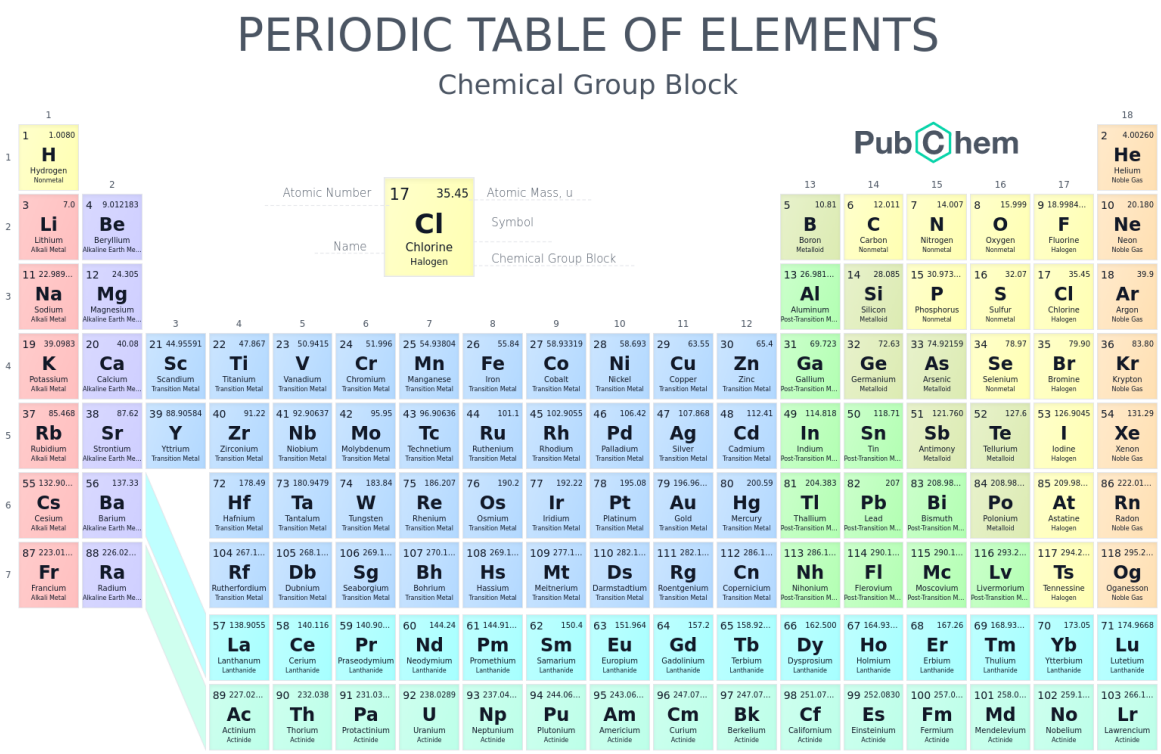
Chemistry

Created	@October 21, 2024 1:55 PM
Class	Science
Multi-select	

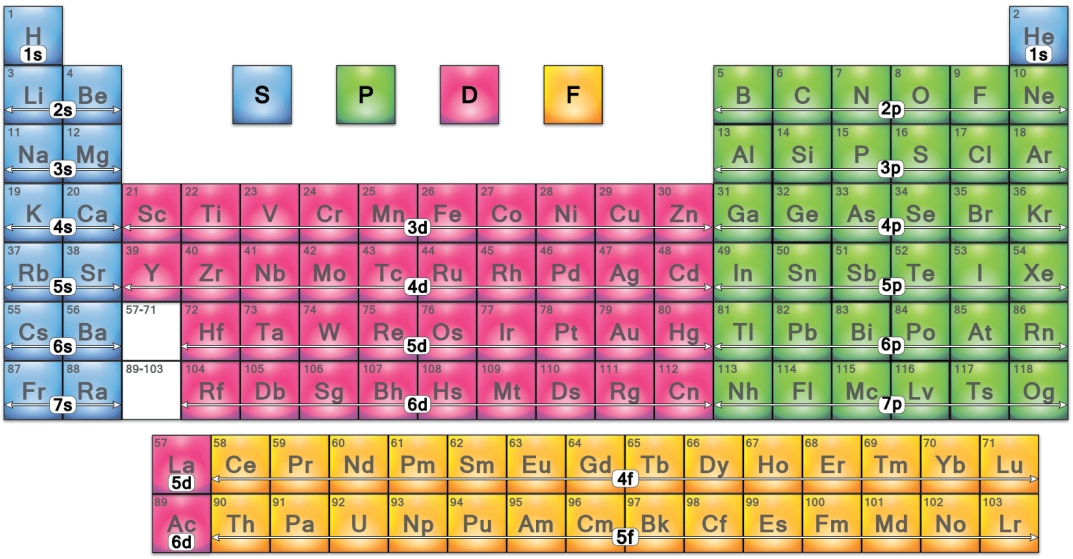
Periodic table
    How to read a periodic table
Molecule of elements
    Bohr Diagram
    Atomic number
    Atomic mass
    Valency
Compounds and mixtures
Naming Metal - nonmetal compounds
    Chemical formula - How to represent compounds
    Ions
    Cations
    Anions
    Valencies
Chemical reactions
    Signs of chemical reaction
    Reactants and products
    Law of conversion
How atoms join to form compounds
    Ionic bonding
    Covalent bonding
    Metallic bonding
Comparing and contrasting ionic, covalent and metallic bonds
Chemical equations
How do living organisms get the energy to live?
    Respiration
    Comparison of combustion and respiration
Acids, bases and neutralisation
    Acids
    Bases and alkalis

Periodic table



How to read a periodic table

1. Periods - elements in the same row with the same amount of electron shells
2. Group - elements in the same column sharing similar chemical properties and have the same amount of electrons in outer shell



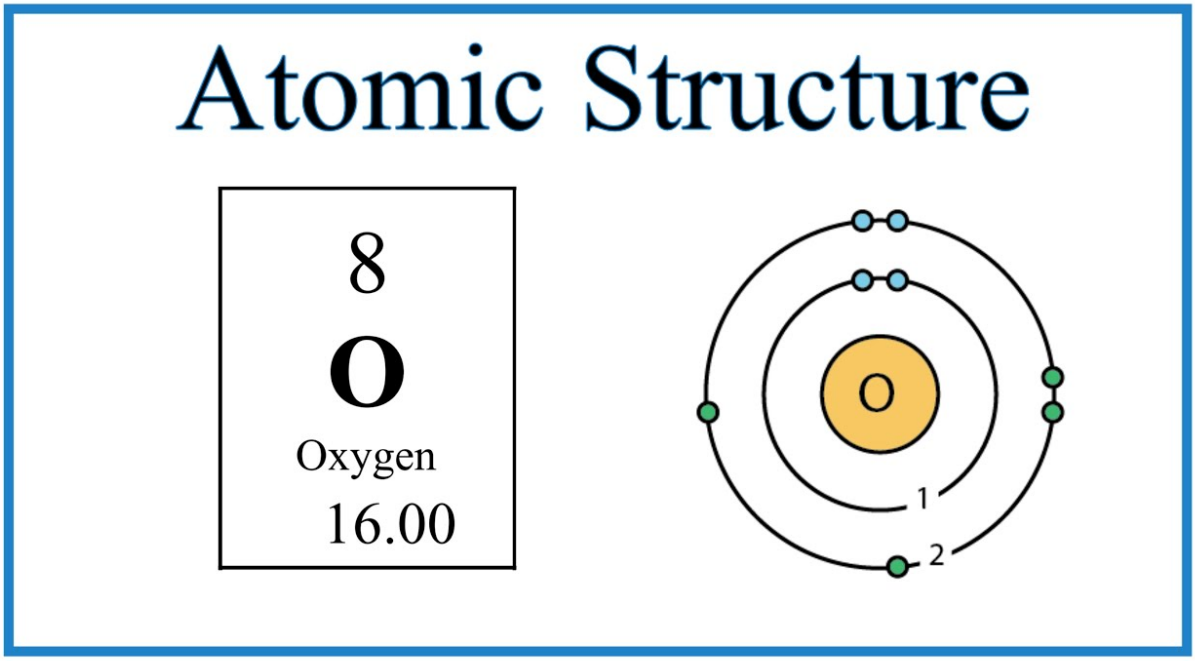
3. Blocks - (s,p,d,f) based on electron configuration. Also explain chemical reactivity and bonding
4. Metals, non metals, metalloids - Metals on the left, metalloids in between and non metals on right

Molecule of elements

When atoms of the same element join together we get a **molecule** of that element

Oxygen is like this. Two oxygen atoms join together to make an oxygen molecule. Most of the oxygen in the air is in this form. Hydrogen and chlorine also have molecules with two atoms.

Bohr Diagram



Atomic number

- Number of protons in the nucleus of an atom

Atomic mass

- The average mass of protons, neutrons and electrons in an atom.

Valency

- Refers to how elements bond with each other
- Determined by the number of electrons in its **outermost** shell
- To have a stable configuration, it sometimes loses them to achieve a positive valency or gain them giving them a negative valency
- Electrons are **negative**
- Protons are **positive**
- Neutrons are **neutral**

Compounds and mixtures

A **compound** is made when atoms of **different elements** join together by **chemical bonding**.

- Properties are often very different from the elements they contain. E.g
  - Hydrogen and oxygen are both gases at room temp, but water is a liquid

A **mixture** is an impure substance created when 2 chemicals aren’t chemically bonded but rather **mixed** together.

Naming Metal - nonmetal compounds

- Name metal first
- Name the non-metal component second and remove the last part of the word and add the suffix of “-ide”
  - Oxygen becomes oxide
  - Chlorine becomes chloride
- List of some anions
  - Ammonium NH_4
  - Bromide Br
  - Chloride CI
  - Hydroxide OH^-
  - Iodide I
  - Nitrate NO_3^-
  - Carbonate CO_3^{2-}
  - Oxide O
  - Sulphate SO_4^{2-}
  - Sulphide S

- Phosphate PO_4^{3-}

Chemical formula - How to represent compounds

Compounds have constant composition with respect to mass because they are composed of atoms in fixed ratios

Ions

An ion is an atom that has gained or lost one or more electrons

Cations

Positive ions are ions that have lost electrons. They have more protons than electrons, so they carry a positive electrical charge.

Anions

Negative ions are atoms that have gained electrons. They have more electrons than protons so they carry a negative electrical charge.

Valencies

The valency of an ion is the charge that is formed when an atom changes into being an ion

E.g. Magnesium atom (Mg) turns into magnesium ion (Mg^{2+}). The valency of magnesium ion is 2+

OR

Oxygen atom (O) turns into the oxide ion (O^{-2}) The valency of the oxygen ion is 2-

Atom	Atom symbol	Electrons exchange	Ion symbol
Lithium	Li	1 lost	Li+
Magnesium	Mg	2 lost	Mg2+

Aluminium	Al	3 lost	Al3+
Nitrogen	N	3 gained	N3-
Oxygen	O	2 gained	O2-
Chlorine	Cl	1 gained	Cl-

Sulphate, phosphate, nitrate and hydroxide will be the main 4 you will need to know and use.
The process is similar, however we need to use brackets when there are 2 or more of sulphate, phosphate nitrate and hydroxide.

- Group 1 has +1 charge
- Group 2 has +2 charge
- Group 13 has 3+ charge
- Group 14 has ± 4 charge
- Group 15 has -3 charge
- Group 16 has -2 charge
- Group 17 has -1 charge
- Group 18 is neutral (noble gases)

Chemical reactions

- **Physical** change, matter changes its **appearance** but not its composition
- **Chemical** change matter does change its **composition**

Signs of chemical reaction

- Change in colour

- Bubbles of fizzing which means a gas is being made
- A change in temperature
  - chemicals become hotter or colder
- A precipitate which is an insoluble solid substance being made
- The reacting chemicals slowly disappear, or new chemicals appear

Reactants and products

The reacting chemicals are called reactants or reagents. They are consumed and used in the chemical reaction.

Law of conversion

- The mass of reactants will always equal to the mass of products.

How atoms join to form compounds

Ionic bonding

- Attraction between 2 atoms that have **gained** or **lost** electrons to become charged ions.
- Only between negatively charged and positively charged ion
  - The negative ion **gives** electrons to the positive to form a **neutral** compound
- They have the following in common
  - Made up of positive and negative ions
  - Usually solids are room temperature

    - Very high melting points because of electrostatic force of attraction between ions is very strong
    - Usually dissolve in water to form aqueous solution

Covalent bonding

- Attraction between 2 atoms that secured by sharing electron/s from each of the atoms
- Bond over non metal atoms
- Properties include
    - Exist as gases, liquids or solids with low melting points because the forces of attraction between the molecules are weak
    - Generally don’t conduct electricity because they aren’t made up of ions
    - Usually insoluble in water

Metallic bonding

- Metallic bonds only exist in a group of metal atoms. They are responsible for maintaining the metal atoms in a solid form.
- They are described as the nuclei of metal atoms in a sea of electrons. This “sea of electrons” is the reason that metals are such good conductors of electricity and heat.

Comparing and contrasting ionic, covalent and metallic bonds

	Ionic	Covalent	Metallic
Electrons	Transferred	Shared, evenly or unevenly	Electron sea
Bond	Metal to nonmetal	Nonmetal to metal	Metal to metal

Electronegativity differences	Differences greater than 2	Differences between 0 and 2	NA
Make compounds	Yes by attraction of opposite charged ions	Molecules or molecular elements	No
State (STP)	Crystalline solid	Liquid, gas or solid	Malleable and ductile solid
Melting point	high	low	low
Conductivity	Liquid and aqueous state, yes	no	yes
Water solubility	high	low	no

Chemical equations

- Substances on the left side are **reactants** and the right are **products**
- State the state of each reactant next to the formula
- Abbreviations
  - Gas (g)
  - Liquid (l)
  - Solid (s)
  - Aqueous (aq)

Chemical reactions

- The total amount of energy stored in a substance is called **enthalpy** which is made up of:
  - Kinetic energy
    - Relates to the motion of the electrons and the atom.

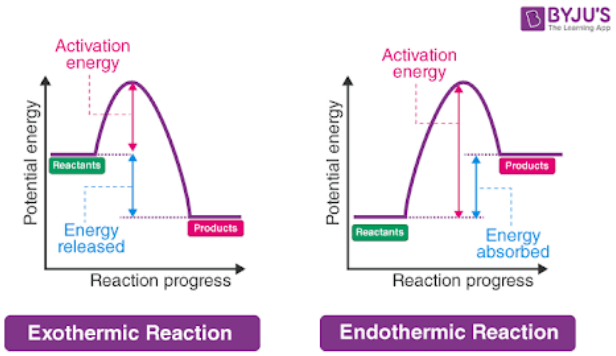
    - Temperature is a measure of the average kinetic energy in atoms
    - When a substance **rises** in temperature, its atoms move faster and therefore **higher** kinetic energy
- Potential energy
    - Attractions and repulsions present in the atom as well as the attractions present between different atoms
    - The extent of the bonds it forms with other atoms

Exothermic reactions

- Chemical reaction that releases energy
- Often causes an **increase** in temperature
    - Energy is released as heat

Endothermic

- A reaction in which energy is absorbed
- Energy must be **added** to the reaction
    - Causes a **drop** in temperature so they can take up energy
- **Absorb** energy
- E.g Photosynthesis is the most important endothermic reaction



Combustion

- Fast reaction of chemical with oxygen
  - Releases the **stored chemical energy** in form of heat, therefore **exothermic** reaction.
- If the reactant is a **metal**, the product will **always** be a **metal oxide**
- If the product that is being combusted is an **organic** material
  (eg. glucose), the products will
  always be **carbon dioxide** and

  water

Complete combustion

- When hydrocarbons or alcohols burn in lots of oxygen, carbon dioxide and water are produced
  - this is called **complete combustion**
- Produce heat energy which is able to be harnessed

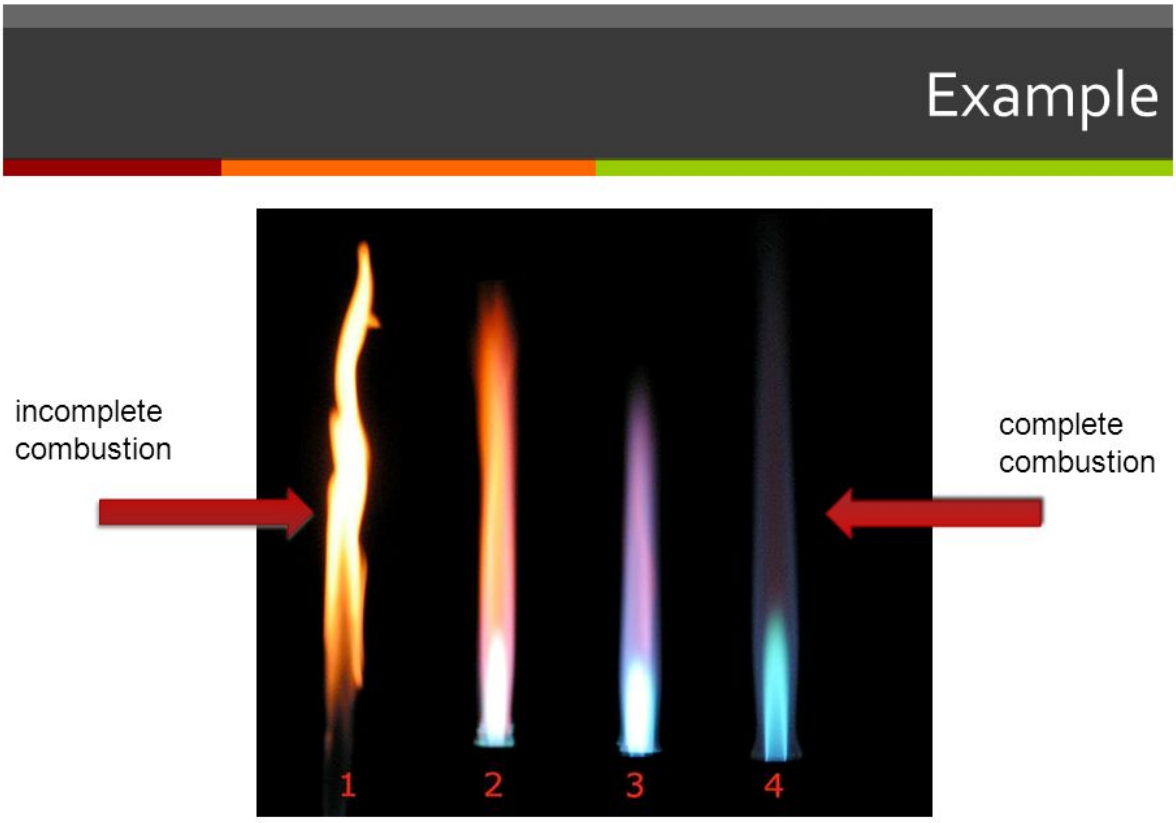
Incomplete combustion

- If supply of oxygen is **limited,** then **incomplete combustion** may occur
  - Characterised by black smoky flames.
- Two reactions occur simultaneously:
  - Methane + oxygen → carbon monoxide + water

$$2\mathrm{CH_4(g)} + 3\mathrm{O_2(g)} \rightarrow 2\mathrm{CO(g)} + 4\mathrm{H_2O(g)}$$

  - Methane + oxygen → carbon + water

$$\mathrm{CH_4(g)} + \mathrm{O_2(g)} \rightarrow \mathrm{C(s)} + 2\mathrm{H_2O(g)}$$



How do living organisms get the energy to live?

- The body needs a constant supply of energy which comes from **digestion**
- **Glucose** from digested carbohydrates is an important substance that contains stored **chemical** energy

Respiration

- Living cells use a process called **respiration** to release energy from digested food (glucose), as it occurs in cells we call it **cellular respiration**

Glucose + oxygen → carbon dioxide + water + energy

- Reactants
  - Glucose from digestive system
  - Oxygen from respiratory system
- Waste products
  - Carbon dioxide exhaled
  - Water exhaled

Comparison of combustion and respiration

Similarities

- Release energy
- Require oxygen and a fuel source
- Product the same products
  - Carbon dioxide and water

Differences

Combustion	Respiration
takes place in open	Takes place in cells

Occurs in single step	Many steps
No enzymes	Controlled by enzymes
Energy release is vigorous and not under control	Energy release is more gradual and under control
Energy is released in form of heat and light (flame can result)	Energy is released in form of heat and energy rich compound

Acids, bases and neutralisation

Acids

- Contain hydrogen
- React with metals to create **salt** and **hydrogen gas**
- React with **carbonates** to create **salt, carbon dioxide** and **water**
- Examples
  - Hydrochloric acid HCI found in the stomach
  - Sulfuric acid $\mathrm{H_2SO_4}$ found in car batteries
  - Nitric acid $\mathrm{HNO_3}$
  - Acetic acid $\mathrm{CH_3COOH}$ found in vinegar
  - Carbonic acid $\mathrm{H_2CO_3}$ found in soft drinks

Bases and alkalis

- Group of substances that neutralise acids, reacting with acids to form **salts** and **water**.
- Common bases used in classrooms
  - Sodium hydroxide NaOH
  - Potassium hydroxide KOH
- Sodium chloride is found in oven cleaners and drain unclogging agents

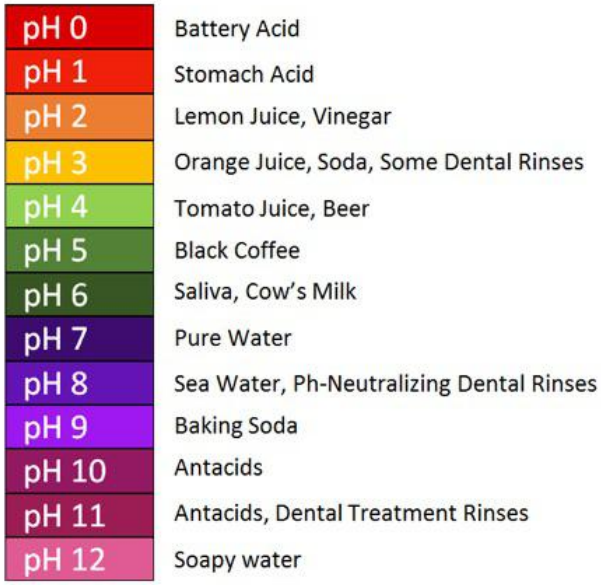
- Ammonium hydroxide floor cleaners
- Sodium bi-carbonate in bi-carbonate soda
- Sodium hydroxide is found in household soap
- Magnesium hydroxide found in antacid tablets

Indicators

- Chemicals that turn different colours in acid and base solutions
  - Red and blue litmus paper
  - Universal indicator
  - Phenolphthalein
  - Red cabbage

pH

- Measures how acidic or basic a substance is
- Scale of 1-14
- Acid < 7 pH
- Base > 7 pH
- Neutral = 7 pH
- Relates to how many H ions in the solution



Neutralisation

- When an acid reacts with a base. Water is always a product in a neutralisation reaction as is salt
- Acid + Base → Salt + Water
- Applications
  - Ant and bee stings are **acidic** so need to be neutralised with a **basic** solution
  - Tooth paste is slightly basic which neutralises acids made by tooth decay

Acids and metals

- Always react with a metal to produce salt and hydrogen gas H_2
- Represented by general word equation
  - ACID + METAL → SALT + HYDROGEN GAS
- Different acids produce different salts. E.g
  - Hydrochloric acid produces chloride salts

- Sulfuric acid produces sulfate salts
- Nitric acid produces nitrate salts

Acids and Carbonates

- Carbonate is a substance containing CO_3
- Acids always react with carbonates to produce a salt, water (H_2O) and carbon dioxide gas(CO_2)

Precipitation reactions

- When **sodium chloride** is dissolved in water to form an **aqueous** solution, it seems to ‘disappear’.
- The sodium ions and the chloride ions

  separate when they **dissolve** in water. Ions in aqueous solutions are therefore separate entities and are able to react independently.
- When two solutions containing dissolved ions are mixed together, these ions are able to come into contact with each other.
- **Oppositely** charged ions **attract**. In some cases, the attraction is strong enough to form ionic bonds and hence a **new ionic compound**.
- Some of these compounds are **insoluble** (unable to dissolve in water) and so a **solid forms**. This solid is called a **precipitate**.
- Chemical reactions in which precipitates form are called precipitation reactions.

Decomposition

- Reaction where **one** substance is broken into **2 or more** new substances
- E.g Hydrogen peroxide is decomposed into water and oxygen

Rate of chemical reactions

- 3 main factors that affect the rate
  - Concentration
  - Surface area
  - Temperature
- Chemical factors that affect reaction rate are called **catalysts** in non-organic and **enzyme** in organic

---