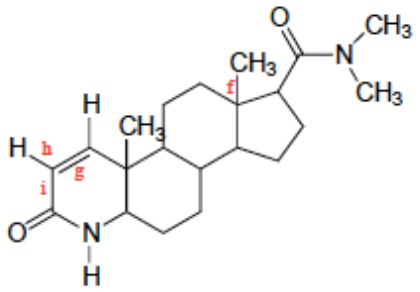
CHE 2060: Practice problems 2

2.1: Covalent bonding in organic molecules

1. What kinds of orbitals are overlapping in bonds b-i indicated below? Be sure to distinguish between σ and π bonds.



Finasteride
(trade name Propecia, a hair-loss drug for men from Merck Pharmacueticals)

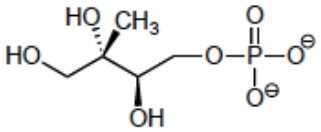
2. Draw, in the same style as the figures above, orbital pictures for the bonding in methylamine.

2.2: Molecular orbital theory

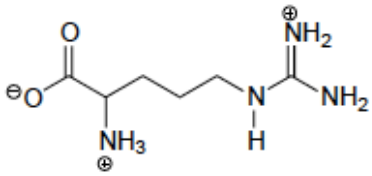
3. H atoms bond to form H_2, but He atoms don't form He_2 molecules. *Why not?*

2.3: Resonance

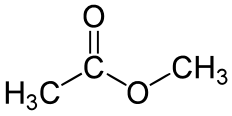
4. Draw four resonance contributors for this molecule and label each major or minor.



5. Draw four resonance contributors that show how the positive charge on the side chain of the amino acid arginine can be delocalized.

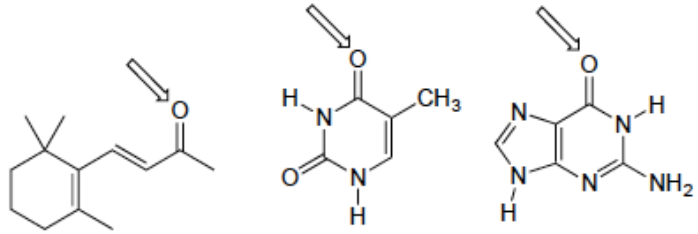


6. Draw three resonance contributors of methyl ethanoate and order them by relative importance. Explain your reasoning



7. Draw two pictures showing the unhybridized p orbitals and the location of π electrons in the 'enolate' anion shown below.
- One picture should represent the major resonance contributor…
- the other the minor contributor.
- How many overlapping p orbitals are sharing how many π-bonded electrons?

8. For each of the compounds below, several minor resonance contributors can be drawn in which the atom indicated by an arrow bears a negative formal charge. Circle all atoms which could bear the corresponding positive formal charge.



beta-ionone - tomato aroma thymine guanine

2.4: Non-covalent interactions

9. Define each of these terms:
(a) covalent bond
(b) hydrogen bond
(c) dipole-dipole bond
(d) van der Waals bond

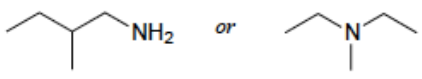
10. Is van der Waals attraction an example of an inductive effect or a field effect?

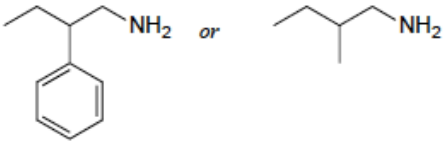
11. Do linear or branched molecules of the same carbon number experience greater van der Waals attraction? Why?

12. What are the essential similarities and differences between dipolar and hydrogen bonding interactions?

2.5: Physical properties of organic compounds

13. For each pair of molecules below, choose the one that is more water-soluble, and explain your choice.

d) 

e) 

14. Give the expected trend (lowest to highest) in boiling points for the following series of compounds.

a) CH_3CHF_2 CH_2F_2 HF CH_3F

b)