

AP Chemistry: Bonding Multiple Choice

41. Which of the following molecules has the shortest bond length?

- (A) N₂ (B) O₂ (C) Cl₂ (D) Br₂ (E) I₂

51. Pi bonding occurs in each of the following species EXCEPT...

- (A) CO₂ (B) C₂H₄ (C) CN⁻ (D) C₆H₆ (E) CH₄

60. Which of the following has a zero dipole moment?

- (A) HCN (B) NH₃ (C) SO₂ (D) NO₂ (E) PF₅

8. Use the following answers for questions 8 - 9.

- (A) A network solid with covalent bonding
(B) A molecular solid with zero dipole moment
(C) A molecular solid with hydrogen bonding
(D) An ionic solid
(E) A metallic solid

8. Solid ethyl alcohol, C₂H₅OH

9. Silicon dioxide, SiO₂

80. For which of the following molecules are resonance structures necessary to describe the bonding satisfactorily?

- (A) H₂S (B) SO₂ (C) CO₂ (D) OF₂ (E) PF₃

Hydrogen Halide	Normal Boiling Point, °C
HF	19
HCl	-85
HBr	-67
HI	-35

18. The liquefied hydrogen halides have the normal boiling points given above. The relatively high boiling point of HF can be correctly explained by which of the following?

- (A) HF gas is more ideal. (C) HF molecules have a smaller dipole moment.
(B) HF is the strongest acid. (D) HF is much less soluble in water.
(E) HF molecules tend to form hydrogen bonds.

42. The SbCl₅ molecule has trigonal bipyramid structure. Therefore, the hybridization of Sb orbitals should be...

- (A) sp² (B) sp³ (C) sp²d (D) sp³d (E) sp³d²

11. Use these answers for questions 11 - 14.

- (A) hydrogen bonding (B) hybridization (C) ionic bonding
(D) resonance (E) van der Waals forces (London dispersion forces)

11. Is used to explain why iodine molecules are held together in the solid state

12. Is used to explain why the boiling point of HF is greater than the boiling point of HBr

13. Is used to explain the fact that the four bonds in methane are equivalent

14. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6 , are identical

17. The Lewis dot structure of which of the following molecules shows only one unshared pair of valence electron?

- (A) Cl_2 (B) N_2 (C) NH_3 (D) CCl_4 (E) H_2O_2

31. The structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values for which of the following? (Assume ideal behavior.)

- (A) Gaseous densities at the same temperature and pressure
(B) Vapor pressures at the same temperature (C) Boiling points
(D) Melting points (E) Heats of vaporization

47. CCl_4 , CO_2 , PCl_3 , PCl_5 , SF_6

Which of the following does not describe any of the molecules above?

- (A) Linear (B) Octahedral (C) Square planar (D) Tetrahedral (E) Trigonal pyramidal

59. Which of the following compounds is ionic and contains both sigma and pi covalent bonds?

- (A) $Fe(OH)_3$ (B) $HClO$ (C) H_2S (D) NO_2 (E) $NaCN$

15. In a molecule in which the central atom exhibits sp^3d^2 hybrid orbitals, the electron pairs are directed toward the corners of...

- (A) a tetrahedron (B) a square-based pyramid (C) a trigonal bipyramid
(D) a square (E) an octahedron

32. CH_3CH_2OH boils at $78^\circ C$ and CH_3OCH_3 boils at $-24^\circ C$, although both compounds have the same composition. This difference in boiling points may be attributed to a difference in...

- (A) molecular mass (B) density (C) specific heat
(D) hydrogen bonding (E) heat of combustion

34. $X = CH_3-CH_2-CH_2-CH_2-CH_3$ $Y = CH_3-CH_2-CH_2-CH_2-OH$ $Z = HO-CH_2-CH_2-CH_2-OH$

Based on concepts of polarity and hydrogen bonding, which of the following sequences correctly lists the compounds above in the order of their increasing solubility in water?

- (A) $Z < Y < X$ (B) $Y < Z < X$ (C) $Y < X < Z$ (D) $X < Z < Y$ (E) $X < Y < Z$

57. Molecules that have planar configurations include which of the following?

I. BCl_3 II. CHCl_3 III. NCl_3

(A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and III

62. The electron-dot structure (Lewis structure) for which of the following molecules would have two unshared pairs of electrons on the central atom?

(A) H_2S (B) NH_3 (C) CH_4 (D) HCN (E) CO_2

68. Which of the following molecules has a dipole moment of zero?

(A) C_6H_6 (benzene) (B) NO (C) SO_2 (D) NH_3 (E) H_2S

8. Questions 8-10 refer to the following diatomic species.

(A) Li_2 (B) B_2 (C) N_2 (D) O_2 (E) F_2

8. Has the largest bond-dissociation energy

9. Has a bond order of 2

10. Contains 1 sigma (σ) and 2 pi (π) bonds

Bond	Average Bond Energy (kJ/mole)
I---I	150
Cl---Cl	240
I---Cl	210



According to the data in the table above, what is the value of ΔH° for the reaction represented above?

(A) -870 kJ (B) -390 kJ (C) $+180 \text{ kJ}$ (D) $+450 \text{ kJ}$ (E) $+1,260 \text{ kJ}$

28. The melting point of MgO is higher than that of NaF . Explanations for this observation include which of the following?

I. Mg^{2+} is more positively charged than Na^+

II. O^{2-} is more negatively charged than F^-

III. The O^{2-} ion is smaller than the F^- ion

(A) II only (B) I and II only (C) I and III only (D) II and III only (E) I, II, and III

32. Types of hybridization exhibited by the C atoms in propene, CH_3CHCH_2 , include which of the following?

I. sp II. sp^2 III. sp^3

(A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and III

40. Of the following molecules, which has the largest dipole moment?

- (A) CO (B) CO₂ (C) O₂ (D) HF (E) F₂

58. On a mountaintop, it is observed that water boils at 90°C, not at 100°C as at sea level. This phenomenon occurs because on the mountaintop the...

- (A) equilibrium water vapor pressure is higher due to the higher atmospheric pressure
(B) equilibrium water vapor pressure is lower due to the higher atmospheric pressure
(C) equilibrium water vapor pressure equals the atmospheric pressure at a lower temperature
(D) water molecules have a higher average kinetic energy due to the lower atmospheric pressure
(E) water contains a greater concentration of dissolved gas

68. In which of the following processes are covalent bonds broken?

- (A) I_{2(s)} → I_{2(g)} (B) CO_{2(s)} → CO_{2(g)} (C) NaCl_(s) → NaCl_(l)
(D) C_(diamond) → C_(g) (E) Fe_(s) → Fe_(l)

40. The geometry of the SO₃ molecule is best described as...

- (A) trigonal planar (B) trigonal pyramidal (C) square pyramidal
(D) bent (E) tetrahedral

66. Ca, V, Co, Zn, As

Gaseous atoms of which of the elements above are paramagnetic?

- (A) Ca and As only (B) Zn and As only (C) Ca, V, and Co only
(D) V, Co, and As only (E) V, Co, and Zn only

Questions 3-5 refer to the following molecules:

- (A) CO₂
(B) H₂O
(C) CH₄
(D) C₂H₄
(E) PH₃

3. The molecule with only one double bond.
4. The molecule with the largest dipole moment.
5. The molecule that has trigonal pyramidal geometry.

28. Of the following compounds, which is the most ionic?

- (A) SiCl_4
- (B) BrCl
- (C) PCl_3
- (D) Cl_2O
- (E) CaCl_2

53. According to the VSEPR model, the progressive decrease in the bond angles in the series of molecules CH_4 , NH_3 , and H_2O is best accounted for by the...

- (A) increasing strength of the bonds
- (B) decreasing size of the central atom
- (C) increasing electronegativity of the central atom
- (D) increasing number of unshared pairs of electrons
- (E) decreasing repulsion between hydrogen atoms

56. The boiling points of the elements helium, neon, argon, krypton, and xenon increase in that order. Which of the following statements accounts for this increase?

- (A) The London (dispersion) forces increase.
- (B) The hydrogen bonding increases.
- (C) The dipole-dipole forces increase.
- (D) The chemical reactivity increases.
- (E) The number of nearest neighbors increases.