General Chemistry CH141 Test 2 & 3 Atomic Structure and Bonding Questions
Fall 2005 Name_____

3. Which of the following is **not true** about a photon? _____
   a) its energy is proportional to its frequency
   b) its energy is proportional to its wavelength
   c) it has momentum
   d) its energy can be absorbed by an electron in an atom
   e) it has both wave-like and particle-like properties

7. What are the possible values of the magnetic quantum number for an electron in a 3*p* subshell? _____

8. What is the energy (in J) of the photon that is emitted from a hydrogen atom that drops from the n=4 level to the n=3 level?

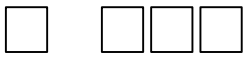
_____

11. (a) Give the electron configuration for the following two atoms (you can simplify by using a noble gas core, e.g. [Ar]):

Ge:

Ti:

(b) Fill in the following orbital diagram for Si:



12. For sodium metal to emit electrons, the metal must be irradiated with electromagnetic radiation that possesses energy of at least 220. kJ/mol. What is the longest possible wavelength for this radiation?

1. For an element M, the chemical equation that corresponds to the electron affinity is:

a. $M\ (g) \rightarrow M^+\ (g) + e^-$
b. $M\ (g) + e^- \rightarrow M^-\ (g)$
c. $M^+\ (g) + X^-\ (g) \rightarrow MX\ (s)$
d. $M^+\ (g) + e^- \rightarrow M\ (g)$
e. $M\ (g) + N\ (g) \rightarrow M^-\ (g) + N^+\ (g)$

2. Cl_2 is the strongest oxidizing agent of the group Cl_2, Br_2, and I_2, because:

a. Cl is the largest
b. Cl has the lowest first ionization potential
c. Cl has the lowest electronegativity
d. Cl has the most negative electron affinity
e. Cl_2 has the most ionic bond

3. Circle the correct answer in each of the following lists:

a. The largest electronegativity: Ge, P, O
b. The largest first ionization potential: K, Ga, Br
c. The largest atomic radius: As, P, N

4. Which of the following pairs of atoms is expected to have the **greatest** bond polarity and the **least** bond polarity?

a. N-O b. B-N c. K-F d. Cl-Cl

greatest _____ least _____

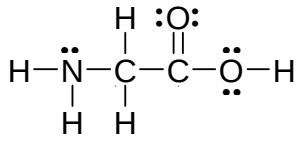
5. What is the hybridization on the sulfur in SF_6?

6. Does the overlap of the two p-orbitals shown at right give a σ or π orbital?

8. Is the π bond in NO_2^- localized or delocalized? Why? (no credit will be given for just yes or no alone with no reasoning.)

9. Calculate the reduced mass for NO in units of kg molecule^{-1}.

10. Consider the Lewis structure for glycine:



a. What are the approximate bond angles about each of the two carbon atoms?

N-C-C bond angle: _____

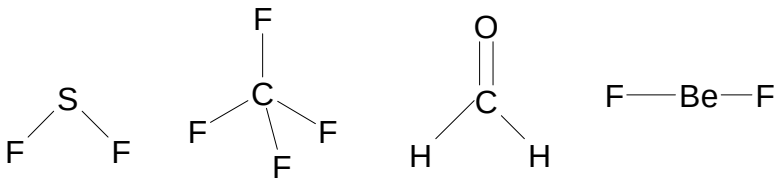
O-C-O bond angle: _____

b. What is the hybridization for the carbon in the -CH2- group: _____

c. What is the hybridization for the carbon in the -COO- group: _____

d. What is the hybridization for the N atom: _____

11. Which of the following are polar?



13. Does F or Cl have a bigger difference between Z and Z_{eff} for the valence electrons. Remember to tell <u>why</u> Z and Z_{eff} are different.

14. Draw the Lewis dot resonance structures for the carbonate ion, CO_3^{2-} . Give the average bond order for the bonds. Don't forget to include the overall ionic charge in your structures.

15. Using molecular orbital theory, decide if OF is more likely to form an OF^+ ion or an OF^- ion.

16. Use VSEPR theory to predict the shape of the following molecules. (Central atom listed first). Give the name of the molecular shape and also draw the shape.

SO_4^{2-} ion

BrF_5

17. Give the Lewis dot formula and calculate the formal charge on each atom in the following two compounds:

NO_3^- (N in the center)

SF_4 (S is the central atom)

Formulas and Constants

$N_A = 6.022 \times 10^{23}\ mol^{-1}$ $\quad \kappa = 8.99 \times 10^{9}\ J\ m\ C^{2}$ $\quad V = \frac{\kappa Q_1 Q_2}{d}$

$1\ cal = 4.184\ J$ $\quad h = 6.63 \times 10^{-34}\ J\ s$ $\quad c = 3.00 \times 10^{8}\ m\ s^{-1}$

$R_H = 1.0968 \times 10^{7} m^{-1} = 1.0968 \times 10^{5}\ cm^{-1} = 2.178 \times 10^{-18}\ J$ $\quad N_A = 6.022 \times 10^{23}\ mol^{-1}$

$\nu \lambda = c$ $\quad p = \frac{h}{\lambda}$ $\quad \lambda = \frac{h}{m\upsilon}$ $\quad \Delta x\, \Delta p \geq \frac{h}{4\pi}$

$\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$ $\quad E = 2.178 \times 10^{-18}\ J \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$ $\quad E = -2.178 \times 10^{-18}\ J \left(\frac{1}{n^2} \right)$

$\Delta E = -2.178 \times 10^{-18}\ J \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$

$\tilde{\nu} = \frac{1}{\lambda}$ $\quad \Delta E = h\nu$ $\quad \nu\lambda = c$ $\quad \Delta E = \frac{hc}{\lambda} = hc\tilde{\nu}$

$\tilde{\nu}\ (cm^{-1}) = \frac{1}{2\pi c} \sqrt{\frac{k}{\mu}} = 5.31 \times 10^{-12} s/cm \sqrt{\frac{k}{\mu}}$ $\quad \mu = \frac{m_1 m_2}{m_1 + m_2}$