pd}-\text{C}$
- $\text{Li}/\text{NH}_3$
- $\text{Na}/\text{NH}_3$
- $\text{H}_2/\text{LindlarCatalyst}$
- Complete hydrogenation of an alkyne:



- Alkyne  $\rightarrow$  cis-alkene; use of lindlar catalyst (Pd-c poisoned with lead) limits further reduction by controlling hydrogens available:



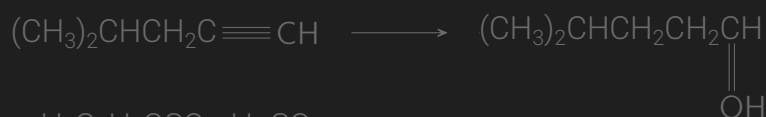
- Alkyne  $\rightarrow$  trans-alkene; using generation of free radicals (•, single electron) that pair up with another electron generated by the dissociation of  $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$  to create a free pair of electrons that then receive a hydrogen from  $\text{NH}_3$ :



2. A mixture of 1-heptyne, 2-heptyne, and 3-heptyne was hydrogenated in the presence of a palladium catalyst until hydrogen uptake stopped. If one assumes that the hydrogenation went to completion for all the reactants present in the mixture, how many distinct seven-carbon isomers were produced?

- Only 1
- 2
- 4
- 6
- $\text{H}_2/\text{Pd}-\text{c}$  (palladium catalyst) generates completely saturated alkenes, thus the location of the double bond in a heptyne will make no difference overall.

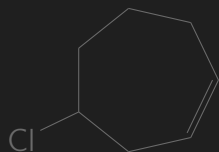
3. Give the best reagents for the reaction



- $\text{H}_2\text{O}$ ,  $\text{H}_2\text{OSO}_4$ ,  $\text{HgSO}_4$
  - $\text{BH}_3$ ,  $\text{H}_2\text{O}_2$ ,  $\text{NaOH}$
  - $\text{K}_2\text{Cr}_2\text{O}_7$
  - $\text{H}_2$ , Lindlar Catalyst
  - First, this is a hydration reaction, so that limits just the first two options.
  - Hydration using  $\text{H}_2\text{O}$  and  $\text{H}_2\text{OSO}_4$  or  $\text{HgSO}_4$  does have difference, but both follow Markovnikov's rule and end produce internal enols and thus internal ketones.
  - Hydroboration-oxidation reaction follows anti-Markovnikov rule and produces a terminal enol and thus an aldehyde, which is the desired product.
4. Which of the alkyne addition reactions below involves an enol intermediate?
- Hydroboration/oxidation
  - dil.  $\text{H}_2\text{SO}_4$  in  $\text{HgSO}_4$
  - Hydrogenation
  - Both hydroboration/oxidation and dil.  $\text{H}_2\text{SO}_4$  in  $\text{HgSO}_4$
  - See question three, both hydroboration/oxidation and dil.  $\text{H}_2\text{SO}_4$  in  $\text{HgSO}_4$  are used in hydration, which have enol intermediates.
  - Hydrogenation only has to do with adding hydrogens to saturate the alkyne through elimination reactions, which question one covers.

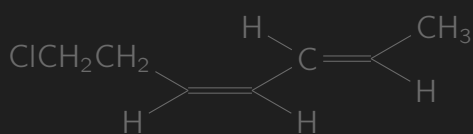
## Week 1 – Chapter 14

1. Name the structure:



- 1-chloro-3-cycloheptene
- 4-chloro-1-cycloheptene
- 4-chloro-1-cyclohexene
- 6-chloro-1-cycloheptene
- When numbering the parent chain, the double bond should receive the lowest number possible; **k=1**
  - Note: define the location *k* of the double bond as being the number of its first carbon, not at the end.
- The locant (*k*) of the double bond should be placed right before the suffix of “ene,” though, it was previously recommended before the parent (both are acceptable), e.g., 2-pentene = pent-2-ene; **1-cycloheptene**
- Name and the side groups (other than hydrogen) according to the appropriate rules; **chloro**
- Define the position of each side group as the number of the chain carbon it is attached to; **4-**

2. Name the structure:

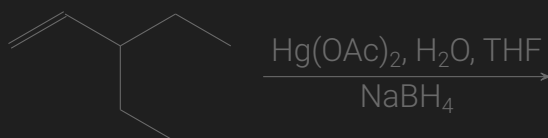


- (2E,4E)-7-chloro-2,4-heptadiene
- (2Z,4Z)-7-chloro-2,4-heptadiene
- (2Z,4E)-7-chloro-2,4-heptadiene
- (2E,4Z)-7-chloro-2,4-heptadiene
- **E-Z notation:** recommended instead of *cis* and *trans* in order to account for cases that has more than two different groups attached to the double bond by first determining the priority using the Cahn-Ingold-Prelog System.
  - **E, entgegen, “opposite”.**
  - **Z, zusammen, “together”; “on ze zame zide.”**

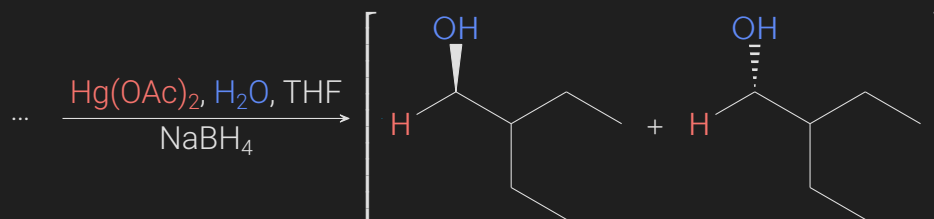


- When numbering the parent chain, the double bond should receive the lowest number possible;  $k=2$ 
  - The two highest priority groups are on **opposite** sides; **2E**
- There is more than one double bond;  $k_2 = 4$ 
  - The two highest priority groups are on **same** side; **4Z**

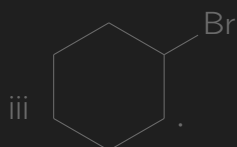
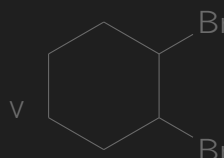
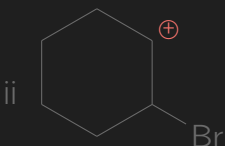
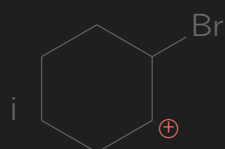
3. How many stereoisomeric product(s) do you get in the reaction below.



- Oxymercuration-demercuration reactions follow Markovnikov's rule, i.e.,  $\text{H}^+$  is added to the carbon with the **greatest** number of hydrogen atoms while the  $\text{X}^-$  **component** is added to the carbon with the **fewest** hydrogen atoms.
- Drawing the intermediate is not necessary, and no chiral centers are found in the products:



4. Which reaction intermediate is formed when  $\text{Br}_2/\text{CCl}_4$  reacts with cyclohexene?



- **Halogenation:** a reaction that involves the addition of one or more halogens to a compound or material.
  - The addition of halogens to alkenes proceeds via **intermediate halonium ions**.

- **Halonium ion:** any onium ion containing a halogen atom carrying a positive charge. This cation has the general structure:  $R \cdot +X R'$
- **Onium ion:** a **cation** formally obtained by the protonation of mononuclear parent hydride of a pnictogen (group 15 of the periodic table), chalcogen (group 16), or halogen (group 17);  $Br^{\oplus}$  in our case.