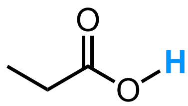
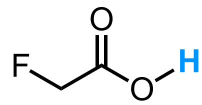
Stability

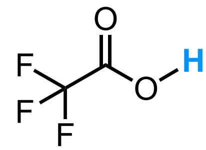
This page will explore how electronics can influence acidity, and how sterics can influence the preferred conformation of a molecule.

1. A. **Draw the conjugate base** that results after deprotonation for each acid shown.
   B. **Select** which **conjugate base** is **most stable** and **least stable**. Why?
   C. **Identify** which original **acid** is **most acidic** and **least acidic**.

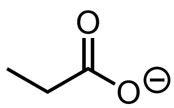
Acid

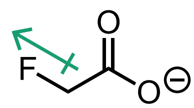


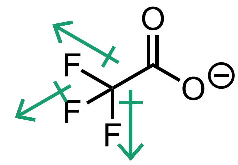




Conjugate Base







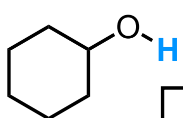
all have similar resonance delocalization, but…

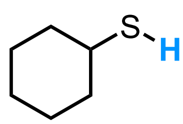
no EWG to help stabilize anion

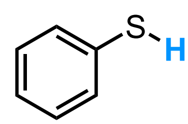
most stable conjugate base: resonance + 3 EWGs

2. A. **Draw the conjugate base** that results after deprotonation for each acid shown.
   B. **Select** which **conjugate base** is **most stable** and **least stable**. Why?
   C. Given that stronger acids have smaller pK_a values, match the following pK_a values to the original acids shown: 8, 11, and 17.

Acid



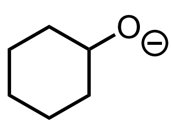


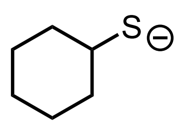


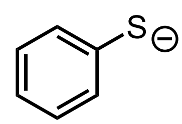
pK_a

17 | 11 | 8

Conjugate Base





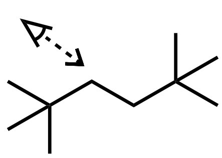


least stable conjugate base = least acidic parent acid

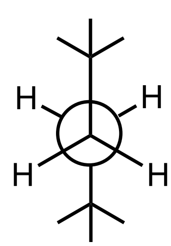
most stable conjugate base; resonance and S is large and polarizable

3.

A. **Draw the structure** of 2,2,5,5-tetramethylhexane

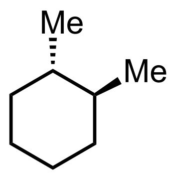


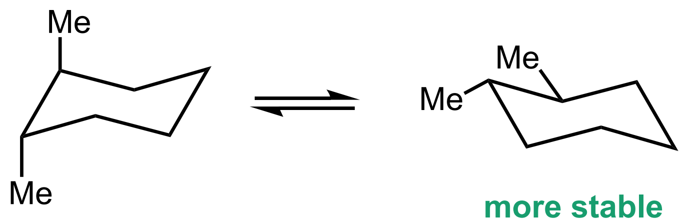
B. **Draw a Newman projection** of the **lowest energy conformation** of this molecule, **looking down the carbon #3 – carbon #4 single bond**. Label the relationship of the largest constituents (eclipsed, gauche, or anti).



anti

4. Given the two possible chair conformations of the following molecule, choose which is lowest in energy and describe why.

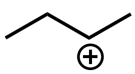




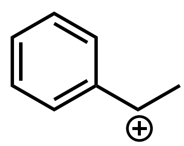
Since the second chair conformation has both methyl groups equitorial, whereas the first has both methyls axial, the second chair is more stable

5. **Considering electronics**, **identify** the **most stable (least reactive)** and **most reactive (least stable)** species in each group shown. **Justify** your choices.
Note: lone pairs are implied based on the formal charge shown

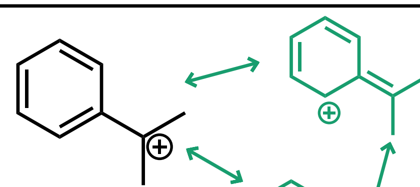
A.

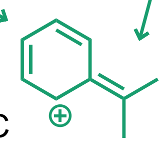


least stable
2° carbocation
no resonance



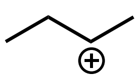
2° carbocation
resonance with C=C



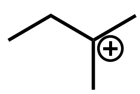


most stable
3° carbocation
resonance with C=C

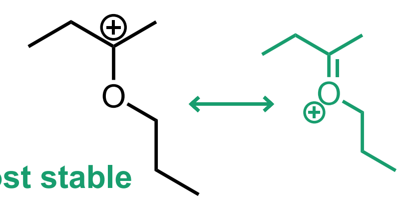
B.



least stable
2° carbocation
no resonance

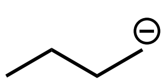


3° carbocation
no resonance

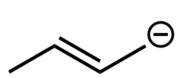


most stable
3° carbocation
resonance with O

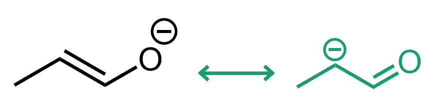
C.



least stable
1° carbanion
no resonance

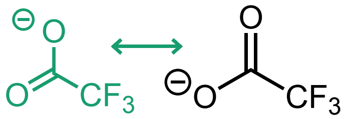


1° carbanion
resonance
with C=C

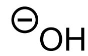


most stable
1° alkoxide
O is more eN than C
resonance with C=C

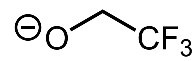
D.



most stable
oxyanion
resonance stabilized with C=O
CF_3 EWG

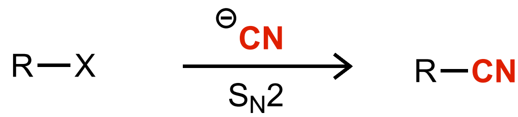


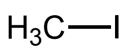
least stable
oxyanion
no resonance
no EWGs



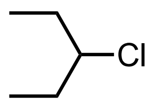
oxyanion
no resonance
CF_3 EWG

6. **Consider** both the "**sterics**" **of the electrophile** and the "**electronics**" **of the leaving group** to **rank the following electrophiles** from **least reactive to most reactive**

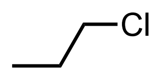




A



B



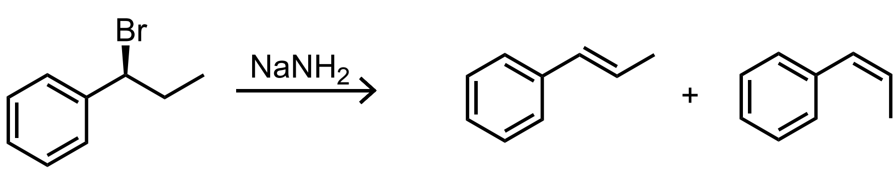
C

D

B	C	D	A
least reactive for S_N2			**most reactive for S_N2**

7. All of the products shown are formed in the elimination reactions below. **Identify the major product in each reaction**. **Justify** your answer.

A.

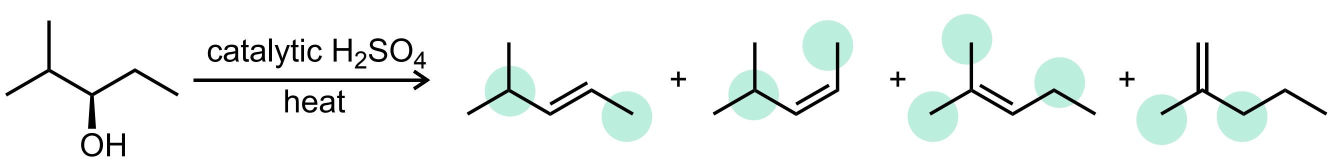


major product
more stable
(*E*)-isomer

(*Z*)-isomer

Both alkenes are stabilized through resonance and di-substituted, but (*E*) alkenes are more stable then (*Z*) alkenes

B.



di-substituted (*E*)-isomer

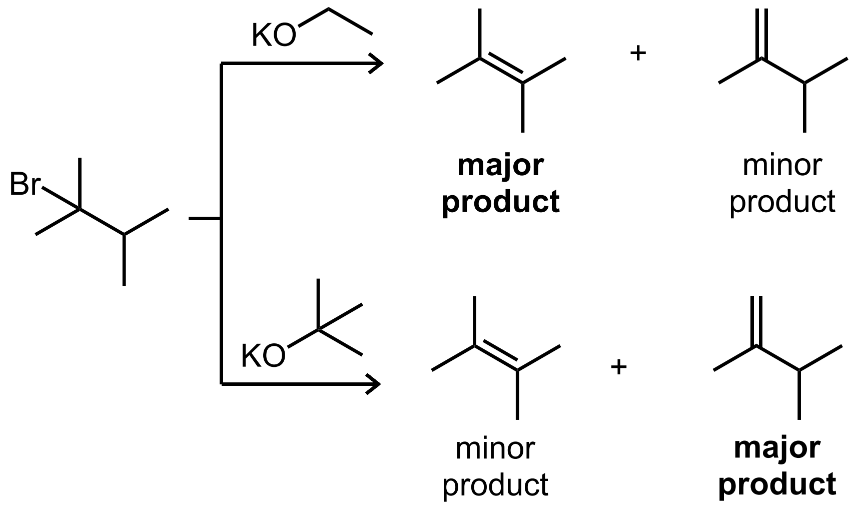
di-substituted (*Z*)-isomer

major product
most stable
tri-substituted
(*E*)-isomer

di-substituted

The major product will be the most stable alkene (most substituted and *E* preferred over *Z*)

8. Considering stereoelectronics of both the reactants and products, **hypothesize why we observe the shown product distributions in the elimination reactions below**.



tetra-substituted alkenes are more stable than di-substituted alkenes

The sterically bulky base is faster at reacting with the less bulky hydrogen, leading to the less substituted alkene as the major product