Name _____

Periodic Table

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Ha	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Please sit with an empty seat between you and your neighbors.

Unless specifically asked, you do not have to draw mechanisms for reactions.

For full credit, any explanations you write should **be complete and grammatically-correct sentences**.

Feel free to ask questions about the questions, but **please don't ask questions about your answers**; I won't answer them and it distracts your neighbors.

	Possible	Earned
Page 2	31	_____
Page 3	28	_____
Page 4	28	_____
Page 5	18	_____
Total	100	_____

1 For all the molecules shown below, please provide the following and note that the connectivity is as indicated in each formula. In other words, if I write H_3C, it means that there are three hydrogens attached to the carbon.
a) The Lewis structure including all lone pairs of electrons.
b) The hybridizaton for all the non-H atoms.
c) The formal charge for all non-H atoms (+, -, or 0 as appropriate). **Hint:** Even if there is not an overall charge in the molecule, there can be a formal charge on atoms. 21 points total

H_3CNO_2

H_3NO

H_2CCCH_2

$[H_2COCH_3]^+$

2) Please provide definitions for the terms provided below in one sentence. (10 pts).
• Electronegativity:

• Nucleophile:

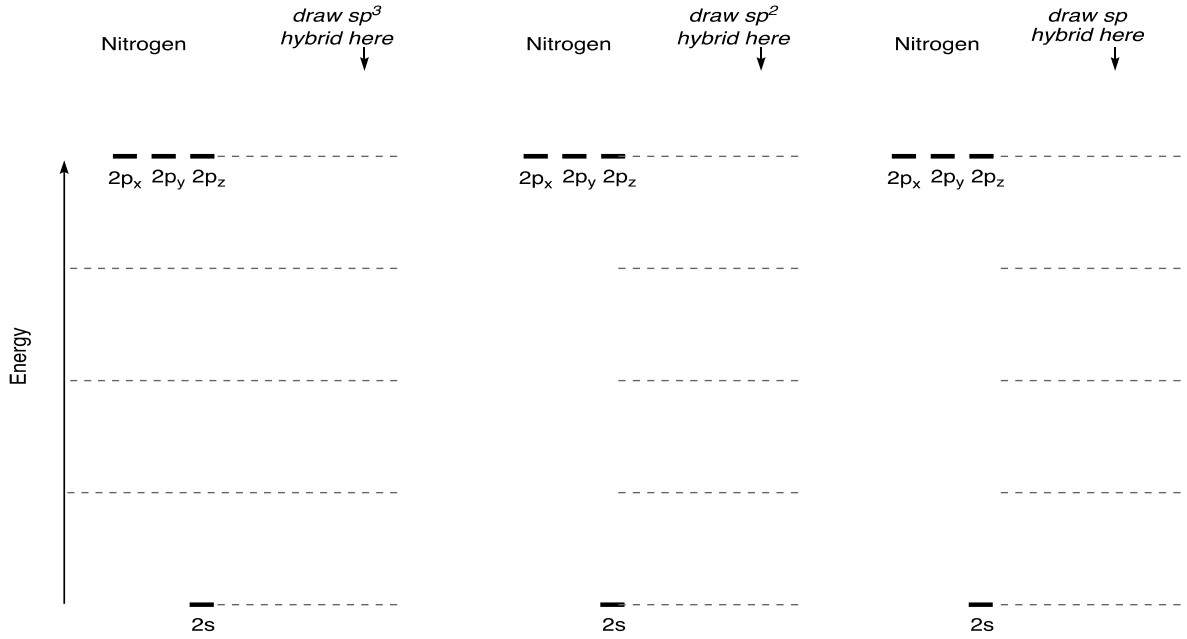
• Electrophile:

• Bonding molecular Orbital:

• Antibonding molecular Orbital:

 Total pts this page:

3) Below are the orbital energies for nitrogen's valence shell orbitals.
a) Provide the energy diagram for all the orbitals of an sp^3 hybridized nitrogen
b) Provide the energy diagram for all the orbitals of an sp^2 hybridized nitrogen
c) Provide the energy diagram for all the orbitals of an sp hybridized nitrogen.
Hint: Your energy diagram should include a total of 4 orbitals in each case. Also, pay attention to the energies of all your orbitals and make sure they are lined up correctly with respect to the starting atomic orbitals and with respect to each other (the grid lines are provided to help you line-up the energies of your orbitals). (12 pts total)

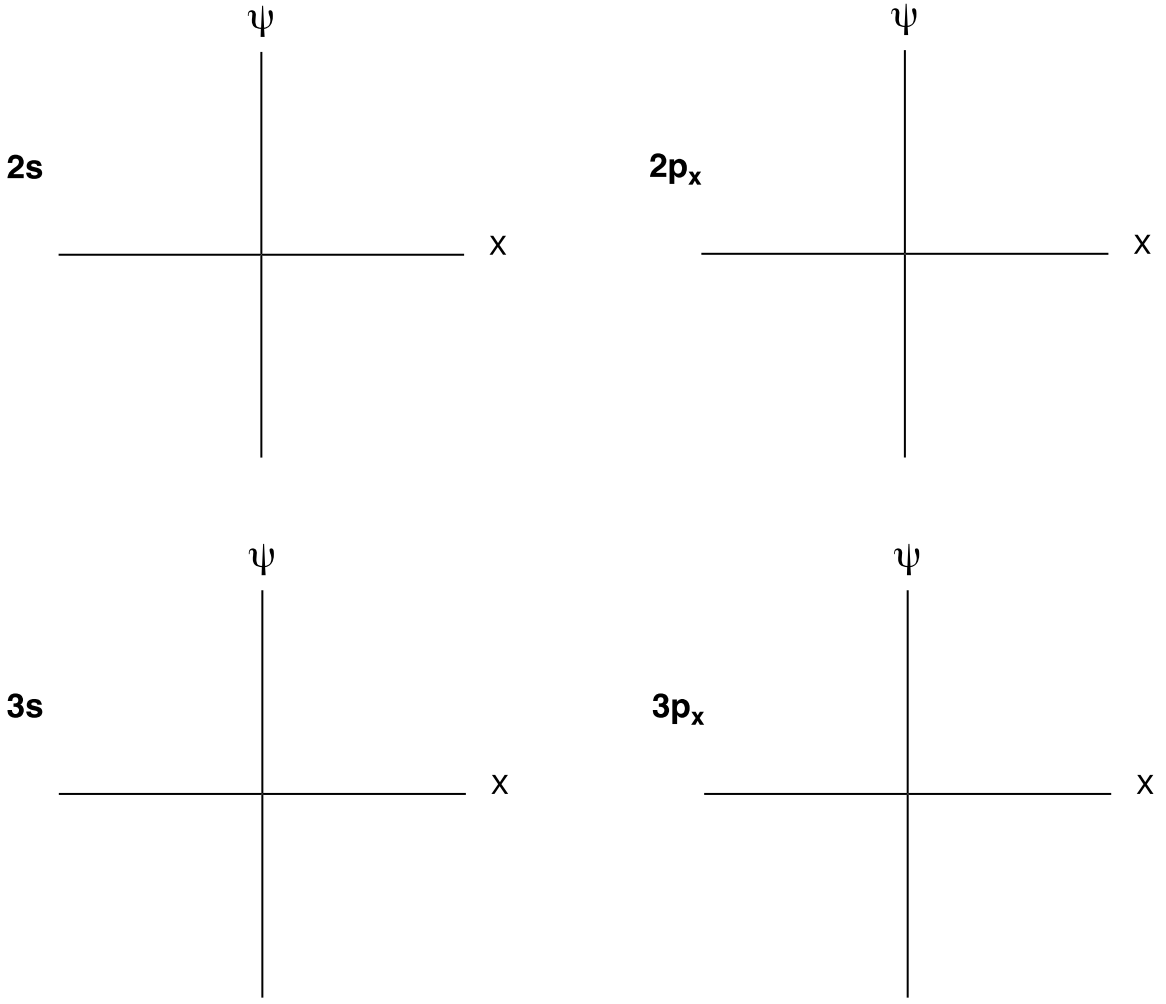


4 a) Draw the 3-dimentional shape of a nitrogen sp hybrid orbital (I just want one orbital). Include the **sign of the wave function** in your drawing. (4 points)

b) How does the 3-dimentional size and shape of an oxygen sp hybrid differ from the nitrogen sp hybrid orbital? Explain this in one sentence. (3 points)

c) Are these molecular orbitals? Provide a **yes** or **no** answer and explain in one sentence. (4 pts)

5) Draw ψ (i.e., the wave function) and show the presence of any nodes for the following orbitals (16 pts)



6) The Pauling electronegativity for hydrogen, boron, carbon, and oxygen are as follows:
H = 2.2 ; B = 2.0 ; C = 2.5 ; O = 3.4. Four bonds are shown below: B-H, C-H; C-O; O-H.
a) Draw a "dipole arrow" (i.e., $\overset{+}{\longleftarrow}$) to indicate the direction of the dipole for each bond (8 pts).

b) Which dipole is larger, B-H, C-H or C-O. Explain your answer in one sentence (4 pts).

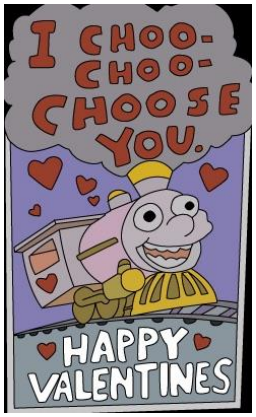
7) I provided three rules for writing reaction mechanisms. Provide them below (in any order you wish) and indicate if they are ever violated. (12 pts)

Rule 1 (can it be violated? **YES** or **NO**):

Rule 2 (can it be violated? **YES** or **NO**):

Rule 3 (can it be violated? **YES** or **NO**):

8) Draw the shape of the π* molecular orbital for a C-O bond. Pay attention to the **shape, sign, and size** of the lobes of your orbital and indicate with a dashed line the presence of any nodes and the **significance of those nodes** with respect to rendering the orbital an antibonding orbital. (6 pts)



 Total pts this page: