***Test 1, Summer 2009*** ***Name _____***
***Chemistry 211*** ***60 points*** ***May 20, 2009***

***Circle the best answer in bold****, or write short answers; be sure to address <u>all</u> parts of each question.*

1. (3) List <u>three</u> reasons why carbon is able to form so many compounds (over 30 million are known!).

2. (3) Circle the name of the American physicist who was responsible for developing the modern theory of covalent bonding in the early part of the 1900's and after whom the electron-dot structure was named:

   a. **Debye** b. **Einstein** c. **Lewis** d. **Pauling** d. **Heisenberg** e. **Schrödinger**

3. (3) A(n) **( orbital, antibonding M.O., shell, tetrahedron , vacuum )** is the space (including shape and orientation) in which there is a high probability of finding an electron.

4. (4) Name and summarize <u>two</u> of the three principles or rules followed in the process of distributing electrons into a set of atomic orbitals.

5. (3) What experimental observation led to the notion of a tetrahedral arrangement of four single bonds around a carbon atom as opposed to a planar arrangement? Sketches may prove useful.

6. (3) In the process of forming ions, atoms gain or lose electrons in order to achieve a(n) **( pair, quartet, sextet, octet, dozen, gross, gazillion )** of electrons in the outermost shell.

7. (3) In 1916 G.N. Lewis first proposed the bonding in covalent substances to be due to a **( sticky, glued, shared, matched, double )** pair of electrons between bonded atoms.

8. (3) The bond length of a double bond is **( longer than, the same as, shorter than )** that of a single bond.

9. (3) The bond strength of a single bond is **( less than 1/3, exactly 1/3, more than 1/3 )** that of a triple bond.

10. (5) Match the LETTER of the functional group name with the number of the structure on the board:

    1. _____ 2. _____ 3. _____ 4. _____ 5. _____

11. (4) Fill the electrons (as arrows) in the atomic orbital diagram for a carbon atom shown below, then show how hybridization occurs to form the hybrid orbitals used by carbon in ethene ($H_2C=CH_2$). Label <u>all</u> orbitals.

    atomic orbital configuration of C: ___ ___ ___ ___ ___

    hybrid orbital configuration of C:

12. (9) For each of the following compounds or ions, indicate the <u>hybrid atomic orbitals</u> used by the central atom and the <u>(ideal) bond angles</u> about the central atom. <u>Name the geometry</u> about the central atom. (You should start by drawing an acceptable Lewis structure of each substance, but your Lewis structure itself will not be graded.)

    $NO_2^+$

    $CO_3^{-2}$

    $H_3O^+$

13. (4) Draw two acceptable Lewis structures for the acetate ion ($CH_3CO_2^-$). Comment on the relative lengths of the two carbon-oxygen bonds. Calculate the formal charge on the carbon that is attached to the two oxygens.

14. (6) Circle the molecules in the group below that are <u>polar</u>. (you may want to draw a Lewis structure first, and predict the geometry, but those will not be graded)

    $CS_2$ $SO_2$ $CH_2Cl_2$

15. (4) The $pK_a$ of phenol is 9; the $pK_a$ of ethyl acetate is 25. Which is more acidic? Could the conjugate base of phenol be used effectively to remove a proton from ethyl acetate?