

## BONDING TEST PAGE 1

Questions 1-7 are based on the following choices:

1)  $C_2Cl_4$  2) HCN 3)  $CaCl_2$  4)  $CO_2$  5)  $Cl_2$

1. Contains two double bonds.
2. Contains a triple bond.
3. Shows  $sp^2$  hybridization.
4. Contains only non-polar covalent bonds.
5. Is a polar molecule that contains covalent bonds.
6. Contains one and only one pi bond.
7. Contains both polar and non-polar covalent bonds.

Questions 8-11. 1) Bonds are polar and the molecule is nonpolar

2) Bonds are polar and the liquid is hydrogen bonded.

3) Bonds are polar, the molecule is polar, and the liquid is not hydrogen bonded.

4) Bonds are nonpolar, the molecule is polar, and the liquid is not hydrogen bonded.

5) Bonds are nonpolar and the only intermolecular forces are van der Waals forces.

8. Ammonia,  $NH_3$

9. Hydrogen,  $H_2$

10. Silane,  $SiH_4$

11. Hydrogen iodide, HI

12. Which of the following molecules has the largest dipole moment?

1)  $CO_2$  2)  $CCl_4$  3)  $CF_4$  4)  $H_2S$  5)  $H_2O$

13. In which of the following substances is hydrogen bonding most significant?

1) HBr 2)  $H_2S$  3)  $CH_3CF_3$  4) LiH 5)  $CH_3OH$

14. For which of the following is the concept of resonance considered LEAST relevant in explaining the shape and the bond length?

1)  $SO_3$  2)  $SO_2$  3)  $C_6H_6$  4)  $CO_2$  5)  $CO_3^{2-}$

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15. Which of the following compounds contains both ionic and covalent bonds?  
1)  $C_2H_2$  2)  $CH_3COOCH_3$  3)  $Na_2CO_3$  4)  $MgCl_2$  5)  $CH_3OCH_3$
16. The hybridization of the sulfur orbitals in  $SO_3$  is best described as  
1)  $sp$  2)  $sp^2$  3)  $sp^3$  4)  $p^3$  5)  $dsp^2$
17. Which of the following molecules has trigonal pyramidal geometry?  
1)  $BCl_3$  2)  $O_3$  3)  $SiCl_4$  4)  $SO_3$  5)  $PF_3$
18. Equivalent resonance structures are used to describe which of the following species? 1)  $NH_4^+$  2)  $N_2$  3)  $H_2CO$  4)  $NO_3^-$  5)  $PO_4^{3-}$
19.  $AsCl_5$  is a trigonal bipyramid. Its hybridization should be 1)  $sp^2$   
2)  $d^2sp^3$  3)  $sp^3d$  4)  $sp^3$  5)  $dsp^2$
20.  $CH_4$ ,  $CO_2$ ,  $PCl_3$ ,  $ICl_5$ ,  $SF_6$   
Which does not describe any of the above molecules? 1) linear  
2) octahedral 3) square planar 4) tetrahedral 5) square based pyramid
21. One can predict the order of decrease in boiling point of the following three substances to be, (from highest to lowest boiling point.)  
1)  $HF$   $HCl$   $F_2$  2)  $F_2$   $HCl$   $HF$  3)  $HF$   $F_2$   $HCl$   
4)  $HCl$   $HF$   $F_2$  5)  $HCl$   $F_2$   $HF$
22. The electronegativities of C and O are 2.5 and 3.5, respectively. Based on this information, the BOND type in  $CO_2$  is 1) non-polar covalent  
2) polar covalent 3) ionic 4) network 5) metallic
23. The tetrahedral model is least appropriate in depicting the structure of which of the following? 1)  $H_2O$  2)  $BeCl_2$  3)  $NH_3$  4)  $CHCl_3$  5)  $SiH_4$
24. The geometry of each of the following molecules is listed. Which would NOT have a permanent dipole? 1)  $BrCl$  - linear 2)  $HgCl_2$  - linear  
3)  $CCl_3F$  - tetrahedral 4)  $NH_3$  - pyramidal 5)  $SCl_2$  - bent
25. Which has a planar geometry? 1)  $ClO_3^-$  2)  $SO_3^{2-}$  3)  $PH_3$  4)  $CO_3^{2-}$  5)  $NH_4^+$
26. The shapes of  $BF_3$  and  $NF_3$  molecules are 1) trigonal planar  
2) pyramidal 3) tetrahedral 4) square planar 5) different
27. The step in the Born Haber cycle which produces the greatest amount of energy is the 1) ionization of the gaseous metal atom. 2) sublimation of the metallic solid. 3) conversion of the diatomic non-metal to free gaseous atoms 4) electron affinity of the gaseous non-metal 5) formation of the ionic crystal from the gaseous anions and cations.

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28. Which sulfide should have the least ionic character? 1) Mg 2) Na 3)Ca  
4)Ba 5) K
29. A compound which contains one or more pi bonds is 1) H<sub>2</sub>S 2) H<sub>2</sub>SO<sub>4</sub>  
3) O<sub>2</sub> 4) SO<sub>3</sub> 5) H<sub>2</sub>SO<sub>3</sub>
30. The bond angle between the hydrogen atoms in H<sub>2</sub>Se is found to be very close to 90°. Which description of the bonds is most consistent with this information? 1)between s orbitals on the hydrogen, and sp<sup>3</sup> orbitals on the Se, with two lone pairs. 2) between s orbitals on the H and p orbitals on the Se 3) Between s orbitals on the hydrogen and sp orbitals on the Se 4) between s orbitals on the hydrogen and sp<sup>2</sup> orbitals on the Se 5) two pi bonds.
31. Which is a free radical? 1) CH<sub>3</sub> 2) NO<sub>2</sub><sup>-</sup> 3) NH<sub>3</sub> 4) PH<sub>3</sub> 5) BeH<sub>2</sub>
32. The octet rule is satisfied for the central atom in 1)XeF<sub>4</sub> 2) SF<sub>6</sub>  
3) PCl<sub>3</sub> 4) BF<sub>3</sub> 5) NO<sub>2</sub>
33. sp<sup>3</sup> hybridization with one unbonded (lone) pair of electrons on the central atom would lead to molecules which are 1) trigonal planar  
2) square planar 3) T shaped 4) linear 5) pyramidal
34. Molecules of SO<sub>2</sub> and NO<sub>2</sub> are different in that only one exhibits  
1)resonance 2) hybridization 3) angular (bent) structure 4)a dipole moment  
5) paramagnetism
35. Which of these diatomic gases would be most stable? 1) Be<sub>2</sub> 2) O<sub>2</sub><sup>2+</sup>  
3) Cl<sub>2</sub><sup>2-</sup> 4) Li<sub>2</sub> 5) N<sub>2</sub>
36. The best description of a C<sub>2</sub>H<sub>2</sub> molecule is 1)sp<sup>3</sup> with two lone pairs.  
2) sp hybridized with two lone pairs 3) sp hybridized with 2 pi bonds  
4) sp<sup>2</sup> hybridized with one lone pair 5) sigma bonds between the carbon and hydrogen, with three pi bonds between the carbons.
37. Hydrogen bonding accounts for all of the following EXCEPT  
1) H<sub>2</sub>O has a higher boiling point than H<sub>2</sub>S 2) NH<sub>3</sub> has a higher boiling point than PH<sub>3</sub> 3) CH<sub>3</sub>OH is a liquid while CH<sub>3</sub>Cl is a gas at room temperature. 4) C<sub>3</sub>H<sub>5</sub>(OH)<sub>3</sub> is an extremely viscous liquid with a low vapor pressure, while C<sub>3</sub>H<sub>7</sub>OH is much less viscous, with a higher vapor pressure. 5) CCl<sub>4</sub> is a liquid, while CH<sub>4</sub> is a gas at room temperature.
38. In which of the following are the compound, geometry, and hybridization of the central atom correctly matched?  
1) ICl<sub>5</sub> - sp<sup>3</sup>d, trigonal bipyramid. 2) SO<sub>2</sub> - sp, angular

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3)  $\text{PCl}_3$  -  $\text{sp}^2$  trigonal planar      4)  $\text{OF}_2$  -  $\text{sp}$  linear      5)  $\text{SF}_6$  -  $\text{sp}^3\text{d}^2$  octahedral.

39-41 1) Van der Waals forces 2) Hydrogen bonding 3) non-polar covalent bonding 4) polar covalent bonding 5) ionic bonding.

39. The bonds between the nitrogen and the hydrogen in an ammonia molecule.

40. The bonding forces overcome when iodine sublimes.

41. The bonding forces overcome when a photon strikes a chlorine molecule.

(42 - 48 ) 1)  $\text{sp}^3\text{d}^2$  2)  $\text{sp}$  3)  $\text{sp}^2$  4)  $\text{sp}^3$  5)  $\text{sp}^3\text{d}$

42. Leads to compounds with bond angles of approximately  $120^\circ$ .

43. Produces compounds with bond angles of both  $120^\circ$  and  $90^\circ$ .

44.  $\text{ICl}_3$  has two lone pairs on the iodine.

45. The dipole moment of  $\text{BeI}_2$  is zero.

46.  $\text{OF}_2$  has a non-zero dipole moment.

47. Hexammine cobalt (III) ion.

48. The hybridization in the carbon atoms in 1,3-butadiene. ( $\text{C}_4\text{H}_6$ , with two double bonds, in the first and third positions .)