1

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

2

Covalent Bond Formation

3

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.

4

Some of the Ways Molecules Trick Us

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

CO_2 N_2

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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

BeH_2 BCl_3 PCl_5 SF_6 NO

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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^o separation of electrons

Shape	Example molecule
Linear	HCl
Bent	H_2O
Pyramidal	NH_3
Tetrahedral	CH_4

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2. Electron pairs in three locations.

120^o separation of electrons

Shape	Example molecule
Triangular	BCl_3

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3. Electron pairs in two locations.

180^o separation of electrons

Shape	Example molecule
Only linear	CO_2

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4. Electron pairs in one location.

no separation of electrons

Shape	Example molecule
Linear	*only* example is H_2

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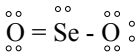
Sample Test Question

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



16

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 _____

21

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

CH_4

H_2

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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 _____

CH_2Cl_2 _____

CF_4 _____

CH_4 _____

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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?