Ions – Atoms can gain or lose electrons to become ions.

Cation:

Anion:

The Octet Rule for Ionic Bonds
atoms gain or lose electrons to achieve a full valence shell of 8 electrons

Metals lose e\textsuperscript{-} to form ________________.

Non-metals can gain e\textsuperscript{-} to form ________________.

Ions create neutral salts through Electrostatic Forces.

Chemical formulas give us the ratio of ions to create a neutral compound.
Names follow the same pattern as the chemical formula

Write the formula unit and name for the ionic compounds (salts) formed by the following pairs of ions.

<table>
<thead>
<tr>
<th>Ions</th>
<th>Formula</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>$K^+$ with $Br^-$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Mg^{2+}$ with $OH^-$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Fe^{2+}$ with $PO_4^{3-}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Pb^{4+}$ with $CO_3^{2-}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ionic compounds are solids in their pure state. The ions are locked in the crystal lattice created by the cations and anions maximizing their attractive forces and minimizing their repulsive forces.

However, when an ionic compound dissolves in water, the ions become completely independent of each other.

Predict how many ions are released into an aqueous solution when 1 formula unit is dissolved in water. Write your answer by completing the reaction for each compound below.

\[ \text{K}_3\text{PO}_4 \]

\[ \text{NaCH}_3\text{CO}_2 \]

\[ \text{Cu(NO}_3\text{)}_2 \]
Octet Rule for Covalent Bonds:
Atoms create compounds by sharing valence electrons to fill shells.

Lewis Structures
A diagram showing how the valence e⁻'s are arranged among atoms in compound

*Group #  =

*If you do not understand this statement, then watch the "Valence electrons & the Octet Rule" Video first.

Bonding Patterns
Neutral Bonding Patterns for Organic Compounds

Periodic Table of the Elements

6C – Carbon
Because carbon atoms have 4 valence electrons, they will share these electrons to form 4 bonds.

7N – Nitrogen
Because nitrogen atoms have 5 valence electrons, they will share these electrons to form 3 bonds and 1 lone pair.

8O – Oxygen
Because oxygen atoms have 6 valence electrons, they will share these electrons to form 2 bonds and 2 lone pairs.

1H – Hydrogen
Because hydrogen atoms have 1 valence electron, they form 1 bond.
Drawing Lewis Structures for Covalent Compounds

1) Determine the number of valence electrons for each atom.

2) Write the symbols for each atom in the molecule arranged around the central atom.

3) Arrange the atoms so that there is a single covalent bond between each pair of bonded atoms (1 covalent bond = 1 e⁻ pair = 2 e⁻’s).

4) Add remaining e⁻ pairs as lone pairs to create octets as needed.

5) If an atom does not have an ‘octet’, shift lone pairs to form multiple bonds between atoms.

6) Verify each atom has an ‘octet’.

Examples of writing Lewis Structures

\[ \text{CH}_3\text{OH} \]

\[ \text{CH}_2\text{CH}_2 \]

Your turn: Draw Lewis Structures for the following compounds.

\[ \text{CH}_3\text{NH}_2 \]

\[ \text{CH}_3\text{CHO} \]
Polyatomic Ions
A group of atoms held together by covalent bonds that have a net charge

Add or remove e⁻ from total number of electrons available.

For Cations:

For Anions:

Neutral Bonding Patterns NO Longer Apply

Exceptions to the Octet Rule can occur for S and P

Draw the Lewis Structures for the following polyatomic ions.

\[ \text{CO}_3^{2-} \]

\[ \text{HPO}_4^{2-} \]
Compounds Part 3: The Mole

Mole: amount of a substance

<table>
<thead>
<tr>
<th>Average Atomic Mass</th>
<th>Molar Mass</th>
</tr>
</thead>
</table>

\[ ^{12}\text{C} \quad \text{and} \quad ^{13}\text{C} \]  
(99% and 1%)

\[ ^{107}\text{Ag} \quad \text{and} \quad ^{109}\text{Ag} \]  
(56.5% and 43.5%)
$6.02 \times 10^{23} = 1 \text{ mole} = X \text{ grams}$

where

Avogadro's number: defined as $6.02 \times 10^{23}$

Molar Mass: determined from the chemical formula and atomic masses of the atoms that form the compound

Which sample contains more atoms: 21 g of carbon or 21 g of silver?

The “Mole” is the bridge between the individual atoms and compounds we imagine when we discuss the theories of chemistry and the grams of atoms and compounds we weigh and measure when perform experiments in the lab to test these theories.
Compounds and the Mole

The chemical formula is the ____________________________ of the atoms that form 1 mole of the compound.

Let’s compare calcium chloride (CaCl₂) and glucose (C₆H₁₂O₆).

<table>
<thead>
<tr>
<th>calcium chloride</th>
<th>glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td></td>
</tr>
<tr>
<td>of cpd</td>
<td></td>
</tr>
<tr>
<td>structure</td>
<td></td>
</tr>
<tr>
<td>when dissolved</td>
<td></td>
</tr>
<tr>
<td>in H₂O</td>
<td></td>
</tr>
</tbody>
</table>

How many moles of the compound are present in a 21 g sample?

a) calcium chloride

b) glucose

How many moles of chloride ions are present in 21 g of calcium chloride?

How many moles of carbon atoms are present in 21 g of glucose?
Molecules and Moles can be used interchangeably because they are linked by Avogadro’s number.

We can NOT compare grams of samples directly. We need to adjust for the different atomic masses of the elements involved.

Example:
Glucose reacts with oxygen to produce carbon dioxide and water according to the balanced reaction shown below.

\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} \]

molecules

moles

molar mass

grams for the mole ratio above