Name: KEY

Chem 121, Fall 2009
Test 3B

Multiple Choice (48 pts): Clearly indicate the correct answer in the space provided.

A 1. The notation for the subshell with $n = 4$ and $l = 2$ is
   (A) 4d subshell.
   B) 4p subshell.
   C) 4f subshell.
   D) 4s subshell.
   E) There is no subshell fitting this description.

l	
0	s
1	p
2	d
3	f

C 2. Given the following sets of quantum numbers for *n, l, m_l, and m_s*, which one of these sets is not possible for an electron in an atom?
   A) $n = 4, l = 2, m_l = 2, m_s = -½$
   B) $n = 3, l = 1, m_l = -1, m_s = -½$
   C) $n = 4, l = 3, m_l = 4, m_s = -½$
   D) $n = 4, l = 3, m_l = -2, m_s = -½$
   E) $n = 5, l = 2, m_l = 2, m_s = -½$

A 3. The requirement that the ground state configuration of an atom is generated by filling electrons into orbitals from the lowest energy to the highest energy observing the maximum number allowed for each of these levels is
   A) the aufbau principle.
   B) Bustamente's principle.
   C) Hund's Rule.
   D) Murphy's rule.
   E) the pauli Principle.

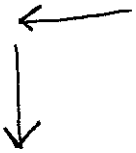
B 4. A correct description for the electron configuration of a vanadium atom is
   A) [Ar] $4s^1\ 3d^4$, paramagnetic.
   B) [Ar] $4s^2\ 3d^3$, paramagnetic.
   C) [Ar] $4s^3\ 3d^2$, paramagnetic.
   D) [Ar] $3d^5$, paramagnetic.
   E) [Ar] $3s^2\ 3d^3$, paramagnetic.

B 5. Which of the following choices is the correct electron configuration for a oxygen atom?

		2s	2p		
A)	[He]	↑↓	↑	↑	↑
B)	[He]	↑↓	↑↓	↑	↑
C)	[He]	↑	↑↓	↑↓	↑
D)	[He]	↑↓	↑↓	↑↓	
E)	[He]		↑↓	↑↓	↑↓

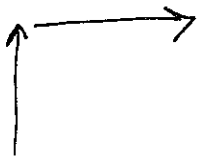
B 6. Which atom has the largest radius?

A) Ca
B) Ba
C) Al
D) Mg
E) C



A 7. Which atom has the smallest first ionization energy?

A) Rb
B) Na
C) Al
D) Ne
E) O



D 8. What is the correct electron configuration for Cr^{+2}?

A) $1s^2 2s^2 3s^2 3p^6 4s^2 3d^4$
B) $1s^2 2s^2 3s^2 3p^6 4s^2 3d^2$
C) $1s^2 2s^2 3s^2 3p^6 4s^1 3d^5$
D) $1s^2 2s^2 3s^2 3p^6 3d^4$
E) None of these

A 9. Cr^{2+} is _____ magnetic and has _____ valence electron(s).

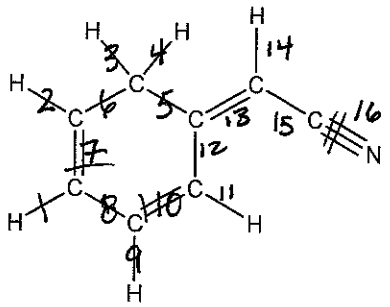
A) para, 12
B) para, 4
C) dia, 6
D) dia, 12
E) dia, 4

B 10. A sp^2 hybrid orbital is a mixture of

A) one s orbital and one p orbital.
B) one s orbital and two p orbitals.
C) two s orbitals and one p orbital.
D) three s orbitals and one p orbital.
E) one s orbital and three p orbitals.

B 11. There are ____ pi bonds and _____ sigma bonds in this molecule.

A) 16, 5
B) 5, 16
C) 4, 16
D) 16, 4
E) None of these



C 12. Molecules with the same number of atoms and valence electrons are called
A) resonant.
B) resonance structures.
C) isoelectronic.
D) contributing structures.
E) isomolecular.

Calculations: Clearly show all work for full credit.

1. (4 pts) Calculate the frequency of visible light having a wavelength of 589.3 nm

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \frac{m}{s}}{589.3 nm} \times \frac{10^{9} nm}{1 m} = 5.091 \times 10^{14} s^{-1}$$

2. (8 pts) What is the energy, in joules, of one mole of photons of the visible light with a wavelength of 589.3 nm? (Hint: see problem above)

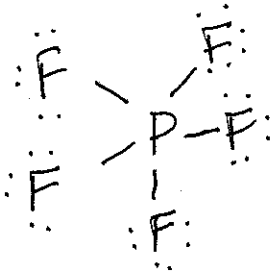
$$E_{mol} = N_A \cdot h \cdot \nu$$

$$= 6.02 \times 10^{23} \cdot 6.626 \times 10^{-34} J \cdot s \cdot 5.091 \times 10^{14} s^{-1}$$

$$= 2.031 \times 10^{5} J$$

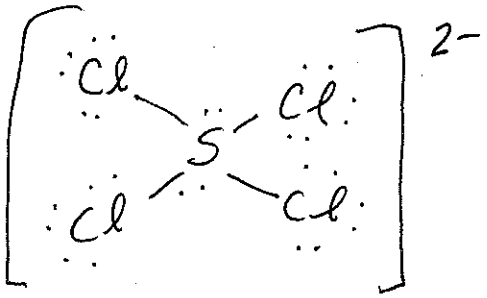
III. Molecules and Molecular Geometry: (40 pts) For each of the following molecules or ions: draw the correct Lewis Dot Structure, give the BD and NBD, determine the molecular geometry, give the hybridization of the central atom and determine if the molecule is polar or nonpolar. **Include all resonance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

PF_5 $5+(5\cdot7)=40$



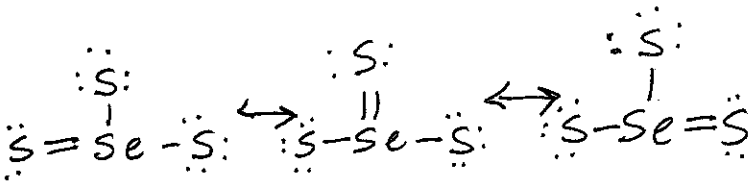
BD: 5
NBD: 0
Molecular Geometry: trig. bipyramidal
Hybridization: sp^3d
Polarity: nonpolar

SCl_4^{2-} $6+(4\cdot7)+2=36$



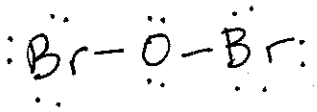
BD: 4
NBD: 2
Molecular Geometry: square planar
Hybridization: sp^3d^2
Polarity: nonpolar

SeS_3 $6+(3\cdot6)=24$



BD: 3
NBD: 0
Molecular Geometry: trig. planar
Hybridization: sp^2
Polarity: nonpolar

OBr_2 $6+(2\cdot7)=20$



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