

Name: KEY

Chem 121, Fall 2009
Test 3A

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

C 1. The notation for the subshell with $n = 5$ and $l = 3$ is

- A) 5d subshell.
- B) 5p subshell.
- C) 5f subshell.
- D) 5g subshell.
- E) 5s subshell.

$$\begin{array}{c} l \\ 0 \\ 1 \\ 2 \\ 3 \end{array} \quad \begin{array}{c} s \\ p \\ d \\ f \end{array}$$

E 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) $n = 3, l = 2, m_l = 2, m_s = -1/2$
- B) $n = 3, l = 1, m_l = -1, m_s = -1/2$
- C) $n = 4, l = 3, m_l = 2, m_s = -1/2$
- D) $n = 4, l = 3, m_l = -2, m_s = -1/2$
- E) $n = 5, l = 2, m_l = 3, m_s = -1/2$

D 3. "No two electrons in the same atom can have all their quantum numbers the same."

This statement is based on the work of

- A) de Broglie
- B) Heisenberg
- C) Einstein
- D) Pauli
- E) Schrödinger

E 4. A correct description for the electron configuration of an iron atom is

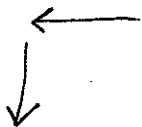
- A) $[\text{Ar}] 3s^2 3d^6$, paramagnetic.
- B) $[\text{Ar}] 4s^2 3d^6$, diamagnetic.
- C) $[\text{Ar}] 4s^1 3d^7$, paramagnetic.
- D) $[\text{Ar}] 3d^8$, paramagnetic.
- E) $[\text{Ar}] 4s^2 3d^6$, paramagnetic.

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

- | | 3s | 3p | | |
|---------|----------------------|----------------------|----------------------|----------------------|
| A) [Ne] | $\uparrow\downarrow$ | \uparrow | \uparrow | \uparrow |
| B) [Ne] | $\uparrow\downarrow$ | $\uparrow\downarrow$ | \uparrow | \uparrow |
| C) [Ne] | \uparrow | $\uparrow\downarrow$ | \uparrow | $\uparrow\downarrow$ |
| D) [Ne] | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow$ | — |
| E) [Ne] | — | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow$ |

E 6. Which atom has the smallest radius?

- A) Ca
- B) Ba
- C) K
- D) Mg
- E) C



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

- A) Al
- B) Sr
- C) Ga
- D) Cr
- E) Fr



C 8. What is the correct electron configuration for Cu^{+2} ?

- A) $1s^2 2s^2 3s^2 3p^6 4s^1 3d^{10}$
- B) $1s^2 2s^2 3s^2 3p^6 4s^2 3d^7$
- C) $1s^2 2s^2 3s^2 3p^6 3d^9$
- D) $1s^2 2s^2 3s^2 3p^6 4s^2 3d^9$
- E) None of these

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

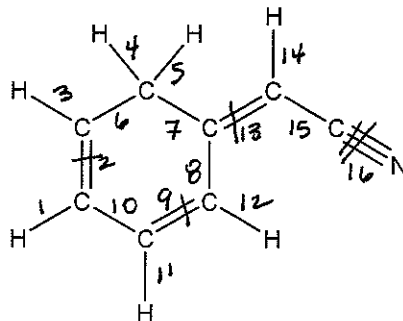
- A) para, 11
- B) para, 1
- C) dia, 8
- D) para, 17
- E) para, 9

E 10. A sp^3 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.

D 11. There are _____ sigma bonds and _____ pi bonds this molecule.

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



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

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

1. (4 pts) Calculate the frequency of visible light having a wavelength of 464.1 nm

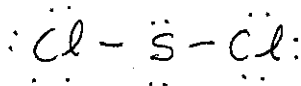
$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \frac{\text{m}}{\text{s}}}{464.1 \text{ nm}} \times \frac{10^9 \text{ nm}}{\text{m}} = 6.464 \times 10^{14} \text{ s}^{-1}$$

2. (8 pts) What is the energy, in joules, of a mole of photons of visible radiation with a wavelength of 464.1 nm? (Hint: see problem above)

$$\begin{aligned} E_{\text{mol}} &= N_A \cdot h \cdot \nu \\ &= (6.02 \times 10^{23}) (6.626 \times 10^{-34} \text{ J} \cdot \text{s}) (6.464 \times 10^{14} \text{ s}^{-1}) \\ &= 2.578 \times 10^5 \text{ J} \end{aligned}$$

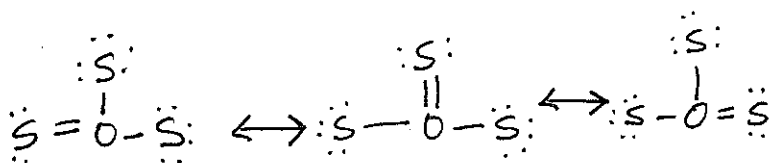
III. Molecules and Molecular Geometry: (40 pts) For each of the following molecules or ions: draw the correct Lewis Dot Structure, give the BD and NBD, determine the molecular geometry, give the hybridization of the central atom and determine if the molecule is polar or nonpolar. **Include all resonance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

$$\text{SCl}_2 \quad 6 + (2 \cdot 7) = 20$$



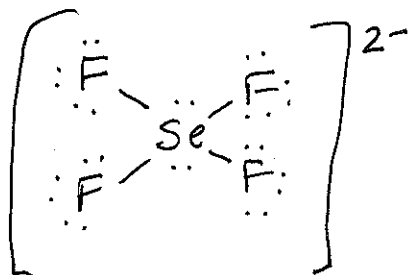
BD: 2
 NBD: 2
 Molecular Geometry: bent
 Hybridization: sp³
 Polarity: polar

$$\text{OS}_3 \quad 6 + (3 \cdot 6) = 24$$



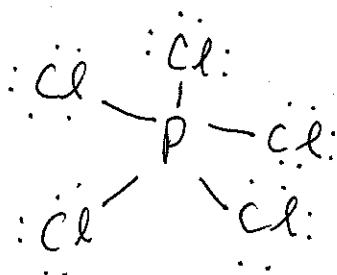
BD: 3
 NBD: 0
 Molecular Geometry: trigonal planar
 Hybridization: sp²
 Polarity: nonpolar

$$\text{SeF}_4^{2-} \quad 6 + (4 \cdot 7) + 2 = 36$$



BD: 4
 NBD: 2
 Molecular Geometry: square planar
 Hybridization: sp³d²
 Polarity: nonpolar

$$\text{PCl}_5 \quad 5 + (5 \cdot 7) = 40$$



BD: 5
 NBD: 0
 Molecular Geometry: trig. bipyramidal
 Hybridization: sp³d
 Polarity: nonpolar