Properties of Solids

Model 1 – Types of Solids

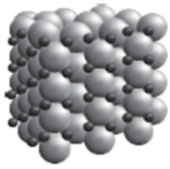
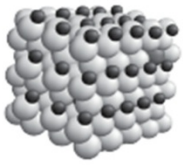
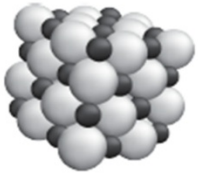
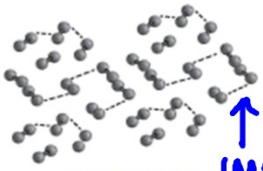
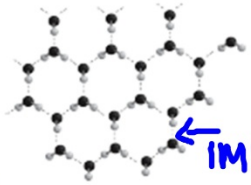
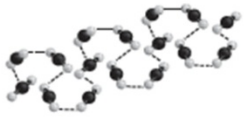
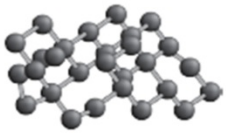
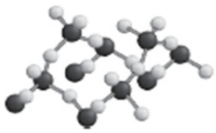
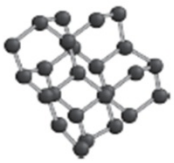
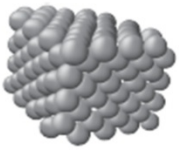
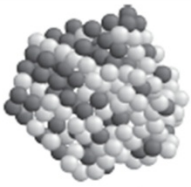
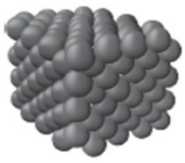
Ionic Solids	 Iron(II) Sulfide (FeS)	 Calcium Bromide ($CaBr_2$)	 Sodium Chloride (NaCl)
Molecular Solids	 Nitrogen (N_2) IMF	 Ice (H_2O) IMF	 Dry Ice (CO_2)
Network Covalent Solids	 Diamond (Carbon)	 Silica (SiO_2)	 Silicon (Si)
Metallic Solids	 Platinum (Pt)	 Brass (Cu and Zn)	 Nickel (Ni)

Table 1

pick one pick one

	A	B	C	D	E	F
	All atoms are nonmetals	All atoms are metals	Atoms are metals and nonmetals	Molecular structure	Formula units	Attractive forces
Ionic Solids			✓		✓	Ionic bond
Molecular Solids	✓			✓		IMF's & Covalent bonds
Network Covalent Solids	✓				✓	Covalent bonds
Metallic Solids		✓			✓	Metallic Bonds

Repeating 3D pattern

Table 2

	Bonds/forces broken upon melting	Individual particles in the liquid
Ionic	Ionic bonds	ions
Molecular	IMF's	molecules
Network covalent	Covalent bonds	atoms
Metallic	metallic bonds	atoms

Model 2 – Melting Points and Enthalpies of Fusion

Type of Solid	Substance	Chemical Formula	Melting Point (°C)	Heat Melting Enthalpy of Fusion (kJ/mole)
Ionic	Iron(II) sulfide	FeS	1195	51.0
	Calcium bromide	$CaBr_2$	730	17.5
	Sodium chloride	NaCl	804	30.3
Molecular	Nitrogen	N_2	–210	0.72
	Water	H_2O	0.0	6.02
	Carbon dioxide	CO_2	–78	8.10
Network covalent	Diamond	C	3550	117.0
	Silica	SiO_2	1650	12.5
	Silicon	Si	1687	50.0
Metallic	Platinum	Pt	1770	24.0
	Brass	Cu and Zn	~930	Varies
	Nickel	Ni	1453	71.0

1. If both molecular and network covalent solids contain covalent bonds, then why are the melting points of molecular solids so much lower than those of network covalent solids?

IMF's are broken in molecular solids whereas covalent bonds in network covalent solids. IMF's are much weaker attractions than covalent bonds, thus molecular solids have lower melting points.

Model 3 – Solubility and Conductivity of Solids

Substance	Chemical Formula	Solubility in Water	Conductive as a Solid	Conductive as a Liquid	Conductive in Aqueous Solution
Iron(II) sulfide	FeS	Insoluble	No	Yes	N/A
Calcium bromide	$CaBr_2$	Very soluble	No	Yes	Yes
Sodium chloride	NaCl	Very soluble	No	Yes	Yes
Nitrogen	N_2	Slightly soluble	No	No	No
Water	H_2O	N/A	No	Slightly	N/A
Carbon dioxide	CO_2	Slightly soluble	No	No	No
Diamond	C	Insoluble	No	No	N/A
Silica	SiO_2	Insoluble	No	No	N/A
Platinum	Pt	Insoluble	Yes	Yes	N/A
Brass	Cu and Zn	Insoluble	Yes	Yes	N/A
Nickel	Ni	Insoluble	Yes	Yes	N/A

N/A = not applicable

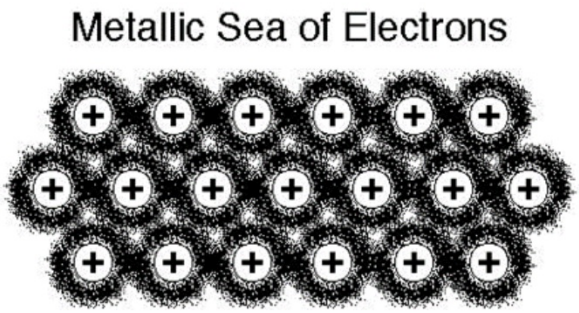
2. In general, which type of solid is very soluble in water? Explain your reasoning.

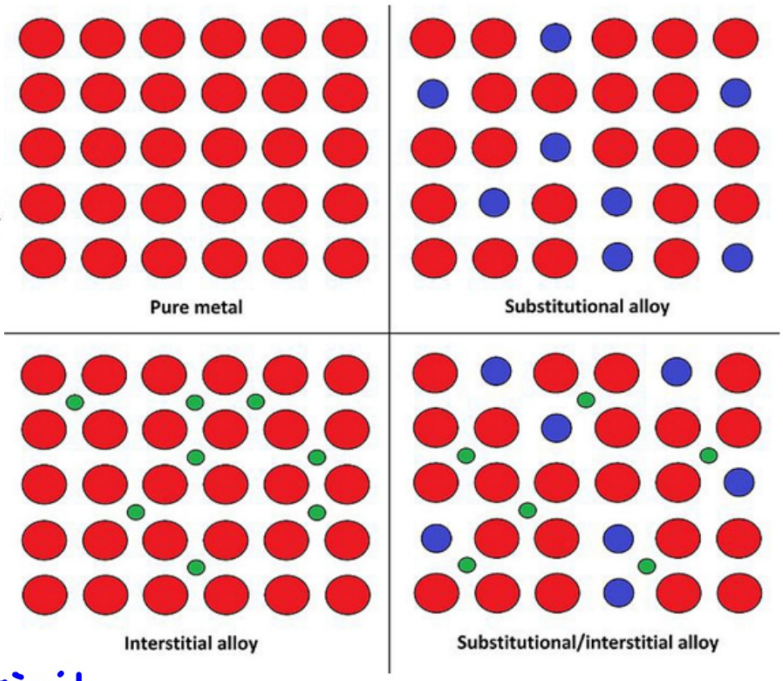
Ionic solids tend to dissolve in water b/c water is polar and will be attracted the ions in the ionic cmpd.

3. Why are ionic compounds conductive as liquids, but not as solids?

Free (separate) ions are required to conduct electricity. Liquid ionic cmpds have separate ions and solids do not.

4. Why are metals conductive as solids?





Metal solids are positive ions w/ a sea of e- which enable electricity to flow through the metal.

Substitutional Alloy

Interstitial Alloy