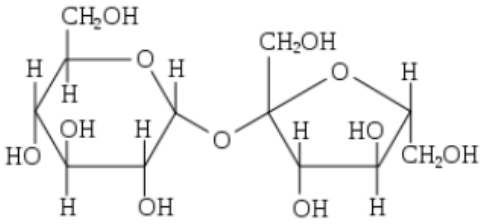
Types of Solids

Solids can be classified on the basis of the bonds that hold the atoms or molecules together. This approach categorizes solids as either molecular, covalent, ionic, or metallic.

Molecular Solids

- Covalently bonded molecules that are solid at room temperature
- Examples are Iodine (I_2), sugar ($C_{12}H_{22}O_{11}$), Dry Ice (frozen CO_2) and plastics.
- When water freezes, it also forms a molecular solid.
- Strong ***intramolecular*** bonds between the atoms that hold the molecule together
- Weak ***intermolecular*** bonds between one molecule and another
- Low melting points and low boiling points

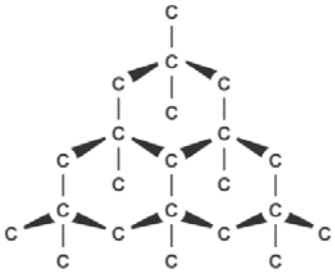


Sucrose (Sugar)

Solid Dry Ice

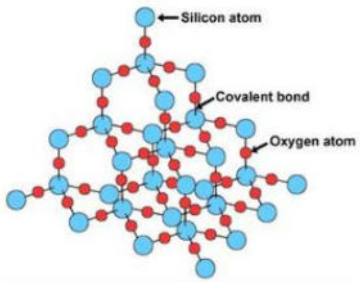
Network Molecular Solids

- Covalently bonded crystals that can be viewed as a single giant molecule made up of an almost endless number of covalent bonds.
- Examples are diamond (made of all carbon atoms) and glass (SiO_2)
- Because all of the bonds in this structure are equally strong, covalent solids are often very hard and they are notoriously difficult to melt.



Carbon Structure for Diamond

Crystalline structure

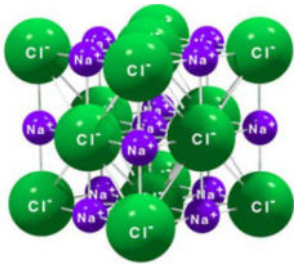


Silicon Dioxide Structure for Glass

Amorphous structure

Ionic Solids

- Made of a metal cation that is attracted to a nonmetal anion due to the transfer of valence electrons.
- Examples are sodium chloride, potassium sulfate, calcium carbonate
- Known as a SALT
- As the ions get larger the ionic bond gets weaker, because the charges are further apart
- High melting points
- High boiling points



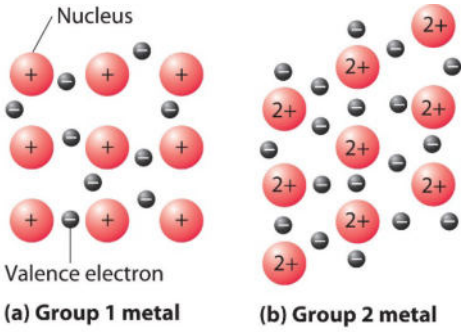
Sodium chloride

Calcium Carbonate

Metallic Solids

- Held together by the force of attraction between atoms in metals
- Valence electrons are ***delocalized***, meaning they can flow from one atom to the next in a ***sea of electrons***
- Examples: Gold, Iron, Bronze and other alloys
- Because these electrons aren't tightly bound to individual atoms, they are free to migrate through the metal. As a result, metals are good conductors of electricity. Electrons that enter the metal at one edge can displace other electrons to give rise to a net flow of electrons through the metal.

Gold



Sea of Electrons