Molecule Type

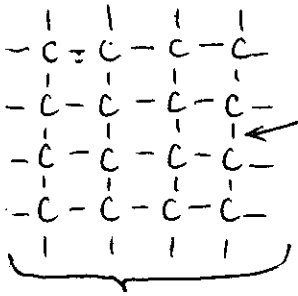
	Macro	vs.	Discrete Covalent
Type of Bonding Intramolecular	ionic covalent metallic		covalent
Size	→ really large → inexact		→ small → exact amount of atoms
Intermolecular Force	N.A.		→ van der Waals force → dipole interaction → hydrogen

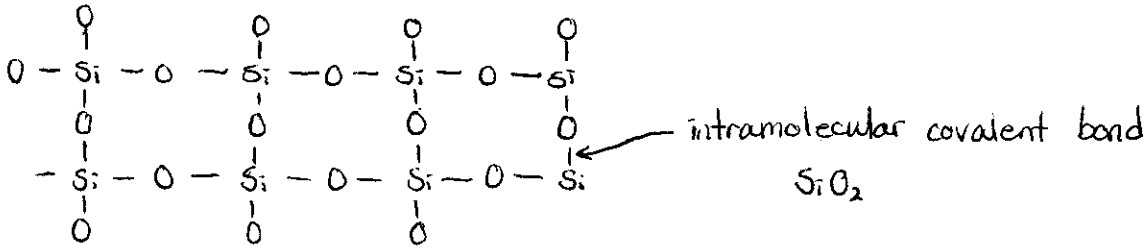
* intra = within
inter = between

examples =

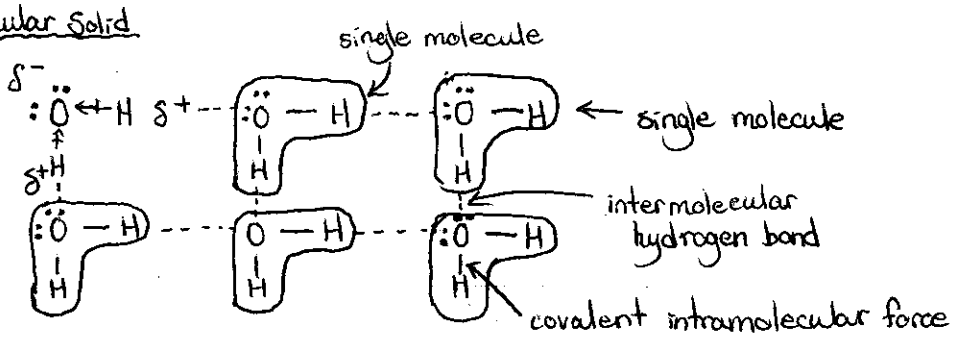
Covalent Network Solid

→ macromolecule
→ diamond
→ quarts





Molecular Solid



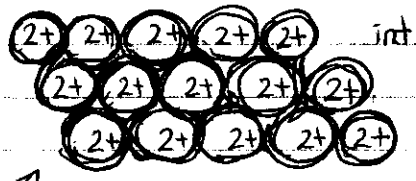
Ionic Solid

Na^{1+} Cl^{1-} Na^{1+} Cl^{1-}
Cl^{1-} Na^{1+} Cl^{1-} Na^{1+}
Na^{1+} Cl^{1-} Na^{1+} Cl^{1-} ← ionic intramolecular force
Cl^{1-} Na^{1+} Cl^{1-} Na^{1+}

single molecule

Metallic Solid

$Mg \rightarrow Mg^{2+} + 2e^-$ ← free roaming, delocalized



intramolecular metallic bond

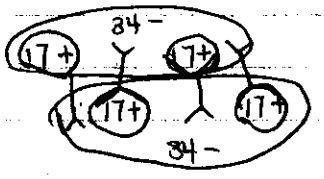
15 Mg^{2+} + $30e^-$

Intermolecular Forces

→ between discrete covalent molecules only
→ three types
  ↳ van der Waal (1)
  ↳ dipole interaction (3,6) ↓ increasing polarity
  ↳ hydrogen bond (10)
→ H-bond (dipole + van der Waal is also present)
→ dipole (van der Waal is also present)
→ van der Waal is just van der Waal

Van der Waals Force

→ attraction between nuclei of one molecule with the e^- cloud of a neighbouring molecule
→ also occur between individual atoms such as noble gases
ex. Cl_2 (l)



>—< = attractions

→ two factors determine strength

1) total # of e^-

→ more e^-, stronger attraction greater van der Waal

	# of e^-	M.P. (melting point)
He	2	1K
Ne	10	25K
Ar	18	84K
Kr	36	116K
Xe	54	161K
Rn	86	202K

↓ Evidence of increasing van der Waals force

2) shape

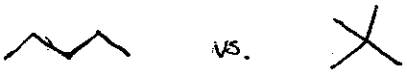
→ related to surface contact

→ greater the surface contact, the greater the van der Waals force

→ solids ⇒ symmetric molecules have higher v.d.W forces (make more organized crystals)

→ liquids ⇒ long snaky molecules have better overlap (more contact between molecules ∴ greater v.d.W

ex. isomers of C_5H_{12}



		vs.	
M.P.	−130°C		−20°C
B.P.	36°C		9°C

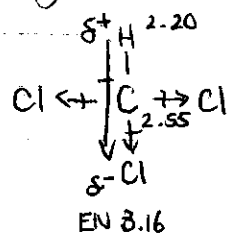
Dipole Interaction

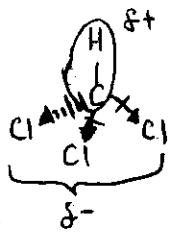
→ need a polarized discrete covalent molecule

↳ bond polarizations

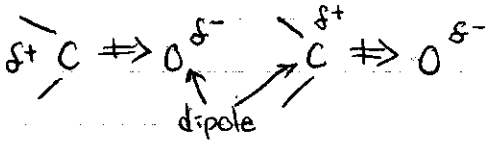
↳ correct geometry

→ regions of δ^+ and δ^- charge interact with δ^- / δ^+ on adjacent molecules

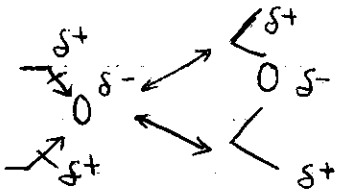




→ stronger polarization & better geometry improve dipoles



better geometry than



Hydrogen Bond

→ be careful, don't over use

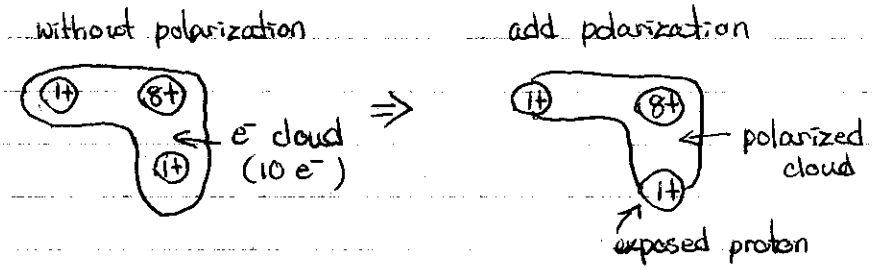
→ two conditions

↳ need an exposed proton

↳ need a hard lone pair

→ exposed proton

ex. H_2O



↳ only N, O, and F can expose a proton

EN 3.04 3.44 3.98

↳ sufficient electronegativity

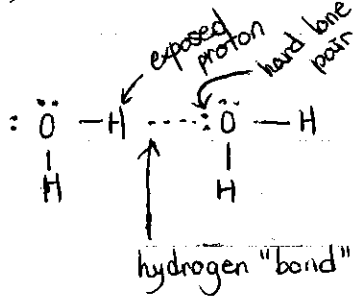
↳ electron cloud is strong & hard (∴ Cl | EN = 3.16) does not expose a proton

→ need a hard lone pair

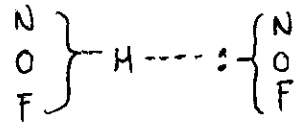
↳ small enough to interact strongly

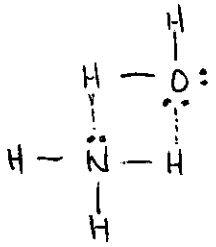
↳ only N, O, & F have such a pair

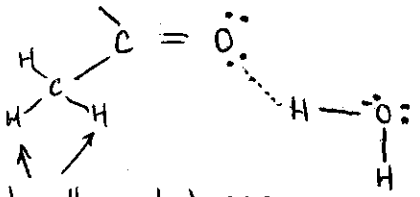
ex.



* "bond" - has directional characteristics

generic 

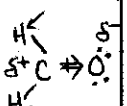
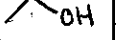




* note: these hydrogen cannot H-bond at all

Classification Exercise

molecular solids, molecular liquids

Ionic Solids	Covalent				Metallic Solids
	Covalent Network Solids	Discrete Covalent Molecules			
		v.d.W	dipole	H-bond	
NaCl (s)	C_n - diamond		 non-polar ∴ not H-bond		Fe (s)
MgO	$(SiO_2)_n$-quartz				$Al_{0.95}Mg_{0.05}$
KI	Si				
LiF	SiC				
	AlN				