Ions

- **Ions**: atoms or groups of atoms with electric charge
- **Cations**: positive charge
- **Anions**: negative charge

Monatomic Cations

- Make from neutral atoms by removing electrons
- Metals, often from first 2 columns of periodic table

\[ \text{Na} \rightarrow \text{Na}^+ + e^- \]
Monatomic Anions

- Make from neutral atoms by adding electrons
- Nonmetals, often halogens

\[ \text{Cl} + e^- \rightarrow \text{Cl}^- \]
Polyatomic Ions

- 2 or more atoms
- Held together by chemical bonds
- Electrically charged
- Cations or anions
- \( \text{NH}_4^+ \), \( \text{H}_3\text{O}^+ \), \( \text{NO}_3^- \), \( \text{SO}_4^{2-} \)
- See table in textbook for more

Ionic Compounds

- Anions & cations, charges balancing
- Coulomb force (attraction of opposite charges)
- Crystalline solids, high melting points.

Structure of Ionic Crystals

- In an ionic crystal, positive and negative ions are arranged in an orderly array. This is what leads to the crystalline appearance.
NaCl Crystal Structure

Ionic Compounds in Solution
- Many ionic compounds dissolve in water
- Properties in solution different from in solids
- Many ionic solutions conduct electricity

NaCl(s) $\rightarrow$ Na$^+$ (aq) + Cl$^-$ (aq)
- Overall solution is still electrically neutral!
Chemistry in Solution

- Ionic solids usually don’t react readily with one another
- But solutions often react very rapidly
- Difference is due to the dissociation in solution

Solution Chemistry:

KI + Pb(NO$_3$)$_2$
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KI + Pb(NO$_3$)$_2$ 

Equations? 

• “Molecular Equation” 

2 KI + Pb(NO$_3$)$_2$ $\rightarrow$  
2 KNO$_3$ + PbI$_2$  

• Drawback is that solution does NOT contain ANY molecules of KI or Pb(NO$_3$)$_2$ 

Ionic Equations 

• Solutions contain free ions  

KI(s) $\rightarrow$ K$^+$ (aq) + I$^-$ (aq)  
Pb(NO$_3$)$_2$(s) $\rightarrow$  
Pb$^{2+}$ (aq) + 2 NO$_3^-$ (aq)  

• Products?  

KNO$_3$(s) $\rightarrow$ K$^+$ (aq) + NO$_3^-$ (aq)  
PbI$_2$(s) $\rightarrow$ (NOT SOLUBLE)
TOTAL Ionic Equation

- Show ALL ions present:
  \[ 2 \text{K}^+ + 2 \text{I}^- + \text{Pb}^{2+} + 2 \text{NO}_3^- \rightarrow \]
  \[ 2 \text{K}^+ + 2 \text{NO}_3^- + \text{PbI}_2(\text{s}) \]
- Note K\(^+\), NO\(_3^-\) on both sides
- “Spectator Ions”

NET Ionic Equation

- Don’t write spectators ions
  \[ 2 \text{I}^- (\text{aq}) + \text{Pb}^{2+} (\text{aq}) \rightarrow \text{PbI}_2(\text{s}) \]
- Only shows reacting ions
- Simpler looking equation; more commonly used