Water Chemistry

Bonding and Solubility

Water as solvent

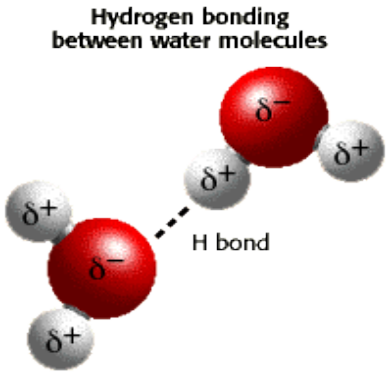
Water known as 'The Universal solvent' because it _____

Water is a _____ molecule, meaning that there is an uneven distribution of electron density.

Water has a partial negative charge (δ-) near the oxygen atom due the _____, and partial positive charges (δ+) near the hydrogen atoms.

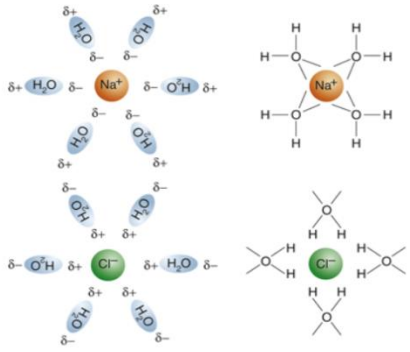
An electrostatic attraction between the _____ charge near the hydrogen atoms and the _____ charge near the oxygen result in the formation of a hydrogen bond as shown on the diagram.

Water molecules containing oxygen atoms which are bonded _____ with hydrogen atoms.



Extra Notes

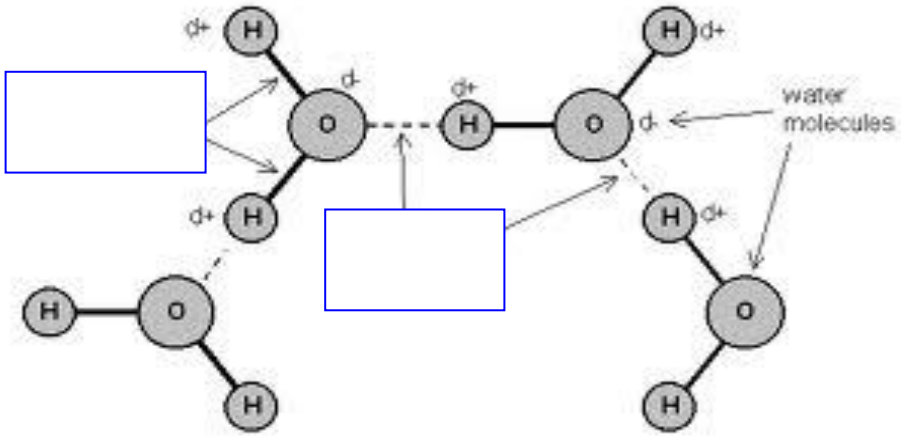
Effects of Hydrogen Bonding

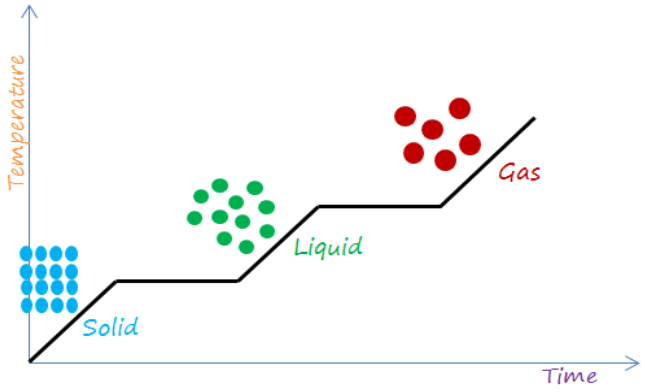


When sodium chloride is placed in a glass of water, the _____ of ions occurs.
The _____ part of an ionic compound is attracted to the oxygen side of water while the _____ portion of the compound is
attracted to the hydrogen side of water.

Despite its name as the "universal solvent" there are many compounds water won't dissolve or won't dissolve well.
If the attraction is high between the opposite-charged ions in a compound, then the solubility will be low.
For example, most of the hydroxide exhibit low solubility in water. Also, nonpolar molecules don't dissolve very well in water, including many organic compounds, such as fats and waxes.

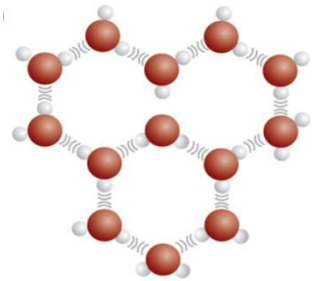
On the diagram below, label the bonds correctly in the spaces provided.





The relatively _____ and _____ of water compared to other substances of the similar molecular weight.
More heat is required to enable the molecules to gain sufficient _____ to break free of the hydrogen bonds, which are stronger than _____ forces alone.

As water freezes into ice, the molecules become frozen in place and begin to arrange themselves in a _____ structure



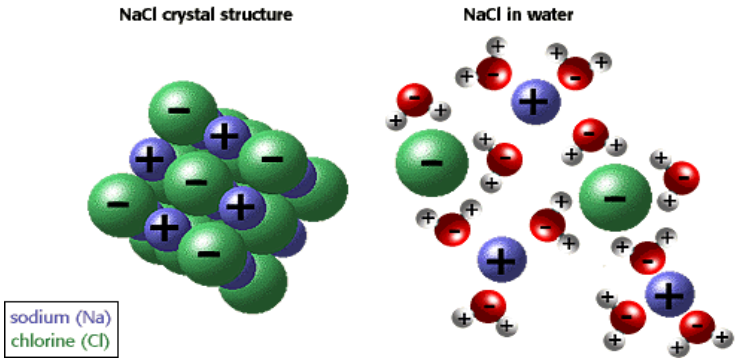
The open, hexagonal crystalline lattice of ice places the water molecules further apart than occurs in the liquid state.
Because water expands on freezing, it is less dense as a solid. Ice therefore floats on water.

While hydrogen bonds are relatively weak compared to other types of bonds, they are strong enough to give water many unique properties.
Various _____ forces between the water molecules, such as _____ forces, draw the liquid particles together.
Individual water molecules attract each other to form water droplets.

Solubility

What is solubility?

When one substance dissolves in another; the particles of the solute and solvent with separate from each other. The separated particles form the solvent and solute will then be attracted to each other.



The attraction between the Na^+ and Cl^- ions in the solid is so strong that only _____ like water dissolve NaCl well.

When dissolved in water, the sodium chloride framework disintegrates as the Na^+ and Cl^- ions become _____ by the polar water molecules.

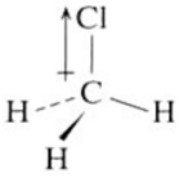
Substances that have _____ bonding are readily soluble in water.

These substances could be from one of the following categories:

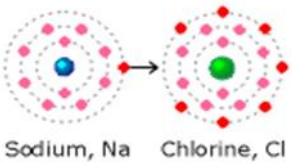
1: _____

2: _____

3: _____.



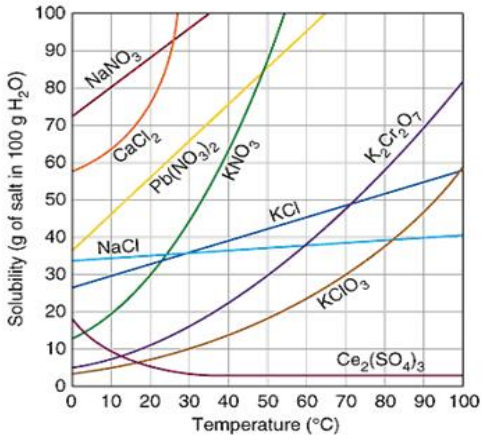
Polar covalent compound

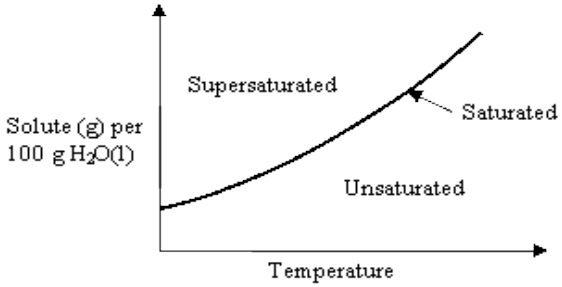


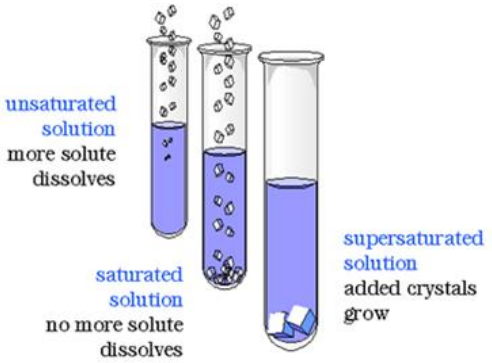
Ionic compound

Solubility curves

A solubility curve is a graph of the solubility of a compound (grams/100 grams water on the Y axis) at various temperatures (Celsius on X Axis). Each compound has a different curve.







When a substance falls:

On the line _____

Below the line _____

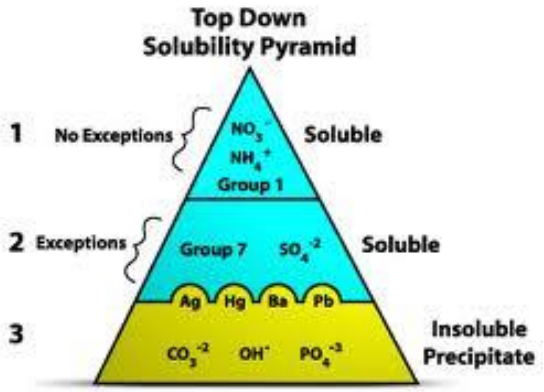
Above the line _____

Saturated	Unsaturated	Supersaturated

Solubility Rules

There are rules, or guidelines, strictly devoted to determining solubility of substances. If a substance involved is not soluble, the reaction will form a precipitate.

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
OH^-	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
K^+	soluble	none
NH_4^+	soluble	none



Extra notes: