KMT of Solids & Liquids

Outcome:

Explain the properties of liquids and solids using the KMT.

Properties of Liquids:

Liquids:

1. ***Particles are closer together than in gases.***
2. ***Particles are in constant, random motion, but only move short distances before colliding (closer together)***
3. ***Liquids do not occupy the entire container, but will take on its shape.***
4. ***Diffusion is slower than in gases (particles move slower)***
5. ***Densities are higher than gases***
6. ***Slightly compressible***

INTERMOLECULAR FORCES of attraction are **STRONGER** in liquids– they hold the particles closer together.

Different liquids have different **VISCOSITIES** – the resistance to friction:

- Strong IMF's → ***greater viscosity*** (ex. oil, molasses, water!)
- Weak IMF's → ***lower viscosity*** (ex. alcohol)
- Viscosity **INCREASES** as temperature **DECREASES**.

Properties of Solids:

Solids:

1. ***Particles are closer together, highly ordered, and are in "fixed" positions (maintain own shape).***
2. ***Usually more dense than liquids (exception: water!)***
3. ***Are not very compressible***
4. ***Diffusion occurs only at the surface of a solid***

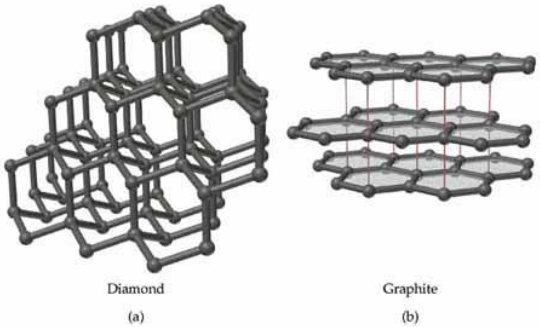
Solids can be ***crystalline*** or ***amorphous***

Crystalline Solids:

Are solids that have a **HIGHLY ORDERED** arrangement of particles. There are 4 main types:

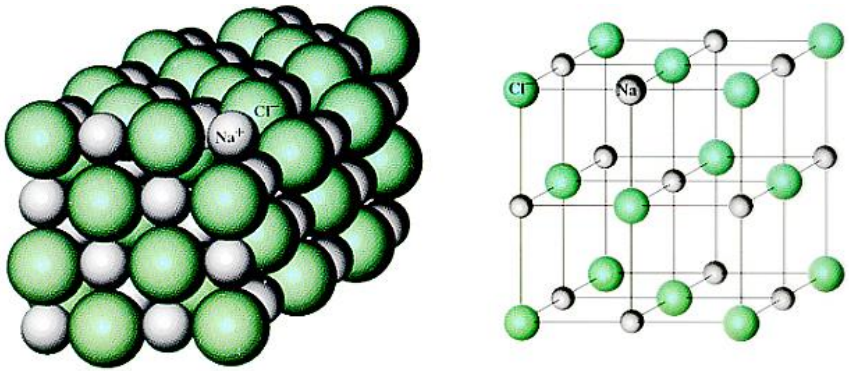
1. Covalent Network:

- Atoms are bonded **COVALENTLY** without forming **MOLECULES**.
- Are very **STRONG**. Ex. ***Diamond, graphite, silicon***



2. Ionic Solids:

- **IONS** arrange themselves in an **ALTERNATING** pattern.
- Very **STABLE** structure. Ex. ***NaCl, CaF_2***

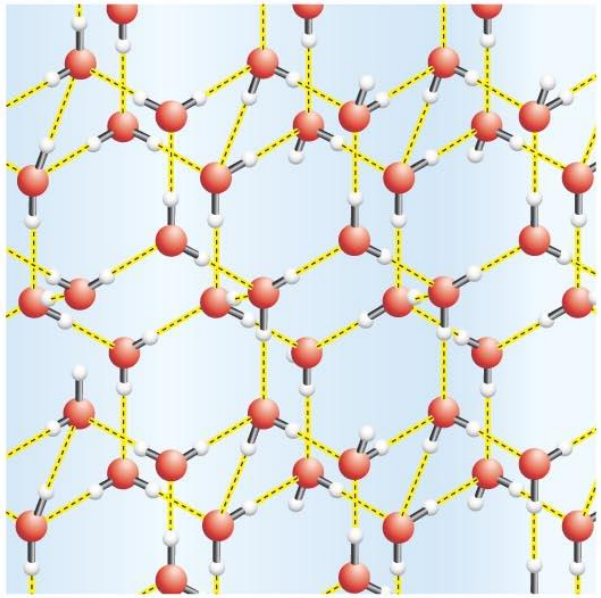


Crystalline Solids:

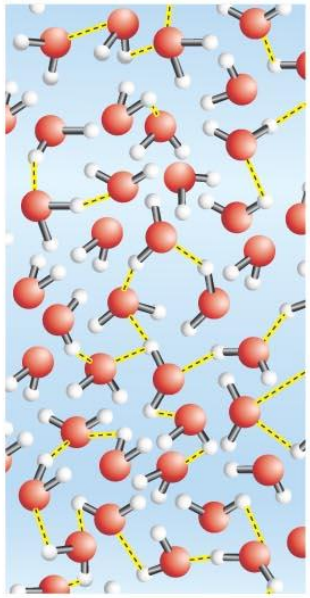
3. Molecular Solids:

- Particles held together by **INTERMOLECULAR FORCES**.
- Usually are very **SOFT**. Ex. I_2, S_8

(a) In ice, water molecules form a crystal lattice.



(b) In liquid water, no crystal lattice forms.

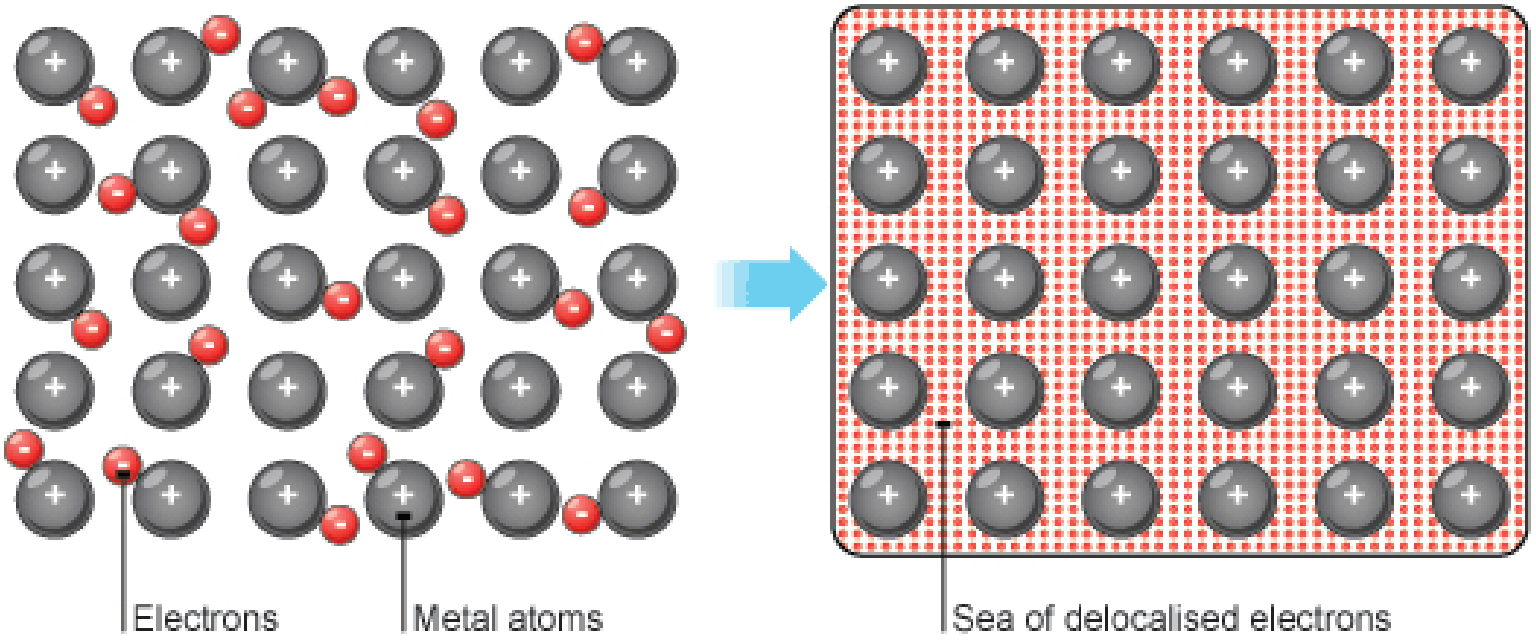


(c) Liquid water is denser than ice. As a result, ice floats.

Crystalline Solids:

4. Metallic Solids:

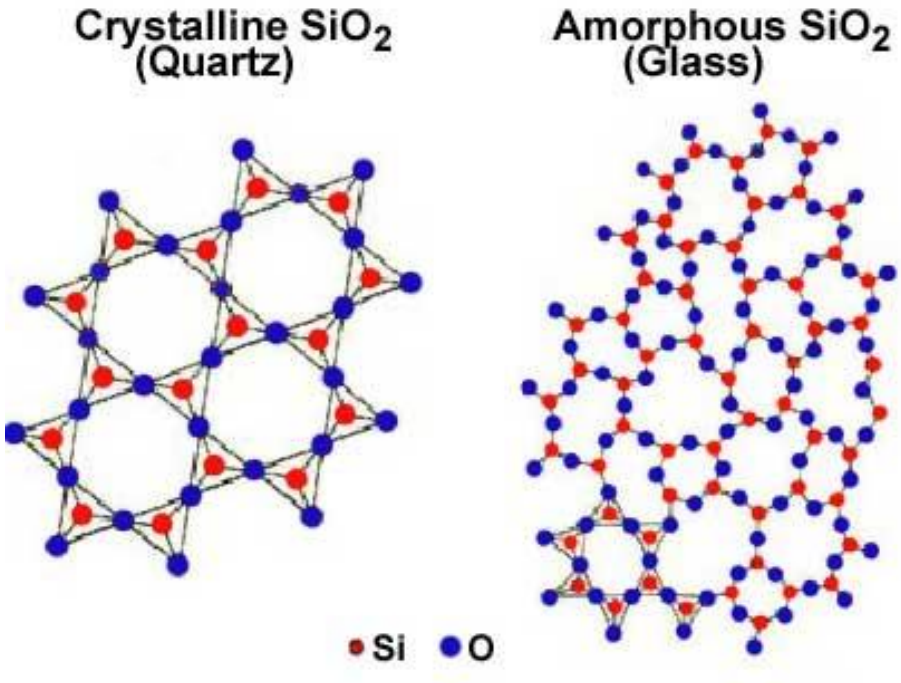
- Atoms held together by mobile **VALENCE ELECTRONS**.
- Strength **VARIES**, Ex. ***Cu, Ag, Pb***



Non-Crystalline Solids:

Amorphous Solids:

- Amorphous means "***without shape***"
- Are solids that lack a **REGULAR** **3-DIMENSIONAL** **ARRANGEMENT** of atoms.
- Are like super cooled **LIQUIDS**.
  - Ex. ***Glass, rubber, plastic***.

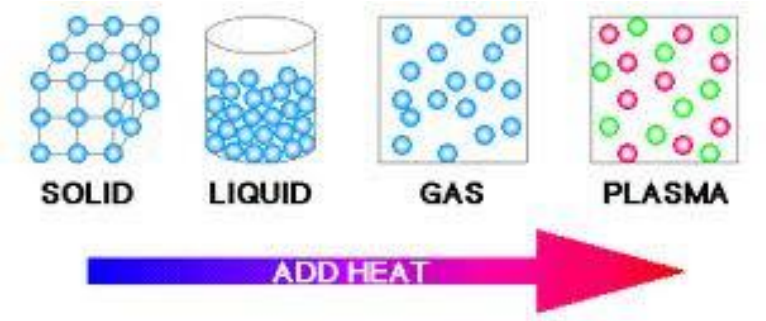


States of Matter:

The state that a substance at room temperature depends on the strength of the intermolecular forces:

- Strong IMF's → ***Solids at room temperature***
- Weaker IMF's → ***Liquids at room temperature***
- Weakest IMF's → ***Gases at room temperature***

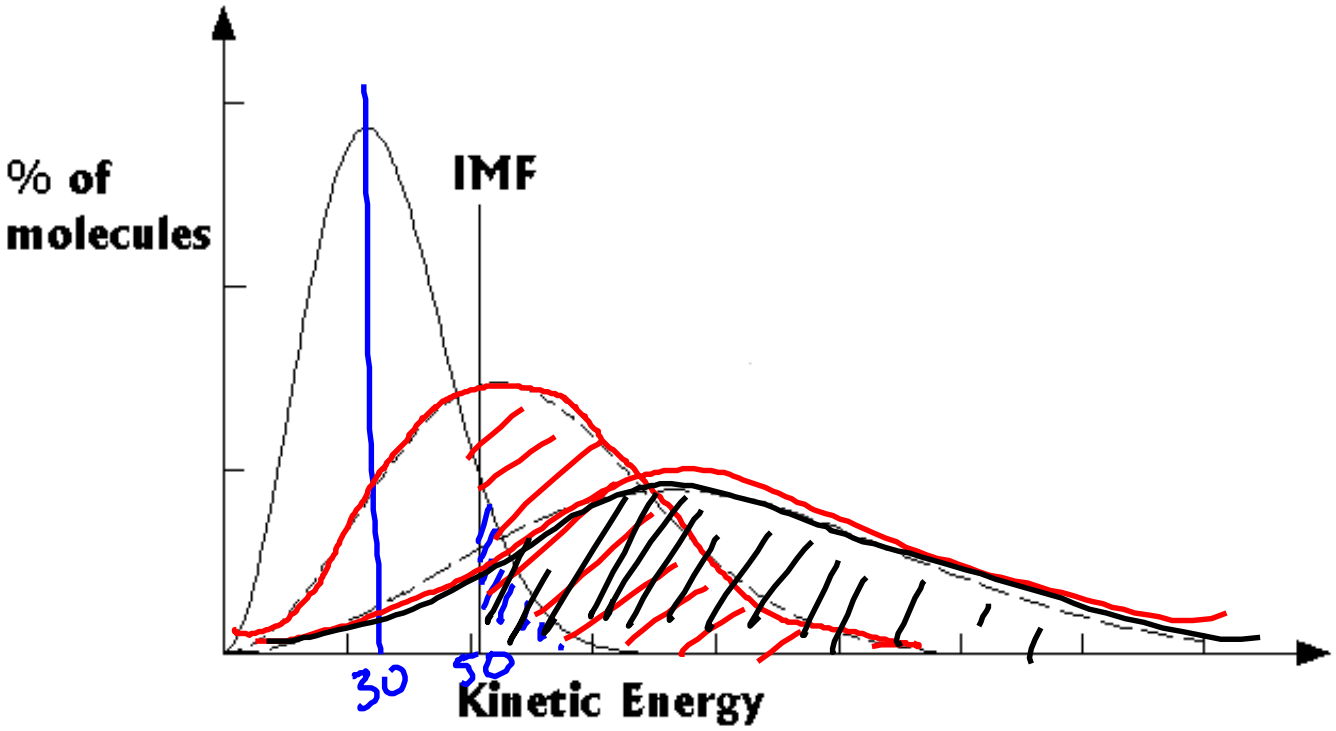
As we add **ENERGY** (**HEAT**) to a solid, the particles gain energy, and will eventually get enough energy to overcome the IMF's, and undergo a phase change.



The reverse is true with cooling (removing energy)

Maxwell-Boltzman Distribution:

In order to change state, molecules must overcome the **IMF'S**



Any molecules to the **LEFT** of the IMF line **DO NOT** have enough **ENERGY** to change state.

Summary:

Gas	Liquid	Solid
Highly compressible	Slightly Compressible	Very slightly compressible
Low Density	Higher density	Usually highest density
Fills container completely	Does not expand to fill container (definite volume)	Maintains its volume
Assumes shape of container	Assumes shape of container	Retains its shape
Rapid diffusion	Slow diffusion	Very slow diffusion at surfaces
High expansion upon heating	Low expansion on heating	Low expansion on heating
Weak/no IMF's	Medium IMF's	Strong IMF's