Formation of ions:

Ions = atom that looses/gains an electron to obtain full outer shell
Positive ion (metal) = looses electrons (cations)
Negative ion (non-metals) = gains electrons (anions)

2 electrons lost = +2 charge
2 electrons gained = -2 charge

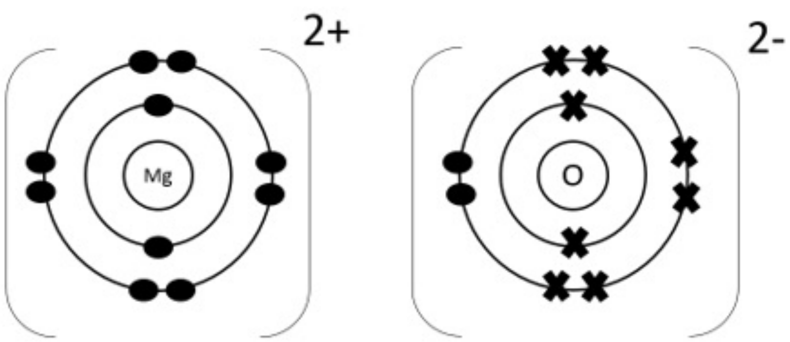
Group number on periodic table dictates electrons lost:
Group 1: +1 charge
Group 2: +2 charge
Group 6: -2 charge
Group 7: -1 charge

Ionic bonding:

Metal transfers electron to Non-metal
Oppositely charged ions have strong electrostatic attraction

Dot & Cross diagrams show transfer of electrons but don't show: structure of compound, size of ions or arrangement

Dot and cross diagram



Magnesium oxide (MgO)

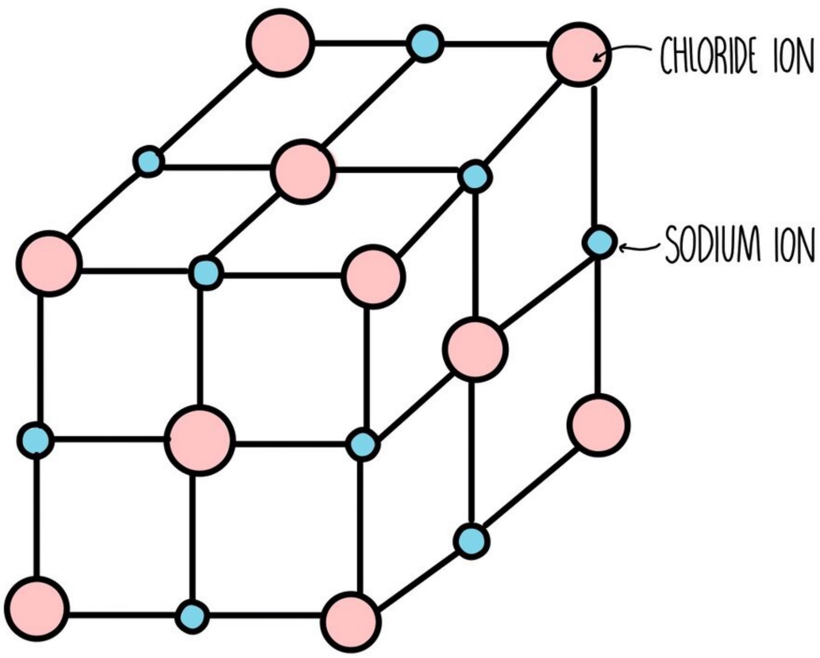
Ionic compounds:

Giant ionic, regular lattice structure
Strong electrostatic forces of attraction between oppositely charged ions

Properties:

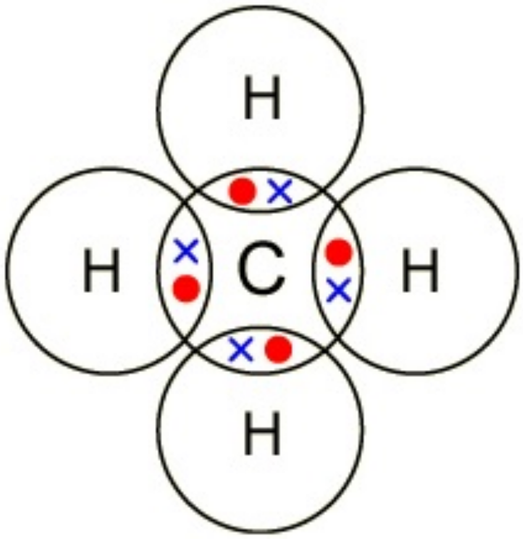
High mp & bp as strong intermolecular bonds take lots of energy to overcome
Molten/aqueous compounds conduct electricity & heat as ions move + carry an electric charge

Ball & Stick model:
Shows arrangement but not relative size of atoms

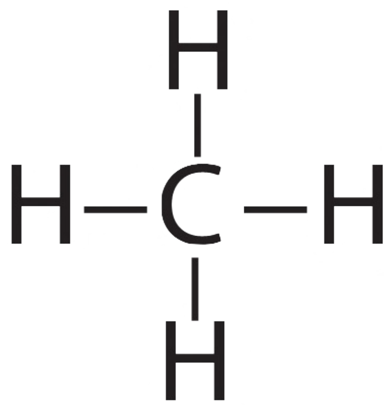


Covalent bonding:

2 Non-metals bond, sharing electrons
+ nuclei attracted to shared pair of - electrons by electrostatic forces = strong bonds
Each covalent bond = 1 extra electron shared

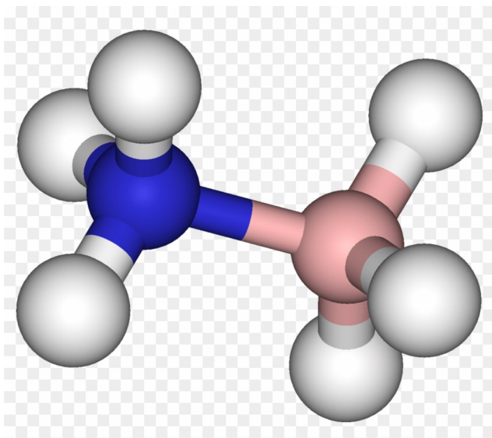


Dot & cross diagrams:
Shared electrons in overlap
Show where electrons come from but not relative size of atoms/arrangement



Displayed formula:
Show connection of atoms in large molecules but not where electrons have come from

3D model:

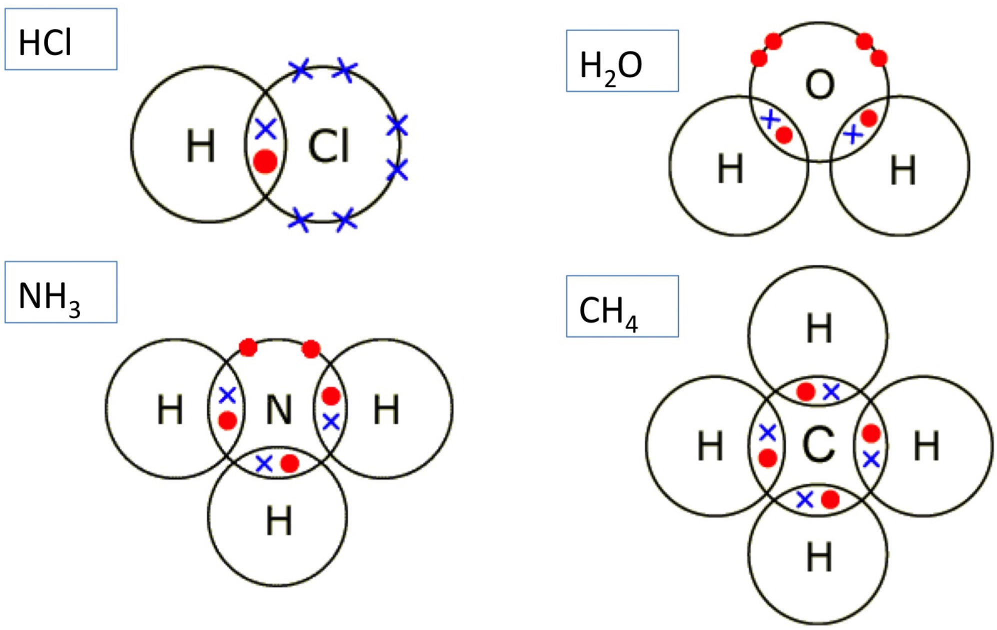


Shows covalent bonds & arrangement but not where electrons come from

Simple molecular substances:

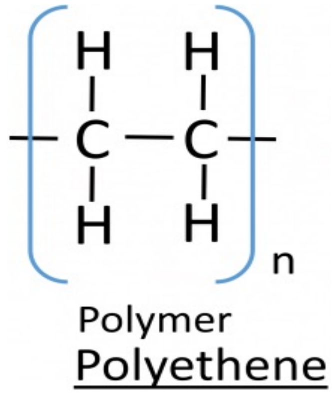
Properties:

Strong covalent bonds
Weak intermolecular bonds = low mp & bp = gases & liquids at room temp
Atomic radius increases = energy needed to overcome bonds increases
Not charged so not conductors of heat or electricity



Polymers:

Long chains of monomers
Joined by strong covalent bonds
Solid at room temp as larger molecules so high mp & bp (not as high at ionic/ covalent bonds)



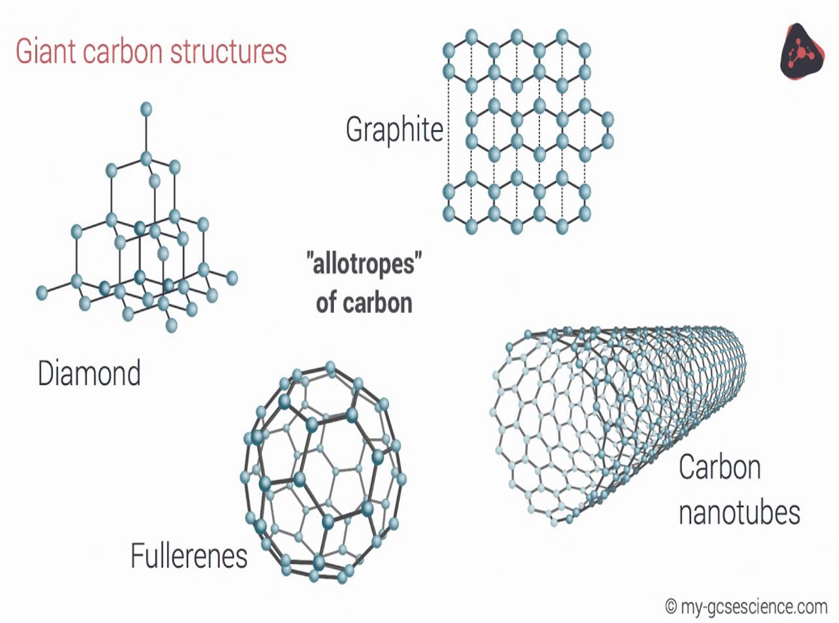
Giant covalent structures (macromolecules):

High mp & bp = lots of energy needed to overcome bonds
No charged ions to conduct electricity & heat

Diamond:
4 covalent bonds
Rigid structure

Graphite:
3 covalent bonds = layers of hexagons
1 delocalised electron

Silicon dioxide:
Silica has 4 covalent bonds



Allotropes of carbon:

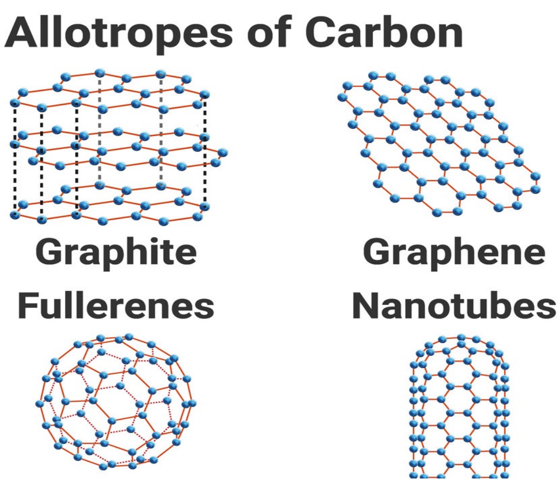
Diamond:
4 covalent bonds = hard
Strong covalent bonds = high bp & mp (high energy to overcome bonds)
No free ions so doesn't conduct heat/electricity

Graphite:
3 covalent bonds = hexagonal layers
No covalent bonds between layers = layers slide over each other (good lubricant)
High mp as strong covalent bonds
1 delocalised electron to carry electric charge = conducts heat & electricity

Graphene:
One sheet of carbon atoms in a hexagonal structure
Strong as strong covalent bonds
Light (one atom thick) = good composite to improve strength
Has delocalised electrons = conducts electricity & heat as charged atoms move

Fullerenes:
Carbon molecules in closed tubes/hollow balls
Hexagonal structures
Can cage other molecules for drug delivery
Have big surface area:volume so good industrial catalysts & lubricants

Nanotubes:
Tiny carbon cylinders
High surface area:volume
Conduct heat & electricity
High tensile strength
Nanotechnology useful in: silicon chips & tennis rackets (to increase strength)



Metallic bonding:

Metals:

Have delocalised electrons in giant structure, strong electrostatic forces of attraction between oppositely charged ions hold a strong, regular structure

Properties:

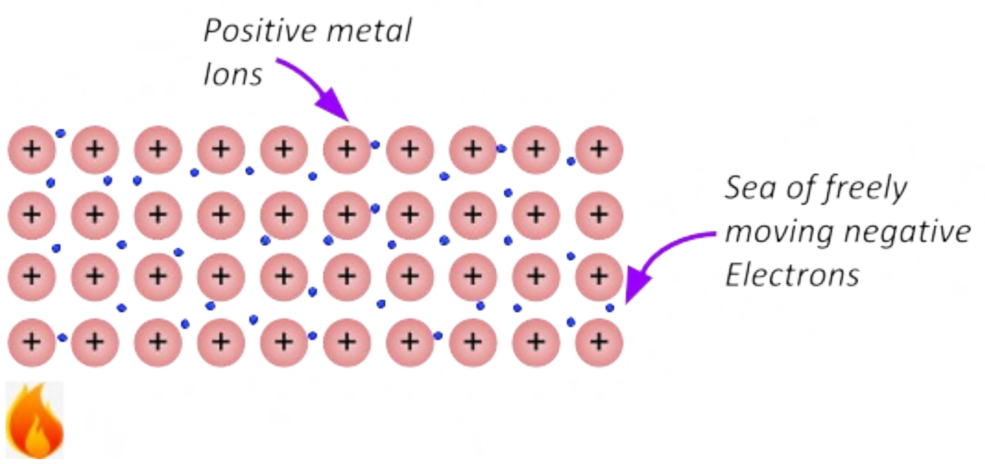
High mp & bp as strong intermolecular bonds (need lots of energy to overcome) = solid at room temp

Conduct heat & electricity as delocalised electrons carry charge

Have layers that slide over each other = malleable (hammered/bent into flat sheets)

Alloys:

Different size/type of atoms distort layers so alloy is stronger than a pure metal



States of matter:

State depends on: strength of intermolecular forces (dictated by: material, temperature & pressure)

Solids:
Strong intermolecular forces = fixed, lattice arrangement
Definite shape & volume kept
Atoms vibrate on the spot

Liquids:
Weak intermolecular forces = move freely but close together
Have definite volume, not density
Constant movement in random motions

Gases:
Weak forces of attraction = move randomly in all directions
No definite volume or density
Constant movement in random directions

Particle model of matter:
Flaws: particles aren't solid spheres

State symbols:

Physical State	State Symbol
Solid	s
Liquid	l
Gas	g
Aqueous Solution	aq

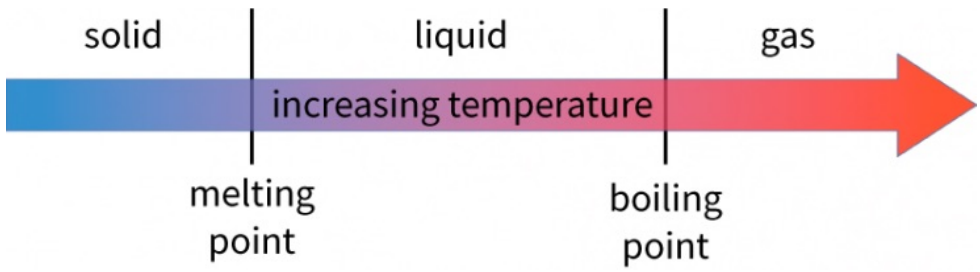
Changing state:

Physical so reversible changes

Heating a solution = thermal energy converted to kinetic (weaker intermolecular forces) until melting point (solid->liquid), with more energy, bonds are broken at boiling point (liquid->gas)

Cooling a solution= atoms move slower (loose energy), bonds form at boiling point, when the gas condenses into a liquid, then liquid cools further so new bonds form. At melting point, a liquid turns into a solid by freezing

Predicting states of substances at temperatures: use a number line



Nanoparticles:

DIAGRAM OF DIAMETERS OF COARSE, FINE & NANO

Properties:

High surface area:volume = need less material to use as effective industrial catalysts