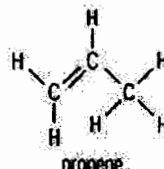


Chemistry 121
Test 3
Spring 2007

You have 75 minutes to complete this 100 point test. Please mark each answer clearly and show all work. You may use a simple scientific calculator. NO GAPHING CALCULATORS.

I. Fill in the blank

- (1 pt) Photons are small packets of energy that have specific frequency.
- (1 pt) Quantum numbers are solutions to the Schrödinger equation and describe the delocalization of electrons in an atom.
- (1 pt) The octet rule is the expectation that atoms tend to lose or gain electrons until they achieve a noble gas-type configuration.
- (1 pt) Pauli Exclusion Principle states that no two electrons can have the same set of four quantum numbers.
- (1 pt) In a covalent bond, electrons are shared between two atoms.
- (2 pts) There are eight σ bonds and one π bond in propene.


- (2 pts) A sp^3d hybrid orbital is formed from a combination of one s orbital, 3 p orbital(s) and one d orbital(s).
- (1 pt) The Heisenberg Uncertainty Principle states that the "the more accurately we know position, the more uncertain we are about motion, and vice versa".

II. Trends and Calculations: Clearly show all work for full credit.

- (10 pts) Calculate the energy of a mole of photons of light that have a wavelength of 488 nm.

$$E = h\nu \quad \nu \cdot \lambda = c$$

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(3.00 \times 10^8 \frac{\text{m}}{\text{s}})}{488 \text{ nm}} \times \frac{10^9 \text{ nm}}{1 \text{ m}} = 4.07 \times 10^{-19} \text{ J/photon}$$

$$E_{\text{mol}} = E_{\text{photon}} \cdot N_A = (4.07 \times 10^{-19} \text{ J/photon}) (6.02 \times 10^{23} \text{ photons/mol})$$

$$= \boxed{2.45 \times 10^5 \text{ J/mol}}$$

$$E \propto \frac{1}{\lambda}$$

2. (10 pts) Rank the following wavelengths in order from lowest energy to highest energy: 500 nm , 190 nm , 250 mm and $320 \mu\text{m}$. (Hint: For comparison, units should be the same.)
- $\times 10^{-9}$
- $\times 10^{-4}$ $\times 10^{-3}$ $\times 10^{-6}$

$$250 \text{ mm} < 320 \mu\text{m} < 500 \text{ nm} < 190 \text{ nm}$$

3. (10 pts) Rank the following atoms from smallest to largest atomic radii: P, As, Cl, O, and C.

$$O < C < Cl < P < As$$

III. Quantum Numbers, Electron Configurations and Lewis Dot Structures:

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

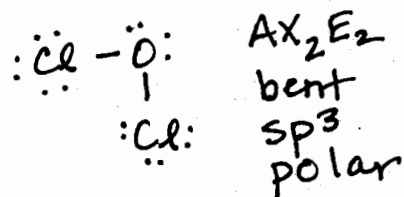
$\frac{n}{l}$	l	m_l	m_s
	5	-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5	$\pm 1/2$
	4	-4, -3, -2, -1, 0, 1, 2, 3, 4	$\pm 1/2$
	3	-3, -2, -1, 0, 1, 2, 3	$\pm 1/2$
	2	-2, -1, 0, 1, 2	$\pm 1/2$
	1	-1, 0, 1	$\pm 1/2$
	0	0	$\pm 1/2$

2. (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).

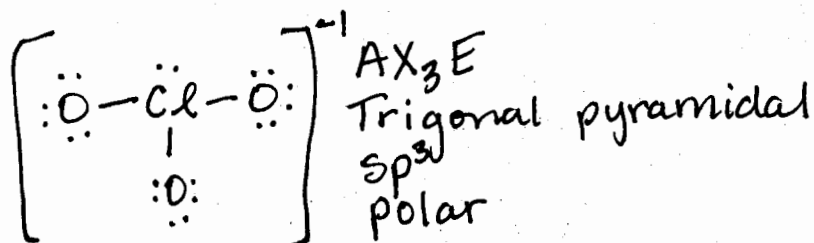
		VE	Circle
a.	Te^{2-} <u>$[\text{Kr}] 5s^2 4d^{10} 5p^6$</u>	<u>8</u>	P or <input checked="" type="radio"/> D
b.	As <u>$[\text{Ar}] 4s^2 3d^{10} 4p^3$</u>	<u>5</u>	<input checked="" type="radio"/> P or D
c.	Mo <u>$[\text{Kr}] 5s^2 4d^4$</u>	<u>6</u>	<input checked="" type="radio"/> P or D
d.	Ti^{2+} <u>$[\text{Ar}] 3d^2$</u>	<u>10</u>	<input checked="" type="radio"/> P or D
e.	Cu <u>$[\text{Ar}] 4s^1 3d^{10}$</u>	<u>1</u>	<input checked="" type="radio"/> P or D

3. (40 pts) For each of the following: (i) Draw the correct Lewis Dot Structure, including all resonance structures, (ii) Give the AXE notation, (iii) Determine the molecular geometry, (iv) Give the hybridization of the central atom, and (v) Indicate if each molecule/ion is polar or nonpolar.

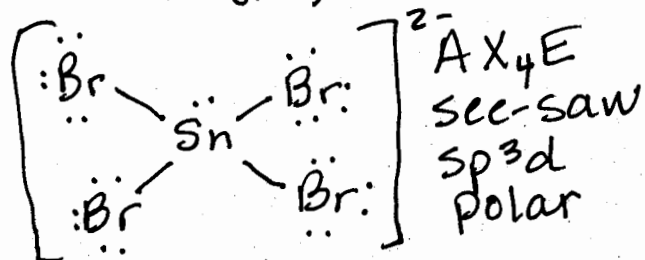
a. OCl_2 $6 + (2 \cdot 7) = 20$



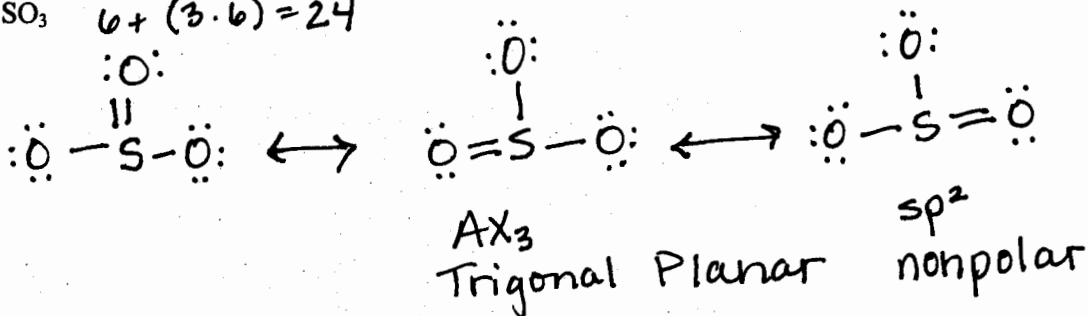
b. ClO_3^- $7 + (3 \cdot 6) + 1 = 26$



c. SnBr_4^{2-} $4 + (4 \cdot 7) + 2 = 34$



d. SO_3 $6 + (3 \cdot 6) = 24$



IV. Essay Question: (10 pts) Explain screening in atoms and explain how it affects effective nuclear charge.

See Lecture notes