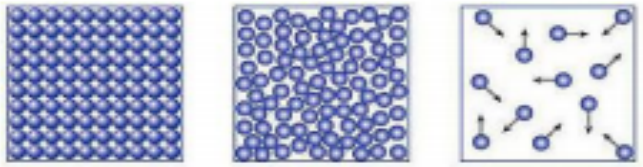
Chemistry Knowledge Organiser
Particles

KPI 1.1: Describe the arrangement of particles in a solid, liquid and gas, and link this to their properties.

Particle Theory

All matter is made up of particles. Particles are found in all three states of matter. Particles in the three states have **different movement and arrangement.**

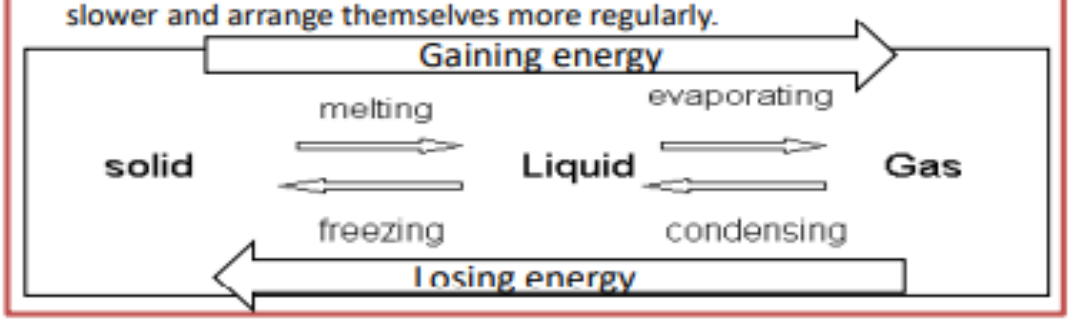


- In **solids**, particles are arranged in a **regular pattern** and they can only **vibrate** in a fixed position. Particles are held together by strong bonds.
- In **liquids**, particles are **arranged randomly** but are **still touching** each other. Particles can slide past each other and move around.
- In **gases**, particles are **far apart** and are **arranged randomly**. Particles carry **a lot of energy** and they move in **all directions** in a **high speed.**

Changes of State

Changes of state take place when the particles **gain or lose energy.**

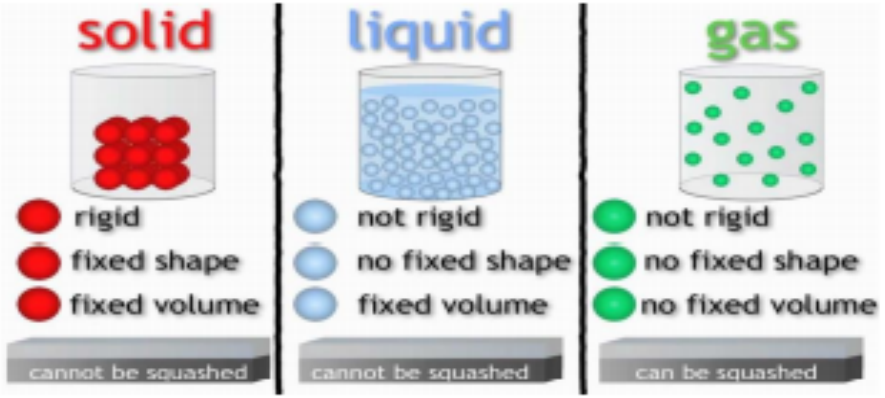
- When energy is applied, particles gain energy, move faster and move further apart.
- When energy is lost, particles become closer to each other, move slower and arrange themselves more regularly.



Key Terms	Definitions
State of matter	Matter is divided into three states: solid, liquid, and gas
Melting	Change of state from solid to liquid
Freezing	Change of state from liquid to solid
Evaporation	Change of state from liquid to gas
Condensation	Change of state from gas to liquid

Properties of Solids, Liquids and Gases

Due to their arrangement and movement, the three states each have different properties.



Solids are rigid, have a fixed shape and fixed volume because particles are held together by **strong bonds and arranged regularly.**

Liquids are not rigid and have no fixed shape, meaning they can flow to fill their container. This is because the **bonds are weaker**, so the particles can move. However, there is a fixed volume because the particles are **still close together.**

Gases are not rigid, have no fixed shape or fixed volume because there is **so much space** between particles and the bonds holding them together are **broken.**

Chemistry Knowledge Organiser
Particles

KPI 1.2: Explain changes of state in terms of the particle model.

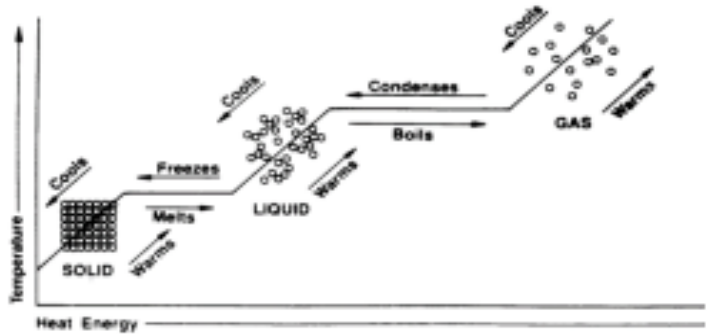
Key Terms	Definitions
Diffusion	Movement of particles from a higher concentration to a lower concentration
Rate	How fast an event e.g. diffusion, is happening
Concentration	The number of particles in a known volume
Particles	All matter is made up of tiny particles

Interpreting the Energy-Temperature Graph

The E-T graph shows how the temperature of a substance changes as heat is applied.

- When the line is sloped, the temperature of the substance is increasing.
- When the line is flat, the temperature stays the same even though heat is being applied. This is because the heat is going into **making the particles change state.**

During the change of state, **the temperature will stay the same until the change of state is complete** e.g. all liquid has turned into gas.



Conservation of Mass

The Law of Conservation of Mass states that **mass cannot be created or destroyed.**

Therefore, mass stays the same before and after a change of state.

For example, 10g of ice melts into 10g of water and 10g of water evaporates into 10g of water vapour. The same applies to other substances.

Diffusion and Factors Affecting Diffusion

Diffusion is the **movement of particles from a higher concentration to a lower concentration.**

Diffusion will stop when particles spread themselves evenly.

Diffusion occurs in liquids and gases but not in solids, because particles in a solid are not free to move.

Examples of diffusion include:

1. Oxygen diffusing into cells.
2. Carbon dioxide diffusing out of cells.

Diffusion

There are **2 factors** affecting the rate of diffusion:

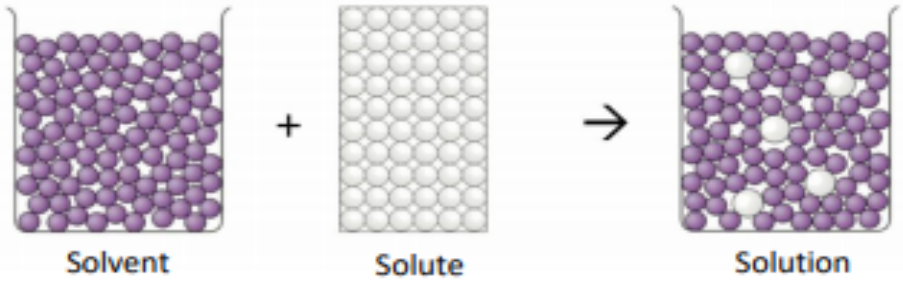
1. **Temperature**: When temperature increases, particles gain more energy. They can then move and spread out at a higher rate.
2. **Concentration**: When concentration increases, the rate of diffusion increases because there are more particles.

Chemistry Knowledge Organiser
Separation

KPI 7.1: Classify substances as pure and impure and describe techniques to separate mixtures.

Dissolving

- During dissolving, the **solvent particles** surround the **solute particles** and move them away so they are spread out in the **solvent.**
- This is how a solution is made.



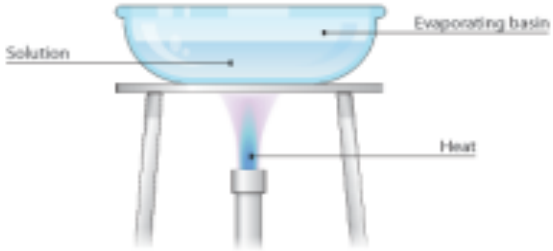
Saturated solutions

- When no more solute can dissolve in a solvent, we say the solution is **saturated.**
- However, more solute will be able to dissolve if the solvent is heated. This is because solubility increases with a higher temperature.
- This happens because the solvent particles are moving slightly faster, as they have more energy. This means there is more space for solute particles to fit in.
- **Mass is always conserved.** For example if 5 grams of solute are dissolved in 100 grams of solvent, the mass of the solution will be 100 + 5= 105 grams.

Key Terms	Definitions
Dissolving	When solvent particles surround solute particles so they are spread out
Saturated Solution	A solution in which no more solute can dissolve
Evaporation	A method for separating a dissolved substance from the liquid
Filtration	A method for separating an insoluble solid from a liquid

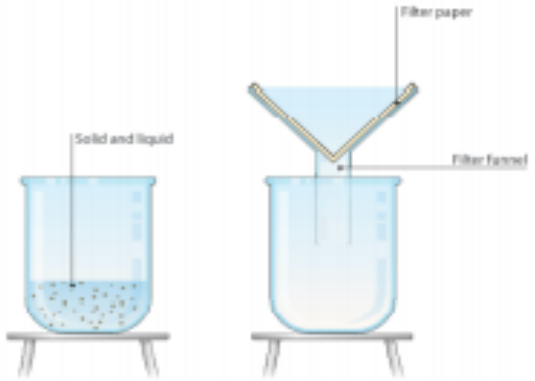
Evaporation

- If you have a solution in which a solute is dissolved, for example salt water, the water can be evaporated to leave you with pure salt.
- This is done by using a Bunsen Burner to heat the solution inside an evaporating basin.



Filtration

- This is a good method of separation for when an insoluble solid is mixed with water e.g. sand and water.
- The mixture is poured through folded filter paper inside a funnel.
- The insoluble solid is trapped in the filter paper and the liquid passes through into the beaker.



Chemistry Knowledge Organiser
Separation

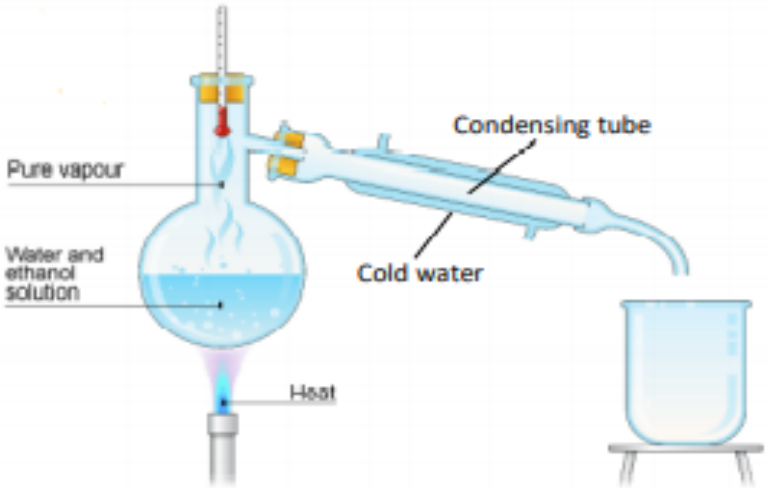
KPI 7.1: Classify substances as pure and impure and describe techniques to separate mixtures.

Key Terms	Definitions
Distillation	A method for separating the parts of a liquid solution according to their boiling point.
Chromatography	A method for separating mixtures of compounds according to their solubilities in a solvent.

Distillation

- This is good for separating a mixture of liquids, e.g. ethanol and water
- Different liquids have different boiling points e.g. ethanol has a lower boiling point than water
- Distillation separates liquids according to their boiling points:

1. The mixture of liquids is heated in the round flask
2. The liquid with the lower boiling point (ethanol in this example) will evaporate first, turning into a gas
3. It passes through the condensing tube which is surrounded by cold water, so the gas condenses back into liquid form
4. It drips into the beaker
5. The liquid with the higher boiling point (water in this example) is left in the round flask because it is not hot enough yet to evaporate.



Chromatography

- Chromatography is used to separate the compounds in a mixture according to how soluble they are in a solvent
- It uses chromatography paper dipped in the solvent as follows:

1. A spot of the mixture, for example felt tip, is placed near the bottom of the paper
2. The paper is dipped in the solvent e.g. water, so that the spot is just above the water level. If the spot goes in the water, it will run.
3. The compounds that are most soluble travel with the solvent up the paper.
4. The compounds are insoluble will stay in the same place.
5. In this way, the compounds are separated according to their solubility in the solvent