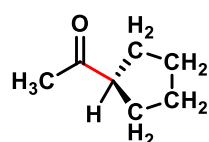
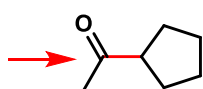
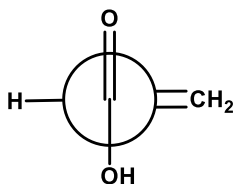
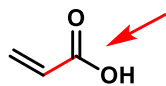
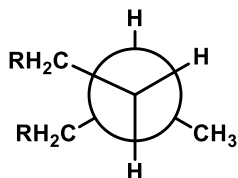
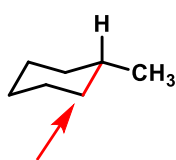
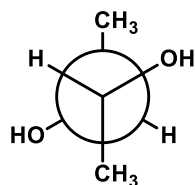
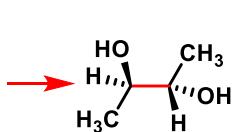
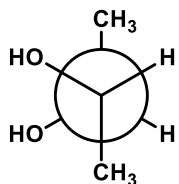
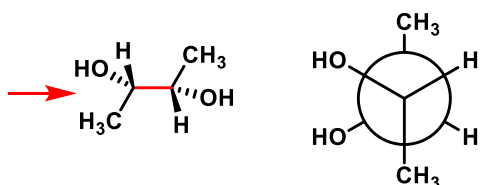
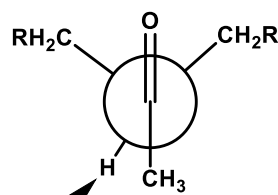


## Homework 2 – 2017/04/03

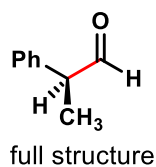
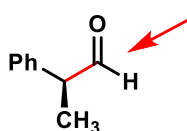
1) Draw Newman projections for these as seen along the **red** arrow:



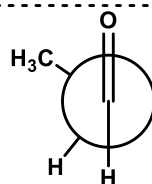
stereochemistry not set,  
so i just picked one



smallest group,  
gets bullied into  
the most crowded  
position

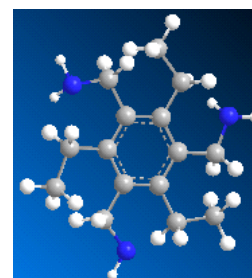
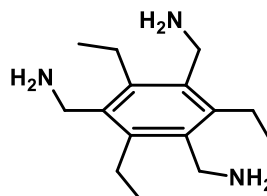
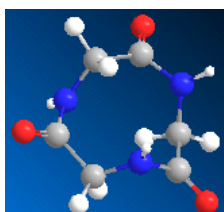
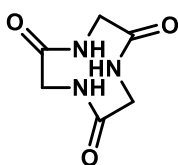
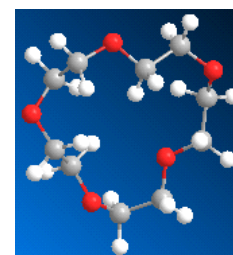
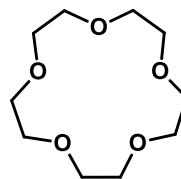
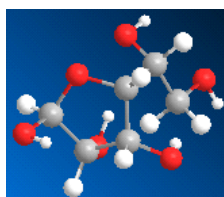
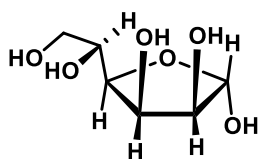
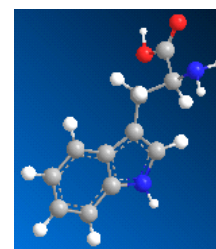
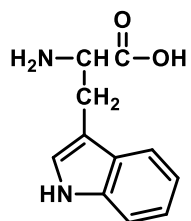
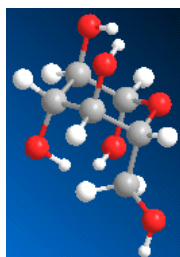
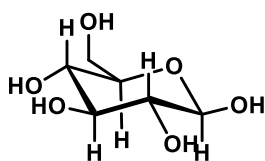
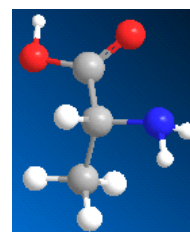
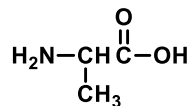
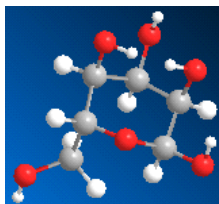
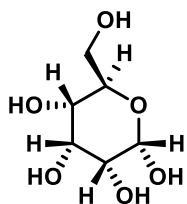


full structure

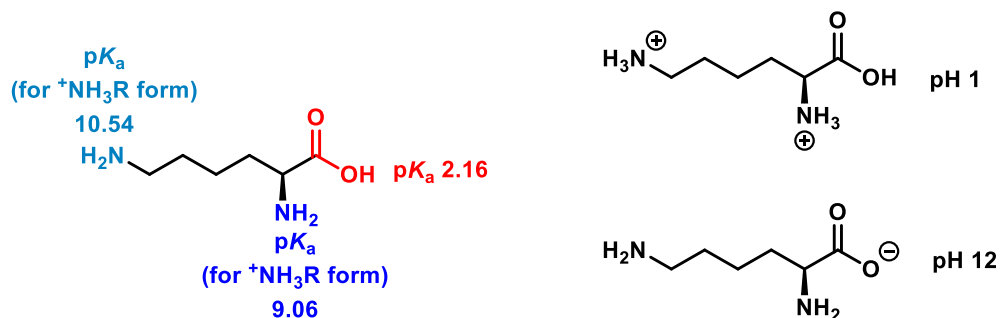


largest group,  
prefers to have  
most space

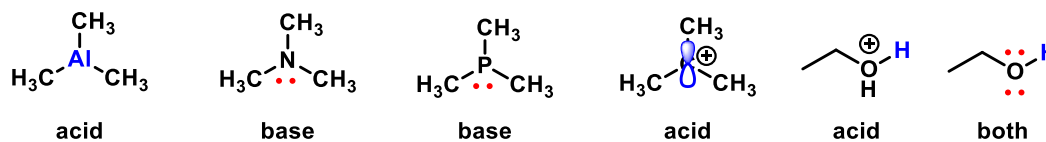
2) Draw the structures (in ChemDraw or by hand) that correspond to the following models!  
(Code: white: H, red: O, blue: N, grey: C)



3) Draw the dominant structure of lysine (an amino acid, see below) in water at pH 1 and at pH 12.



4) Lewis acid or Lewis base?



5) a) Which one of the pairs is a stronger Lewis acid?

$Ca^{2+} < Mg^{2+}$  (same charge,  $Mg^{2+}$  is smaller)

$Na^+ < Mg^{2+}$  ( $Mg^{2+}$  has larger charge and is smaller)

$Cu^+ < Cu^{2+}$  (same element,  $Cu^{2+}$  has larger charge)

$Li^+ > Na^+$  (same charge,  $Li^+$  is smaller)

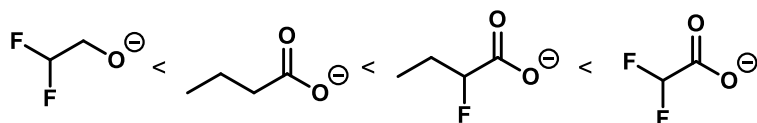
$Ag^+ > [Ag(NH_3)_2]^+$  (same charge, the Lewis acidity of  $Ag^+$  in  $[Ag(NH_3)_2]^+$  is moderated by the lone pairs donated by the ammine ligands)

b) Place the lanthanide trications ( $Ln^{3+}$ ) in order of increasing Lewis acidity! (Yay, lanthanides!)

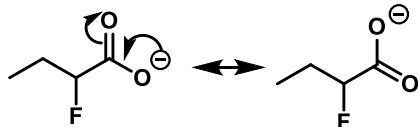
The one at the beginning is the weakest Lewis acid, and the acidity increases with increasing atomic number. This is due to the so-called lanthanide contraction: with increasing atomic number the lanthanide atoms/ions become smaller and smaller. (You can see this if you look up the ionic radii.) The full list:

$La^{3+} < Ce^{3+} < Pr^{3+} < Nd^{3+} < Pm^{3+} < Sm^{3+} < Eu^{3+} < Gd^{3+} < Tb^{3+} < Dy^{3+} < Ho^{3+} < Er^{3+} < Tm^{3+} < Yb^{3+} < Lu^{3+}$

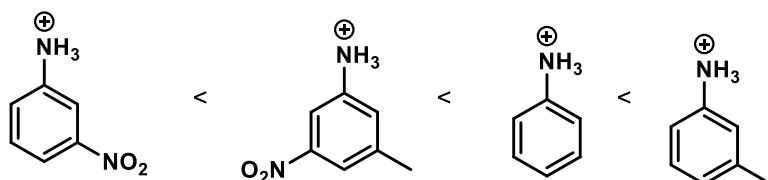
6) Place these in increasing order of stability:



- 1) Electron-withdrawing groups (such as fluorine) help stabilize the negative charge.
- 2) It is stabilizing to distribute the charge over several atoms; if you can draw several resonance structures with the charges on different atoms, that's great.



You can do this for the three most stable anions (that is, both oxygens can take the negative charge, see example). There is no such option for the alcoholate.

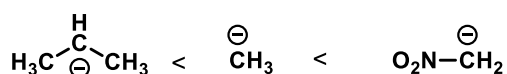


Electron-withdrawing groups (such as nitro groups) **destabilize** the positively charged ions. Methyl (alkyl) groups are mildly electron-donating, and so help stabilize the protonated species.

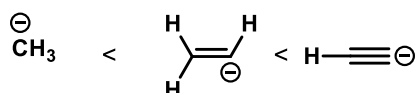
The order of stability is simply:

awfully destabilized < still horrible, but slightly less so because of the methyl group < whatever < whatever + a little help from the methyl group

Nitro groups are very very electron-withdrawing, so their effect is much stronger than the compensation given by the methyl



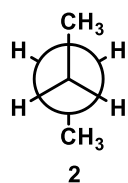
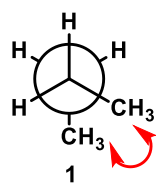
As in the previous example: NO<sub>2</sub> is electron-withdrawing, Me is electron-donating. As we're dealing with negatively charged ions here, the nitro is stabilizing, the methyl destabilizing.



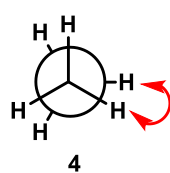
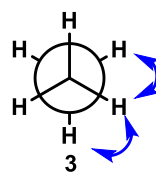
The electrons will prefer to be in the orbital with the higher s character. The alkyne is sp, the alkene sp<sup>2</sup>, and the methyl anion's carbon is sp<sup>3</sup>, with 50%, 33% and 25% s-character, respectively.

Another way of saying it (as the book does), is that sp-carbons are more electronegative than sp<sup>2</sup>-carbons, which in turn are more electronegative than sp<sup>3</sup>-carbons.

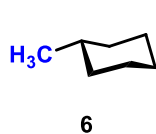
7) In each pair, pick the more stable conformation, and explain your choice.



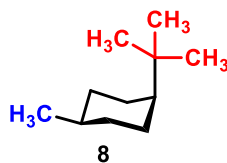
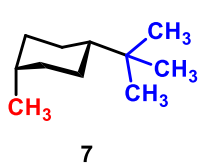
2 is more stable than 1, as the two large groups (the methyls) are further away from each other in 2 than in 1



3 is more stable than 4, because in 4 you have the Hs eclipsed, which 3 avoids

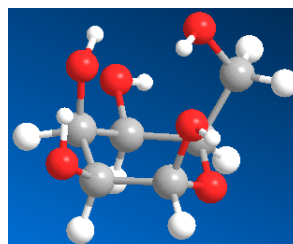
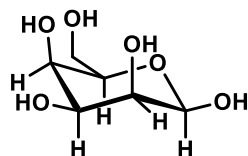
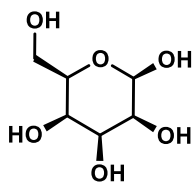


6 is more stable than 5, as the largest group (methyl) is in an equatorial position

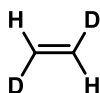


7 is more stable than 8, as the larger group (*tert*-butyl) is in an equatorial position

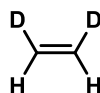
8) What is the most stable conformation of  $\beta$ -D-talose?



9) Draw the alkene with the lowest molecular weight for which *cis/trans* isomers are possible.



*trans*



*cis*