Type of Solid	Form of Unit Particles	Forces Between Particles	Structure & Bonding	Properties	Examples
Covalent-Network Solids	Composed of atoms covalently bonded together into a three-dimensional network or layers of two-dimensional networks.	Covalent Bonds	Atoms connected in an extended network of covalent bonds.	○ Very hard. ○ Brittle. ○ Dull surface. ○ Very high melting point. ○ Low Density. ○ Poor to variable thermal and electrical conduction. ○ Semiconductors or insulators.	Carbon, metalloids, and compounds of metalloids. **Examples**: SiO_2, Silicon Carbide, C (Diamond), Quartz, Graphite.
Metallic Solids	Atoms	Metallic Bonds	3-D arrays of metal ions surrounded by a uniform sea of delocalized valence electrons.	○ Soft to very hard. ○ Malleable (and ductile; easily deformed under stress. ○ Lustrous. ○ Low to very high melting points. (Depends strongly on electron configuration). ○ Typically high density. ○ Excellent thermal and electrical conduction (Good conductors of heat and electricity).	Metal atoms only, Mixtures of metals from alloys. **Examples**: Al, Cr, Fe, Mg.
Ionic Solids	Positive and Negative Ions	Electrostatic Attractions	3-D crystal lattice of ions locked in place by relatively strong ionic bonds.	○ Hard, but brittle. ○ Shatter under stress. ○ Relatively dense. ○ Dull Surface. ○ High melting point. ○ Poor thermal and electrical conduction (Poor conductors of heat and electricity). ○ Nonconductors (insulators) in pure form, Conductors in water solution.	Compounds of metal cations and nonmetal anions; typical salts. **Examples**: NaCl, CaF_2, & Al_2O_3, $Mg(NO3)_2$.
Molecular Solids	Atoms or Molecules	London Dispersion forces Dipole-dipole forces Hydrogen Bond	Individually covalently bonded molecules held together by weak IMF.	○ Fairly soft. ○ Low to moderately high melting point. ○ Low density. ○ Dull surface. ○ Poor thermal and electrical conduction. ○ Nonconductors.	Compounds of nonmetals only. **Examples**: P_2O_5, $H_2O(s)$, $C_2H_{12}O_6$, $C_{12}H_{12}O_{11}$, CO_2, Ar.

Note:

- A *malleable material* is one in which a thin sheet can be easily formed by hammering.
- A *ductile material* is one that can easily be stretched, under tensile stress, into a wire when pulled.