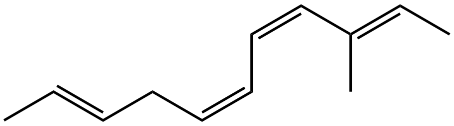
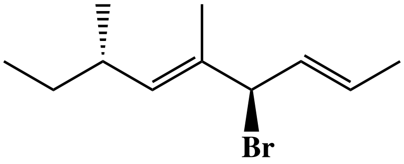
Signature__________________________ Pg 1 _____________(23)

1. (5 pts) What is the most important question in organic chemistry?

2. (12 pts) Write an acceptable IUPAC name for the following two molecules. Where appropriate, use E and Z or R and S.





3. (6 pts) Draw the structure that corresponds to the following name:

(2*E*,4*Z*)-3,5-dimethyl-2,4-heptadiene

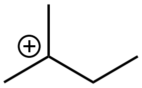
8. (2 pts each) Write the mechanistic element (of the four) that is appropriate when you see the following species in a mechanism:

A nucleophile and an electrophile are present	____
The carbon containing species is a weak base and there is a strong acid present	____
The carbon containing species is a strong acid and a base is present	____
The carbon containing species can fragment to make water and a tertiary carbocation	____

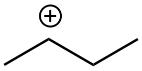
9. (2 pts each no partial credit) The following statements are true. Choose from among the following five possibilities and in the space provided, write the letter of the one *or more* phenomena that best explain the true statement.

A. The inductive effect **B. Hyperconjugation** **C. Resonance delocalization of a charged species**

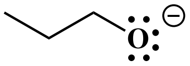
D. Greater s character of the orbital containing an electron pair on a negatively-charged atom **E. The negative charge is on a more electronegative element**



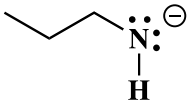
is lower in energy than



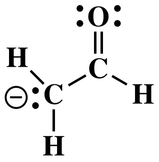
because of: _________________



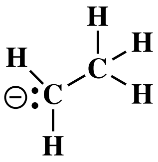
is lower in energy than



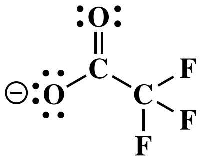
because of: _________________



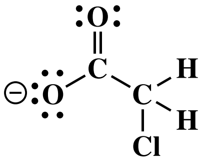
is lower in energy than



because of: _________________



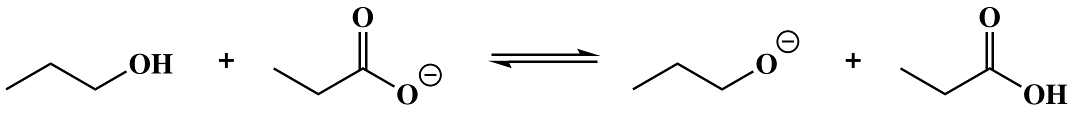
is lower in energy than



because of: _________________

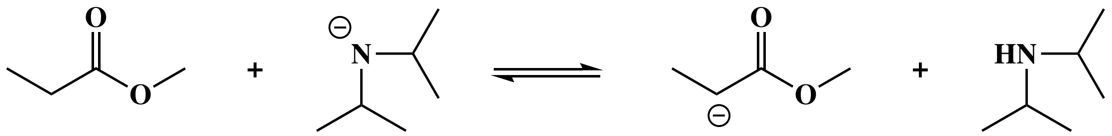
$H_3C{-}C{\equiv}C{:}^{\ominus}$ **is lower in energy than** $H_3CH_2CH_2C{:}^{\ominus}$ **because of:** _________________

6. (10 pts) For each acid-base reaction, **circle the side of the equation that predominates at equilibrium.**



$$H_3C-OH \quad + \quad F_3C-O^{\ominus} \quad \rightleftharpoons \quad H_3C-O^{\ominus} \quad + \quad F_3C-OH$$

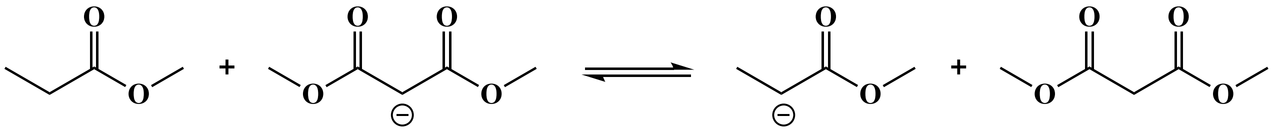
$$HF \quad + \quad Br^{\ominus} \quad \rightleftharpoons \quad F^{\ominus} \quad + \quad HBr$$



$pK_a = 19$

$pK_a = 40$

Think about this last one!



7. (2 or 4 pts each) For the following, **circle the capitalized word** that best completes the statement.

In general, it is best to think of alkenes as NUCLEOPHILES or ELECTROPHILES that react with NUCLEOPHILES or ELECTROPHILES such as Br_2.

In general, NUCLEOPHILES or ELECTROPHILES serve as electron sources and NUCLEOPHILES or ELECTROPHILES serve as electron sinks for the arrows used to indicate bond-making steps in reactions.

A pi bond or lone pair will serve as an ELECTRON SOURCE or ELECTRON SINK for an arrow that indicates the making of a new bond.

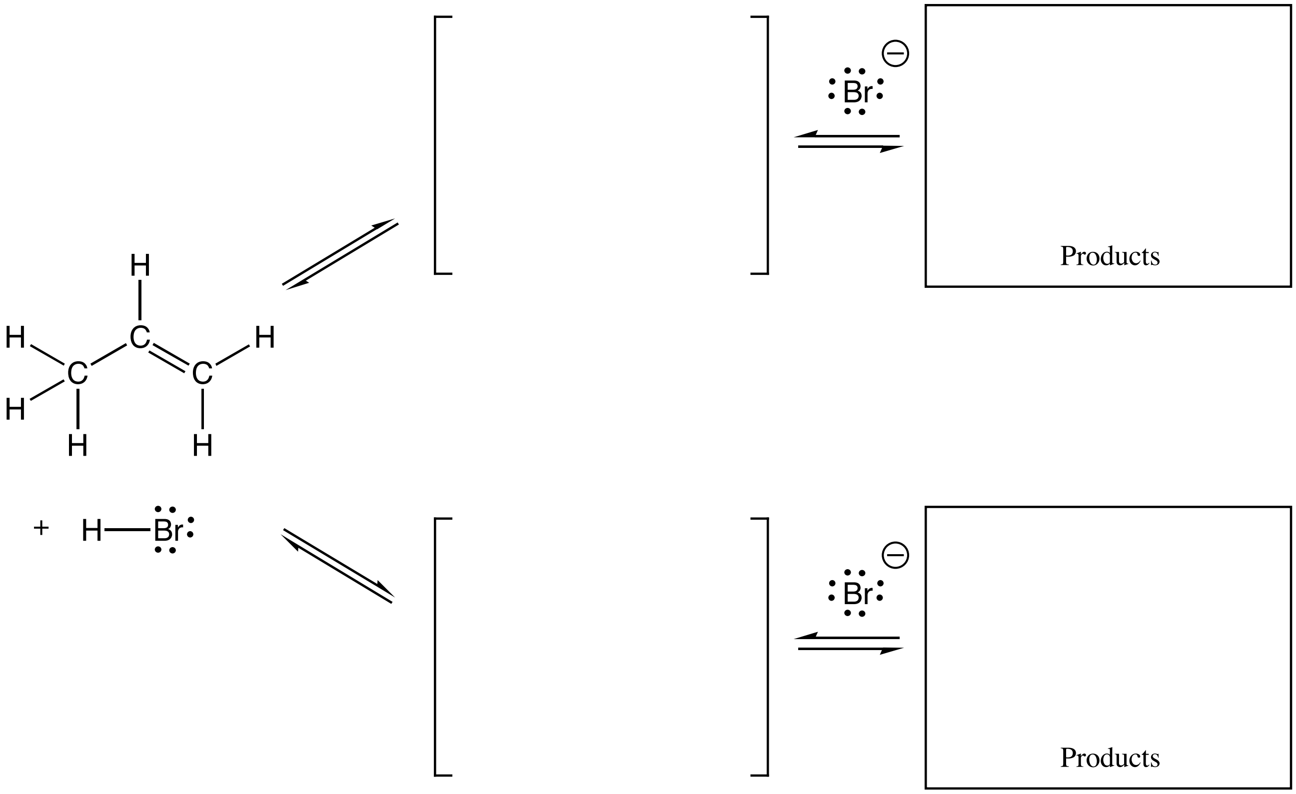
An atom that can accommodate a new bond can serve as an ELECTRON SOURCE or ELECTRON SINK for an arrow that indicates the making of a new bond.

A reaction that occurs slower generally has a LOWER or HIGHER activation energy.

A reaction that has a strong thermodynamic driving force (a strong motive) is FAVORABLE or UNFAVORABLE as written.

A reaction will have a strong motive (thermodynamic driving force) if the bonds made are STRONGER or WEAKER than the bonds that are broken.

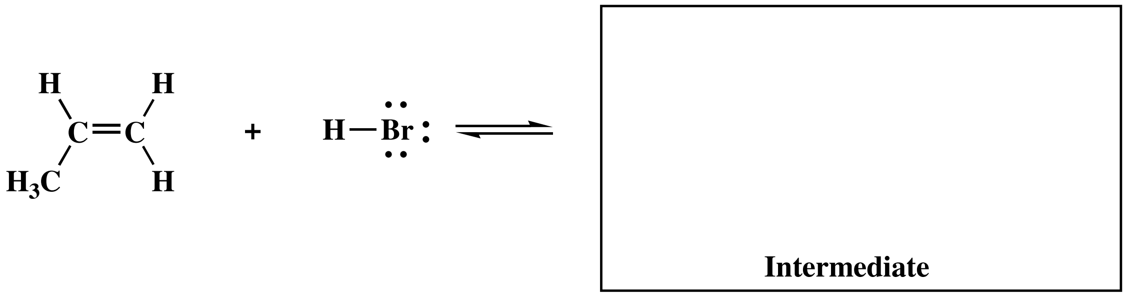
Addition of H-X to an Alkene



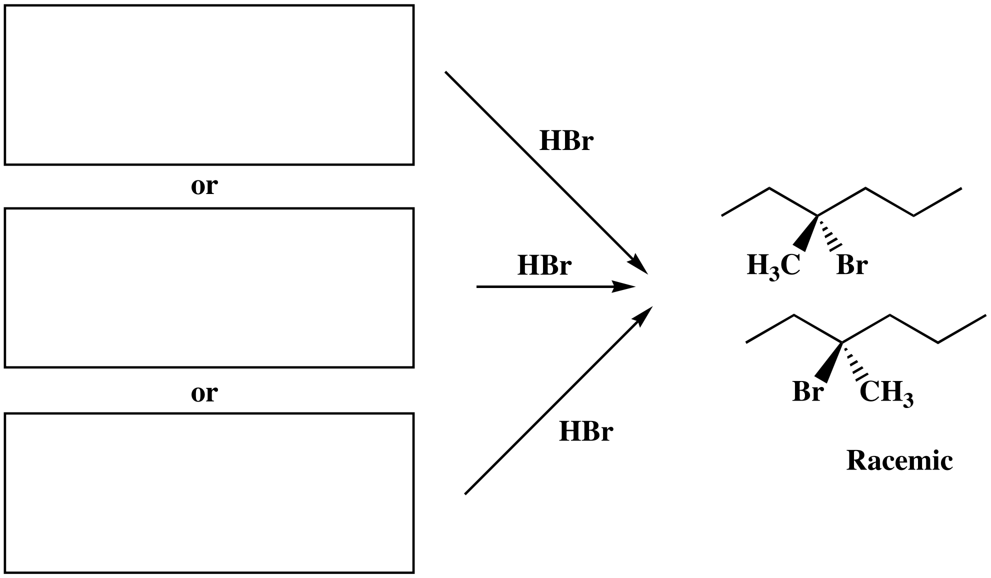
Signature__________________________ Pg 6 ____________(24)

11. (6 pts each) For each set of reagents, draw the important intermediate or transition state that we discussed in lecture in the box provided. **You must show all lone pairs and formal charges on the structures you draw!! Draw all species produced in this step of the mechanism** <u>Next, draw arrows on the starting materials to indicate electron flow to generate the intermediate or transition state that you have drawn.</u> *If the intermediate or transition state is chiral, you only need to draw one of the enantiomers, not both*. Please read these directions again to make sure you know what we want. Note that we are only interested in the first step of the mechanism here, not the whole mechanism!

A.

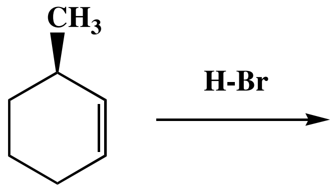


14. (6 pts) Assuming no rearrangements, **draw the three different alkenes that can give rise to the indicated racemic mixture of products when reacted with HBr.**



14. (18 pts) **For the following reaction, draw all possible products including the different regioisomers and stereoisomers**. For this part, assume no rearrangement takes place**.**

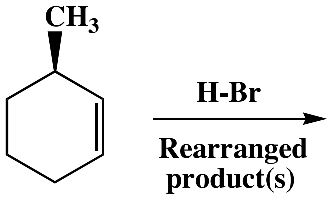
A) No rearrangement

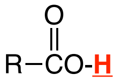
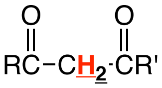
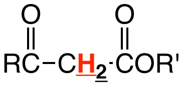
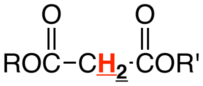
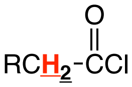
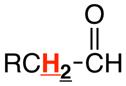
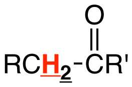
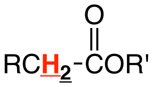
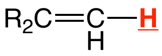


B) In your answer to part A), did you draw any pairs of enantiomers? _________

C) Is your answer to part A) a racemic mixture? _________

D) Now draw any additional product(s) you would see upon rearrangement of the intermediate carbocation.



Compound		pKa
Hydrochloric acid	$\underline{H}$-Cl	-7
Protonated alcohol	$RCH_2O\underline{H_2}^{\oplus}$	-2
Hydronium ion	$\underline{H}_3O^{\oplus}$	-1.7
Carboxylic acids	 $R-\overset{\overset{O}{\|}}{C}O-\underline{H}$	3-5
Thiols	$RCH_2S\underline{H}$	8-9
Ammonium ion	$\underline{H}_4N^{\oplus}$	9.2
β-Dicarbonyls	 $R\overset{\overset{O}{\|}}{C}-C\underline{H_2}-\overset{\overset{O}{\|}}{C}R'$	10
Primary ammonium	$\underline{H}_3\overset{\oplus}{N}CH_2CH_3$	10.5
β-Ketoesters	 $R\overset{\overset{O}{\|}}{C}-C\underline{H_2}-\overset{\overset{O}{\|}}{C}OR'$	11
β-Diesters	 $RO\overset{\overset{O}{\|}}{C}-C\underline{H_2}-\overset{\overset{O}{\|}}{C}OR'$	13
Water	$HO\underline{H}$	15.7
Alcohols	$RCH_2O\underline{H}$	15-19
Acid chlorides	 $RC\underline{H_2}-\overset{\overset{O}{\|}}{C}Cl$	16
Aldehydes	 $RC\underline{H_2}-\overset{\overset{O}{\|}}{C}H$	18-20
Ketones	 $RC\underline{H_2}-\overset{\overset{O}{\|}}{C}R'$	18-20
Esters	 $RC\underline{H_2}-\overset{\overset{O}{\|}}{C}OR'$	23-25
Terminal alkynes	$RC\equiv C-\underline{H}$	25
LDA	$\underline{H}-N(i\text{-}C_3H_7)_2$	40
Terminal alkenes	 $R_2C=\underset{H}{C}-\underline{H}$	44
Alkanes	$CH_3CH_2-\underline{H}$	51