

# States of Matter

## Kinetic Theory of Gases

- No intermolecular forces are present between gas molecules
- The actual volume of gas molecules is negligible compared to the volume occupied
- All collisions between gas molecules are elastic, no energy is lost
- The kinetic energy of gas molecules is directly proportional to temperature

## Ideal Gases & Real Gases

- Gases that follow the kinetic theory are known as ideal gases, however, gases, in reality, do not follow this theory exactly even though they come close, they are known as real gases
- Under conditions of low temperature and high pressure, real gases deviate from ideal behaviour
- Under conditions of high temperature and low pressure, real gases show ideal behaviour
- Non-polar and small size gases behave more ideally; e.g He, H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>
- Polar with Hydrogen Bonding and large molecule gases deviate from ideal behaviour; NH<sub>3</sub>

## Ideal Gas Equation

$$pV = nRT$$

p = pressure (Pa)

V = volume (m<sup>3</sup>)

n = number of moles of gas (mol)

R = gas constant (8.31 JK<sup>-1</sup>mol<sup>-1</sup>)

T = temperature (Kelvin)

It's necessary to convert to the correct units

## Lattice Structures

- most ionic, covalent and metallic structures are lattice structures
- The ions, atoms or molecules are arranged in a regular and repeating arrangement

## Giant Ionic Lattices

- An ionic bond is formed by the transfer of electrons from a metal to a non metal atom
- The ions have an electrostatic force of attraction between them
- Ionic compounds are arranged in giant ionic lattices
- The positive and negative ions are arranged in an alternating order
- For example, NaCl and MgO
- They are strong but brittle
- They have high melting and boiling points due to strong electrostatic forces
- Soluble in water as they can form ion-dipole bonds
- Only conduct electricity in molten or aqueous states as ions can move around

### Covalent Lattices

- Covalent bonds are formed by the sharing of electrons between nonmetals
- Covalent compounds can have simple molecular or giant molecular lattices
- Iodine and Ice have simple molecular lattices
- Sand, Graphite and Diamond have giant molecular lattices
  
- Simple covalent structures have low melting and boiling points
- Mostly insoluble in water unless they are polar or can form Hydrogen bonds
- Do not conduct electricity in solid or liquid state
  
- Giant covalent compounds have high melting and boiling points
- Can be hard or soft depending on structure
- Mostly insoluble in water
- Mostly do not conduct electricity unless free electrons available

### Metallic Lattices

- Metals form giant metallic lattices where metal ions are surrounded by a sea of delocalised electrons
- are often packed in hexagonal layers or cubic arrangement
- Metallic compounds are malleable
- The metal layers can slide
- Metallic compounds are strong and hard due to strong forces between ions and electrons
- Metals have high melting and boiling points
- Pure metals are insoluble in water
- Can conduct electricity in solid or liquid states due to delocalised electrons

	M.P/ B.P	Conductivity	Solubility	Hardness	Forces	Examples
<b>Giant Ionic</b>	high	Molten or aqueous	soluble	Hard, brittle	Electrostatic attraction	NaCl
<b>Giant Metallic</b>	high	Solid or liquid	insoluble	Hard, malleable	Attraction between Electrons and Ions	Copper
<b>Simple Covalent</b>	low	No	Insoluble unless polar	Soft	Weak intermolecular	Cl <sub>2</sub>
<b>Giant Covalent</b>	V.high	No except graphite	insoluble	Very hard except graphite	Strong covalent bonds	SiO <sub>2</sub>