

Student Handout 3 of 3: Intermolecular Forces

Type of Substance	Structural Unit	Force between Units	Properties	Example
Ionic	<p style="text-align: center;">ions</p> $\begin{matrix} m^+ & x^- & m^+ & x^- \\ x^- & m^+ & x^- & m^+ \\ m^+ & x^- & m^+ & x^- \\ x^- & m^+ & x^- & m^+ \end{matrix}$	Ionic Bonding (strong)	<ul style="list-style-type: none"> High melting point Conducts electricity only when melted or dissolved Usually water soluble Insoluble in non-polar solvents ("like dissolves like") 	NaCl MgO
Molecular	<p>a) non-polar molecules</p> <p style="text-align: right;">} covalent bonds</p>	Dispersion Forces (weak)	<ul style="list-style-type: none"> Low melting point and boiling point Nonconducting, insoluble in H₂O Soluble in nonpolar solvents 	H ₂ CCl ₄
	<p>b) polar molecules</p> $\begin{matrix} x-x & x-x & x-x \\ x-x & x-x & x-x \\ x-x & x-x & x-x \\ x-x & x-x & x-x \end{matrix}$	Dispersion Forces Dipole Hydrogen Bonding (Intermediate)	<ul style="list-style-type: none"> Higher melting point and boiling (higher than non-polar covalent solids) Nonconducting Likely to be soluble in H₂O 	HCl NH ₃ H ₂ O
Covalent Network Solids	<p style="text-align: center;">atoms</p> $\begin{matrix} & & & \\ -x-x-x-x- \\ & & & \\ -x-x-x-x- \\ & & & \\ -x-x-x-x- \\ & & & \end{matrix}$	Covalent Bond (strong)	<ul style="list-style-type: none"> Hard, solid VERY high melting point Non-conductors Insoluble in common solvents 	C (diamond) SiO ₂ (glass sand quartz) Si SiC
Metallic	<p style="text-align: center;">cations and mobile electrons</p> $\begin{matrix} m^+ & e^- & m^+ & e^- \\ e^- & m^+ & e^- & m^+ \\ m^+ & e^- & m^+ & e^- \\ e^- & m^+ & e^- & m^+ \end{matrix}$	Metallic Bond	<ul style="list-style-type: none"> Variable melting points (Hg is liquid at room temp. vs. Mg that melts at ~650°C) Insoluble in common solvents Malleable, ductile Good conductors May react with H₂O 	Na Hg Mg Fe

Bonding Hierarchy

