**Test from chemistry, section: bonding**
**Year 5, school year 2005/2006**

Written by: Mgr. Silvia Mahmoodová, PhD.

1. Which of the following has the longest bond?
(A) H-F
(B) H-I
(C) H-Cl
(D) H-Br

2. Which of the following is the shortest bond?
(A) H-S
(B) H-O
(C) H-F
(D) H-C

3. Which of the following bonds is the longest?
(A) C-C double bond
(B) C-C triple bond
(C) C-H single bond
(D) C-C single bond

4. Which of the following is the strongest bond?
(A) Mg-O
(B) C-H
(C) Na-Na
(D) H-H

5. Which of the following is the strongest covalent bond?
(A) C-H
(B) C-F
(C) C-N
(D) C-O

6. Which of the following is the weakest ionic bond?
(A) Cs-I
(B) K-I
(C) Li-I
(D) Na-I

7. Which of the following has the smallest bond dipole?
(A) C-H
(B) C-F
(C) C-Si
(D) C-C

8. Which of the following molecules has a net dipole?
(A) NH3
(B) SF6

(C) $CCl_4$
(D) $SiH_4$

9. What is the relationship between bond dipole and bond strength?
(A) Bonds with larger dipoles tend to be weaker than those without dipoles.
(B) Bonds with larger dipoles tend to be stronger than those without dipoles.
(C) There is no relationship.
(D) None of the above

10. What is electronegativity?
(A) The amount of energy released when an electron is added to an atom
(B) The charge on an atom in its preferred oxidation state
(C) The power of an atom to attract electrons to itself
(D) None of the above

11. What type of bond is formed when a highly electronegative element and an electropositive element form a bond?
(A) Nonpolar covalent
(B) Polar covalent
(C) Nonpolar ionic
(D) Ionic

12. Which of the following atoms has the highest electronegativity?
(A) Cl
(B) Cs
(C) Br
(D) B

13. Which of the following is the largest?
(A) P
(B) $Cl^-$
(C) $K^+$
(D) Cannot be determined

14. Why do ionic compounds form crystal lattices instead of isolated molecules?
(A) Bernoulli's law dictates that a crystal lattice is more stable than separated ion pairs.
(B) Pascal's law dictates that a crystal lattice is more stable than separated ion pairs.
(C) Coulomb's law dictates that a crystal lattice is more stable than separated ion pairs.
(D) Ionic compounds do not form crystal lattices.

15. Which of the following has a noble gas configuration?
(A) Cl
(B) $O^-$
(C) $Ar^-$

(D) K+

16. Why does MgO exist as Mg2+ O2- not Mg+ O- ?
(A) Mg2+ and O2- are both noble gas configurations.
(B) A covalent compound is formed between Mg and O.
(C) Coulomb's law indicates that forming ions with higher charges leads to a more stable ionic compound.
(D) None of the above

17. Predict the formula of lithium nitride.
(A) LiN
(B) Li3N
(C) Li2N
(D) LiN3

18. Predict the formula of magnesium argonide.
(A) MgAr
(B) MgAr2
(C) Mg2Ar
(D) None of the above

19. Why do atoms share their electrons?
(A) To be neighborly
(B) To attempt to steal the electrons from the other atoms
(C) To achieve a full octet for both atoms
(D) None of these answers

20. If two atoms are bonded together, one with six valence electrons, the other with four, how many electrons must they share for both to achieve a full octet?
(A) 6
(B) 8
(C) 3
(D) 2

21. Why does sharing an electron pair between nuclei create a bond?
(A) The increase in electron density between the nuclei joins the nuclei together.
(B) The increase in electron density between the nuclei is coulombically favorable.
(C) This does not create a bond.
(D) None of the above

22. How many resonance structures are possible for SO32-?
(A) 0
(B) 1
(C) 3
(D) 2

23. How much charge resides on each oxygen in SO32-?

(A) -1/3
(B) -1
(C) +1
(D) -2/3

24. Which of the following molecules has more than one resonance structure?
(A) S2O32-
(B) HCl
(C) MgCl2
(D) CO

25. What is the formal charge on boron in BF4-?
(A) 1
(B) -1
(C) 0
(D) None of the above

26. Lewis structures with less formal charge are more stable. Given this statement, determine which structure is more stable, the octet or non-octet structure of BCl3. (Hint: the octet structure places a double bond between the B and a Cl atom.)
(A) The non-octet structure shows boron to be electron deficient, and thus, it has a +2 formal charge. Therefore, the octet structure is more stable.
(B) The octet structure is more stable because violating the octet rule is a destabilizing factor.
(C) The octet structure would place a formal charge on both B and Cl while the non-octet structure does not, so the non-octet structure is preferred.

(D) None of the above

27. What is the formal charge on each hydrogen in CH3+?
(A) 1
(B) -1
(C) 0.33
(D) 0

28. What is the formal charge on a triply-bonded oxygen?
(A) +1
(B) 0
(C) -1
(D) Cannot be determined

29. How many lone pairs are present in the Lewis structure for NF3?
(A) 1
(B) 10
(C) 3
(D) None of the above

30. Explain why the Lewis structure for SF6 has twelve electrons around sulfur instead of eight.
(A) Such a Lewis structure violates the octet rule and is incorrect.
(B) Sulfur has a formal charge of -6 because S is in Group 6.
(C) Sulfur can have an expanded octet.
(D) None of the above

31. How many lone pairs are present on iodine in IF4-
(A) 0
(B) 1
(C) 3
(D) 2

32. Which of the following is a correct explanation of why it is difficult to draw the Lewis structure for NO.
(A) As an odd electron molecule, it is impossible to complete the octet on both atoms.
(B) One can only draw structures with high formal charges.
(C) It is impossible to tell where to place the odd electron.
(D) None of the above

33. How many different types of oxygen atoms are present in the molecule CH2OHCO2-?
(A) 1
(B) 2
(C) 3
(D) None of the above

34. What is the molecular geometry of oxygen in H3O+?
(A) Tetrahedral
(B) Trigonal Planar
(C) Trigonal Pyramidal
(D) Trigonal Bipyramidal

35. Why is it reasonable for VSEPR to assume that electron pairs are oriented as far away as possible from one another?
(A) This assumption correctly predicts the observed geometries for most compounds.
(B) Hybridization tells us that this assumption is correct because each set of hybrid orbitals places the orbitals as far away from each other as possible.
(C) This is not a reasonable assumption and is why VSEPR has been shown to be wrong.
(D) Coulomb's law shows us that electrons repel each other, so the most stable arrangement maximizes the distance between electron pairs.

36. What is the molecular geometry of I3-?
(A) Linear
(B) Trigonal
(C) Bent

(D) Trigonal Bipyramidal

37. Which has a smaller bond angle between oxygen atoms, SO32- or CO32-?
(A) Neither, they are both trigonal planar.
(B) Neither, they are both trigonal pyramidal.
(C) SO32-
(D) CO32-

38. Which of the following ions produces unreasonable Lewis structures?
(A) I3-
(B) Br3-
(C) F3-
(D) None of the above

39. How many different types of bonding overlap are possible for a homonuclear diatomic molecule like W2 when only considering bonding through the p orbitals?
(A) 0
(B) 1
(C) 2
(D) 3

40. What property of B2 would change if the energy of its p bonds were raised above its s bond formed from the overlap of its 2p orbitals?
(A) Magnetism
(B) Bond order
(C) Melting point
(D) Fermi level

41. The Lewis structure of NO is difficult to draw due to its odd number of electrons. Use molecular orbital theory to predict which atom has the odd electron.
(A) O
(B) N
(C) Neither
(D) Cannot be determined

42. Light can be used to excite electrons enough to remove an electron from a molecule. When light of an appropriate frequency is shined on oxygen, the O-O bond becomes stronger despite the loss of an electron. Explain.
(A) Losing an electron always results in an increase in bond strength because the positively charged ion produced holds the electrons it has more strongly.
(B) The light removes an electron from a bonding orbital, increasing the bond order and bond strength.
(C) The light removed an electron from an antibonding orbital, increasing the bond order and bond strength.
(D) None of the above

43. Is molecular nitrogen paramagnetic or diamagnetic? Why?
(A) Diamagnetic because it has some of its electrons unpaired
(B) Paramagnetic because it has all of its electrons paired
(C) Diamagnetic because it has some of its electrons unpaired
(D) Diamagnetic because it has all of its electrons paired

44. How does the molecular orbital diagram for LiF account for the fact that LiF is an ionic compound?
(A) The bonding molecular orbital, into which the lithium atom has donated its valence electron, is closest in energy to fluorine's 2s orbital. Then the electrons in this orbital are located primarily on fluorine. Therefore, the diagram shows an electron transfer from Li to F.
(B) The nonbonding electron pairs on fluorine are not involved in the bonding, so there are electrons localized on fluorine.
(C) The diagram treats all molecules as inherently covalent and so molecular orbital theory cannot be applied to ionic compounds.
(D) None of the above

45. What determines the heights of the orbitals for each single atom in a correlation diagram?
(A) Its electronegativity in relation to that of other atoms in the molecule
(B) Its energy in relation to that of other atoms in the molecule
(C) Its principal quantum number in relation to that of other atoms in the molecule
(D) Its ionization potential in relation to that of other atoms in the molecule

46. Which atom's 2s orbital would be lower on the orbital correlation diagram, B or C?
(A) Neither, all 2s orbitals have the same energy.
(B) B
(C) C
(D) Cannot be determined but they are different

47. What is the hybridization of oxygen in CH2OH+?
(A) sp3
(B) dsp3
(C) sp
(D) sp2

48. What is the hybridization of the central nitrogen in N2O?
(A) sp
(B) sp2
(C) sp3
(D) None of the above

49. Which of the following statements contrasts hybridization and molecular orbital theory for polyatomic molecules?
(A) Hybridization delocalizes the bonding electrons over the surface of

the entire molecule while molecular orbital theory accounts for bonds one at a time.
(B) Hybridization simplifies molecular orbital theory by only considering one bond at a time. Molecular orbital theory for polyatomic molecules considers all of the bonds at once.
(C) Hybridization uses orbital correlation diagrams to figure out the bonding in a molecule while molecular orbital theory does not.
(D) They are equivalent bonding descriptions.

50. Photoelectron spectroscopy can be used to determine the energy levels in molecules. The photoelectron spectrum for silane reveals two different low energy peaks indicating the two distinct energy levels for the bonded electrons. Which of the following bonding descriptions is not consistent with the experimental results?
(A) Molecular orbital theory
(B) LCAO
(C) Hybridization
(D) None of the above