Name: KEY

Chemistry 121
Fall 2006
Test 3

Instructions: You have 50 minutes to complete this 100-point exam. You may use a simple scientific calculator. No programmable calculators allowed.

I. Multiple Choice (10 pts) Carefully and clearly circle the best answer.

1. Which of the following atoms is diamagnetic?
   a. Si
   b. S
   (c) Mg
   d. Ti

2. Cobalt has _____ valence electrons.
   a. 2
   b. 7
   (c) 9
   d. 27

3. Which of the following sets of quantum numbers cannot exist according to quantum theory?
   a. $n = 8, l = 2, m_l = 0, m_s = ½$
   b. $n = 4, l = 3, m_l = -3, m_s = -½$
   (c) $n = 3, l = 4, m_l = 3, m_s = ½$
   d. $n = 2, l = 0, m_l = 0, m_s = ½$

4. Which of the following is correctly ranked from smallest atom to largest atom?
   a. Si<O<N
   b. Si<N<O
   (c) O<N<Si
   d. N<O<Si

5. What rule states that the most stable electron configuration is that with the highest number of unpaired electrons?
   a. Pauli Exclusion
   b. Aufbau
   (c) Hund's
   d. None of these.

II. Calculations and Molecules: Show all work. Partial credit will be given for correct work. If I cannot read the work, it will not be graded.

6. (15 pts) Ultraviolet light in the range of 200. nm – 290. nm is termed UV-C. This radiation is extremely high in energy and can be very damaging to human skin. Luckily, it is filtered out of our atmosphere by the ozone layer. What is range of frequencies for this radiation? (Hint: calculate the frequency that corresponds with each end of the above range)

$$\nu_{200.} = \frac{c}{\lambda} = \frac{3.00\times10^{8}\,\frac{m}{s}}{200.\,nm} \times \frac{10^{9}\,nm}{m} = 1.50\times10^{15}\,s^{-1}$$

$$\nu_{290.} = \frac{c}{\lambda} = \frac{3.00\times10^{8}\,\frac{m}{s}}{290.\,nm} \times \frac{10^{9}\,nm}{1\,m} = 1.03\times10^{15}\,s^{-1}$$

$$1.03\times10^{15}\,Hz - 1.50\times10^{15}\,Hz$$

7. (5 pts) If n = 5, list all valid sets of quantum numbers.

n	l	m_l	m_s
5	4	-4, -3, -2, -1, 0, 1, 2, 3, 4	$\pm 1/2$
	3	-3, -2, -1, 0, 1, 2, 3	$\pm 1/2$
	2	-2, -1, 0, 1, 2	$\pm 1/2$
	1	-1, 0, 1	$\pm 1/2$
	0	0	$\pm 1/2$

8. (15 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**.

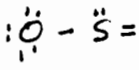
	Circle	If no, then explain why.
a. 3d	(Y) or N	
b. $n = 3, l=2, m_l = 2, m_s = ½$	(Y) or N	
c. $n = 2, l=2, m_l = 0, m_s = ½$	Y or (N)	$l \neq n$
d. 1p	Y or (N)	$l=1, n=1, l \neq n$
e. 9f	(Y) or N	

9. (15 pts) Write the **NOBLE GAS** electron configuration for the following atoms and ions, indicate the number of valence electrons (VE) and determine if they are paramagnetic (P) or diamagnetic (D).

	Noble Gas Electron Configuration	VE	Circle
a. Br^{1-}	$[Ar]4s^2 3d^{10} 4p^6$	8	P or (D)
b. Cr	$[Ar]4s^1 3d^5$	6	(P) or D
c. Ni	$[Ar]4s^2 3d^8$	10	(P) or D
d. Sr^{2+}	$[Kr]$	8	P or (D)
e. P	$[Ne]3s^2 3p^3$	5	(P) or D

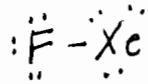
10. (40 pts) For each of the following molecules or ions: **(i)** Draw the correct Lewis Dot Structure, **(ii)** Give the AXE notation, **(iii)** Determine the molecular geometry, **(iv)** Give hybridization of the central atom, and **(v)** Indicate if each molecule is polar or nonpolar.

a. SO_2 $6+2(6)=18$



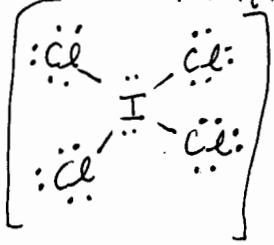
AX_2E
Bent
sp^2
polar

c. XeF_2 $8+2(7)=22$



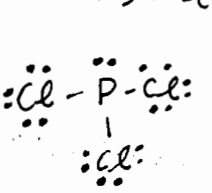
AX_2E_3
linear
sp^3d
nonpolar

b. ICl_4^{-1} $7+4(7)+1=36$



AX_4E_2
square planar
sp^3d^2
nonpolar

d. PCl_3 $5+3(7)=26$



AX_3E
trigonal pyramidal
sp^3
polar

III. (10pts) Essay Question: Explain the trend of ionization energy in relation to the periodic table and describe how the trend is caused by effective nuclear charge.

See lecture notes