Introduction to Ionic bonding

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11-14-07

Bonding General

- Bonding is an attractive force holding atoms together.
  - Forces:
    - Nuclear Force: Very strong force holding the nucleus together.
    - Electrostatic attraction: The attraction of positive and negative particles together.
    - Gravitational: Mass attracting to other masses. Minimal until the mass reaches very large amounts… Like planets. Sometimes referred to as the weak force.
    - Magnetic Force.

Bond Types

- Ionic
  - Valence electron transfer
- Covalent
  - Valence electrons being shared
- Metallic
  - Sea of electrons. Good conductors

What do I really have to know about Ionic bonding

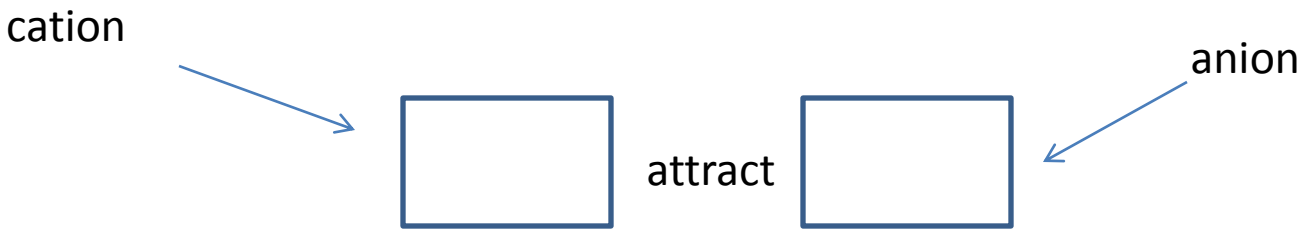
- You must be able to recognize an ionic formula when you see one!!!!

IONIC

CATION = ANION

Metal (cation) bonded to a non-metal (anion)

Na^+Cl^-



- A Family might also fill the role of the cation or anion.
- Ammonium = NH_4^+
- Nitrate = NO_3^{-1}

Notes Outline

- Ionic Compounds
  - Metal = Non-metal
  - Cation = Anion

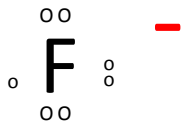
IONIC

FORMATION OF AN IONIC SUBSTANCE

- Metal

K° $^{+}$

Non-metal



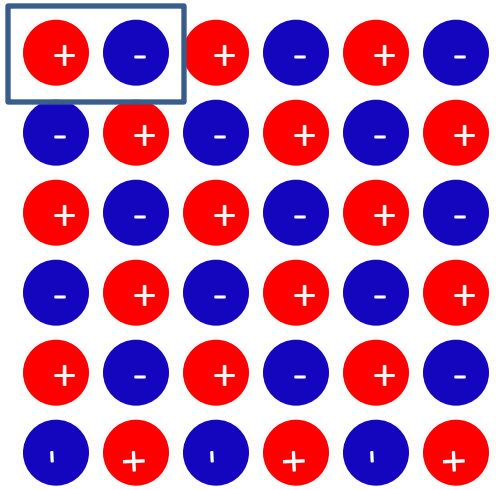
K^{+} F^{-}

attraction

KF

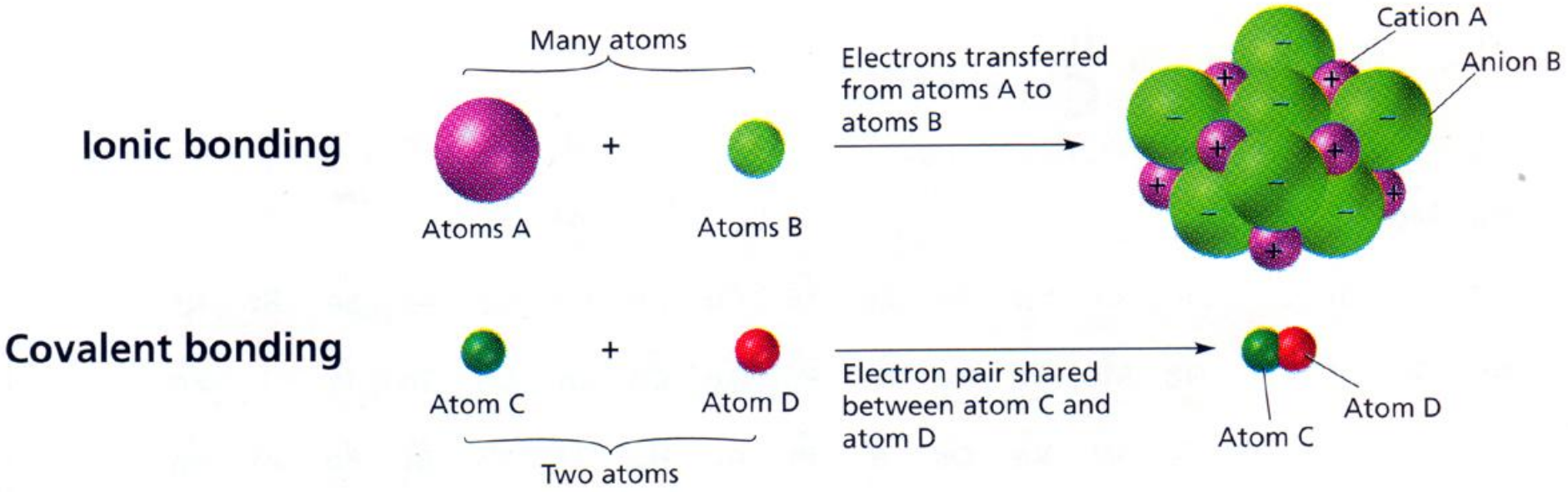
What does KF mean?

Empirical formula: simplest ratio of atoms

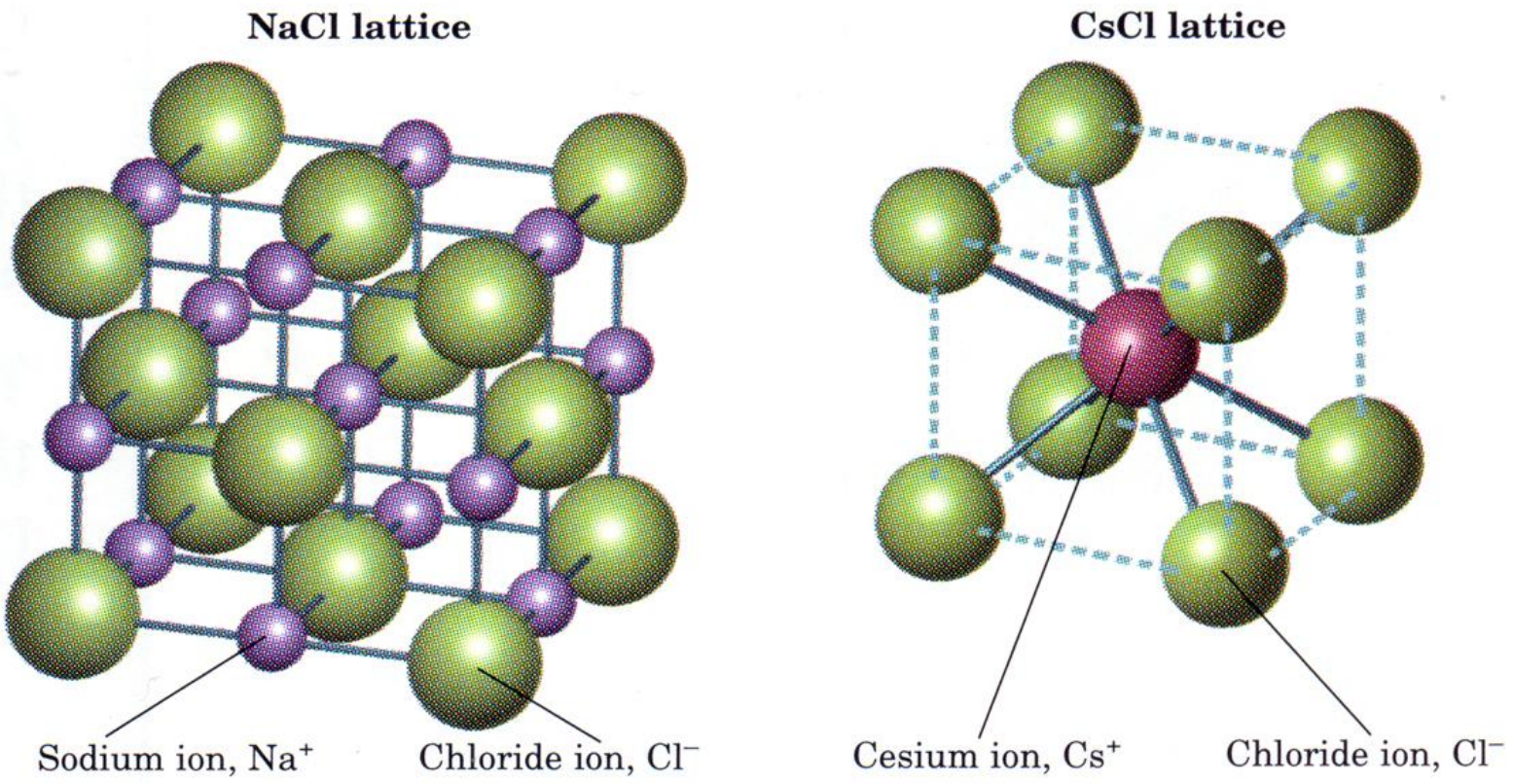


Ionic vs. Covalent

Formula unit vs. molecule



Crystalline structure

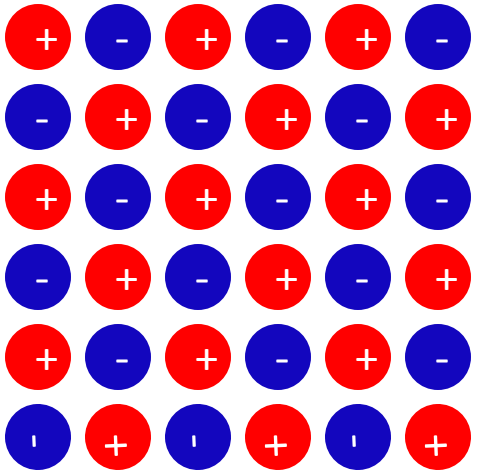


IONIC SOLID PROPERTIES

WHAT FACTORS AFFECT THE MELTING POINT OF IONIC COMPOUNDS

- Difference of Charge
  - High melting points
  - +'s attract to many –'s
  - NaF (Na^{+1} F^{-1})

NaP (Na^{+} P^{-3})



Practice

- Assign the following substances their ionic charges
- Arrange them in order of increasing melting point.
- Ca_3P_2
- NaI
- $MgSO_4$
- $MgCl_2$
- AlN

Practice

- Assign the following substances their ionic charges
- Arrange them in order of increasing melting point.
- Ca_3P_2 Ca^{+2} P^{-3}
- NaI Na^{+1} I^{-1}
- $MgSO_4$ Mg^{+2} SO_4^{-2}
- $MgCl_2$ Mg^{+2} Cl^{-}
- AlN Al^{+3} N^{-3}

Practice

- Assign the following substances their ionic charges
- Arrange them in order of increasing melting point.

		Rank
• Ca_3P_2	Ca^{+2} P^{-3}	4
• NaI	Na^{+1} I^{-1}	1
• $MgSO_4$	Mg^{+2} SO_4^{-2}	3
• $MgCl_2$	Mg^{+2} Cl^{-}	2
• AlN	Al^{+3} N^{-3}	5

Notes Outline

- Ionic Compounds
  - Metal = Non-metal
  - Cation = Anion
  - Empirical formula
    - Simplest ratio of atoms
- Strength of ionic bonds (crystalline structure)
  - Difference of Charge

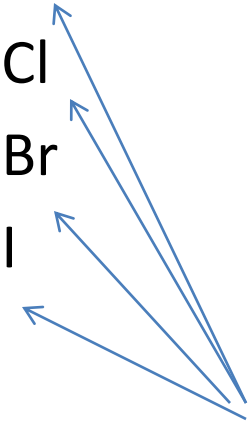
Ionic Solid Properties

What factors affect the melting point of ionic compounds

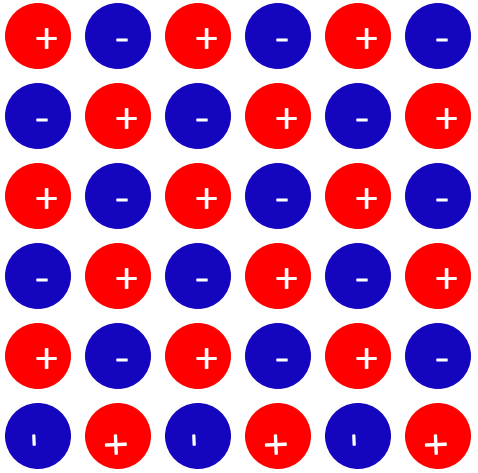
Atomic Radius

The larger the radius the weaker that attraction!

- NaF
- NaCl
- NaBr
- NaI



Larger Atomic radius equals weaker bonds



Practice??

- List the following substances in order of increasing melting points.
  - $CaCl_2$
  - NaCl
  - NaF
  - $AlCl_3$
  - AlP

Answers

- List the following substances in order of increasing melting points.
  - $CaCl_2$
  - NaCl
  - NaF
  - $AlCl_3$
  - AlP

Lowest melting point = lowest attraction

Charge difference +2/-1

Smallest charge difference +1/-1

Cl has a larger radius and is therefore a greater Distance away making it weaker

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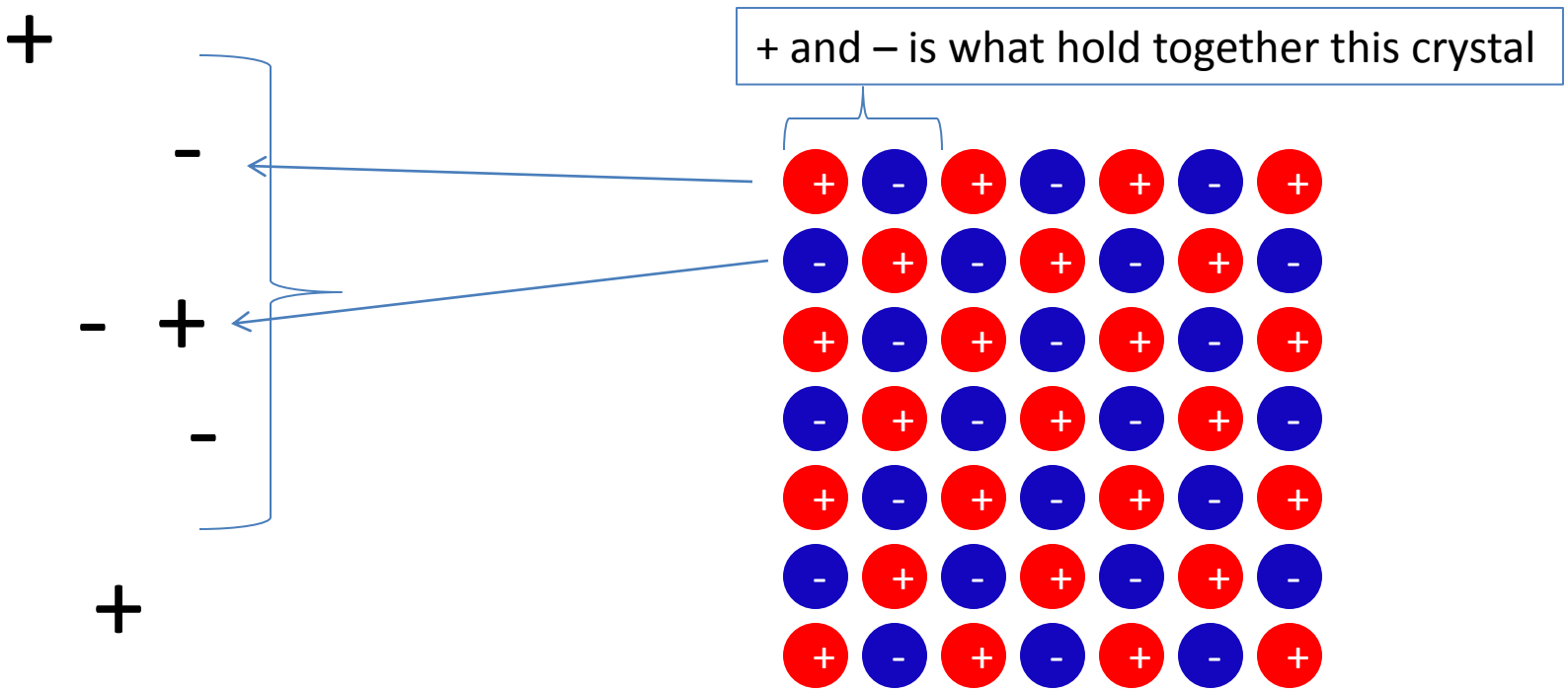
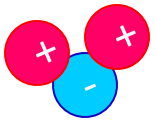
  - Difference of Charge
  - Atomic radius

Dissolving Ionic Crystals

- Electrostatic attraction holds together the ionic bond, but what happens if other +/- are present in the solution?
- Salt will break apart (dissolve)
- Ionic compounds can dissolve in polar solvents(charged)

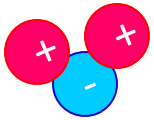


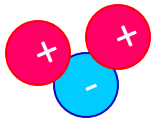
Dissolving Ionic Crystals

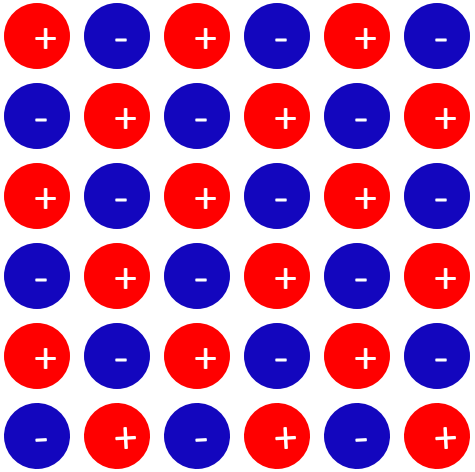


Water (H_2O)

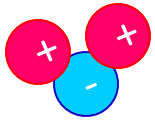
Electrostatic attraction pulls apart

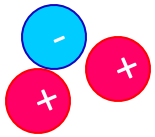






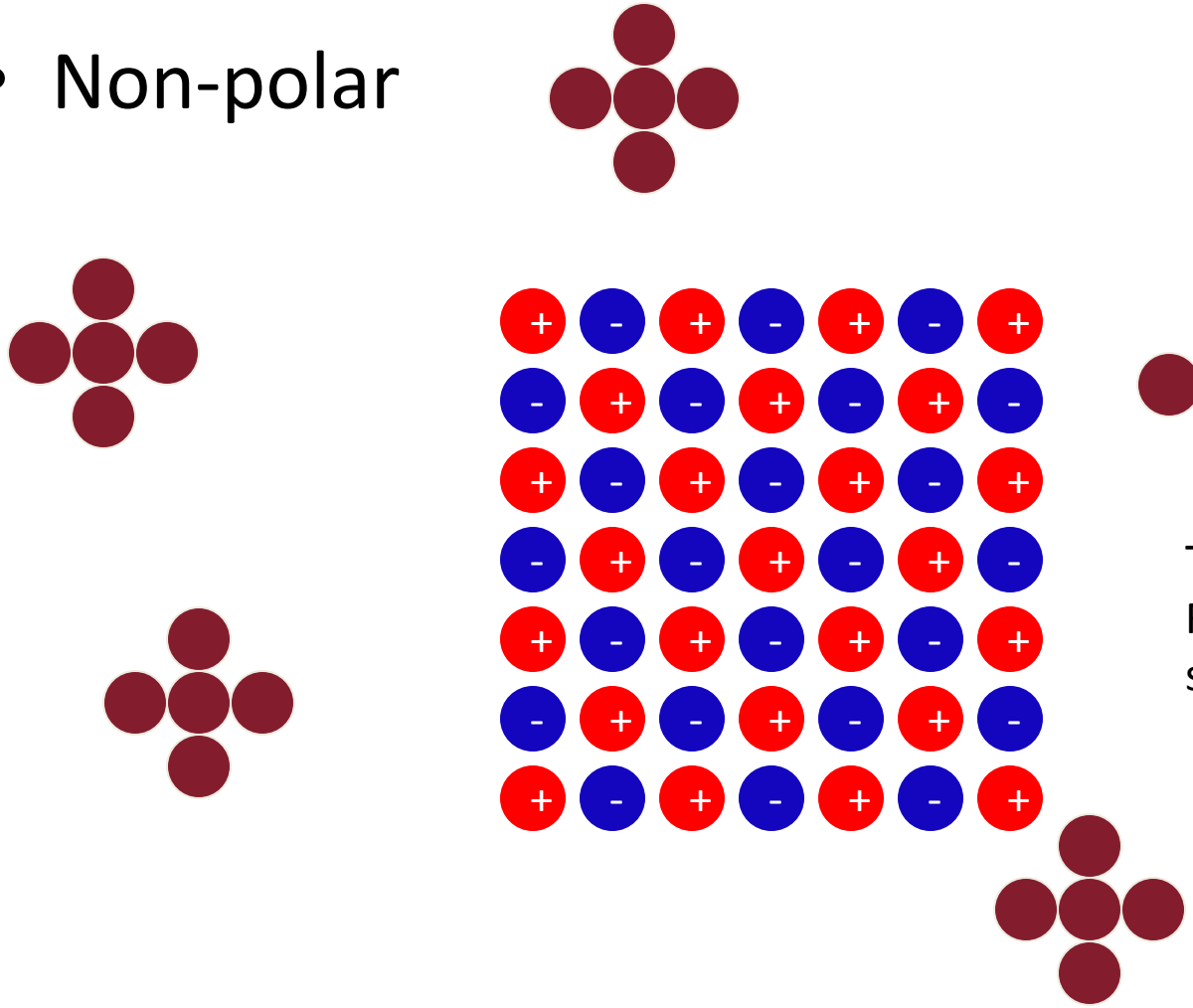
Do you see how a substance might become saturated???





Dissolve salt in non-polar solvent???

- Non-polar

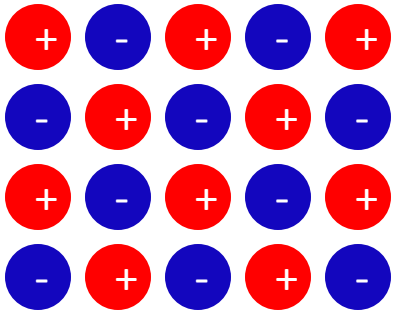


There is no reason
For the ions to
separate

Ionic Crystal Dissociate in Solution

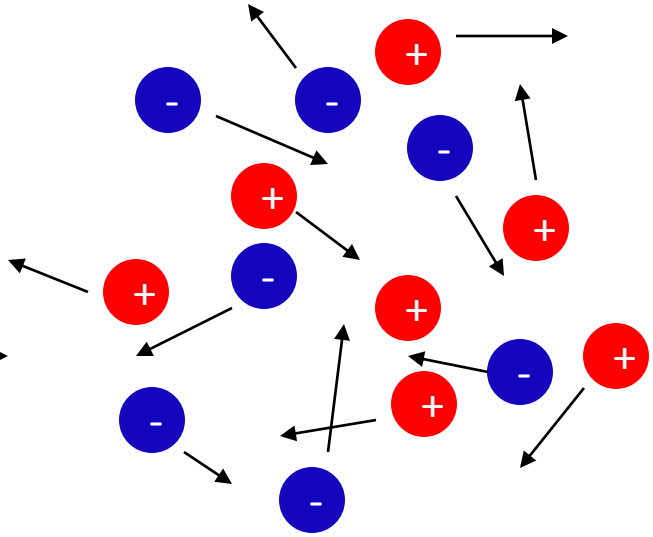
- $NaCl \rightarrow Na^{+} + Cl^{-}$
- $Na_3PO_4 \rightarrow 3Na^{+} + PO_4^{-3}$

Solid Ions



Dissolving particles

Free ions (liquid/aqueous)



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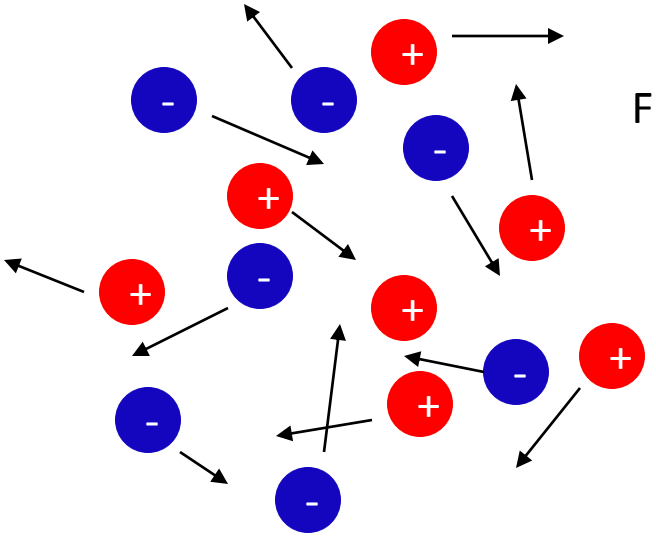
- Strength of ionic bonds (crystalline structure)
  - Difference of Charge
  - Atomic radius
- Dissolving ionic compounds
  - Better opportunities

Property of Ionic solutions

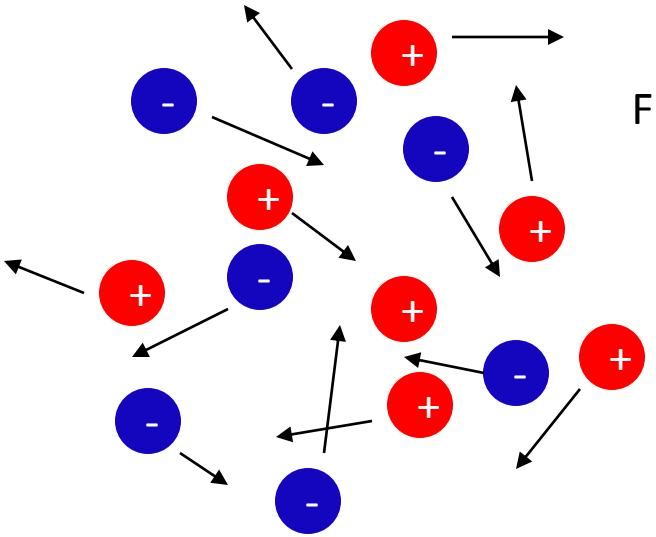
- Charged Ions conduct e^-
  - Pure water does not conduct electricity
  - Dissolve some ionic compound in water and it conducts electricity.



Free ions (liquid/aqueous)

Property of Ionic solutions

- Requirements for a solution to conduct electricity
  - Free moving charges



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- Dissolving ionic compounds
  - Better opportunities
  - Electrolyte/non-electrolyte