

KEY

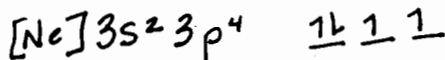
Chemistry 121
Fall 2005
Test 3 FORM A

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. How many unpaired electrons are there in the ground state of sulfur?

- a. 6
b. 4
c. 2
d. 0



2. Which set of atoms below is arranged in order of decreasing ionization energy?

- a. F, P, Se, Ge
b. Ge, Se, P, F
c. F, Se, P, Ge
d. Ge, P, Se, F

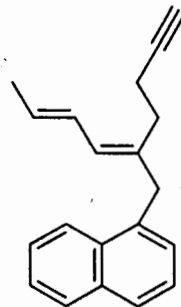


3. What molecule below is isoelectronic with carbonate, CO_3^{2-} ? $4 + 3(6) + 2 = 24$

- a. NO_3^- $5 + 3(6) + 1 = 24$
b. OCl_3^-
c. SO_3^{2-}
d. SO_2

4. How many pi-bonds are in the molecule on the right?

- a. 6
b. 7
c. 8
d. 9



5. Which of the following is not a valid set of quantum numbers?

- a. $n=5, l=3, m_l=-2, m_s=1/2$
b. $n=4, l=3, m_l=-4, m_s=1/2$
c. $n=7, l=2, m_l=-2, m_s=1/2$
d. $n=8, l=3, m_l=-2, m_s=1/2$

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) The yellow light emitted from a firefly (lightening bug) is the result of a reaction between luciferin, ATP and oxygen. It has a wavelength of 510. nm.

a. What is the frequency of this light? $\lambda \cdot \nu = c$

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \frac{m}{s}}{510. \text{ nm}} \times \frac{10^9 \text{ nm}}{1 \text{ m}} = 5.88 \times 10^{14} \text{ s}^{-1}$$

b. What is the energy of a mole of photons of this light?

$$E = h\nu = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(5.88 \times 10^{14} \text{ s}^{-1}) \\ = (3.90 \times 10^{-19} \text{ J/photon}) \left(\frac{6.02 \times 10^{23} \text{ photons}}{1 \text{ mol}} \right) \\ = 2.35 \times 10^5 \text{ J/mol}$$

7. (5 pts) If $n=4$, list all valid sets of quantum numbers.

n	l	m_l	m_s
4	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	$\pm 1/2$

Form A - KEY

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.

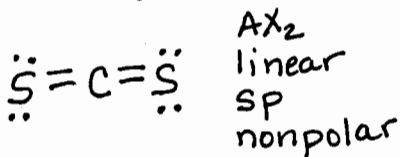
	Circle	If no, then explain why.
a. 9d	<input checked="" type="radio"/> Y or <input type="radio"/> N	
b. $n = 3, l = 2, m_l = 3, m_s = 1/2$	Y or <input checked="" type="radio"/> N	$m_l \neq l$
c. $n = 2, l = 2, m_l = 0, m_s = 1/2$	Y or <input checked="" type="radio"/> N	$l \neq n$
d. 3f $n = 3, l = 3$	Y or <input checked="" type="radio"/> N	$l \neq n$
e. $n = 7, l = 5, m_l = 0, m_s = -1$	Y or <input checked="" type="radio"/> N	$m_s = \pm 1/2$ not -1

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).

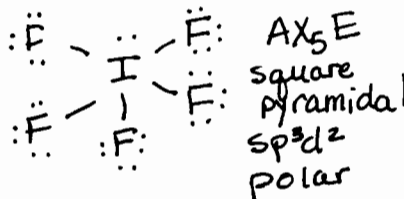
	Noble Gas Electron Configuration	VE	Circle
a. Se^{2-}	<u>$[Ar] 4s^2 3d^{10} 4p^6$</u>	<u>8</u>	P or <input checked="" type="radio"/> D
b. Ti	<u>$[Ar] 4s^2 3d^2$</u>	<u>4</u>	<input checked="" type="radio"/> P or D
c. Pd	<u>$[Kr] 5s^2 4d^8$</u>	<u>10</u>	<input checked="" type="radio"/> P or D
d. Cl	<u>$[Ne] 3s^2 3p^5$</u>	<u>7</u>	<input checked="" type="radio"/> P or D
e. Cu	<u>$[Ar] 4s^1 3d^{10}$</u>	<u>1</u>	<input checked="" type="radio"/> 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 it is polar or nonpolar.

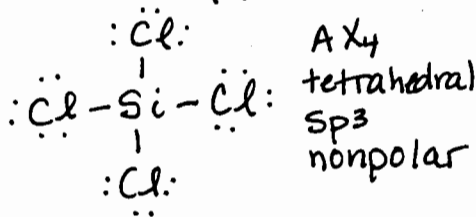
a. CS_2 $4 + 2(6) = 16$



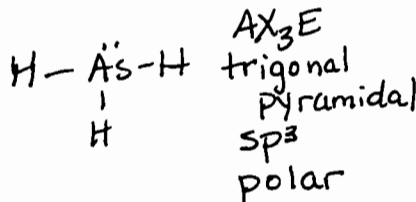
c. IF_5 $7 + 5(7) = 42$



b. $SiCl_4$ $4 + 4(7) = 32$



d. AsH_3 $5 + 3(1) = 8$



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

See lecture notes.