CHEM-1211
Fall 2013
Second Examination
Form A

Multiple Choice - Choose the BEST Answer

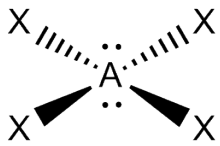
1. Chlorine is much more apt to exist as an anion than is potassium. This is because _____.

A) chlorine is smaller than potassium
B) chlorine has a smaller ionization energy than potassium
C) chlorine is less metallic than potassium
D) chlorine is a gas and potassium is a solid
E) the electron affinity shows that chlorine can accept an e- easier than potassium

2. The second ionization energy, I_2, of an element is always greater than the first ionization energy, I, because _____.

A) after an electron is removed the Z_{eff} for the last e^- decreases causing more energy to remove a 2nd electron.
B) the atom is more stable after one electron is removed requiring more energy to remove the 2nd electron.
C) after an electron is removed the atom is less stable, Z_{eff} decreases, I_2 increases.
D) after an electron is removed the Z_{eff} for the outer most e^- increases requiring more energy to remove a 2nd electron.
E) 2nd ionization energy = 2 x (1st ionization energy) for an atom

3. The following Lewis Structure has the generic formula AX_4E_2. Which of the following groups does element A belong to if it has a formal charge of zero and X belongs to group VIIA?



A) IVA
B) VA
C) VIA
D) VIIA
E) VIIIA

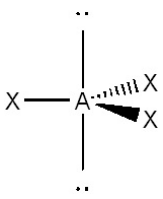
4. How many equivalent Lewis dot resonance structures does the $POCl_3$ molecule have?

A) 1
B) 2
C) 3
D) 4
E) 6

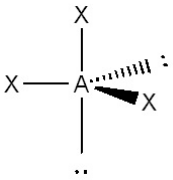
Multiple Choice - Choose the BEST Answer

5. Which of the following images depicts the correct location according to VSEPR of three bonding pairs and two lone pairs of electrons?

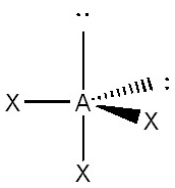
A)



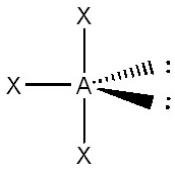
B)



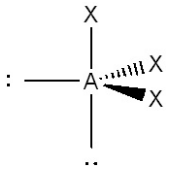
C)



D)



E)



6. If a molecule has the VSEPR type AX_3E_2, as in the previous problem, why would molecular structure you selected in the previous problem be predicted?

A) The repulsion between the bonding pair – bonding pair electrons have the greatest repulsion in the molecule so it is the only repulsion (two at 90° and one at 180°) that needs to be addressed.

B) The repulsion between the lone pair – bonding pair electrons (3 at 90°, 2 at 120° and 1 at 180°) have the greatest repulsion in the molecule.

C) This structure minimizes the lone pair – lone pair repulsion (one at 90°), bonding pair – lone pair repulsions (1 at 90°, 2 and 120°, 1 at 180°), and bonding pair – bonding pair repulsions (2 at 90° and 1 at 120°) in that order.

D) This structure minimizes the lone pair – lone pair repulsion (one at 120°), bonding pair – lone pair repulsions (4 at 90° and 2 at 120°), and bonding pair - bonding pair repulsions (2 at 90° and 1 at 180°) in that order.

E) None of the above

Multiple Choice - Choose the BEST Answer

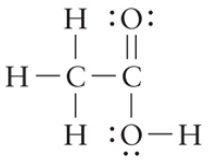
7. What is the hybridization for the central atom in ClO_2^-?

A) sp
B) sp^2
C) sp^3
D) sp^4
E) sp^3d

8. Which of the following bonds has the most ionic character?

A) B–C
B) C–Cl
C) Ga–Cl
D) N–O
E) P–S

9. According to valence bond theory, which orbitals overlap in the formation of the C–O single bond in the molecule below?



A) 2p on C and 2p on O
B) sp^2 on C and sp^3 on O
C) sp^3 on C and sp^3 on O
D) sp on C and sp^3 on O
E) sp^2 on C and 2p on O

10. What is the VSEPR electronic arrangement for H_3O^+?

A) Angular
B) Trigonal planar
C) Trigonal pyramidal
D) T-shaped
E) Tetrahedral

Multiple Choice - Choose the BEST Answer

11. Which of the following statements is true about the molecule $SOCl_2$?

A) The molecule is polar.
B) The molecule's shape is T-shaped.
C) The molecule's shape is tetrahedral.
D) The molecule's electronic arrangement is trigonal bipryamidal.
E) Answers A and B are both correct.

12. When promotion of an electron occurs, an electron is relocated from a full orbital to an empty orbital higher in energy. This promotion of an electron takes energy to occur. With this being the case, why does it occur naturally?

A) The amount of energy needed depends on the size and the charge of the atoms. Promotion only occurs when the atoms are small and the charge is large.
B) More bonds are able to be formed; when they are formed, the overall energy of the molecule is lower than it would have been if it formed fewer bonds.
C) Promotion is necessary in order for hybridization of orbitals to occur.
D) Once promotion occurs, more electrons are able to be shared between two atoms. The more electrons that are shared the stronger the bond.
E) The greater the electronegativity, the easier it is for an electron to have enough energy to be promoted to an orbital higher in energy.

13. An approximate solution to the molecular Schödinger equations can be constructed from linear combinations of atomic orbitals. What are LCAOs?

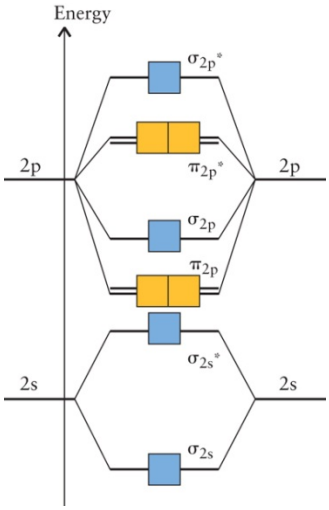
A) sums of atomic wave functions
B) differences of atomic wave functions
C) localization of electrons between two atoms
D) delocalization of electrons over an atom
E) A and B

14. A sigma bond is defined as any bond that _____.

A) is cylindrically symmetric about the internuclear axis
B) has two electrons; the electron reside on opposite sides of the internuclear axis of each other
C) has a single nodal plane containing the internuclear axis
D) shares two electrons
E) has two orbitals overlapping

Multiple Choice - Choose the BEST Answer

15. Using the skeletal MO diagram as a guide, what is the bond order of C_2?



A) 0
B) 0.5
C) 1
D) 1.5
E) 2

16. According to Molecular Orbital Theory, as the number of valence electrons in **bonding** orbital increases,

A) the bond order increases.
B) the length of the bond increases.
C) the strength of the bond decreases.
D) A, B and C are correct.
E) None of the above.

17. In the molecular orbital diagram of OH^-, the σ bonding orbital, was formed from the 1*s* orbital of hydrogen with the $2p_z$ orbital of oxygen. This σ bonding orbital has a greater contribution from which of the following orbitals?

A) 1*s* orbital of Hydrogen
B) $2p_z$ orbital of Oxygen
C) 2*s* orbital of Oxygen
D) 1*s* orbital of Oxygen
E) $2p_z$ orbital of Hydrogen

Multiple Choice - Choose the BEST Answer

18. The following atoms are in order of increasing atomic radii. Which of the following reasons best explains the trend?

$$S < P < Si < Al$$

A) The number of electrons increase which cause more electron-electron repulsion, making the radii larger.
B) The electrons reside in larger energy levels, which are further from the nuclei resulting in larger radii.
C) The number of protons and electrons decrease, and the effective nuclear charge decreases causing the radii to increase.
D) The number of protons increase causing the electrons to separate out further from the protons and results in a larger radii.
E) The atoms are not in the correct order of increasing atomic radii.

19. 6.416 g of methane reacts with 25.60 g oxygen to form carbon dioxide and water vapor (all gases are ideal). After the reaction, all remaining gases are captured in a 10.00 L sealed flask at 423.15 K. What is the partial pressure in atm of the water vapor in the sealed flask?

A) 2.78 atm
B) 1.20 atm
C) 4.17 atm
D) 0.667 atm
E) 2.69 atm

20. A bubble forms at the bottom of a lake. The bubble has a volume of 1.25 μL at the bottom of the lake where the pressure is 3.00 atm. What is the new volume of the bubble when it reaches the surface of the lake and the pressure is now 730 torr? Assume the temperature does not change.

A) 2.40 μL
B) 3.60 μL
C) 2.31 μL
D) 3.90 μL
E) 0.400 μL