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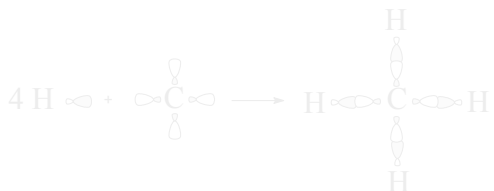
Covalent Bonds: Sharing e⁻

Covalent bonding- valence e⁻ are *shared* between atoms

Number of unpaired valence e⁻ is perfect indicator of how many bonds an atom needs to form to become stable

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Covalent Bond Formation



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Electron Dot Structures

1. Add the number of valence electrons from each atom in the formula.
2. Join atoms with covalent bonds.
3. For each bond, subtract 2 from the total electrons to account for. Use the leftover electrons to give each atom 8 electrons (except H).
4. Repeat as necessary.

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Some of the Ways Molecules Trick Us

Multiple Covalent Bonds- double and triple bonds can form between two atoms



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Some of the Ways Molecules Trick Us

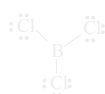
Coordinate Covalent Bond- one atom contributes both electrons to a bond



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Some of the Ways Molecules Trick Us

Exceptions- Be, B, P, S, N



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Naming Covalent Compounds

Name of first element
 root of second element
 suffix *-ide*

- must use prefixes to denote how many of each
 Mono-di-tri-tetra-penta-hexa

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Sample Test Questions

Classify the following compound as ionic or covalent:
 SO_2

What is the name of N_2O_4 ?

What is the formula of dihydrogen monoxide?

Draw the Lewis dot structure of SiCl_4 . Include all lone pairs in the diagram.

Draw the Lewis dot structure of silicon dioxide. Include all lone pairs in the diagram.

Draw the Lewis dot structure of PBr_5 . Include all lone pairs in the diagram. This compound violates the octet rule.

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Sample Test Questions

Draw the Lewis dot structure of PBr_5 . Include all lone pairs in the diagram. This compound violates the octet rule.

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Shapes of Molecules

VSEPR theory is used to predict the shape (and therefore reactivity) of a molecule.

VSEPR- Valence-Shell Electron-Pair Repulsion

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1. Electron pairs in four locations.

109° separation of electrons

<u>Shape</u>	<u>Example molecule</u>
Linear	HCl
Bent	H ₂ O
Pyramidal	NH ₃
Tetrahedral	CH ₄

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2. Electron pairs in three locations.

120° separation of electrons

<u>Shape</u>	<u>Example molecule</u>
Triangular	BCl ₃

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3. Electron pairs in two locations.

180° separation of electrons

Shape Example molecule

Only linear CO₂

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4. Electron pairs in one location.

no separation of electrons

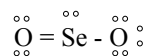
Shape Example molecule

Linear *only* example is H₂

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Sample Test Question

What is the shape of the following molecule, for which the correct Lewis dot structure is given?



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Sample Test Question

Draw the Lewis dot structure for a molecule of SCl_2 .

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Sample Test Question

What is the molecular shape of nitrogen trioxide?

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Polar Bonds

When two atoms of different electronegativity bond, a dipole (dipole moment) is the result.

dipole moment- a molecule has separated centers of partial positive (δ^+) and partial negative (δ^-) charge.



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Sample Test Question

Using chart 1, determine the type of bond involved between the following pairs of elements.

- C-H _____
- C-Cl _____
- N-H _____
- Ca-Cl _____

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Determining if a Bond is Polar

1. Determine the difference in electronegativity of the two atoms involved (given in chart form).

- C-H _____
- C-Cl _____
- N-H _____
- Ca-Cl _____

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Determining if a Bond is Polar

1. Determine the difference in electronegativity of the two atoms involved (given in chart form).
2. Difference in electronegativity determines the type of bond

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Examples

CsF

NaCl



HCl

CH₄

H₂

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Determining if a Bond is Polar

1. Determine the difference in electronegativity of the two atoms involved (given in chart form).
2. Difference Type of bond
 < 0.5 Nonpolar Covalent
 0.5-2.0 Polar Covalent
 > 2.0 Ionic

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Generalizations

1. Bonds involving the same element cannot be polar.
2. The further away elements are on the periodic table, the more likely they are to be ionic.

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Polar and Nonpolar Molecules

Molecules with polar bonds can be nonpolar if the dipole moments counter-balance each other.



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Sample Test Question

Classify the following *molecules* as polar or nonpolar.

OFH _____
 CH₂Cl₂ _____
 CF₄ _____
 CH₄ _____

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Properties of Covalent and Ionic Compounds

Ionic	Covalent
• metal-nonmetal	nonmetal-nonmetal
• solid	solid, liquid or gas
• hard and brittle (salt)	brittle and weak (sugar) or soft and waxy (butter)
• high mp and bp	low mp and bp
• soluble in water*	solubility varies widely
• nonconductor if solid or conductor if liquid	insulators

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What Do Compounds Really Look Like?

