

Practice Exam 3

For review on July 24, 2015

PART A (MULTIPLE CHOICE) Circle the correct response to each question:

1. What is the wavelength of a photon of red light (in nm) whose frequency is 4.64×10^{14} Hz?
(A) 646 nm
(B) 1.55×10^6 nm
(C) 155 nm
(D) 464 nm
2. The complete electron configuration for antimony is
(A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^3$
(B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4d^{10} 4p^3$
(C) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6 5s^2 4d^{10} 5d^{10} 5p^3$
(D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^3$
3. Order the elements S, Cl, and F in terms of increasing ionization energy.
(A) S, Cl, F
(B) Cl, F, S
(C) F, S, Cl
(D) F, Cl, S
4. Which of the following has the smallest radius?
(A) F^-
(B) Ne
(C) O^{2-}
(D) Mg^{2+}
5. This molecule shows the smallest number of lone pairs in its Lewis structure.
(A) CH_3CHO
(B) CO_2
(C) CH_3Cl
(D) C_2H_6
6. In the Lewis structure for ICl_2^- , how many lone pairs of electrons are around the central iodine atom?
(A) 0
(B) 1
(C) 2
(D) 3
7. In the cyanide ion (CN^-), the nitrogen has a formal charge of
(A) -2
(B) -1
(C) 0

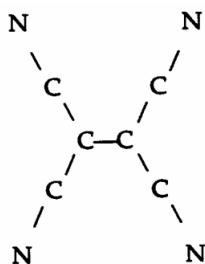
(D) +1
8. The Cl–Kr–Cl bond angle in KrCl₄ is closest to

- (A) 90°
- (B) 109°
- (C) 120°
- (D) 150°

9. The hybridization of the central atom in O₃ is:

- (A) sp
- (B) sp²
- (C) sp³
- (D) dsp³

10. Tetracyanoethylene has the skeleton shown below:



From its Lewis structure determine the following:

- (A) 4 sigma and 5 pi
- (B) 6 sigma and 8 pi
- (C) 9 sigma and 8 pi
- (D) 9 sigma and 9 pi

PART B (SHORT ANSWERS) Please show all of your calculations in the places provided.

1. (a) (5 pts) An electron in the hydrogen atom can drop from the n=3 level to the n=2 level. What is the Energy of this transition? What wavelength of light is emitted?

(b) (5 pts) Given the following sets of quantum numbers, identify the shell and subshell:

(i) [4, 3, 3, ½]

(ii) [3, 2, 0, ½]

2. (a) (5 pts) Write complete ground state electron configurations for the following atomic species:

(i) S^{2-}

(ii) Mo^{2+}

(iii) Rb

(iv) Sb

(v) Ge

(b) (5 pts) Arrange each group of atoms, ions or compounds in the designated order:

(i) increasing radius: Br^- Rb^+ Se^{2-} Te

(ii) Lowest first ionization energy: As Bi Pb Sn

(iii) Number of valence electrons: Sr S Si Cs

(iv) Increasing Electron affinity: O Ge Zr Rb

(v) Increasing Lattice Energy: InAs KBr SrSe

3. (a) (5 pts) Write Lewis dot structure for the following molecules:

(i) NOCl

(ii) XeF_2

(iii) SO_2

(iv) HCN

(v) NH_4^+

(b) (5 pts) Salts containing the fulminate ion, CNO^- , are used in explosive detonators. Draw two resonance forms for fulminate ion and use formal charges to predict which is more stable.

4. (a) (5 pts) Use VSEPR to predict the geometry of the following ion and molecular species:

(i) XeO_3

(ii) AsF_3

(iii) CH_2Cl_2

(iv) IBr_2^+

(v) ClF_2^-

(b) (5 pts) Which of the molecules in part 4(a) would be expected to have a dipole moment? For those molecules, draw the expected direction of the dipole.

5. a. (5 pts) Describe the bonding in formaldehyde (H_2CO) in terms of hybrid atomic orbitals and molecular orbitals.

(b)(5 pts) The C_2 molecule exists in the vapor phase at high temperature. Draw a molecular orbital diagram for C_2 and find the bond order for this molecule.

Equations

$$c = \lambda \times \nu$$

$$E = h\nu$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$\Delta E = -2.179 \times 10^{-18} \text{ J} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

