This was an old exam. On tomorrow's test we will have more questions with $E=h\nu$ and $\nu = c/\lambda$.

Chemistry 201
Practice

Name Key

Part One: Multiple Choice (40 points)
Select the best answer to each question. There is only one correct answer.

1. Which quantum number distinguishes the different shapes of the orbitals?
   a. n, principal b. l, azimuthal c. m_l, magnetic d. s, spin e. none do

2. Which quantum number determines the size of an orbital shell?
   a. n, principal b. l, azimuthal c. m_l, magnetic d. s, spin e. none do

3. An orbital can hold at most _____ electrons.
   a. 2 b. 8 c. 18 d. 32 e. depends on the orbital

4. Which element has the highest electronegativity?
   a. oxygen b. sodium c. bromine d. sulfur e. hydrogen

5. What is the bond order of the nitrogen molecule?
   a. zero b. one c. two d. three e. four

6. Which atom has the largest atomic radii?
   a. potassium b. calcium c. arsenic d. bromine e. they are the same

7. Which group forms oxides of the formula R_2O?
   a. halogens b. chalcogens c. noble gases d. alkali metals e. alkaline earth metals

8. Which of the following electron pair arrangements consists of 109.5 degree bond angles?
   a. octahedral b. trigonal planar c. linear d. tetrahedral e. none of these

9. Which hybridization occurs around the carbons in CH_2CH_2 (ethylene)?
   a. sp^3 b. sp^2 c. sp d. no hybridization

10. How many different "*shapes*" (values of quantum number l) are possible for n=7?
    a. 4 b. 5 c. 6 d. 7 e. 8
    $l = 0, 1, 2, 3, 4, 5, 6$

11. How many unpaired electrons are in selenium
    a. 0 b.1 c. 2 d. 3 e. 4

12. When an atom gains an electron and becomes an anion it:
    a. gets bigger b. gets smaller c. does not change size

13. Which of the following molecules is a notable exception to the octet rule?
    a. ammonia b. methane c. carbon dioxide d. boron trifluoride e. water
    six electrons not eight around B

14. Which of the following molecules has the shortest bond length?
    a. fluorine b. oxygen c. nitrogen d. they are the same

15. Which of the following molecules is polar?
    $5+6+6 = 17$
    a. carbon dioxide b. sulfur hexafluoride c. carbon tetrachloride d. nitrogen dioxide

16. Which of the following species is non-linear?
    a. NO_2^+ $[:O=N=O:]^+$ like carbon
    b. CS_2 $:S=C=S:$
    c. OCN^{1-} $[\ddot{O}\!\!:\!\!-C\equiv N:]^{1-}$ linear
    d. SO_2 $\ddot{O}\!\!:\!\!-\ddot{S}\!\!-\!\!\ddot{O}:$ resonance bent
    e. CO_2 $:O=C=O:$

    $\ddot{O}\!\!:\!\!-\ddot{N}\!\!=\!\!O:$ bent

17. Which pair is isoelectronic (having the same number of electrons)?
    a. Na^{1+}, K^{1+} b. Cl^{1-},F^{1-} c. Ca^{2+},Mg^{2+} d. Al^{3+}, Ne e. P^{1-}, Ca^{1+}

a molecule with an odd number of electrons - a radical

Key

18. All of the following have noble gas electronic configurations except:
a. Cl^{1-} b. N^{3-} c. Mg^{2+} d. P^{3+} e. Ar

* 19. Which name is associated with the rule that states no two electrons can have the same exact set of quantum numbers?
a. Pauli b. Hund c. Heisenberg d. Rutherforde. Aufbau

20. As the frequency of electromagnetic radiation increases its energy:
a. increases b. decreases c. remains constant d. fluctuates

* We didn't talk much about the people.

Part Two: Short Answer (24 points)
Write your answer in the space provided

1. Explain the difference between ionization energy and electron affinity.
Ionization energy is the energy required to completely remove an electron from a neutral gaseous atom. Electron affinity is the energy released or required to add an electron to a neutral gaseous ion.

2. What are the four quantum numbers and what does each represent?
n = size m_l = orientation
l = shape m_s = electron spin

3. What does VSEPR mean – briefly state this theory.
Valence Shell Electron Pair Repulsion Theory - Electron pairs will maximize the distance between them in 3-D space.

4. Consider the molecules PF_5 and NF_5. One is stable and one is not. Which one is which and why?
Nitrogen cannot form five bonds because it cannot expand its valence beyond 8 electrons. PF_5 is stable; NF_5 does not exist.

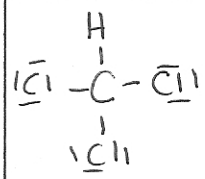
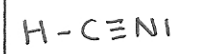
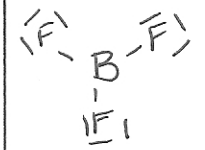
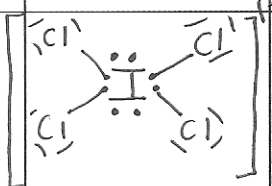
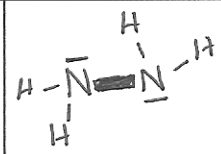
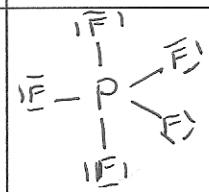
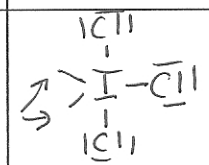
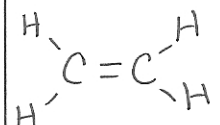
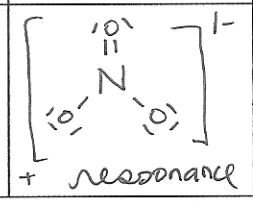
5. Consider the molecules C_2H_4 and Si_2H_4. One is stable and one is not. Which one is which and why?
Silicon is too large to effectively overlap p-orbitals. Silicon does NOT form double or triple bonds. C_2H_4 is stable; Si_2H_4 does not exist.

6. What causes line spectra?
When an electron absorbs a photon it will move from one quantum level to another. This creates absorption spectra. When an atom's ~~absorbs~~ electron moves to a lower energy level it emits a photon. This causes a "line" to be produced in a spectra.

Key

Part Three: Molecular Structure (36 points)

For each central atom in each molecule – fill in the requested information:

Molecule	Lewis Dot Structure	Arrangement of Pairs	Shape ~~(Molecular Geometry)~~	Polar (P) or Non-Polar (N)
$CHCl_3$		Tetrahedral	Tetrahedral	P
HCN		Linear	Linear	P
BF_3		Trigonal Planar	Trigonal Planar	N
ICl_4^{1-}		Octahedral	Square Planar	P All ions are polar.
N_2H_4		Tetrahedral around each nitrogen	Trigonal Pyramidal for each nitrogen	P (not very polar)
PF_5		Trigonal Bipyramidal	Trigonal Bipyramidal	N
ICl_3 lone pairs		Trigonal Bipyramidal	T-shape	P
C_2H_4		Trigonal Planar for each carbon	Trigonal Planar for each carbon	N
NO_3^{1-}	 + resonance structures	Trigonal Planar	Trigonal Planar	~~P~~ all ions are polar