Bonding-Topic 14 (AHL)

A 97-16. Which of the following decrease(s) as the number of bonds between two atoms increases?

I. Bond length
II. Bond strength

A. I only B. II only C. Both I and II D. Neither I nor II

A 96-17. How many of the molecules below are polar?

BF_3 CF_4 SF_2

A. Zero B. One C. Two D. Three

A 95-20. When the species below are arranged in order of **increasing** length of the nitrogen-nitrogen bonds, the correct order is

A. $N_2 < H_2NNH_2 < FNNF$
B. $FNNF < H_2NNH_2 < N_2$
C. $H_2NNH_2 < N_2 < FNNF$
D. $N_2 < FNNF < H_2NNH_2$

Questions 14 and 15 refer to the following substances:

A. $MgCl_2$ B. BCl_3 C. CCl_4 D. SCl_2

A 94-14. Which substance contains one or more atoms that do not conform to the octet rule?

A 94-15. Which substance contains polar covalent molecules?

A 95-16. What shape is expected for phosphine, PH_3?

A. Linear B. Planar
C. Pyramidal D. Tetrahedral

A 94-19. The shortest carbon-oxygen bond is found in

A. H_3COH B. H_2CO
C. CO_2 D. CO

A 93-14. When the carbon-carbon bonds in the following compounds are arranged in order of **increasing** length, the correct order is

A. C_2H_6, C_2H_4, C_2H_2
B. C_2H_4, C_2H_2, C_2H_6
C. C_2H_4, C_2H_6, C_2H_2
D. C_2H_2, C_2H_4, C_2H_6

A 93-16. All of the following substances can be represented by Lewis electron-dot structures in which there is an octet of electrons around each atom **except**

A. CO_2 B. NO_2 C. F_2 D. N_2

A 91-15. In how many of the following species do the underlined atoms not have an octet of electrons?

$H\underline{S}^-$ $\underline{C}H_2Cl_2\underline{B}F_3$ $\underline{N}H_4^+$

A. 0 B. 1 C. 2 D. 3

G 93-15. Lewis structures of all of the following species show that the octet rule is only observed with the species

A. PF_5 B. SiF_6^{2-} C. SiF_4 D. ClF_4^-

G 92-16. Identify the shape of the following **ION**: ICl_4^-

A. Octahedral B. Tetrahedral
C. Square planar D. Pyramidal

H 96-12. A molecule of ethyne, C_2H_2, contains

A. 2 σ bonds and 1π bond B. 2 σ bonds and 3π bonds
C. 3 σ bonds and 2π bonds D. 5 σ bonds

H 95-10. Some of the more common oxides of nitrogen which contribute to the problems of smog and air pollution around the world are NO_2, N_2O and N_2O_4. Which of these molecules violate(s) the 'octet rule'?

A. NO_2 only B. N_2O only C. NO_2 and N_2O_4 only D. NO_2, N_2O and N_2O_4

H 94-49. A covalent compound is found to contain only silicon and hydrogen. The most probable formula for the compound is

A. SiH B. SiH_2 C. SiH_3 D. SiH_4

H 93-8. For which of the following species would one usually draw resonance structures?

A. O_2^{2-} B. H_2CO C. CH_3COOH D. CH_3COO^-

H **92-20. Which best represents the Lewis electron-dot structure of the nitrate(III) ion (nitrite ion), NO_2^-?

(See hard copy)

H 92-5. The electronic configuration for element 34 may be represented as: {Ne} $3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^{4.}$ One could use this information and/or the Periodic Table to predict that

A. element 34 would form ions in water solution with a charge of -4.
B. Element 34 is less "metallic" than element 8.
C. One atom of element 34 would combine chemically with 3 atoms of element 12.
D. Element 34 forms compounds in which its "oxidation number: varies from -2 to +6.

H 92-7. From its position in the periodic table, which one of the following statements about element 15 would one expect to be **true**?

A. Its oxide is a better base (proton acceptor) than the oxide of element 11.
B. Its maximum positive oxidation number is less than that of element 11.
C. Its compounds generally have lower melting points than the compounds of element 11.
D. Its compounds generally have bonds with a high degree of ionic character.

H 91-9. Which one of the following diatomic species would you expect to have the longest bond length?

A. NO^- B. N_2 C. O_2^{2-} D. O_2

H 91-10. Atoms of an element X have the electronic configuration $1s^22s^22p^63s^23p^4$. Which one of the following compounds is most likely to be formed with aluminum?

A. AlX B. AlX_2 C. Al_2X_3 D. Al_3X_2

H 90-6. Which of the following statements indicate that the bonding in hydrogen bromide is covalent?

I. Hydrogen bromide is a gas.
II. Aqueous HBr reacts with active metals to produce hydrogen.
III. HBr is not acidic in the absence of water.
IV. Dry HBr is non-conducting.

A. I and II only B. II and III only
C. III and IV only D. I, III, and IV only

H 90-13. What value would n be expected to have in $SbCl_6^{n-}$?

A. -4 B. -2 C. -1 D. +1

H 96-10. Three oxides of nitrogen are NO, NO_2, and N_2O. Which of these molecules contain(s)

an odd number of electrons?

A. NO only B. N_2O only
C. NO and NO_2 only D. NO, NO_2, and N_2O

H 96-13. According to the electron pair repulsion theory, which species is expected to exhibit the **smallest** bond angles, F—E—F, between the fluorine atoms? (E is the other element)

A. BF_3 B. NF_3 C. CF_4 D. C_2F_4

H 96-14. What hybrid orbitals are present in the compound Buta-1,3-diene, $H_2C{=}CH{-}CH{=}CH_2$?

A. sp hybrids only B. sp^2 hybrids only
C. sp and sp^2 only D. sp, sp^2 and sp^3

H 95-11. How many p bonds are present in CO_2?

A. One B. Two C. Three D. Four

H 95-12. The F-B-F bond angle in the BF_3 molecule is most similar to the bond angle in

A. BF_4^- B. C_2F_4 C. CF_4 D. C_2F_6

H**95-13. In which of the following structures do all the carbon atoms lie in one plane?

(See hard copy)

A. I only B. II only C. I and II only D. II and III only

H**94-14. Which compound(s) can be correctly described as containing both sp^2 and sp^3 hybridized carbon atoms?

(See hard copy)

A. I only B. II only C. I and II only D. I and III only

H 94-15. Which one of the following species has the same 3-dimensional structure as SO_3^{2-}?

A. SO_3 B. BF_3 C. NH_3 D. CO_3^{2-}

H 94-16. Which one of the following molecules would be predicted to have a non-zero dipole moment?

A. BF_3 B. NF_3 C. CF_4 D. SF_6

H 93-7. The hybridization of the carbon atom in the carbonate ion, CO_3^{2-}, is best described as

A. sp B. sp^2 C. sp^3 D. sp^3d^2

H 93-9. In the Lewis structure for the molecule ClF_3, the number of lone pairs around the central chlorine atom is

A. 0 B. 1 C. 2 D. 3

H 93-10. In which of the following sets of molecules are all the atoms arranged in a linear fashion?

A. CO_2, HCN, N_2 B. HCCH, XeF_2, O_3 C. H_2S, CO, CO_2 D. H_2O, Cl_2, NO_2

H 91-6. In the Lewis structure for the ion ClF_2^+, the number of lone pairs of electrons around the central atom is

A. 0 B. 1 C. 2 D. 3

H 92-16. Which of the molecules given below has/have a non-zero molecular electric dipole?

HCl	H_2O	NH_3	BF_3	CH_4
I	II	III	IV	V

A. I only B. I and II only C. IV and V only D. I, II, and III only

1. 95/9. Which pair of elements is most likely to form a covalentlybonded compound?
A. Li and F B. P and O C. Ca and O D. Zn and Br
2. 95/10. Some of the more common oxides of nitrogen which contribute to the problems of smog and air pollution around the world are NO_2, N_2O and N_2O_4. Which of these molecules violate(s) the 'octet rule'?
A. NO_2 only B. N_2O only C. NO_2 and N_2O_4 only D. NO_2, N_2O and N_2O_4
3. 94/10. If the formula for a compound of praseodymium is found to be $Pr_3(PO_4)_4$, the formula expected for the oxide of praseodymium is
A. Pr_3O_4 B. Pr_2O_3 C. PrO_2 D. PrO_3
4. 94/11. Which one of the following compounds would be expected to have the greatest ionic character?
A. CsCl B. $MgCl_2$ C. $AlCl_3$ D. HCl
5. 94/12. Which of the following species display **only** covalent bonding? I. $SiCl_4$ II. PCl_5 III. $Ba(CN)_2$ IV. Rb_2CO_3
A. I and II only B. III and IV only C. II and III only D. I and IV only
6. 93/5. Which compound contains both ionic and covalent bonds?
A. Copper(II) chloride, $CuCl_2$ B. Magnesium nitride, Mg_3N_2
C. Dichloromethane, CH_2Cl_2 D. Lithium aluminium hydride, $LiAlH_4$
7. 93/6. Which one of the following terms describes the extent to which a chemically bonded atom attracts electrons?
A. Crystal lattice energy B. Electronegativity
C. Electron affinity D. Bond dissociation energy
8. 93/8. For which of the following species would one usually draw resonance structures?

A. O_2^{2-} B. H_2CO C. CH_3COOH D. CH_3COO^-

9. 98/11. The elements X and Y have 6 and 7 electrons respectively, in the highest main energy levels ;of their atoms. What is the formula and type of bonding used in a compound formed by these elements?

A. XY_2, ionic B. X_2Y, ionic C. X_2Y, covalent D. XY_2, covalent

10. 92/52. Diamond and graphite are two allotropic forms of carbon. Diamond is harder than graphite because in diamond

A. the van der Waals' forces between molecules is greater.
B. the planar covalent bonding between atoms is greater.
C. its structure has double bonds which give great strength to the crystal.
D. there is tetrahedral covalent bonding between atoms.

11. 91/9. Which one of the following diatomic species would you expect to have the longest bond length?

A. NO^- B. N_2 C. O_2^{2-} D. O_2

12. 91/10. Atoms of an element X have the electronic configuration $1s^22s^22p^63s^23p^4$. Which one of the following compounds is most likely to be formed with aluminum?

A. AlX B. AlX_2 C. Al_2X_3 D. Al_3X_2

13. 90/4. The total number of valence electrons in the oxalate ion in potassium oxalate, $K_2C_2O_4$, is

A. 32 B. 34 C. 36 D. 44

14. 90/6. Which of the following statements indicate that the bonding in hydrogen bromide is covalent?

I. Hydrogen bromide is a gas.
II. Aqueous HBr reacts with active metals to produce hydrogen.
III. HBr is not acidic in the absence of water.
IV. Dry HBr is non-conducting.

A. I and II only B. II and III only
C. III and IV only D. I, III, and IV only

15. 90/13. What value would n be expected to have in $SbCl_6^{n-}$?

A. -4 B. -2 C. -1 D. +1

16. 95/11. How many π bonds are present in CO_2?

A. One B. Two C. Three D. Four

17. 95/12. The F-B-F bond angle in the BF_3 molecule is most similar to the bond angle in

A. BF_4^- B. C_2F_4 C. CF_4 D. C_2F_6

18. 94/13. In the Lewis electron-dot structure for hydrazine, N_2H_4, the total number of unshared electron pairs in the molecule is

A. 0 B. 1 C. 2 D. 4

19. 94/16. Which one of the following molecules would be predicted to have a non-zero dipole moment?

A. BF_3 B. NF_3 C. CF_4 D. SF_6

20. 93/7. The hybridization of the carbon atom in the carbonate ion, CO_3^{2-}, is best described as

A. sp B. sp^2 C. sp^3 D. sp^3d^2

21. 93/9. In the Lewis structure for the molecule ClF_3, the number of lone pairs around the central chlorine atom is

A. 0 B. 1 C. 2 D. 3

22. 93/10. In which of the following sets of molecules are all the atoms arranged in a linear fashion?

A. CO_2, HCN, N_2 B. HCCH, XeF_2, O_3 C. H_2S, CO, CO_2 D. H_2O, Cl_2, NO_2

23. 92/59. Which of the following bond-angle descriptions is **INCORRECT**?

A. $C_6H_{13}NH_2$, $< HNH = 120^o$ B. CH_20, $< HCO = 120^o$
C. CH_3Cl, $< HCCl = 109^o$ D. CH_3COOH, $< COH = 109^o$

24. 91/6. In the Lewis structure for the ion ClF_2^+, the number of lone pairs of electrons around the central

atom is

A. 0 B. 1 C. 2 D. 3

25. 91/8. The molecular shape of the CCl_3^- ion is

A. linear B. trigonal planar C. pyramidal D. square planar

26. 90/7. What shape would you predict for the tetrafluoroborate ion?

A. Trigonal pyramidal B. Square pyramidal C. Square Planar D. Tetrahedral

27. 90/9. All of the following species are linear EXCEPT

A. HCCH B. HCN C. NNO D. ONO^-

31. 94/17. The compound which is expected to have the **lowest** boiling point at one atmosphere pressure is

A. $CH_3CH_2CH_2F$ B. $CH_3CH_2CH_2OH$ C. CH_3CH_2COOH D. $CH_3CH_2CH_2NH_2$

32. 94/28. In a solid such as iodine, $I_2(s)$, the intermolecular bonding forces which cause the substance to remain in the solid state are

A. covalent bonds B. ionic bonds. C. metallic bond D. van der Waals' forces.

33. 92/16. Which of the molecules given below has/have a nonzero molecular electric dipole?

HCl H_2O NH_3 BF_3 CH_4

I II III IV V

A. I only B. I and II only C. IV and V only D. I, II, and III only

34. 92/18. Which one of the compounds given below is the **best** example of a network solid?

A. NaCl(s), table salt B. $C_{25}H_{52}(s)$, paraffin wax

C. CaO(s), calcium oxide D. $SiO_2(s)$, quartz

35. 92/19. Which liquid substance has polar molecules, predominantly covalent bonding between atoms of the molecule, and a significant degree of hydrogen bonding between molecules?

A. Liquid hydrogen chloride, HCl(l)

B. Liquid sodium chloride, NaCl(l)

C. Liquid phosphorous(III) chloride, $PCl_3(l)$

D. Liquid hydrogen, $H_2(l)$

53. 94/28. In a solid such as iodine, $I_2(s)$, the intermolecular bonding forces which cause the substance to remain in the solid state are

A. covalent bonds B. ionic bonds C. metallic bond D. van der Waals' forces

54. 93/24. Which one of the following solid substances is best described as a network covalent solid?

A. SiO_2 B. CO_2 C. CsCl D. I_2