### Acids

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid</td>
<td>Corrosive substance which has a pH lower than 7. Acidity is caused by a high concentration of hydrogen ions.</td>
</tr>
<tr>
<td>Acidic</td>
<td>Having a pH lower than 7.</td>
</tr>
<tr>
<td>Alkali</td>
<td>A base which is soluble in water.</td>
</tr>
<tr>
<td>Alkaline</td>
<td>Having a pH greater than 7.</td>
</tr>
<tr>
<td>Base</td>
<td>A substance that reacts with an acid to neutralize it and produce a salt.</td>
</tr>
<tr>
<td>Neutral</td>
<td>When a substance is neither acidic nor alkaline, and has a pH of 7.</td>
</tr>
<tr>
<td>Litmus Paper</td>
<td>An indicator that can be red or blue. Red litmus paper turns blue in alkalis, while blue litmus turns red in acids.</td>
</tr>
<tr>
<td>pH</td>
<td>A scale of acidity or alkalinity. A pH value below 7 is acidic, a pH value above 7 is alkaline.</td>
</tr>
<tr>
<td>Universal Indicator Paper</td>
<td>Paper stained with universal indicator, a chemical solution that produces many different colour changes corresponding to different pH levels.</td>
</tr>
</tbody>
</table>

Some acids are more dangerous. Hydrochloric Acid (HCl), Sulfuric Acid (H₂SO₄) and Nitric Acid (HNO₃) are acids which we use in the Science Lab. These acids can come as dilute or more concentrated.

Dilute acids are not as dangerous as concentrated acids. This is because there are fewer acid particles in the same volume.

Acids include:
- Vitamin C – Ascorbic Acid
- Lemons – Citric Acid
- Vinegar – Ethanoic Acid
- Fizzy Drink – Carbonic Acid

Red litmus paper turns blue when it is put into an alkali. If the substance was an acid or neutral the red litmus paper would stay red.

Blue litmus paper turns red when it is put into an acid. If the substance was an alkali or neutral, the blue litmus paper would stay blue.

### Bases

A base is a substance that can react with acids and neutralize them. Metal oxides, metal hydroxides and metal carbonates are examples of bases. Many bases are insoluble – they don’t dissolve in water. However, if a base does dissolve in water, we also call it an alkali.

Some alkalis are harmful. However, many are harmless and useful. Many cleaning products such as bleach, washing powder and oven cleaner contain alkalis. The most dangerous alkalis in our homes are oven cleaners and caustic soda (used to unblock drains).

Bases include:
- Soap and washing up liquid are safe alkalis.
- Oven cleaner is a very strong alkali which is very corrosive.

| pH Scale |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|          |          |          |          |          |          |          |          |          |          |          |
| acidic    | neutral  | alkaline |          |          |          |          |          |          |          |          |

Further Reading:

- If you look around your kitchen, you may find some acids to eat or drink.
  - Vinegar – Ethanoic Acid
  - Fizzy Drink – Carbonic Acid
  - Lemons – Citric Acid
  - Vitamin C – Ascorbic Acid

- Many cleaning products such as bleach, washing powder and oven cleaner contain alkalis. The most dangerous alkalis in our homes are oven cleaners and caustic soda (used to unblock drains).
  - Soap and washing up liquid are safe alkalis.
  - Oven cleaner is a very strong alkali which is very corrosive.
Acids

- **Acids** are a family of chemicals, examples are lemon juice, vinegar and Coca Cola. There is also acid in our stomach.
- Acids contain H⁺ ions.
- **Strong acids** like hydrochloric acid are very corrosive this means they destroy skin cells and cause burns
- **Weak acids** like vinegar are safe to eat but are still irritant to sensitive parts of the body.

Alkalis

- **Alkalis**, are a family of chemicals that have a soapy feel, they are also corrosive, examples of these are toothpaste, soap and oven cleaner.
- Alkalis contain OH⁻ ions.
- Alkalis are bases that dissolve in water. Therefore not all bases are alkalis. See the example below. Copper oxide is a base but not an alkali. Sodium hydroxide is a base and an alk⁻⁻:

<table>
<thead>
<tr>
<th></th>
<th>Copper oxide</th>
<th>Sodium hydroxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can it neutralise acids?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is it a base?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can it dissolve in water?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Is it an alkali?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Indicators

- **Indicators** are chemicals that show whether a substance is an acid or an alkali.
- There are many examples of indicators for example litmus paper and universal indicator.
- There are also natural indicators like red cabbage.

Acid | A substance which forms H⁺ ions.
--- | ---
Alkali | A soluble base that contains OH⁻ ions
Base | A substance that will neutralise an acid
The pH scale | A scale which measures how acidic a substance is
Indicator | A chemical which will change colour depending on the acidity of the substance

Safety

- When handling acids and alkalis in the lab we need to take many **safety precautions** for example wearing goggles.
- If an acid is dilute (lots of water has been added) it will be irritant and cause redness or blistering of the skin.
- If an acid is concentrated it will destroy skin cells.

The pH Scale

- The pH scale measures how strong an acid or alkali is.
- The pH scale runs from 0-14
- The pH scale measures the concentration of H⁺ ions, the lower the number the higher the concentration.
- Acids have a pH between 0 and 6, pH 1-3 are strong acids, 4-6 are weak acids.
- Alkalis have a pH between 8 and 14, 8-10 weak alkalis, 11-14 strong alkalis
- Anything with a pH of 7 is neutral, for example water.
Neutralisation

- When an acid reacts with an alkali a neutralisation reaction occurs, this means what you make has a pH of 7.
- When a neutralisation reaction happens the products are a salt and water. (See below for how to name a salt)
- There are many example of neutralisation reactions, for example a wasp sting is alkali so we add vinegar (an acid) to it to neutralise it.
- Farmers also spread alkalis onto fields to neutralise the acid in the soil.
- Another example is indigestion when there is to much acid in our stomach, we neutralise this with alkali tablets

<table>
<thead>
<tr>
<th>Key Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutralisation</td>
<td>A reaction where an acid and an alkali make a salt and water</td>
</tr>
<tr>
<td>Reactant</td>
<td>What you start with in a chemical reaction</td>
</tr>
<tr>
<td>Product</td>
<td>What is made in a chemical reaction</td>
</tr>
<tr>
<td>Soluble</td>
<td>Will dissolve in water</td>
</tr>
<tr>
<td>Insoluble</td>
<td>Does not dissolve in water</td>
</tr>
</tbody>
</table>

### Salts
- When a neutralisation reaction happens a salt is made
- To name a salt you need to use the alkali to form the first part of the name and the acid to form the second part of the name
- Hydrochloric acid makes “chlorides”
- Nitric acid make “nitrates”
- Sulphuric acid makes “sulphates”

<table>
<thead>
<tr>
<th>Alkali</th>
<th>Acid</th>
<th>Salt?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium hydroxide</td>
<td>Hydrochloric acid</td>
<td>Calcium Chloride</td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>Nitric acid</td>
<td>Magnesium Nitrate</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>Sulphuric acid</td>
<td>Calcium Sulphate</td>
</tr>
<tr>
<td>Aluminium hydroxide</td>
<td>Nitric acid</td>
<td>Aluminium Nitrate</td>
</tr>
<tr>
<td>Potassium hydroxide</td>
<td>Sulphuric acid</td>
<td>Potassium Sulphate</td>
</tr>
</tbody>
</table>

### Chemical Reactions
- In chemical reactions, what we start with is known as the reactants and what we make is known as the products.
- We can show reactants and products in a word equation

\[
\text{Acid} + \text{Alkali} \rightarrow \text{Salt} + \text{Water}
\]

### Salts
- There are two types of salt that could be made in a neutralisation reaction, soluble or insoluble salt
- Insoluble salts can be separated using filtration
- Soluble salts dissolve in water and can be separated using evaporation

### Examples of neutralisation reactions

<table>
<thead>
<tr>
<th>Reaction</th>
<th>General equation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid and Alkali</td>
<td>Acid + Alkali \rightarrow Salt + Water</td>
<td>Sodium Hydroxide + Sulphuric Acid \rightarrow Sodium Sulphate + Water</td>
</tr>
<tr>
<td>Acid and Metal Carbonate</td>
<td>Acid + Metal Carbonate \rightarrow Salt + Water + Carbon Dioxide</td>
<td>Hydrochloric acid + Magnesium Carbonate \rightarrow Magnesium Chloride + Carbon Dioxide + Water</td>
</tr>
<tr>
<td>Acid and metal Oxide</td>
<td>Acid + Metal Oxide \rightarrow Salt + Water</td>
<td>Sulphuric acid + Calcium Oxide \rightarrow Calcium Sulphate + Water</td>
</tr>
</tbody>
</table>
There are three states of matter.

<table>
<thead>
<tr>
<th>State</th>
<th>Arrangement</th>
<th>Movement</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids</td>
<td>Tightly packed and in a pattern.</td>
<td>Only vibrate on the spot</td>
<td>Rigid, fixed shape and volume</td>
</tr>
<tr>
<td>Liquids</td>
<td>Touching but not in a pattern</td>
<td>Can move around each other</td>
<td>Fixed volume, No fixed shape and not rigid</td>
</tr>
<tr>
<td>Gases</td>
<td>Not touching at all</td>
<td>Are free to move</td>
<td>Not rigid, no fixed and volume</td>
</tr>
</tbody>
</table>

**Particle Model**

**Transport**
Diffusion is described as movement of particles from a high concentration to an area of low concentration which does not require energy. Fluids (liquids and gases) generally move by diffusion. Osmosis is described as the movement of water molecules from an area of high water concentration to an area of low water through a semi-permeable membrane. Again this does not require energy.

Active transport is the movement of substances from a low concentration to a high concentration. This requires energy and carrier proteins.

**Structure of Atoms**
In the centre of the atom (nucleus) two main parts are found called protons (positively charged) and neutrons (no charge).
Surrounding the nucleus are shells which contain electrons (negatively charged).

**Melting & Boiling Points**
The melting and boiling points can be used to identify the state of substances. For example, Bromine has a melting point of -7°C and boiling point of 59°C. The state at room temperature is liquid.

**Change of State**
Sublimation
This is when a solid becomes a gas but doesn’t experience the liquid state

Evaporating & Condensing
Evaporating is when liquids gain heat energy and become gases. Condensing is when gases become liquids as they lose heat energy

Melting and freezing
Melting is when the particles in solids gain energy and move more slowly and then gain a tight pattern and become a solid.
Freezing is when particles lose energy and move more slowly and then gain a tight pattern and become a solid.

**Atoms, Elements, Compounds and Mixtures**
1. Atoms are the smallest unit of an element
2. Elements are made up of only one type of atom
3. Compounds are molecules with two or more atoms chemically joined
4. Mixtures are molecules with different, elements, compounds or mixtures that can be easily separated.

**Symbols and Formulae**
The first two symbols of the periodic table include:

- **H** = Hydrogen
- **He** = Helium
- **Li** = Lithium
- **Be** = Beryllium
- **B** = Boron
- **C** = Carbon
- **N** = Nitrogen
- **O** = Oxygen
- **F** = Fluorine
- **Ne** = Neon
- **Na** = Sodium
- **Mg** = Magnesium
- **Al** = Aluminium
- **Si** = Silicon
- **P** = Phosphorus
- **S** = Sulfur
- **Cl** = Chlorine
- **Ar** = Argon
- **K** = Potassium
- **Ca** = Calcium

**Common Formulae**
- Water = H₂O
- Methane = CH₄
- Carbon dioxide = CO₂
- Hydrochloric acid = HCl
- Sulphuric acid = H₂SO₄
- Calcium carbonate = CaCO₃
- Sodium hydroxide = NaOH
**Definition**

**Periodic Table**
A table of all the known elements in order of their atomic number.

**Group**
Vertical columns on the periodic table.

**Period**
Horizontal rows on the periodic table.

**Atom**
The smallest piece of an element.

**Element**
A substance containing only one type of atom.

**Compound**
Two or more different elements which are chemically joined together.

**Mixture**
Two or more different elements or compounds which are not chemically joined together.

**Chemical Reaction**
A process in which one or more substances are changed into others, by their atoms being rearranged. Also known as irreversible reactions.

**Physical Reaction**
A process in which the physical properties are changed, but no new substances are made. Also known as reversible reactions.

**Reactant**
A substance that reacts together with another substance to form products during a chemical reaction.

**Product**
A substance formed in a chemical reaction.

**Conservation of Mass**
The total mass of the products in a chemical reaction will be the same as the total mass of the reactant.

---

**Keyword**

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Periodic Table</strong></td>
</tr>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td><strong>Period</strong></td>
</tr>
<tr>
<td><strong>Atom</strong></td>
</tr>
<tr>
<td><strong>Element</strong></td>
</tr>
<tr>
<td><strong>Compound</strong></td>
</tr>
<tr>
<td><strong>Mixture</strong></td>
</tr>
<tr>
<td><strong>Chemical Reaction</strong></td>
</tr>
<tr>
<td><strong>Physical Reaction</strong></td>
</tr>
<tr>
<td><strong>Reactant</strong></td>
</tr>
<tr>
<td><strong>Product</strong></td>
</tr>
<tr>
<td><strong>Conservation of Mass</strong></td>
</tr>
</tbody>
</table>

---

**Chemical Reactions & Equations**
The changes in a chemical reaction can be modelled using equations. In general we write:

**Reactants → Product**

The reactants are shown on the left of the arrow, and the products are shown on the right of the arrow. The arrow tells us a chemical reaction has taken place.

E.g.

Iron + Oxygen → Iron Oxide

The Iron and oxygen react together (reactants) to produce Iron Oxide (product).

---

**Naming Compounds**
Metal + Non-Metal (which contain two elements)
1. The metal always goes first.
2. The ending of the non-metal changes to ‘ide’.

E.g.

Copper + Oxygen → Copper Oxide
Lithium + Fluorine → Lithium Fluoride

To name compounds which have a metal, non-metal and oxygen (three or more elements)
1. The metal always goes first.
2. The ending of the non-metal changes to ‘ate’.

E.g.

Copper, Sulfur, Oxygen
Copper Sulfate

---

**Conservation of Mass**
No atoms are created or destroyed in a chemical reaction. Instead, they just join together in a different way than they were before the reaction, and form products. This means that the total mass of the products in a chemical reaction will be the same as the total mass of the reactants.

---

**Balancing Equations**
A balanced equation gives more information about a chemical reaction because it gives the symbols and formulae of the substances involved.

Cu + O₂ → CuO

The above equation is not balanced because there is one copper atom on both sides of the arrow, but two oxygen atoms on the left hand side, and only one on the right. You need to adjust the number of units of some substances until you have equal numbers of atoms on both sides of the arrow. You cannot change the formulae of a substance (you can’t change the small number).

2Cu + O₂ → 2CuO
Elements
- An **element** contains only one type of atom
- They are found on the **Periodic Table** of elements which contains all 116 elements.
- All elements are given a **symbol**
- Symbols to learn:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Cl</td>
<td>Chlorine</td>
</tr>
<tr>
<td>Ar</td>
<td>Argon</td>
</tr>
<tr>
<td>Au</td>
<td>Gold</td>
</tr>
<tr>
<td>Ag</td>
<td>Silver</td>
</tr>
<tr>
<td>Cu</td>
<td>Copper</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>H</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>O</td>
<td>Oxygen</td>
</tr>
<tr>
<td>N</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>He</td>
<td>Helium</td>
</tr>
<tr>
<td>Fe</td>
<td>Iron</td>
</tr>
<tr>
<td>S</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
</tbody>
</table>

**Compounds**
- A **compound** contains *two or more* different types of atom which are **chemically bonded** together.
- Compounds form in chemical reactions.
- For example if iron and sulphur are heated up, they form a compound **iron sulphide**
- Compounds have a symbol for example H₂O means 2 hydrogens and 1 oxygen
- Other examples of compounds include, water, carbon dioxide and methane
- Compounds are very hard to **separate** because chemical bonds are strong
- Compounds have different properties to the elements that started, for example iron is **magnetic**, iron sulphide is not.

**Mixtures**
- A mixture is **two or more** different atoms which are **not chemically bonded**
- Examples are, air, salt water and petrol
- These can be **easily separated** using different techniques, for example distillation, chromatography and evaporation

**Chemical Reactions**
- In a chemical reaction we start with **reactants** and we make **products**. We represent this using a word or symbol equation.
- For example Sodium + Chlorine → Sodium Chloride
  - Reactants
  - Products
- We can also represent this reaction using a symbol equation
- 2Na + Cl₂ → 2NaCl
**Key Terms**

<table>
<thead>
<tr>
<th><strong>Definitions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atom</strong></td>
</tr>
<tr>
<td><strong>Proton</strong></td>
</tr>
<tr>
<td><strong>Electron</strong></td>
</tr>
<tr>
<td><strong>Neutron</strong></td>
</tr>
<tr>
<td><strong>Atomic number</strong></td>
</tr>
</tbody>
</table>

---

**The periodic Table**

All the different elements are arranged on the periodic table. The elements are arranged in order of increasing atomic number. On the periodic table, we can see the metal elements and non metal elements.

---

**Structure of the Atom**

- An atom is made up of three subatomic particles: protons, electrons and neutrons.
- Protons and neutrons are found in the nucleus of the atom (in the centre).
- Electrons are found orbiting the nucleus in shells (also known as energy levels).
- Protons have a positive charge.
- Electrons have a negative charge.
- Neutrons have a no charge.

---

**Groups and Periods**

Elements are arranged on the periodic table in groups and periods. Horizontal rows are called periods and vertical columns are called groups.

---

**Atomic Number and Mass Number**

This is the total of protons + neutrons

This is the number of protons

Therefore sodium has 11 protons, 11 electrons and 23-11=12 neutrons.
### Particle
The general term for a small piece of matter.

### State of Matter
The distinct forms in which matter can exist (solid, liquid, gas).

### Solid
A substance with a fixed shape and volume.

### Liquid
A substance with a fixed volume but not a fixed shape.

### Gas
A substance that does not have a fixed shape or volume.

### Change of State
The change of a substance from one physical form to another.

### Melting
The change of state when a solid changes to a liquid.

### Freezing
The change of state when a liquid changes to a solid.

### Condensing
The change of state when a gas changes to a liquid.

### Evaporation
The change of state when a liquid changes to a gas.

### Density
The amount of mass that 1cm³ of a substance has.

### Density (formula)
Density = mass / volume
\[ p = \frac{m}{v} \]

### Dense
Something which is heavy for its volume.

---

### Solid, Liquid, Gas

<table>
<thead>
<tr>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>The particles vibrate in a fixed position.</td>
<td>The particles are close together and move around each other.</td>
<td>The particles are far apart and move quickly in all directions.</td>
</tr>
<tr>
<td>The particles cannot move from place to place.</td>
<td>The particles are arranged in a random position.</td>
<td>The particles are arranged in a random way.</td>
</tr>
<tr>
<td>Particles have a fixed shape and cannot flow.</td>
<td>The particles flow and take the shape of the bottom of their container.</td>
<td>The particles flow and completely fill their container.</td>
</tr>
<tr>
<td>The particles cannot be compressed (squashed)</td>
<td>The particles cannot be compressed.</td>
<td>The particles can easily be compressed.</td>
</tr>
</tbody>
</table>

---

### Forces between particles:

**Solid:** There are strong forces of attraction between the particles in a solid. Therefore, particles can only vibrate in a fixed position.

**Liquid:** There are weaker forces of attraction between the particles in a liquid. Therefore, the particles are close together, and are able to move around each other.

**Gas:** The forces of attraction between the particles are overcome. Therefore, the particles are far apart and move quickly in all directions.

---

### Calculating Volume:

\[ V = L \times W \times H \]

- **Volume = 10cm x 5cm x 4cm**
- **Volume = 200cm³**

### Calculating Density:

\[ \text{Density} = \frac{\text{Mass}}{\text{Volume}} \]

- **Density = 20g ÷ 200cm³ = 0.1g/cm³**

### Density:
1kg of a gas has a larger volume than 1kg of a solid. There is empty space between particles in a gas, but in a solid, they're tightly packed together.
**Particle Theory**
All matter is made up of particles. Particles are found in all 3 states of matter. Particles in the 3 states behave differently.

In **solids**, particles are arranged in a **regular pattern** and they can only **vibrate** in a fixed position. Particles in solids are not free to move. In **liquids**, particles can **slide pass** each other. They are **arranged randomly**.
In **gases**, particles carry a lot of energy and they **move in all directions** in a high speed. Particles are **far apart** and are **arranged randomly**.

**Change of State**
Changes of state take place when the particles gain or lose energy. When energy is applied, particles gain energy and move further apart. When energy is lost, particles become closer to each other and arrange themselves more regularly.

**Key Terms**
<table>
<thead>
<tr>
<th>Key Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of matter</td>
<td>Matter is divided into three states: solid, liquid, and gas.</td>
</tr>
<tr>
<td>Melting</td>
<td>Change of state from solid to liquid.</td>
</tr>
<tr>
<td>Freezing</td>
<td>Change of state from liquid to solid</td>
</tr>
<tr>
<td>Evaporation</td>
<td>Change of state from liquid to gas.</td>
</tr>
<tr>
<td>Condensation</td>
<td>Change of state from gas to liquid.</td>
</tr>
<tr>
<td>Diffusion</td>
<td>Particles spread from a region of higher concentration to a region of lower concentration.</td>
</tr>
<tr>
<td>Rate</td>
<td>How fast an event, e.g. diffusion, is happening.</td>
</tr>
<tr>
<td>Concentration</td>
<td>The number of particles in a known volume.</td>
</tr>
<tr>
<td>Particles</td>
<td>All matter is made up of tiny particles.</td>
</tr>
<tr>
<td>Pressure</td>
<td>Pressure is formed when particles collide with the walls of containers.</td>
</tr>
</tbody>
</table>

**Interpreting the Energy-Temperature Graph**
During the change of state, the temperature will stay the same until the change of state has been completed, i.e. all liquid has turned into gas, all liquid has frozen into solid, etc.
<table>
<thead>
<tr>
<th>Keyword</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution</strong></td>
<td>A liquid mixture in which a solute has dissolves in the solvent</td>
</tr>
<tr>
<td><strong>Solute</strong></td>
<td>A minor component in a solution – dissolves in the solvent</td>
</tr>
<tr>
<td><strong>Solvent</strong></td>
<td>The liquid which the solute dissolves in</td>
</tr>
<tr>
<td><strong>Saturated</strong></td>
<td>The point at which no more solute can dissolve</td>
</tr>
<tr>
<td><strong>Pure</strong></td>
<td>Only one type of particle</td>
</tr>
<tr>
<td><strong>Dissolve</strong></td>
<td>Solid is mixed into a liquid to become a solution</td>
</tr>
<tr>
<td><strong>Particle</strong></td>
<td>A small piece of matter – everything is made up of these</td>
</tr>
<tr>
<td><strong>Filter</strong></td>
<td>To remove solid particles from liquid particles</td>
</tr>
<tr>
<td><strong>Evaporate</strong></td>
<td>Particles go from a liquid to a gas</td>
</tr>
<tr>
<td><strong>Separate</strong></td>
<td>To remove one type of particle from another</td>
</tr>
<tr>
<td><strong>Soluble</strong></td>
<td>A substance is capable of dissolving</td>
</tr>
<tr>
<td><strong>Mixture</strong></td>
<td>More than one type of particle</td>
</tr>
<tr>
<td><strong>Solubility</strong></td>
<td>How much of a substance will dissolve in a solution</td>
</tr>
<tr>
<td><strong>Insoluble</strong></td>
<td>A substance is not capable of dissolving</td>
</tr>
</tbody>
</table>

**Filtration:**
- A method for separating an insoluble solid from a liquid. A beaker containing a mixture of insoluble solid and liquid. There is filter paper in a filter funnel above another beaker.

- The mixture if insoluble solid and liquid is poured into the filter funnel.
- The liquid particles are small enough to pass through the paper as a filtrate. The solid particles are too large to pass through the filter paper and stay behind as the residue.

**Distillation:**
- A method used for separating the solvent from a solution. E.g. water can be separated from a salt solution because the water has a much lower boiling point than the salt.
- Salt water is heated. The water evaporates and its vapours rise.
- The vapours rise and pass into the condenser, where they cool and condense.
- Liquid water drips into a beaker and the salt will be left in the round bottom flask.

**Evaporation:**
- A method used to separate a soluble solid from a liquid.
- A solution is placed in an evaporating basin and heated with a Bunsen Burner.
- The water will begin to evaporate and solid particles will begin to form in the basin.
- Once the water has evaporated, it will leave solid crystals behind.

**Chromatography:**
- Paper chromatography is a method for separating dissolved substance from one another. Often used when the dissolved substance are coloured such as inks, food colouring or plant dyes.
- A pencil line is drawn on the paper, and spots of ink are placed on the line.
- There is a solvent usually water or ethanol in a container/beaker.
- The paper is lowered into the solvent. The solvent travels up the paper, taking some of the substances with it.
- As the solvent travels up the paper, the different coloured substances are spread apart.

Further Reading: [https://www.bbc.com/bitesize-guides/zgvc4wx/revision/1](https://www.bbc.com/bitesize-guides/zgvc4wx/revision/1)
Elements
Elements are made up of one type of atom. All the elements are found listed in the periodic table – there are currently 118 of them.

Compounds
Compounds are formed by chemical reactions. Compounds contain two or more elements that are chemically joined to each other. In order to separate the elements in a compound you would need to carry out another chemical reaction. Examples of compounds are:
- Carbon dioxide (CO₂)
- Water (H₂O)

Key Terms

<table>
<thead>
<tr>
<th>Key Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure</td>
<td>A material that is composed of only one type of particle.</td>
</tr>
<tr>
<td>Impure</td>
<td>A material that is composed of more than one type of particle.</td>
</tr>
<tr>
<td>Evaporation</td>
<td>A change of state involving a liquid changing to a gas.</td>
</tr>
<tr>
<td>Distillation</td>
<td>A process for separating the parts of a liquid solution. The solvent is heated and the gas is collected and cooled.</td>
</tr>
<tr>
<td>Filtration</td>
<td>The act of pouring a mixture through a mesh, in attempts to separate the components of the mixture.</td>
</tr>
<tr>
<td>Mixture</td>
<td>A material made up of at least two different pure substances.</td>
</tr>
<tr>
<td>Chromatography</td>
<td>A technique used to separate mixtures of coloured compounds.</td>
</tr>
</tbody>
</table>

Pure Substances
If you could see the particles in pure water, you would only see water particles. There would be no other particles. Pure substances can be elements or compounds. Examples of pure substances include gold, oxygen and pure water.

Impure Substances
Impure materials may be mixtures of elements, mixtures of compounds, or mixtures of elements and compounds. For example, even the most pure water will contain dissolved gases from the air. Impurities in a substance will affect its properties. For example, they may change its boiling point.

Mixtures
A mixture contains different substances that are not chemically joined to each other. For example, a packet of sweets may contain a mixture of different coloured sweets. The sweets are not joined to each other, so they can be picked out and put into separate piles.

Elements
Elements are made up of one type of atom. All the elements are found listed in the periodic table – there are currently 118 of them.

Compounds
Compounds are formed by chemical reactions. Compounds contain two or more elements that are chemically joined to each other. In order to separate the elements in a compound you would need to carry out another chemical reaction. Examples of compounds are:
- Carbon dioxide (CO₂)
- Water (H₂O)
**Distillation**
This is good for separating a liquid from a solution. For example, water can be separated from salty water by simple distillation. This method works because the water evaporates from the solution, but is then cooled and condensed into a separate container. The salt does not evaporate and so it stays behind. Distillation can also be used to separate two liquids that have different boiling points.

**Filtration**
This is good for separating an insoluble solid from a liquid. (An insoluble substance is one that does not dissolve). Sand, for example, can be separated from a mixture of sand and water using filtration. That's because sand does not dissolve in water.

**Chromatography**
Simple chromatography is carried out on paper. A spot of the mixture is placed near the bottom of a piece of chromatography paper and the paper is then placed upright in a suitable solvent, e.g. water. As the solvent soaks up the paper, it carries the mixtures with it. Different components of the mixture will move at different rates. This separates the mixture out.
Elements
- An element contains only one type of atom
- They are found on the Periodic Table of elements which contains all 116 elements.
- All elements are given a symbol
- Symbols to learn:
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Cl</td>
<td>Chlorine</td>
</tr>
<tr>
<td>Ar</td>
<td>Argon</td>
</tr>
<tr>
<td>Au</td>
<td>Gold</td>
</tr>
<tr>
<td>Ag</td>
<td>Silver</td>
</tr>
<tr>
<td>Cu</td>
<td>Copper</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>H</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>O</td>
<td>Oxygen</td>
</tr>
<tr>
<td>N</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>He</td>
<td>Helium</td>
</tr>
<tr>
<td>Fe</td>
<td>Iron</td>
</tr>
<tr>
<td>S</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
</tbody>
</table>

Compounds
- A compound contains two or more different types of atom which are chemically bonded together.
- Compounds form in chemical reactions.
- For example if iron and sulphur are heated up, they form a compound iron sulphide.
- Compounds have a symbol for example H₂O means 2 hydrogens and 1 oxygen.
- Other examples of compounds include, water, carbon dioxide and methane.
- Compounds are very hard to separate because chemical bonds are strong.
- Compounds have different properties to the elements that started, for example iron is magnetic, iron sulphide is not.

Mixtures
- A mixture is two or more different atoms which are not chemically bonded.
- Examples are, air, salt water and petrol.
- These can be easily separated using different techniques, for example distillation, chromatography and evaporation.

Chemical Reactions
- In a chemical reaction we start with reactants and we make products. We represent this using a word or symbol equation.
- For example Sodium + Chlorine → Sodium Chloride
  Reactants                         Products
- We can also represent this reaction using a symbol equation
- 2Na + Cl₂ → 2NaCl
Physical and chemical reactions

Physical reactions are when a reaction can be reversed. This means that the original starting reactants can be separated from the product.

Chemical reactions are when a reaction cannot be reversed. This means that the original reactants can not be separated.

There are many signs that can show whether a physical or chemical reaction is taking place.

Examples of Physical and chemical reactions

Physical reactions include ice melting, freezing water, building a sand castle.

Chemical reactions include wood burning, reacting an acid and alkali.

Evaporation and Crystallisation

When a product is made as a solution, one way to separate it from the solvent is to make crystals. This involves evaporating the solution to a much smaller volume and then leaving it to cool. As the solution cools, crystals form, and these can be obtained by filtration.

Simple distillation

Simple distillation separates a liquid from a solution. For example, water can be separated from salty water. This method works because the water evaporates at a different temperature.

Acids and Alkalis

Examples of strong acids are such as hydrochloric acid. Weak acids are such as ethanoic acid. Concentrated acids are made up of only a few water particles and many acid particles. A weak/dilute acid contains many water particles and a few acid particles. The pH scale is used to show the different concentrations of acids and alkalis. pH 1-2 are strong acids and 3-6 weak. pH 7 is considered neutral. This means it is not an acid nor alkali. pH 12-14 are strong alkalis.

Indicators

Indicators can be used to identify the pH of substances. There are many different types:

a. Universal Indicator: is a solution that can change all the colours of the pH scale.

b. Litmus paper: is a paper that turns blue in alkali and red in acid. It does not show whether a solution is a concentrated or not.

c. Red cabbage: is a solution that can show whether a substance is acid, alkali or neutral.

Neutralisation

This is when an acid and alkali are reacted together. This reaction is useful for indigestion, treating an insect bite or in lakes and agriculture. The equation is:

\[
\text{acid} + \text{alkali} \rightarrow \text{salt + water}
\]

As one of the products is water. This has a pH of 7 and is neutral.