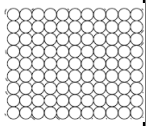
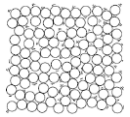
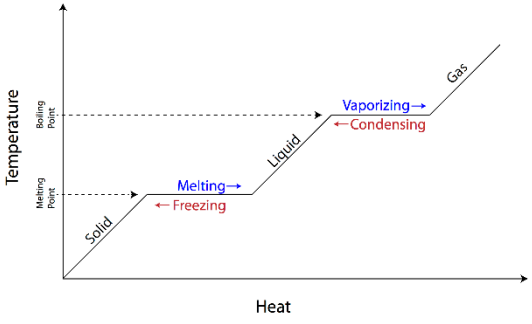
Y7 Chemistry T1- States of matter & Separating techniques

State	Particle arrangement	How the particles move	Properties
Solid		Particles are held in a fixed position and vibrate on the spot.	Solids cannot be squashed, do not flow, have a fixed shape and volume, and have a high density.
Liquid		Particles are free to move past each other but are still very close.	Liquids cannot be squashed, flow quite easily, and have a fixed volume but no fixed shape.
Gas		Particles are far apart and can move anywhere by themselves.	Gases are quite easy to squash, flow easily, have no fixed volume and no fixed shape.

Changing State

Substances must be heated to make them melt or boil and cooled to make them condense or freeze.

Heating makes particles move faster and weakens the forces of attraction between the particles. Cooling slows the particles down and strengthens the forces of attraction between the particles. Substances melt and boil at different temperatures called the melting point and boiling point. These are different for each substance.



Key words	
Particle	The tiny pieces that everything is made out of.
Pure	A substance made up of only one type of particle.
Mixture	A substance made up of two or more different types of particles that are not chemically joined.
Melting	When a solid changes state to a liquid.
Freezing	When a liquid changes state to a solid.
Condensing	When a gas changes state to a liquid.
Boiling	When a liquid changes state to a gas.
Sublimation	A solid changing straight to a gas.
Melting point	The temperature at which a solid turns into a liquid, this is the same as the temperature that a liquid turns in to a solid.
Boiling point	The temperature at which a liquid turns into a gas, this is the same as the temperature that a gas turns in to a liquid.

Solutions

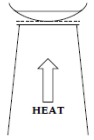
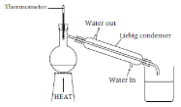
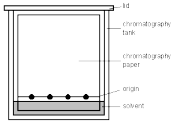
A **solution is** a liquid containing dissolved substances. The substance being dissolved is called the solute and the liquid in which it is being dissolved is the **solvent.**

Solute + solvent → solution

A substance that will dissolve is soluble, one that will not is **insoluble**.

The amount of solute that will dissolve is effected by the type of solute, the type of solvent and the temperature.

When no more of a substance will dissolve in a solvent the solution is saturated.

Separation technique	What it separates	diagram	How it works
Filtration	Insoluble solid from a liquid		The particles of the liquid and any dissolved particles are small enough to fit through the filter paper, however any solid particles cannot pass through and become trapped in the paper.
evaporation	Soluble solid from a liquid		The boiling point of the liquid is much lower than that of the dissolved solid, the liquid evaporates when heated and the solid is left behind.
Distillation	A liquid from a solution		The liquid is heated and evaporates, the vapours are trapped and cooled, condensed and collected.
Chromatography	A mixture of dyes or colours		The different colours in the inks have different solubilities and are transported different distances up the paper.

Pressure

Pressure is a measure of how hard a gas pushes against its surroundings.

The pressure may increase because:

- the container has been squashed, making the volume smaller; this means that the particles will be hitting the walls more often.
- the number of particles has been increased, which means there are more particles moving around to hit the walls.
- the temperature of the particles has increased, so they will move around faster and hit the walls harder and more often.

If the particles are in a container which is flexible, like a balloon or a syringe, an increase in pressure will make the volume increase.

Diffusion

The natural mixing of substances is called **diffusion**. Diffusion occurs because particles in a substance are always **moving** around. Diffusion is fastest in **gases**, and slower in liquids. Diffusion in solids is extremely slow.

Brownian motion is the random movements of particles in liquids and gases.

Year 7- Atoms, elements and compounds

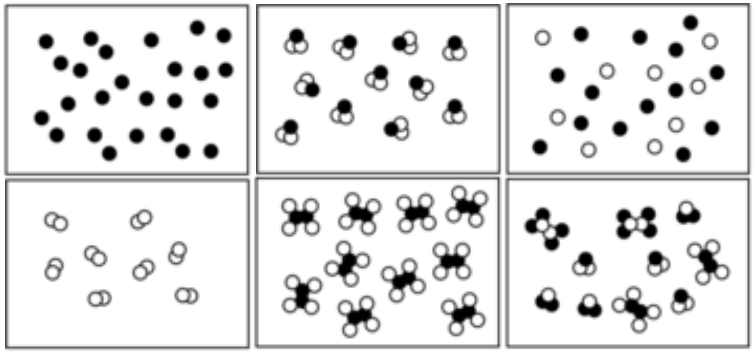
Atoms and elements

An **element** is a simple substance that cannot be split into anything simpler by chemical reactions. **Atoms** are the smallest particles of an element that can exist. Atoms of one element are all the same, and are different from atoms of all the other elements.

There are over 100 different elements. All the elements are shown in the **Periodic Table**. Each element has a **chemical symbol**, which is usually one or two letters.

A symbol is written with the first letter as a capital, and the second letter is small.

carbon C	**oxygen O**
nitrogen N	**hydrogen H**
gold Au	**silver Ag**
copper Cu	**aluminium Al**



Element **Compound** **Mixture**

Chemical reactions

In a **chemical reaction** a new substance is always formed. Most chemical changes are not easily reversed; they are **irreversible**. In a **physical change** no new substance is formed. Melting and evaporation are examples of physical changes. Physical changes are usually reversible.

You can tell that a reaction has occurred if there is a **colour change** or when a **gas** is given off. Most chemical reactions also involve an **energy change**. This is usually in the form of heat, but can also involve light being given off (for example, when something burns).

Compounds

Elements can join together to make compounds. The name of the compound tells you the elements that are in it.

Compounds made from two elements always have a name which ends in '**-ide**'. For example, sodium chloride contains sodium and chlorine.

Compounds made from three elements, one of which is oxygen, always have a name which ends '**ate'.** For example, calcium carbonate contains calcium, carbon and oxygen.

A compound always contains the same elements in the same ratio so can be represented by a chemical formula.

Mixtures

Mixtures are different substances that are combined physically, but not chemically. They can be separated by physical techniques (filtration, evaporation, distillation etc).

Elements and compounds can also be mixed together. A **mixture** is easier to separate than the elements in a compound. Soil, river water and sea water are examples of mixtures that occur naturally.

Elements and compounds melt and boil at a fixed temperature. Mixtures do not have definite **melting points** and **boiling points**.

Chemical Formula

A chemical formula tells you the name and number of atoms in a compound. The smallest particle of many compounds is called a **molecule**. Molecules are made up of atoms. Some elements are also made of molecules. For example, a molecule of oxygen contains two oxygen atoms joined together. The formula is O_2.

If there is only one atom of a particular element we simply write its symbol, if there is more than 1 atom of a particular element we write its symbol followed by the number of atoms hanging of the line. For example, CO_2 contains 1 carbon atom and 2 oxygen atoms.

Word equations

We can write **word equations** to show a chemical reaction. The chemicals that you start with are called the **reactants**. The chemicals at the end are called the **products**.

When writing word equations, the reactants are on the left and the products are on the right, separated by and arrow.

Reactants → Products

hydrogen + oxygen → water

Word equations should only contain the names of the elements and compounds, not a mixture of names and formula.

Conservation of mass

In a chemical reaction, the mass of the reactants is always the same as the mass of the products. This is because atoms are not created or destroyed in chemical reactions; they are just rearranged into different compounds.

Sometimes the chemicals in a reaction *seem* to gain or lose mass. If you heat copper it reacts with oxygen from the air to form copper oxide, which has a greater mass than the original copper. However, if you could find the mass of oxygen that had reacted, you would find that the total mass of the reactants (copper and oxygen) was exactly the same as the mass of the product (copper oxide).

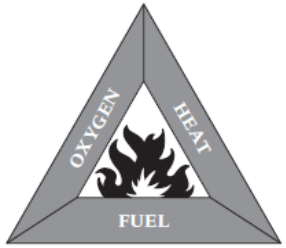
When you burn a piece of wood, the ashes that are left have a smaller mass than the wood you started with. This is because one of the products of the reaction is carbon dioxide gas, which has escaped into the air.

Chemical reactions

Elements and compounds can react chemically by mixing them with other chemicals, or by using heat or electricity.
You can tell that a **chemical reaction** has occurred if a new substance has been formed. This might be observed through a colour change, a gas being given off(bubbles), a solid being formed (eg a precipitate) or an energy change.
Most chemical reactions involve an energy change. This is usually in the form of heat, but can also involve light being given off, for example, in burning (**combustion**).
In a chemical reaction a new substance is always formed.
Most chemical reactions are not easily reversed (they are **irreversible**).
Some chemical reactions take place just by mixing. When you make a solid by mixing two liquids, the solid is called a **precipitate**.
Other chemical reactions need energy to start them off. This energy can be in the form of heat, light or electricity.
When you use energy to split up compounds they are **decomposed**.

Combustion reactions

Combustion is the chemical name for burning. A fire needs three things to keep burning: fuel, oxygen and heat. We show these three things on the Fire Triangle.



If any one of these three things runs out, the fire will go out.
When a metal burns, the metal combines with oxygen from the air to form a chemical called an **oxide**.

magnesium + oxygen → magnesium oxide
reactants *products*

Fossil fuels contain a lot of carbon and hydrogen. When they burn they use up oxygen from the air and produce water and carbon dioxide. We can show the reaction using a word equation. Energy is in brackets in this equation because it is not a chemical substance.

fuel + oxygen → carbon dioxide + water (+ energy)

Thermal decomposition

In a thermal decomposition reaction, a substance splits in to less complex substances when heated.
Metal carbonates undergo thermal decomposition.

Metal carbonate → metal oxide + carbon dioxide

You can test for carbon dioxide being given off by bubbling it through limewater. If the limewater goes cloudy carbon dioxide is present.

Oxidation

Combustion is an example of a type of reaction called oxidation. In an oxidation reaction, a substance gains oxygen. Most oxidation reactions give out heat energy.

Copper + oxygen → copper oxide
Carbon + oxygen → carbon dioxide

Exothermic and Endothermic reactions

An **exothermic** reaction is a reaction that gives out heat energy. The temperature of the surroundings increases.
Combustion is an example of a type of exothermic reaction.
Exothermic reactions are useful as fuels, they can also be used in hand warmers and self-heating cans.
An **Endothermic** reaction is a reaction that absorbs heat energy.
Thermal decomposition is an example of an endothermic reaction. The temperature of the surroundings decreases.
Endothermic reactions can be used in cold packs to treat sports injuries.
To find out if a reaction is exothermic or endothermic you need to find the initial temperature of the reactants, then mix the chemicals and record the new temperature. If the temperature has gone up the reaction is exothermic, if the temperature has gone down the reaction is endothermic.

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Changing rates of reaction

Some chemical reactions occur slowly like rusting other chemical reactions are much quicker like explosions. The speed of a chemical reaction can be altered by changing the conditions of the reaction.
If the temperature of the reaction is increased the reaction gets faster. This is because the reactant particles have more energy to react.
If the surface area of a solid is increased the reaction will get faster. This is because more of the reactant particles are available to react.
A catalyst can be added to a reaction. This is a chemical that makes the reaction faster without being used up in a reaction. Catalysts can be used again and again.