Name: KEY

Chemistry 121
Spring 2009
Test 3, Form A

Instructions: You have 75 minutes to complete this 100-point exam. You may NOT use a calculator. For any calculations, set them up and solve for the unknown.

I. Fill-in the blank (10 pts, 2 points each)

1. Einstein/Planck defined photons as packets of energy with specific frequency.
2. A(n) atomic spectrum is defined by discrete frequencies that have been emitted by excited atoms.
3. Hund's Rule states that the most stable configuration of electrons is that with the highest number of unpaired electrons.
4. Atoms tend to lose or gain electrons until they have achieved an octet.
5. Effective nuclear charge for a valence electron is affected by core electrons that screen the nucleus.

II. Short Answer and Calculations: Clearly indicate your answer in the space provided and show all work. Partial credit will be given for correct work. If I cannot read the work, it will not be graded.

1. (5 pts) Write all sets of possible quantum numbers for n = 6.

n	l	ml	ms
6	5	-5,-4,-3,-2,-1,0,1,2,3,4,5	±1/2
	4	-4,-3,-2,-1,0,1,2,3,4	±1/2
	3	-3,-2,-1,0,1,2,3	±1/2
	2	-2,-1,0,1,2	±1/2
	1	-1,0,1	±1/2
	0	0	±1/2

2. (15 pts) Write the **full or Noble gas** electron configuration (as indicated) for the following atoms and ions, indicate the number of valence electrons (VE) and determine if they are paramagnetic (P) or diamagnetic (D).

				VE	Circle
a.	**Noble**	Sb	$[Kr]\,5s^2 4d^{10} 5p^3$	5	(P) or D
b.	**Full**	Cu	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$	1	(P) or D
c.	**Noble**	P^{3-}	$[Ne]\,3s^2 3p^6$	8	P or (D)
d.	**Full**	Cr^{2+}	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$	12	(P) or D
e.	**Noble**	Ba	$[Xe]\,6s^2$	2	P or (D)

3. (10 pts) Blue-Ray DVD players operate at a frequency of $7.41 \times 10^{14}\ s^{-1}$.
   a. Set-up and solve for the wavelength (in nm).

$$\lambda \nu = c$$

$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \frac{m}{s}}{7.41 \times 10^{14} s^{-1}} \times \frac{10^{9} nm}{1 m}$$

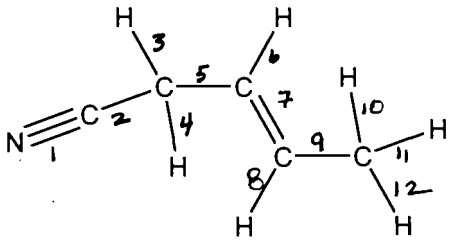
   b. Set-up and solve for the energy of a mole of photons of this light.

$$E_{N_A} = N_A \cdot h \cdot \nu$$
$$= 6.02 \times 10^{23} \cdot 6.626 \times 10^{-34} J \cdot s \cdot 7.41 \times 10^{14} s^{-1}$$

4. (5 pts) Rank the following in order of smallest atomic size to largest: O, S, P, Ge, and F.

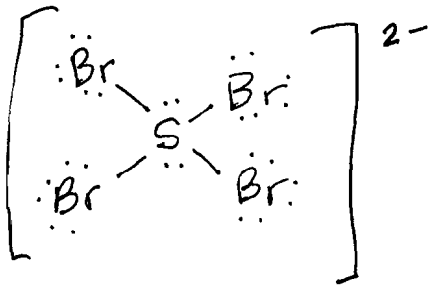
$$F < O < S < P < Ge$$

5. (3 pts) Circle the atom with the highest electronegativity in each pair:
   a. C – (F)
   b. Ge – (P)
   c. (O) – C
6. (2 pts) The molecule below has 12 sigma bonds and 3 pi bonds.



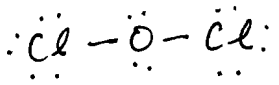
7. (40 pts) For each of the following molecules or ions: draw the correct Lewis Dot Structure, give the BD and NBD, determine the molecular geometry, give the hybridization of the central atom and determine if the molecule is polar or nonpolar. **Include all resonance structures.**

SBr_4^{2-} $6+(4\cdot7)+2=36$



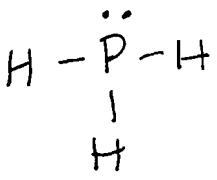
BD: 4
NBD: 2
Molecular Geometry: square planar
Hybridization: sp^3d^2
Polarity: nonpolar

OCl_2 $6+(2\cdot7)=20$



BD: 2
NBD: 2
Molecular Geometry: bent
Hybridization: sp^3
Polarity: polar

PH_3 $5+(3\cdot1)=8$



BD: 3
NBD: 1
Molecular Geometry: trigonal pyramidal
Hybridization: sp^3
Polarity: polar

SeO_2 $6+(2\cdot6)=18$

BD: 2
NBD: 1
Molecular Geometry: bent
Hybridization: sp^2
Polarity: polar

8. (10 pts) Indicate whether or not the following quantum numbers or orbitals can exist using Y for yes and N for no. For those that **cannot exist, explain why**.

	Circle	If no, then explain why.
a. 10s	(Y) or N	
b. 2d	Y or (N)	$n=2, l=2$ $n \neq l$
c. $n = 2, l = 3$ $m_l = 0, m_s = ½$	Y or (N)	$n=2, l=3$ $n \neq l$
d. 4f	(Y) or N	
e. $n=7, l=6, m_l = -3, m_s = 1$	Y or (N)	$m_s \neq 1$, must $= \pm 1/2$

III. Essay: (10 pts) In 4 – 6 grammatically correct sentences, answer **ONE (and only one)** of the following questions. If you answer both questions, I will only grade the first one that you answer.

a. Explain the difference between a sigma and a pi bond.
b. What does the Schrodinger equation describe and how do the quantum numbers relate to it?

See lecture notes