

EXTRA PROBLEMS FOR PRACTICE

UNIT 09 - BONDING AND ATTRACTIVE FORCES



Match the description in the first column with the term in the second column.

1	It shows the arrangements of valence electrons about atoms in a chemical species.	A	bond polarity
2	This bond is weaker than a multiple bond in a similar bonding environment.	B	covalent
3	This type of bond exists between C & H in CH ₄ .	C	bond angle
4	A measure of the spatial distribution of electron density in a covalent chemical bond.	D	bonding pair
5	This is the type of bond that exists in MgO.	E	double bond
6	This is the type of covalent bond that exists between C atoms in H ₂ CCH ₂ .	F	electronegativity
7	The type of covalent bond that exists between C atoms in HCCH.	G	ionic
8	This is a measure of the relative attraction an atom has for a shared pair of electrons in a chemical bond.	H	hybridization
9	HCl has this type of covalent bond but Cl ₂ does not.	I	Lewis structure
10	The name and symbol given to the type of bond between C and H in CH ₄ .	J	polar covalent bond
11	The name & symbol given to the weaker bond existing between C and O in CO.	K	pi (π)
12	Along with bond lengths, this measurement is required to define the shape and size of a molecule.	L	single covalent bond
13	A model that helps us determine the molecular structure of simple covalent compounds.	M	sigma (σ)
14	The formation of an atomic orbital from the blending of two or more atomic orbitals.	N	triple bond
15	Two electrons localized between two nuclei resulting in a chemical bond.	O	VSEPR

Are the following statements true or false?

16. The formal charge of an "atom" in an ionic compound is simply its ionic charge.
17. An ionic bond is characterized by a small difference in electronegativity values between the bonded atoms.
18. FeCl₃ contains a metallic bond.
19. CO₂ contains covalent bonds.
20. Multiple bonding occurs among the atoms carbon, nitrogen, and oxygen.
21. N₂ contains three bonding pairs of electrons between the nitrogen atoms.
22. The electron domain geometry in NH₃ is tetrahedral.
23. The molecular geometry of NH₃ is tetrahedral.
24. ICl is a polar molecule whereas I₂ is not.
25. A bond dipole exists when two bonded atoms have the same electronegativity.
26. According to valence bond theory, a chemical bond between two atoms occurs when a valence orbital on each atom overlaps and four electrons are shared.
27. The oxygen atom in water uses sp³ hybrid orbitals.

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Questions 28 through 42 are multiple choice questions. Questions 43-44 are free response questions.

28. Which pair of atoms should form the most polar bond?
(a) F and B (b) C and O (c) F and O (d) N and F (e) B and N
29. The electrostatic force of attraction is greatest in which compound?
(a) BaO (b) MgO (c) CaS (d) MgS (e) CaO
30. Which molecule has the weakest bond?
(a) CO (b) O₂ (c) NO (d) N₂ (e) Cl₂
31. How are the bonding pairs arranged in the best Lewis structure for ozone?
(a) O—O—O (b) O=O—O (c) O≡O—O (d) O≡O=O (e) O=O=O
32. Which species has the shortest bond length?
(a) CN⁻ (b) O₂ (c) SO₂ (d) SO₃ (e) CO₂
33. Which species requires the least amount of energy to remove an electron from the outermost energy level?
(a) Na⁺ (b) Ne (c) F⁻ (d) O²⁻ (e) Mg²⁺
34. Which species has a valid non-octet Lewis structure?
(a) GeCl₄ (b) SiF₄ (c) NH₄⁺ (d) SeCl₄ (e) CO₃²⁻
35. Which of these molecules is not polar?
(a) H₂O (b) CO₂ (c) NO₂ (d) SO₂ (e) NH₃
36. Which species contains a central atom with *sp*² hybridization?
(a) C₂H₂ (b) SO₃²⁻ (c) O₃ (d) BrI₃ (e) NH₃
37. For ClF₃, the electron domain geometry of Cl and the molecular geometry are, respectively . . .
(a) trigonal planar and trigonal planar. (b) trigonal planar and trigonal bipyramidal.
(c) trigonal bipyramidal and trigonal planar. (d) trigonal bipyramidal and T-shaped.
(e) trigonal planar and T-shaped.
38. The size of the H-N-H bond angles of the following species increases in which order?
(a) NH₃ < NH₄⁺ < NH₂⁻ (b) NH₃ < NH₂⁻ < NH₄⁺
(c) NH₂⁻ < NH₃ < NH₄⁺ (d) NH₂⁻ < NH₄⁺ < NH₃
(e) NH₄⁺ < NH₃ < NH₂⁻
39. What is the molecular geometry and polarity of the BF₃ molecule?
(a) trigonal pyramidal and polar (b) trigonal pyramidal and nonpolar
(c) trigonal planar and polar (d) trigonal planar and nonpolar
(e) T-shaped and polar
40. Which set does not contain a linear species?
(a) CO₂, SO₂, NO₂ (b) H₂O, HCN, BeI₂
(c) OCN⁻, C₂H₂, OF₂ (d) I₃⁻, BrF₃, SCN⁻
(e) H₂S, ClO₂⁻, NH₂⁻

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41. How many sigma and how many pi bonds are in $\text{CH}_2=\text{CHCH}_2\text{C}=\text{OCH}_3$?
- (a) 5 sigma and 2 pi
(b) 8 sigma and 4 pi
(c) 11 sigma and 2 pi
(d) 11 sigma and 4 pi
(e) 13 sigma and 2 pi
42. Suppose a Lewis structure for a neutral fluorine-containing molecule results in a formal charge on the fluorine atom of +1. What conclusion can you draw?
- (a) The structure actually represents an ion.
(b) The F atom in the structure must have four covalent bonds attached to it.
(c) There must be another F atom in the structure carrying a -1 formal charge, since F is the most electronegative element and it should have a negative formal charge.
(d) There must be a better Lewis structure, since F is the most electronegative element and it should have a negative formal charge.
43. Consider the following chemical species: the nitrogen molecule, the nitrite ion, and the nitrate ion.
- a. Write the chemical formulas for each of the species and identify the oxidation number of the nitrogen atom in each formula.
- b. Draw Lewis structure for each of the species. Where appropriate, draw resonance structures for each.
- c. List the chemical species in order of increasing N-O bond length, the formula with the shortest bond first. Justify your answer.
32. Consider the chemical species IF_5 and IF_4^+ .
- a. Draw the Lewis structure and make a rough three-dimensional sketch of each of these species.
- b. Identify the orbital hybridization, the electron domain geometry, and the molecular geometry of each species.
- c. Identify the approximate bond angle of each species.
- d. Predict which, if any, is a polar species. Justify your answer.

Name:

Molecules, Shapes, Angles, Pictures

Compound	Bond Type(s)	Bond Dipoles	Central Atom: Lone and Bonding Pair	Picture	Shape and Angle
PCl_6^{-1}			Lone: Bond:		_____
SO_3			Lone: Bond:		_____
CH_3Cl			Lone: Bond:		_____
NO_3^{-1}			Lone: Bond:		_____
SOF_4			Lone: Bond:		_____
IF_5			Lone: Bond:		_____
ClO_2^{-1}			Lone: Bond:		_____
SOCl_2			Lone: Bond:		_____
ICl_4^{-1}			Lone: Bond:		_____
XeOF_2	Lone: Bond:		_____
SeCl_4			Lone: Bond:		_____