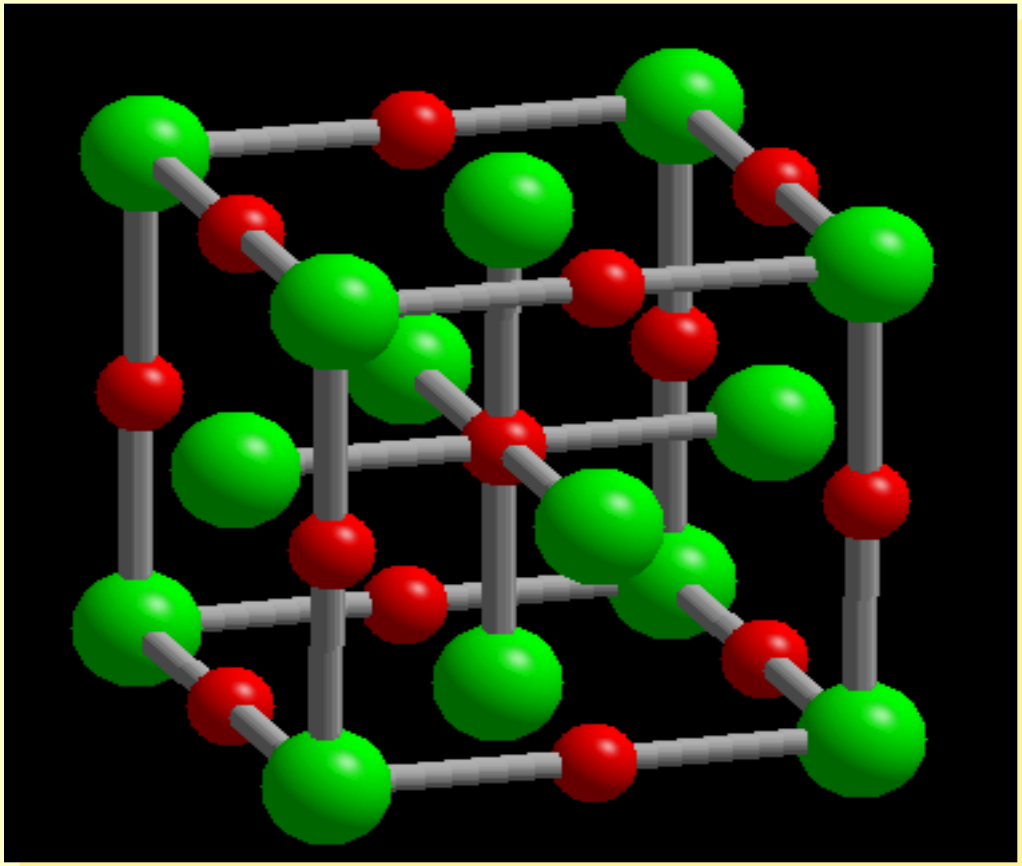
Solids



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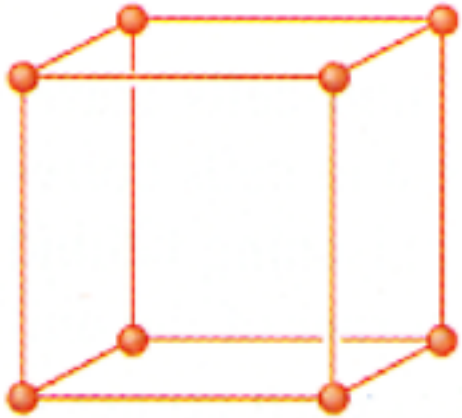
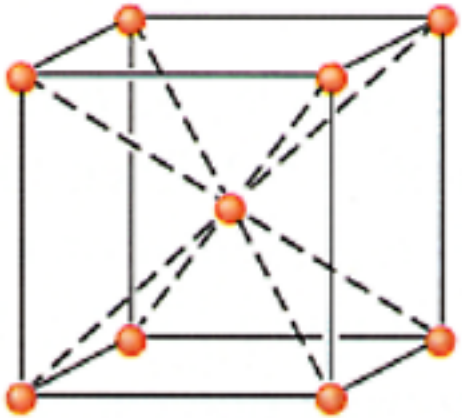
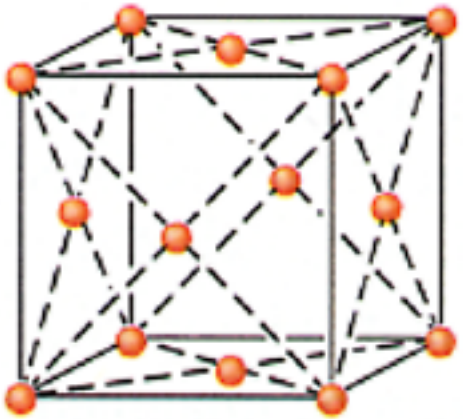
Crystal Systems



Simple cubic

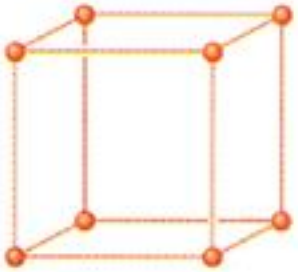


Body-centered cubic

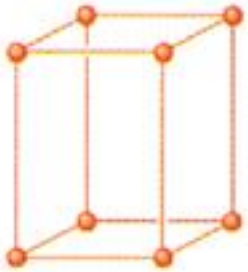


Face-centered cubic

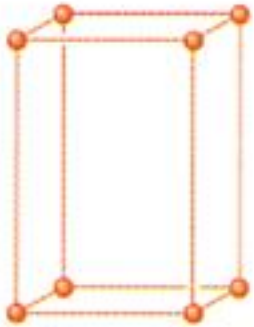
Crystal Systems



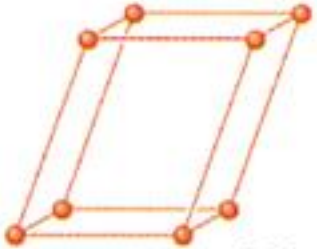
Cubic, simple



Tetragonal, simple

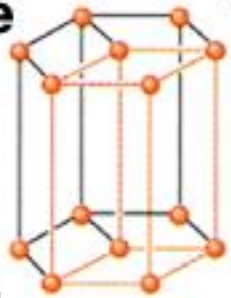


Orthorhombic, simple

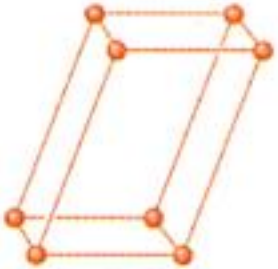


Monoclinic, simple

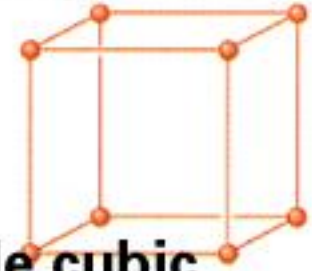
Rhombohedral



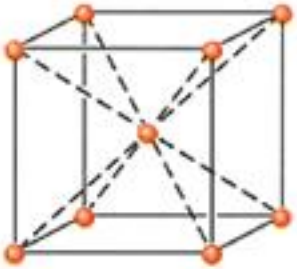
Hexagonal



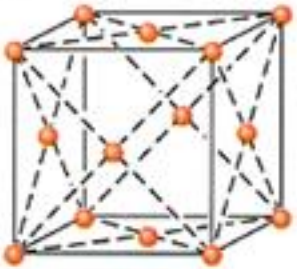
Triclinic



Simple cubic



Body-centered cubic

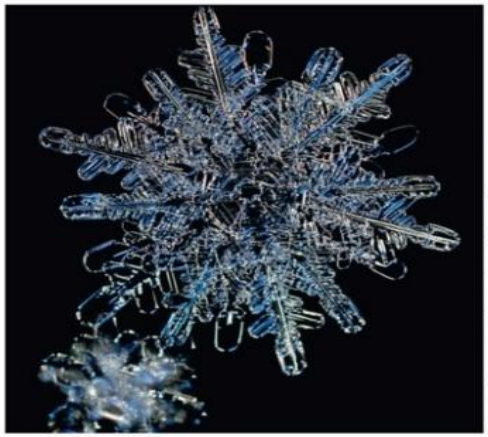


Face-centered cubic

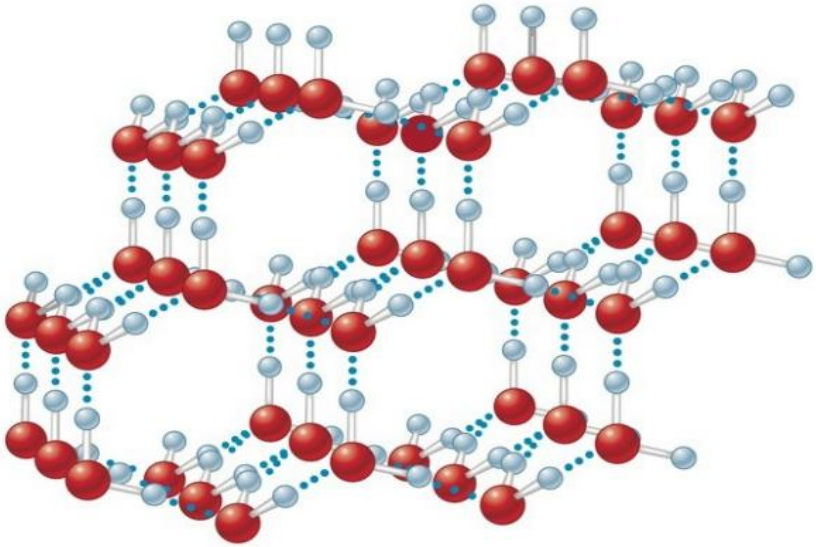
Types of Crystalline Solids

Type	Attractive forces	examples
Molecular	IMF's	Ice, dry ice, sugar
Ionic	Ionic bonds	NaCl, CaF_2, ZnS
Metallic	Metallic bonds	Na, Fe, Zn, Au
Covalent network	Covalent bonds	Diamond, graphite, gemstones

Example of a molecular solid: ice

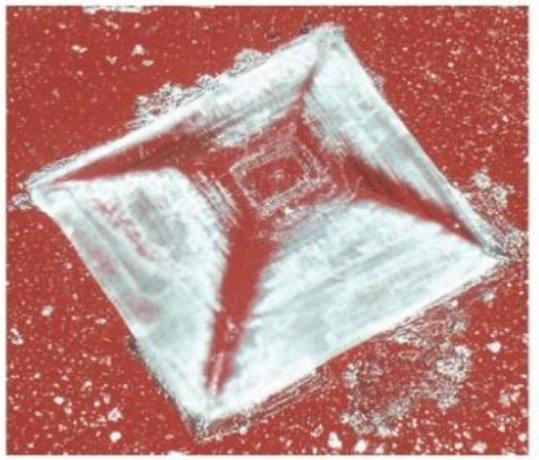


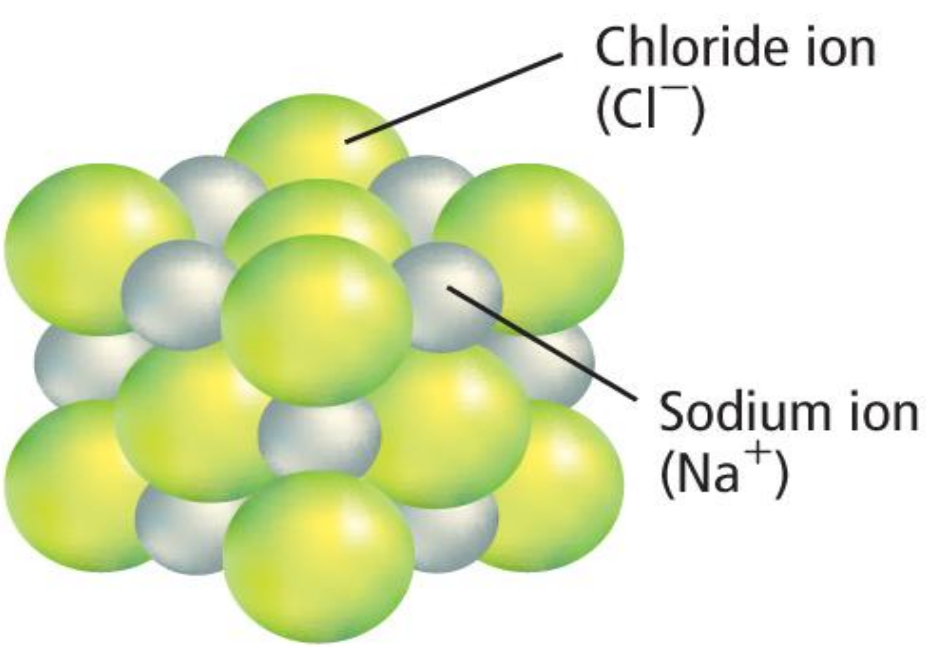
Note: the regular arrangement of the crystal maximizes the H-bonding (4/molecule) and as a side effect actually causes the molecules to move *further apart* than in the liquid state, thus rendering ice less dense than liquid water – ice floats. (Weird!)



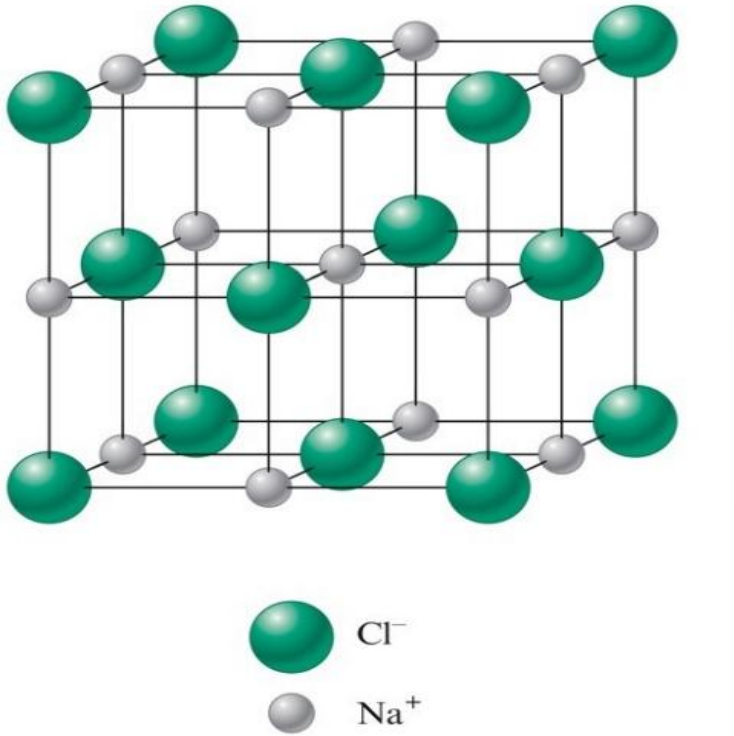
Example of an ionic solid:

salt



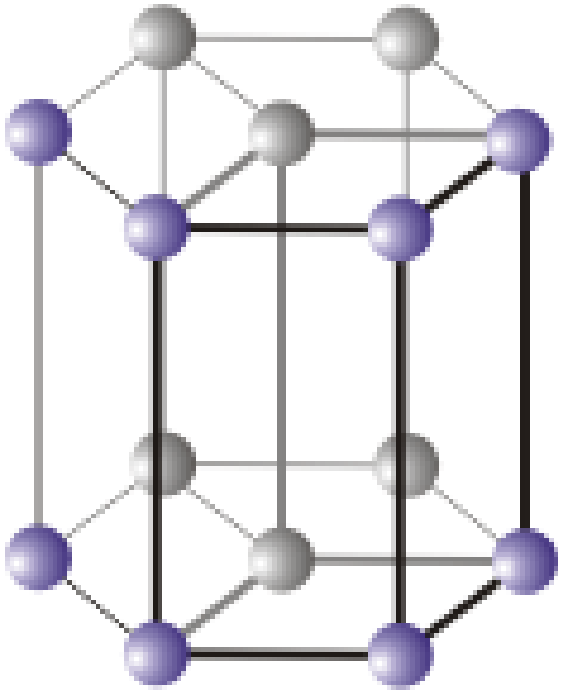


Sodium chloride crystal

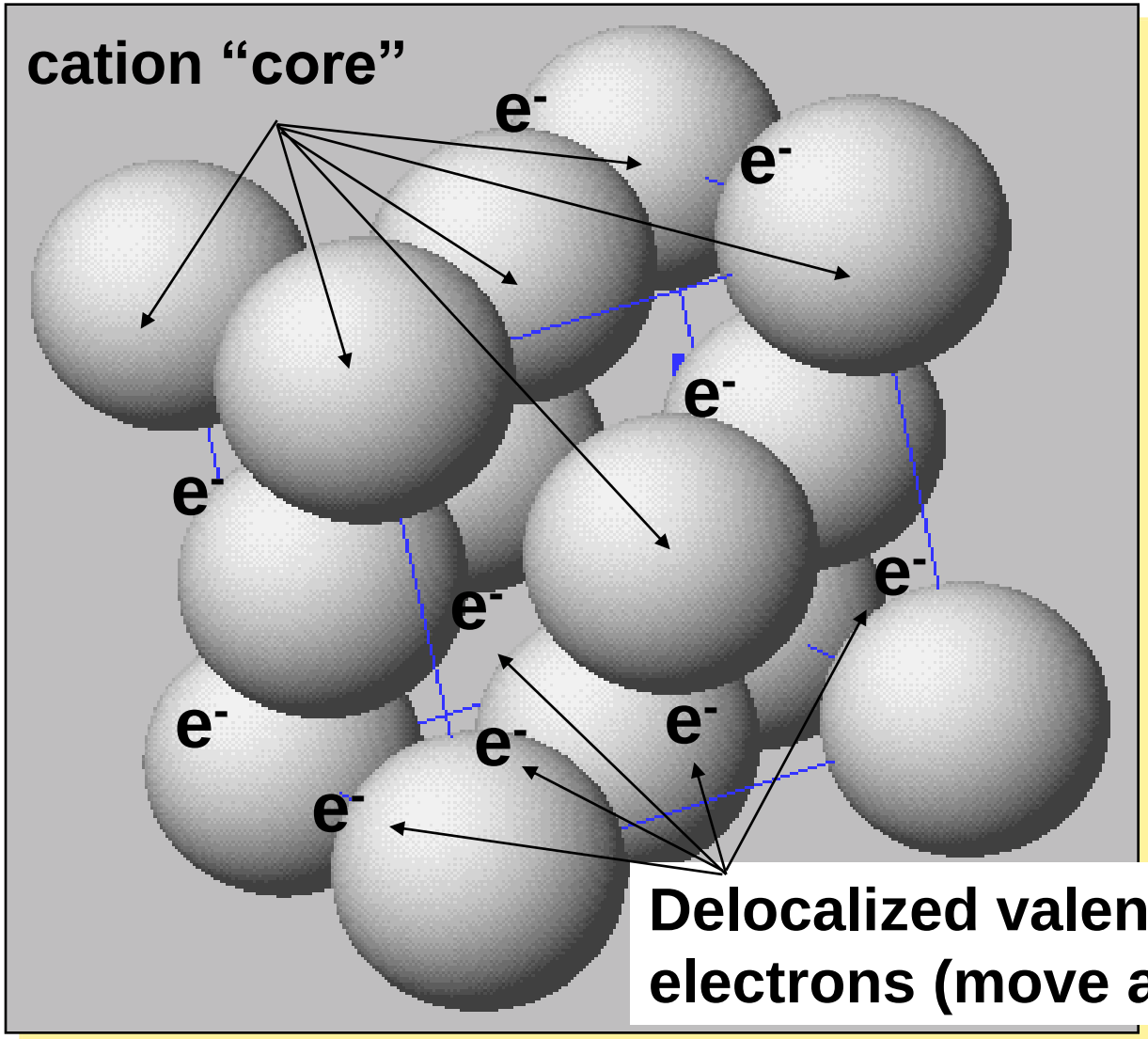


Example of a metallic solid:

magnesium

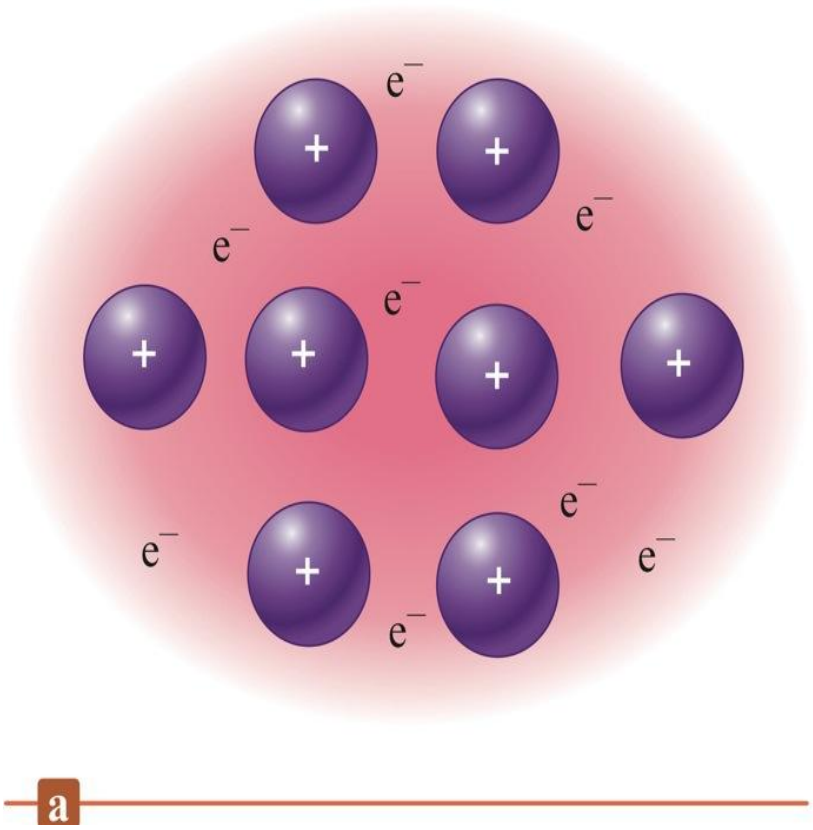


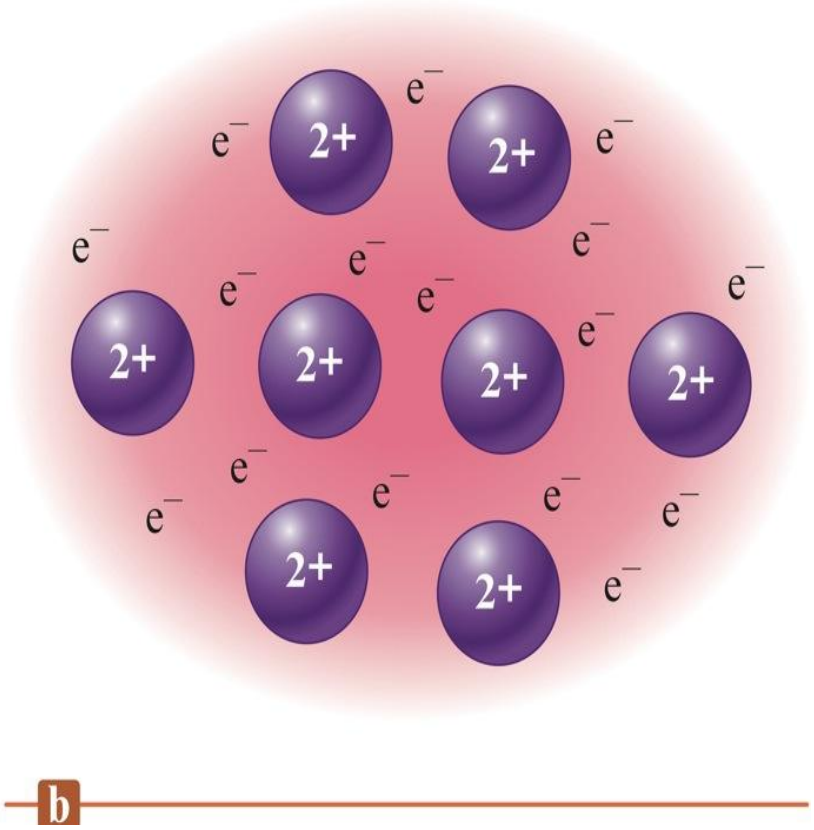
sea of electrons model



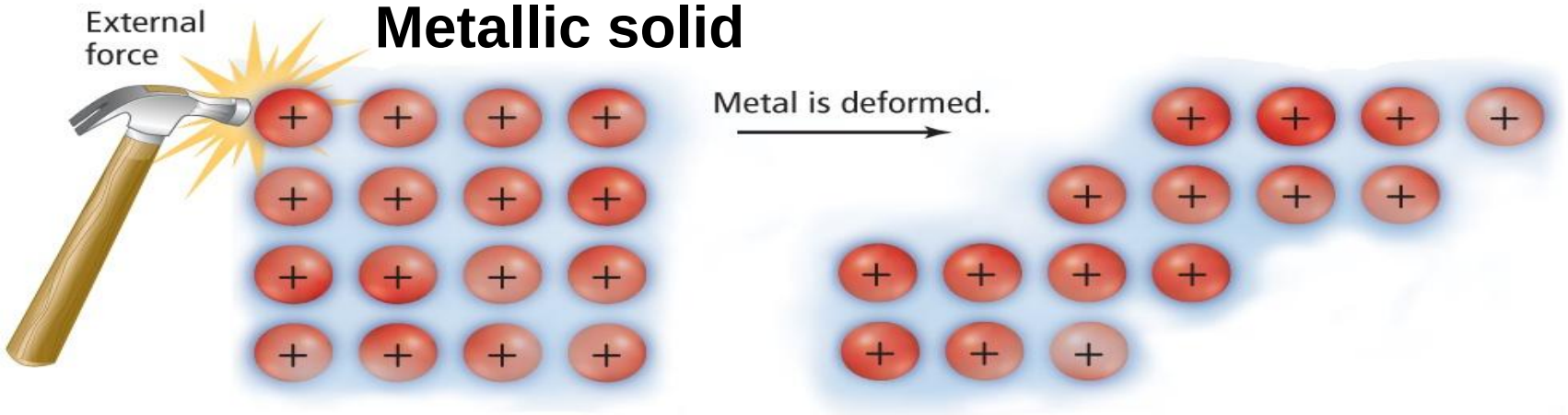
bonding in metals: - the “sea of electrons” model

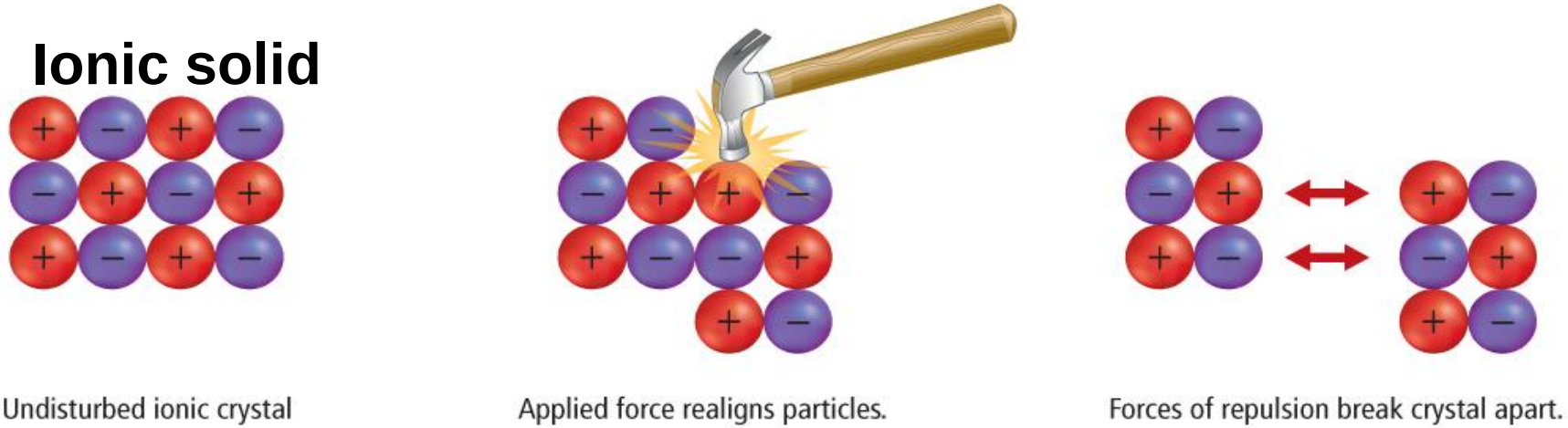
- **A regular array of cations in a “sea” of delocalized mobile valence electrons.**





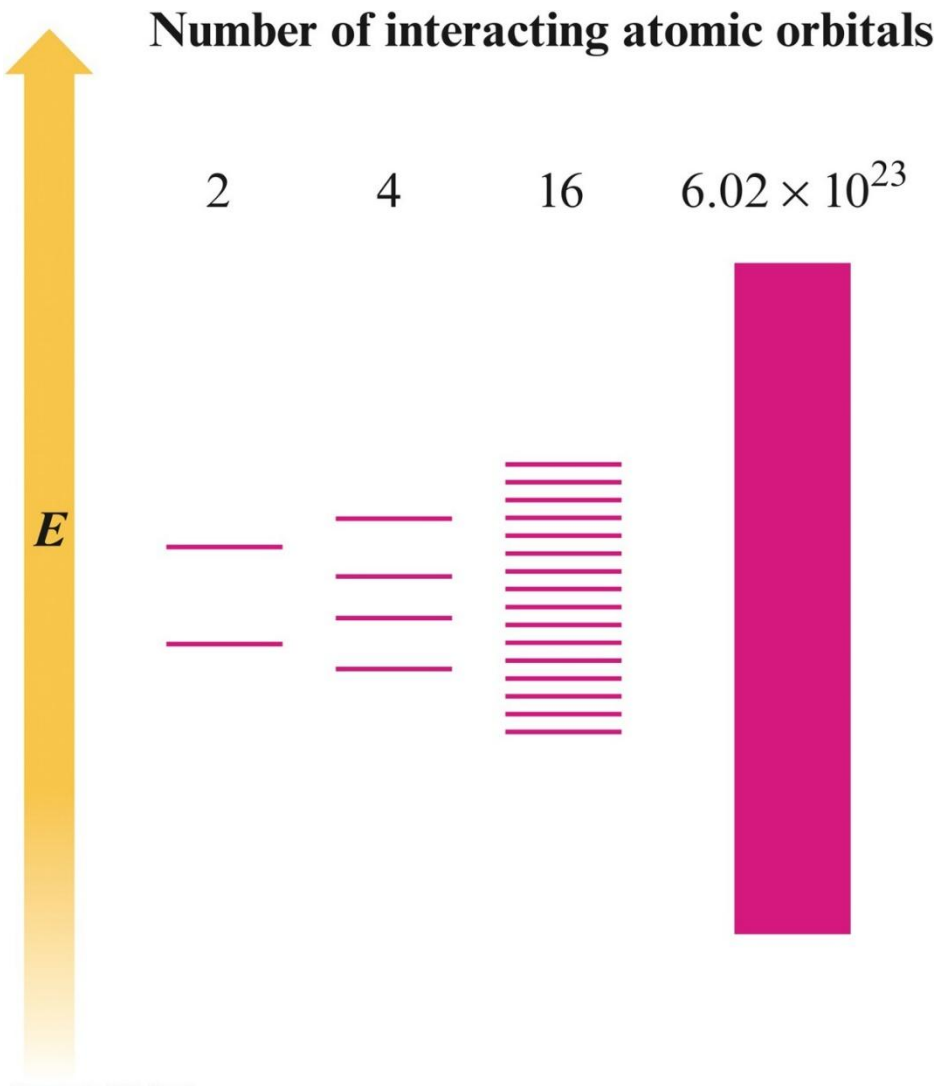
Why are metal solids malleable while ionic solids are brittle?





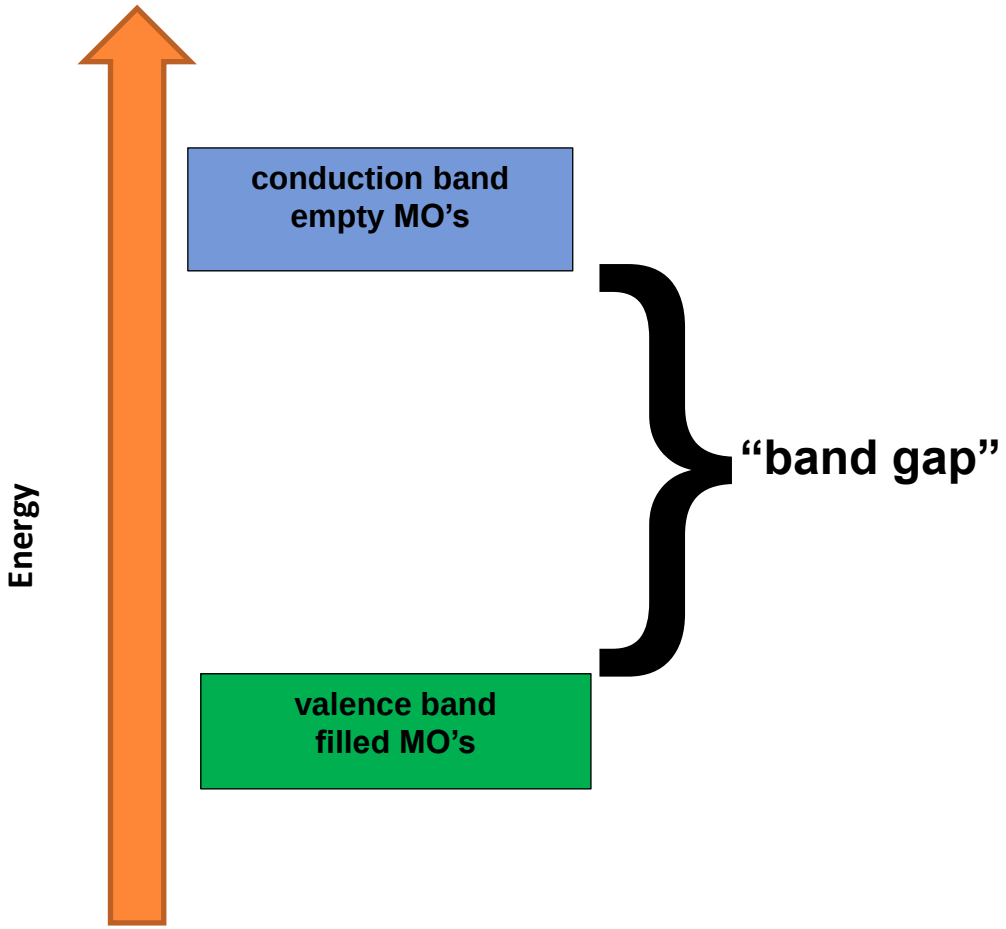
Bonding in metals: Band or Molecular Orbital (MO) Model

Molecular Orbital Energy Levels Produced When Various Numbers of Atomic Orbitals Interact

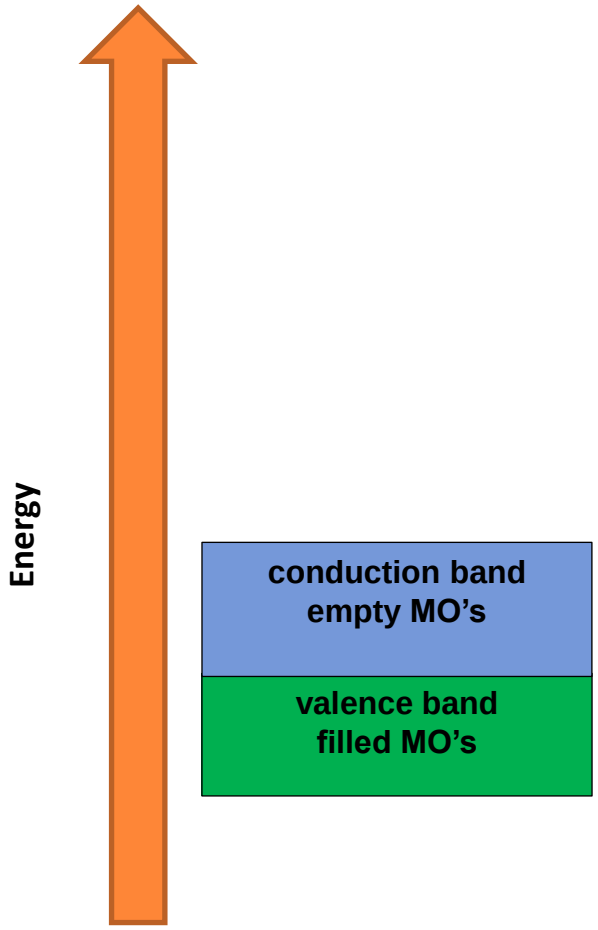


Partial Representation of the MO Energies in

a) an insulator

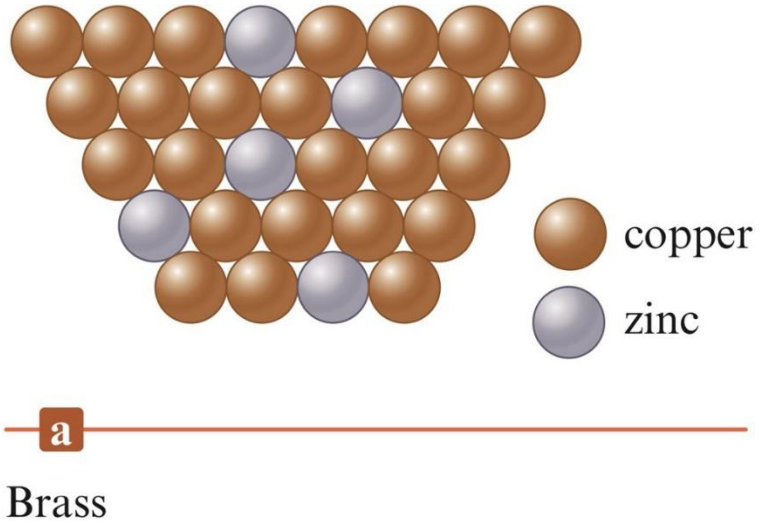


b) a typical metal



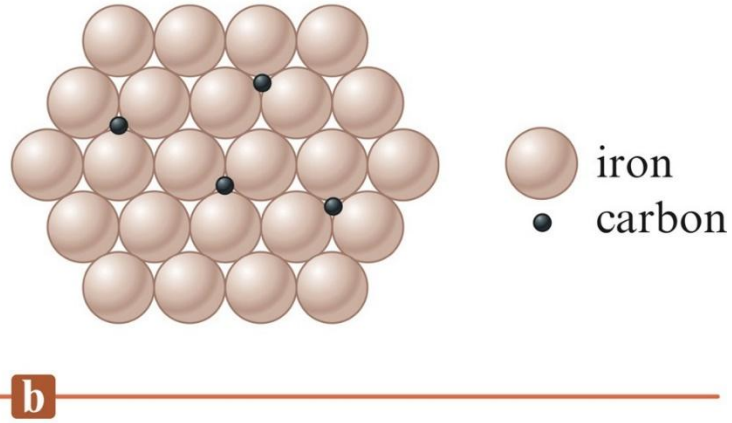
Two Types of Alloys

- **Brass is a *substitutional* alloy.**



Brass

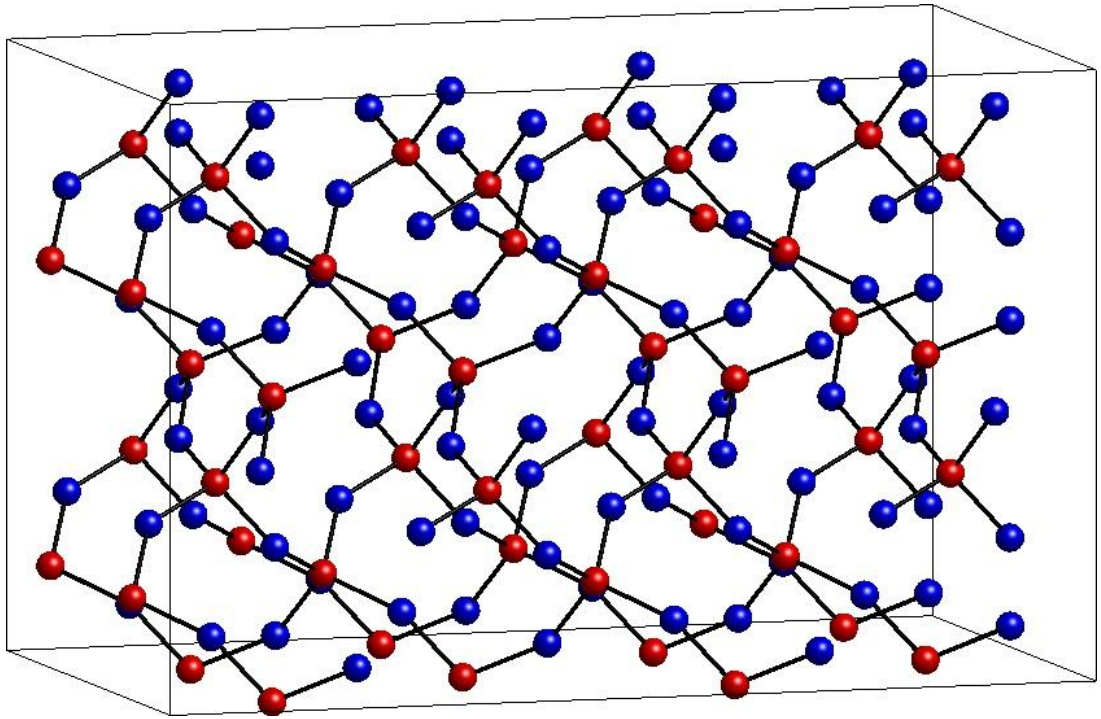
- **Steel is an *interstitial* alloy.**



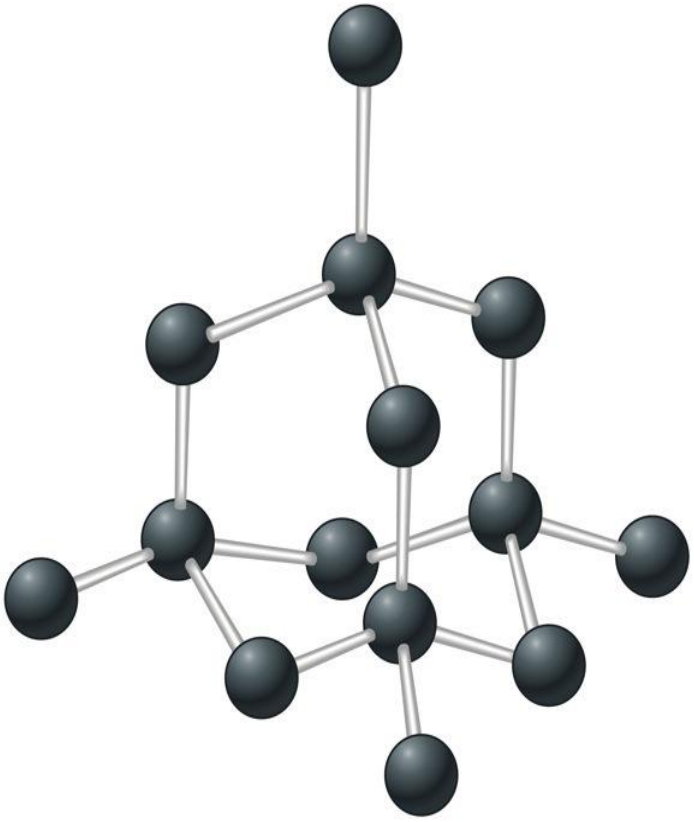
Steel

Example of a covalent solid:

quartz

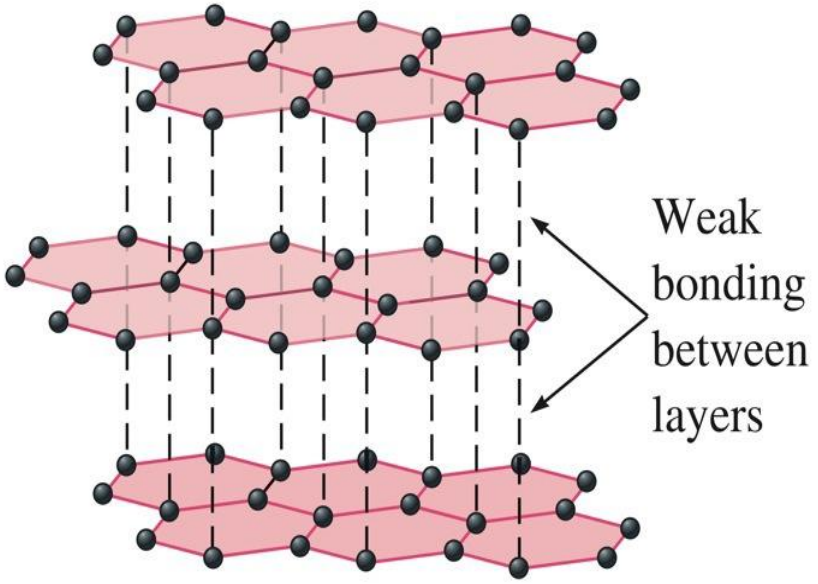


The structures of diamond and graphite



a

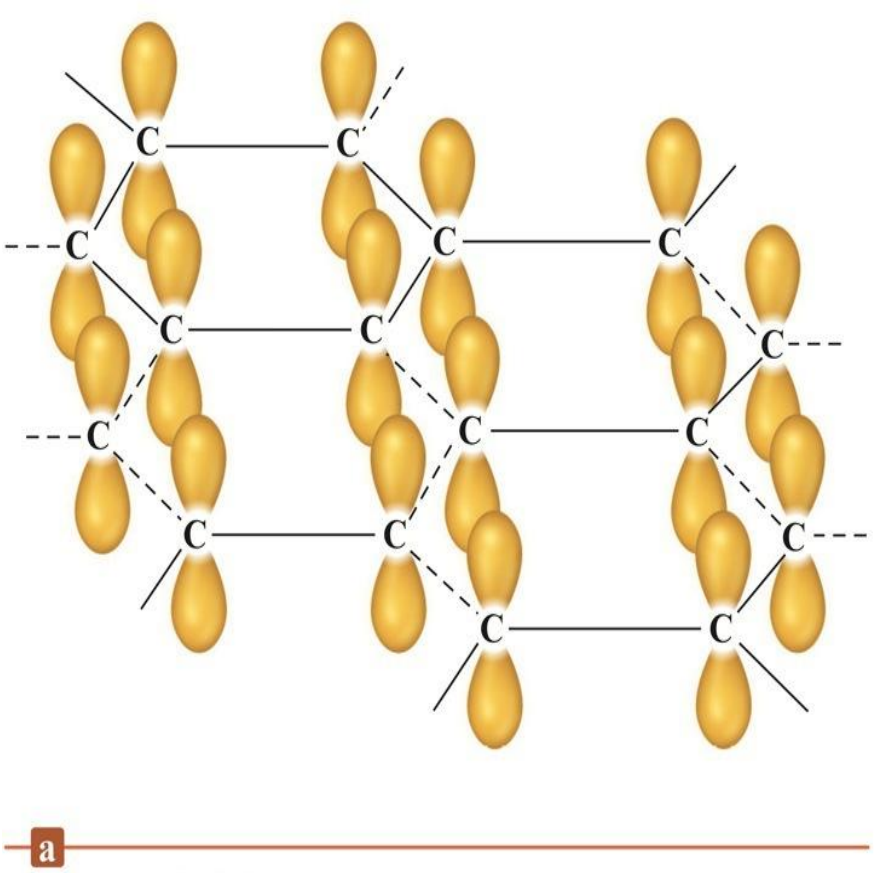
Diamond

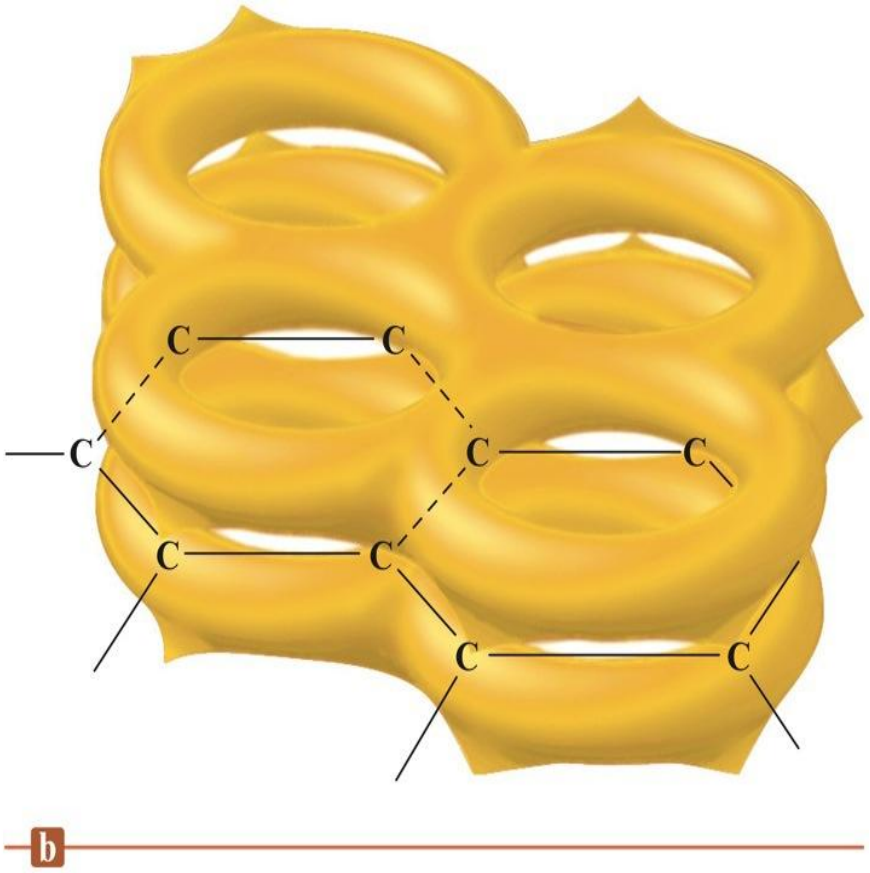


b

Graphite

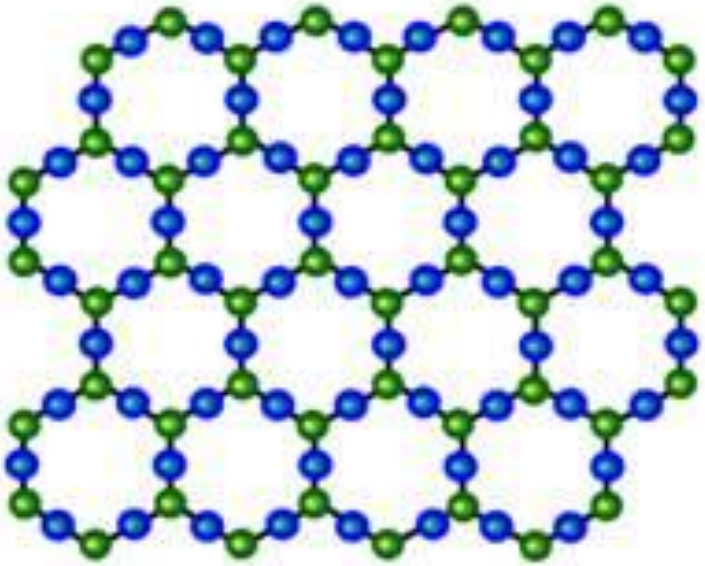
The unhybridized *p* orbitals and π-system in graphite



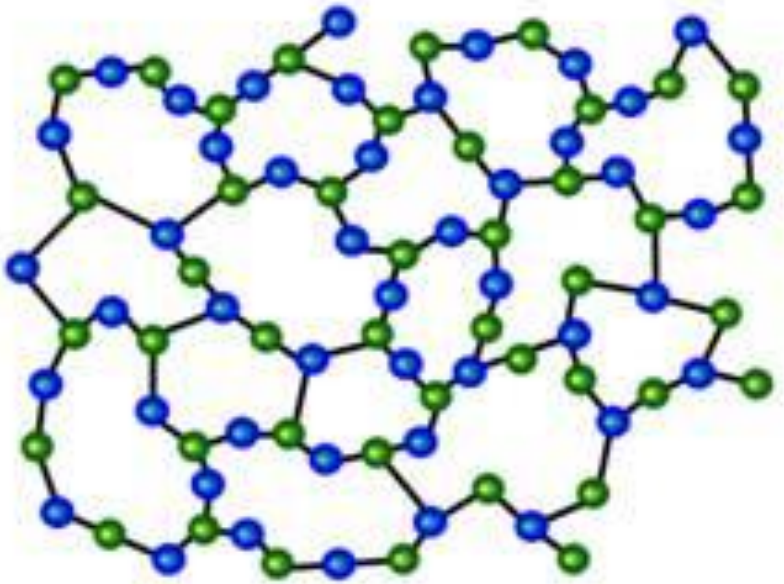


SiO_2: quartz vs. glass

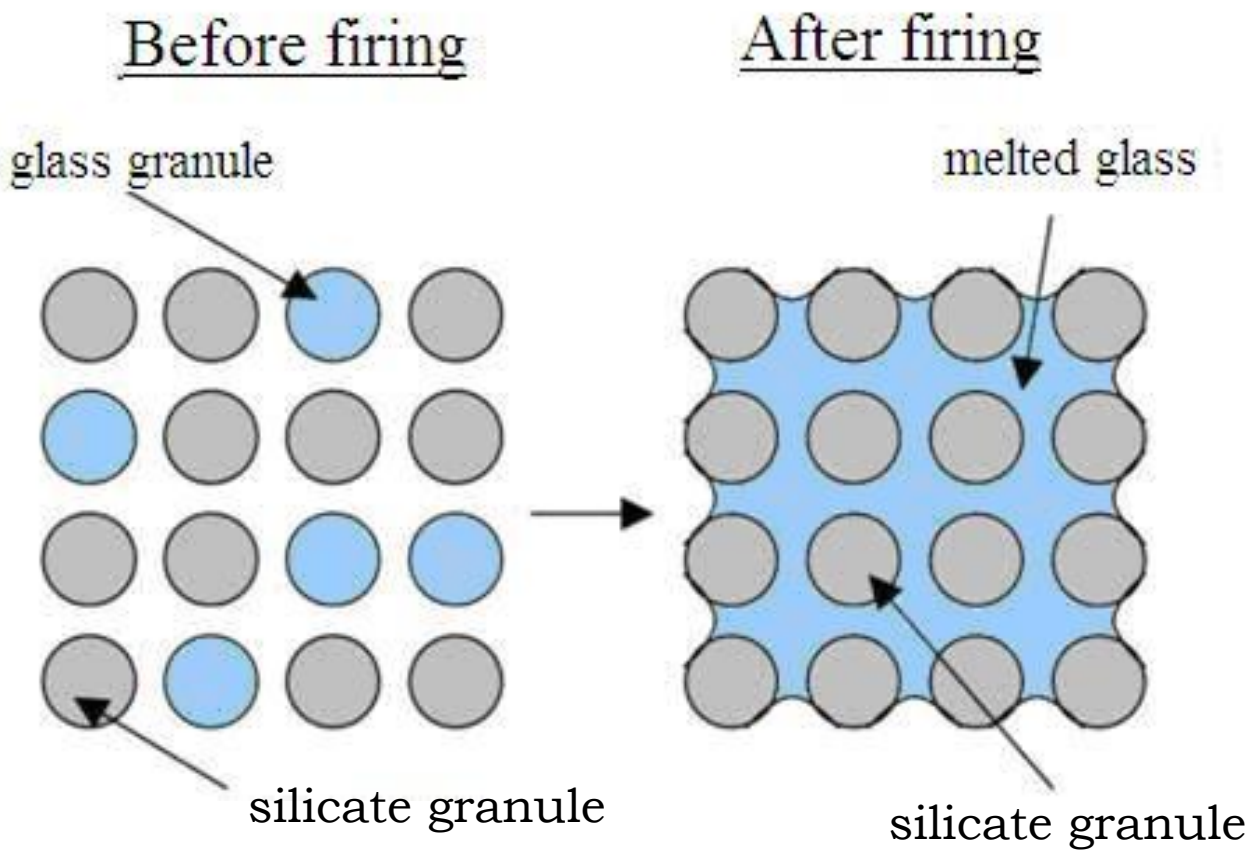
quartz (crystalline)



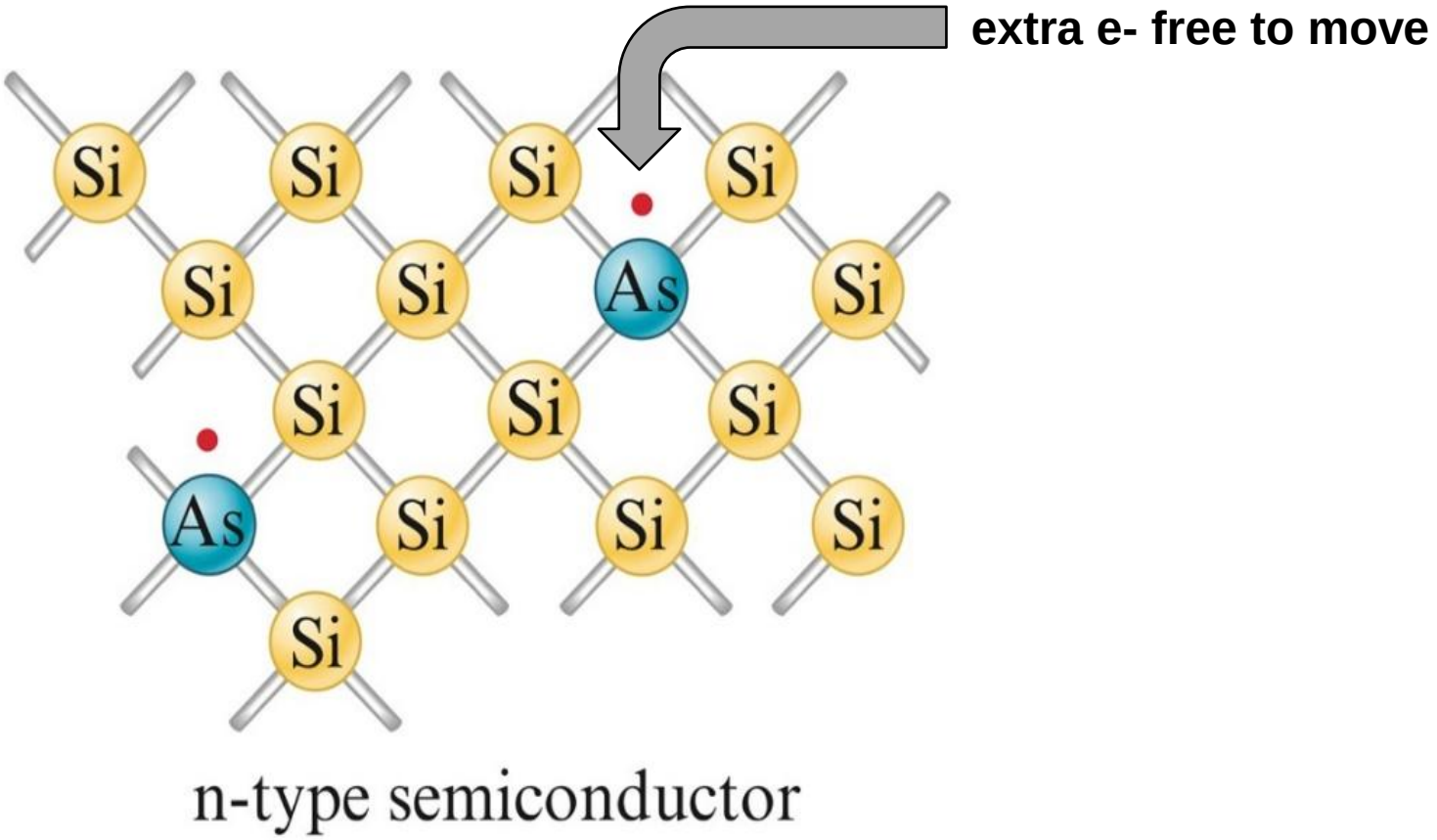
glass (amorphous)



Ceramics

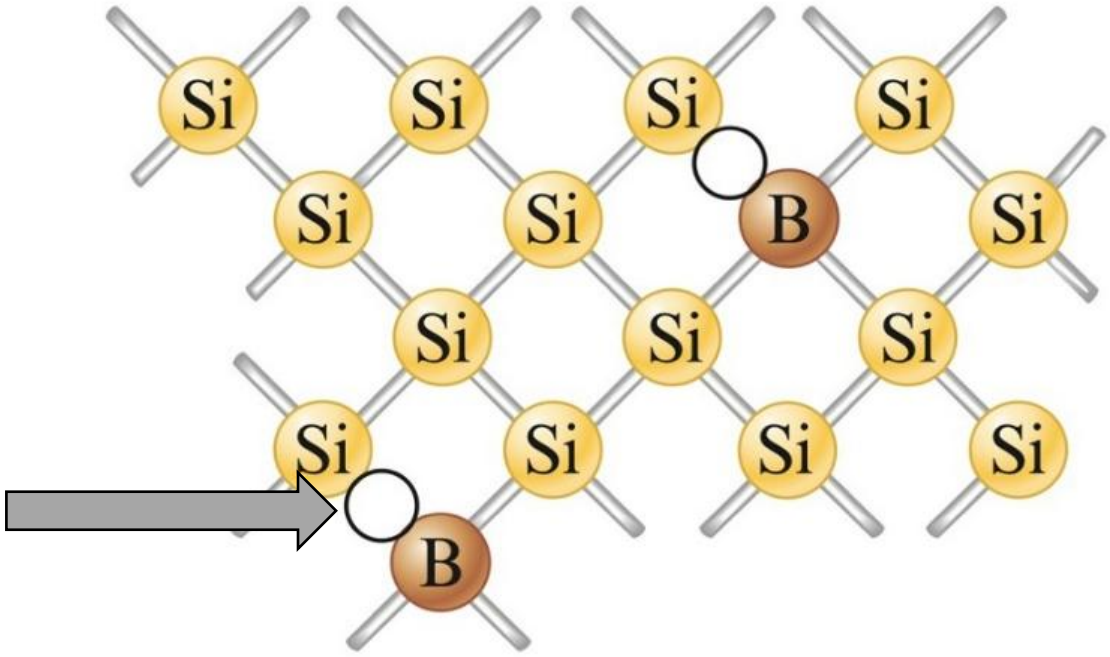

Before firing
After firing
glass granule
melted glass
silicate granule
silicate granule

n-type semiconductor: silicon crystal doped with arsenic



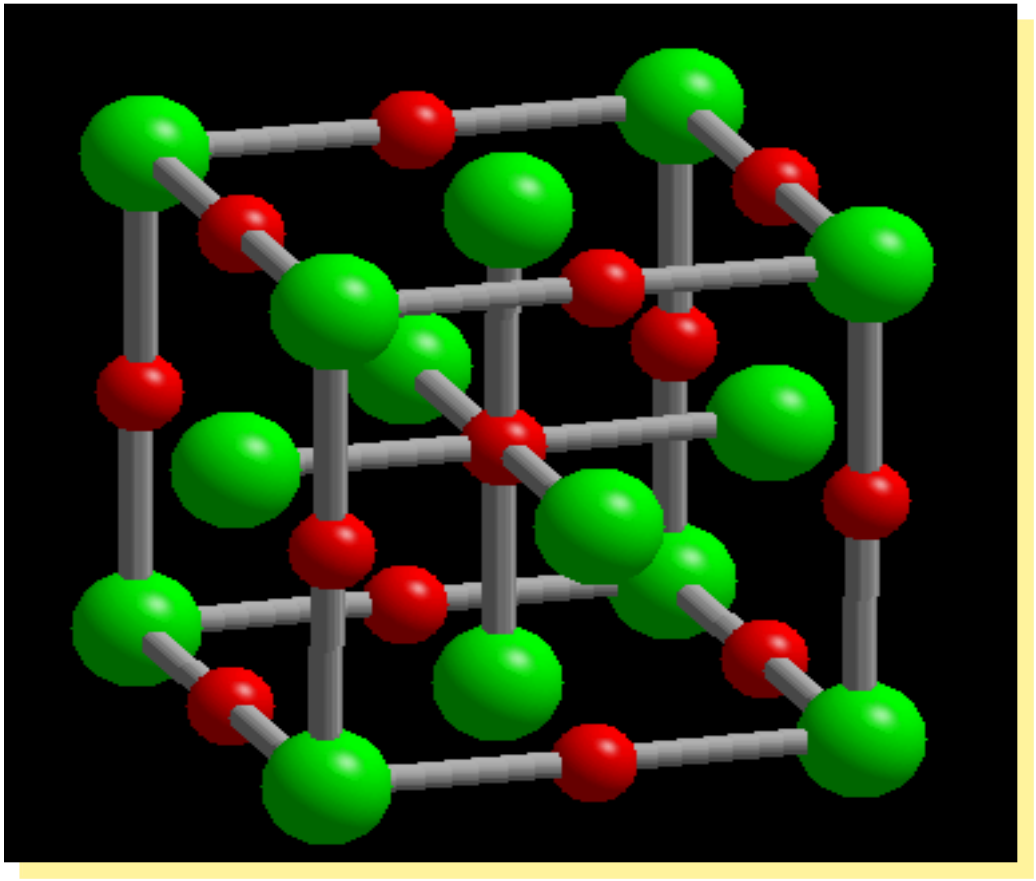
p-type semiconductor: silicon crystal doped with boron

A missing electron → a positive "hole" that moves in the opposite direction to the electrons that move to fill it



p-type semiconductor

Solids



Adapted from a presentation by Dr. Schroeder, Wayne State University

credits

- **Lifeinplanelight.wordpress.com**
- **Kinime.net**
- **Cengagelearning.com**
- **Periodni.com**
- **Chemistry.about.com**
- **Physicaplus.org.il**
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