

1. Multiple choice – Write the letter that corresponds to the correct answer in the space provided. Circling the answer will **NOT** count.

c i. A molecule has 5 groups of electrons around the central atom. 3 of the groups are lone pairs. The hybridization of the central atom is:

- a. sp^2 b. sp^3 c. sp^3d d. sp^3d^2

b ii. An atom emits a red (689 nm) photon. A different atom emits a blue (486 nm) photon. The first photon has _____ energy than the second.

- a. more b. less
c. the same d. none of the above

c iii. All tetrahedral molecules are

- a. polar b. non-polar
c. sp^3 hybridized d. sp^2 hybridized

c iv. A molecule has 5 groups of electrons around the central atom. 3 of the groups are lone pairs. The molecular geometry is:

- a. square planar b. tetrahedral
c. linear d. trigonal bipyramidal

c v. All molecules with lone pairs are:

- a. polar b. non-polar
c. can't determine polarity d. none of the above

2. An electron drops from the fifth energy level to the second energy level in a Be^{3+} ion.
 a. Calculate the **wavelength** of the light emitted in nm.

$$\frac{1}{\lambda} = \frac{Z^2 R_H}{hc} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) = \frac{(4)^2 \cdot 2.180 \times 10^{-18} \text{ J}}{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})} \left(\frac{1}{2^2} - \frac{1}{5^2} \right) = 3.687 \times 10^7 \text{ m}^{-1}$$

$$\lambda = \frac{1}{3.687 \times 10^7 \text{ m}^{-1}} = 2.712 \times 10^{-8} \text{ m} \times \frac{1 \text{ nm}}{10^{-9} \text{ m}} = 27.12 \text{ nm}$$

- b. Calculate the **frequency** of the light in Hz.

$$\nu = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m s}^{-1}}{2.712 \times 10^{-8} \text{ m}} \times \frac{1 \text{ Hz}}{1 \text{ s}^{-1}} = 1.105 \times 10^{16} \text{ Hz}$$

3. a. Draw the **molecular orbital energy level diagram** for N_2^{2-} .



- b. Calculate the **bond order**.

$$B.O. = \frac{1}{2}(B - A) = \frac{1}{2}(8 - 4) = 2$$

- c. Is the ion diamagnetic or paramagnetic?

Paramagnetic

4. For each compound shown, write everything you know about it.

a. CO

Covalent – molecule



EPG = MG = linear

Polar

sp^2 hybridization on C & O

2 π bonds, 1 σ bond

Formal charges:

+1 on O

-1 on C

M.O. Energy Level Diagram

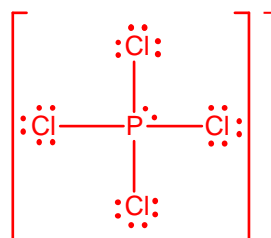


Diamagnetic

Bond Order = 3

b. PCl_4^-

Covalent – ion



EPG = Trigonal Bipyramidal

MG = See-saw

polar

sp^3d hybridization on P

sp^3 hybridization on Cl

4 σ bonds, 0 π bonds

Formal Charges:

-1 on P

0 on each Cl

