Ionization energy and Electronegativity

Ionization energy is the energy required to remove one electron from an atom. The stronger the electrostatic attraction the harder it is to remove.	Electronegativity is the tendency of an atom in a bond to draw the bonding electron towards itself.
Ionization energy increases along periods and up groups.	Electronegativity follows the trend of ionization energy.

Electronegativity only makes sense when an atom is in a bond and therefore is not very applicable to noble gases.

Balancing equation tips

Simple equation?

> Balance normally

Combustion reaction? (CHO)

> Carbon, then hydrogen, then oxygen.

Complex equation?

> Simultaneous equations in which each substance has a variable, and an equation is written for each element.

State symbols are also used. If a substance is in a solution it can be assumed to be aqueous. If an ionic solid is produced it can be called a precipitate.

Bonding properties

Melting point	Related to strong electrostatic attraction
Malleability	Whether the substance can be shaped or snaps. Depends on how the attraction changes when it is deformed or stressed.
Electrical conductivity	Needs mobile charged particles.

Reaction types

Combination	Two or more reactants come together to form a product
Decomposition	A single reactant breaks into two or more products
Single displacement	A singular element displaces another element in a bond
Double displacement	Two substances break down and the cations and anions switch
Combustion	Reaction of oxygen with a fuel. When complete it produces carbon dioxide and water.

Electrostatic attraction

$$F = \frac{kq_1q_2}{r^2}$$

Coulomb's Law: describes the strength of the
force between two charged particles.

- F = force
- k = constant
- q1 and q2 are the charges on the two particles
- r = distance between them

When charges increase the strength increases. When distance decreases strength increases.

Atom size

Determined by the electrostatic attraction between the electrons and the protons in the nucleus.
Three determining factors:
- Nucleus charge (more protons, greater attraction)
- Distance from nucleus (more shells, less attraction)
- Shielding (more core electrons, less attraction)

The trend shows increasing atomic radii down groups and decreasing radii across periods.

Ions increase in size down a group (the same as atoms)
Decrease gradually in size from group 1 - 14, before jumping in size at group 15 before decreasing again.

Ionic bonding

Ionic bonding occurs between a metal and a non metal ion with the electrostatic attraction between the ions. The electron will leave the low electronegative metal and move to the high electronegative non-metal.

Properties of ionic substances:
- High melting point (strong bonds)
- Brittle (when deformed ions repel)
- Non-conductive when solid
- Conductive when dissolved in water (aqueous)

Ionic substances are lattices as the bonds are non directional and exist all around the ion.

Covalent bonding

Covalent bonding occurs between two non-metals that have high electronegativity. This means that neither atom wants to give up electrons and they rather share them.	The electrostatic attraction occurs between the positively charged nucleus and the negatively charged electrons. The positive nuclei will repel each other.
The electrons move around the two atoms freely however they spend most of the time in between. Unlike metallic bonds the electrons are unable to drift away.	In general the shorter the bond the stronger the electrostatic attraction. This is because the distance that balances the attractive and repulsive forces balance is shorter.
Properties:	
Molecular covalent	Covalent lattice
-Low melting point -Brittle as solid, weak -Doesn't conduct	-High melting point -Brittle but strong -Doesn't conduct

Covalent bonds are directional, the exist only between the involved atoms. Covalent bonds can come in molecules or lattices. As molecules there are exact numbers of atoms and the formula is precise. Lattices also called giant covalent or giant lattice are an indeterminate number of atoms. The formula is a ratio.

Lewis structures

Shows the atoms involved in bonding.Only the valence electrons are shown.

A single bond has two electrons and can be represented as two dots or one line.

The fewer the valence electrons the more bonds the atom can form.

If the atom is smaller it usually forms stronger bonds, however if there are multiple bonding pairs it will be stronger.

Allotropes

Atoms don't always bond the same way. An allotrope is a different bonding arrangement of a certain element.

Different bonding at the atomic level leads to different properties on the macroscopic level.

Example 1: Carbon
Diamond: three-dimensional tetrahedral lattice hard, strong, clear, nonconductive.
Graphite: two-dimensional hexagonal lattice soft, grey, conductive.
Amorphous carbon (coal, soot): no regular pattern, but three-dimensional bonding. soft, black, nonconductive

Example 2: Tin
alpha-tin: covalent lattice structure like diamond grey, dull, crumbly
beta-tin (stable above 13°C): metallic lattice Silvery-white, malleable.

Metallic bonding

Metallic bonding occurs between two metals. Due to the low ionization energy metals lose their electron easily. The repulsion from the neighbouring ions repel while the electrons act as a glue pulling it together.

Properties:
- Melting points vary (reflects range of bond strength)
- Malleable (Electrons act as glue, whatever the shape)
- Conductive (The electrons move freely)

Metals are lattices as the bonds are non-directional.

Scientific notation and significant figures

Scientific notation	Count place values from new and old decimal point
Decimal notation	Count place values specified by the exponent
Significant figures	-Non zeros count -Captive zeros count -Leading zeros don't count -Trailing zeros after decimal count
Multiplying and dividing	Give your answer to the smallest number of sig figs given
Adding and subtracting	Give your answer to the number of decimal places used

Mantissa's of scientific notation show the significant figures for a value.

Empirical formula

The empirical formula is the lowest whole--number ratio of atoms in a substance. For a lattice the empirical formula will be the same.

For molecular substances they will be expressed in a molecular formula which can sometimes be simplified.

The empirical formula can be derived from mass percentages using the pneumonic: Percent to mass, Mass to moles, Divide by small Times 'til whole.

We can find the molecular formula by finding the simplification factor which is the molecular molar mass divided by the empirical molar mass.