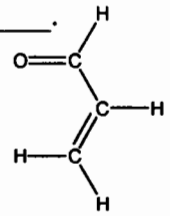
Name: KEY

Chem 121
Test 3
Version A

You have 50 minutes to complete this 100 point test. Show all work for full credit. You may use a non-graphing, scientific calculator.

1. (10 pts) Fill in the blank:
   a. NO_2^+ and SCN^{1-} are isoelectronic because they have the same number of valence electrons.
   b. Effective nuclear charge is the pull towards the nucleus that particular electron experiences in a multi-electron atom. (hint: three words)
   c. Electronegativity helps us to determine what atom carries the partial negative charge in a polar bond.
   d. The energy and frequency of a photon are directly related to one another.
   e. The entire d-set of orbitals can hold 10 total electrons and the entire f-set of orbitals can hold 14 total electrons. But, each single orbital can only hold two electrons, according to the Pauli Exclusion Principle. (hint: three words)
   f. There are seven σ bonds and two π bonds in the molecule in the right margin.



2. (15 pts) Give the full electron configurations (NOT the Noble Gas) for the following atoms/ions. Indicate the number of valence electrons and determine if the atom/ion is diamagnetic or paramagnetic.

	Electron Configuration	# VE	D or P
Fe^{2+}	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$	14	P
Se	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$	6	P
Cl^{1-}	$1s^2 2s^2 2p^6 3s^2 3p^6$	8	D
Sr	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2$	2	D
Cu	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$	1	P

3. (4 pts) Circle the atom with the largest ionization energy.
   a. Ge or (S)
   b. Al or (P)

4. (6 pts) Circle the atom/ion with the largest atomic/ionic radii.
   a. (Se) or P
   b. Br or (Br^{1-})
   c. (Si) or O

5. (15 pts) The campus radio station operates at a frequency of 88.1 MHz.
   a. Calculate the wavelength of light (in m) that corresponds to the campus radio station. (1 MHz = 10^6 Hz)

$\nu \cdot \lambda = c$

$$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \frac{m}{s}}{88.1 MHz} \times \frac{1 MHz}{10^6 Hz} \times \frac{1 Hz}{s^{-1}} = \boxed{3.41 m}$$

   b. Calculate the energy of a mole of photons with this frequency.

$$E = h\nu = (6.626 \times 10^{-34} J \cdot s)(88.1 MHz)\left(\frac{10^6 Hz}{1 MHz}\right)\left(\frac{s^{-1}}{1 Hz}\right)$$
$$= 5.84 \times 10^{-26} J/photon$$

$$E_{mol} = N_A \cdot E = \frac{6.02 \times 10^{23} photons}{1 mol} \times \frac{5.84 \times 10^{-26} J}{photon}$$

$$= \boxed{0.0352 J/mol}$$

6. (10 pts) Using 4 – 6 grammatically correct sentences, explain how screening occurs in atoms and how this influences atomic size.

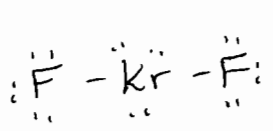
See lecture notes

7. (10 pts) Write all the possible valid sets of quantum numbers for n = 5.

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	$\pm 1/2$

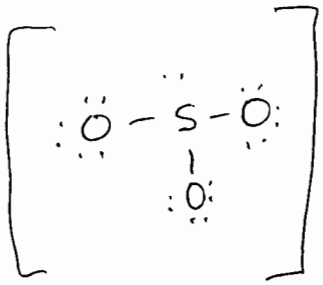
8. (40 pts) Draw the Lewis Dot Structures for the following molecules/ions. For each structure, give the following: (i) AXE Notation, (ii) molecular geometry, (iii) polar/nonpolar, and (iv) hybridization.

a. KrF_2 $8 + (2 \cdot 7) = 22$



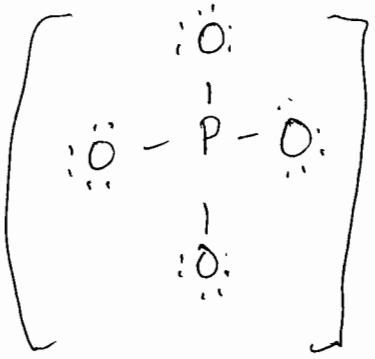
AX_2E_3
linear
nonpolar
sp^3d

c. SO_3^{2-} $6 + (3 \cdot 6) + 2 = 26$



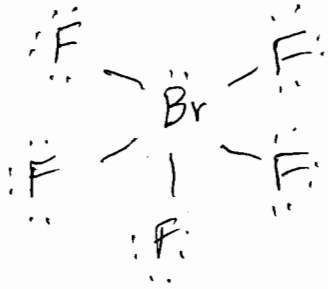
AX_3E
trigonal pyramidal
polar
sp^3

b. PO_4^{3-} $5 + (4 \cdot 6) + 3 = 32$



AX_4
tetrahedral
nonpolar
sp^3

d. BrF_5 $7 + (5 \cdot 7) = 42$



AX_5E
square pyramidal
polar
sp^3d^2