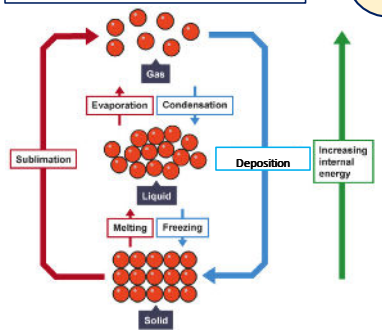
# Pa: Particle Model of Matter

| Keyword | Definition |
|---|---|
| Boyle's law | For a fixed mass of gas at a constant temperature, its pressure multiplied by its volume is constant. |
| Compression | Squeezing or pressing together. |
| Density | Mass per unit volume of a substance, e.g. kg/m$^3$. |
| Displacement | Distance in a given direction. Measured in metres. |
| Internal energy | The energy of the particles within a substance due to their individual motion and positions. |
| Latent heat | The energy transferred to or from a substance when it changes its state. |
| Mass | The quantity of matter in an object (measured in kilograms, **kg**). |
| Specific heat capacity | The energy needed to raise the temperature of 1 kg of a substance by 1°C. |
| Specific latent heat of fusion | The energy needed to change the state of 1 kg of a substance between solid and liquid states, with no change of temperature. |
| Specific latent heat of vaporisation | The energy needed to change the state of 1 kg of a substance between liquid and gaseous states, with no change of the temperature. |
| Temperature | A way of indicating the average kinetic energy of the particles in a substance. |
| Vibrate | To oscillate (move to and fro) around a certain position. |

## Pa 04. Changes in State

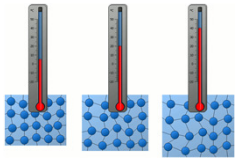
A



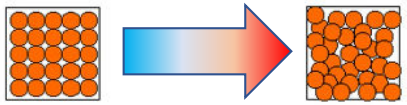

- Changes of state are physical changes.
- Heating will cause an increase in internal energy, causing a change in the motion or the arrangement of the particles.
- Reducing the internal energy will cause the substance to recover its original properties.

Key Point

Internal energy is the total kinetic and potential energy of the particles in a system.



Increasing the kinetic energy of the particles in a substance will increase the temperature of the substance as temperature is a measure of the average kinetic energy.

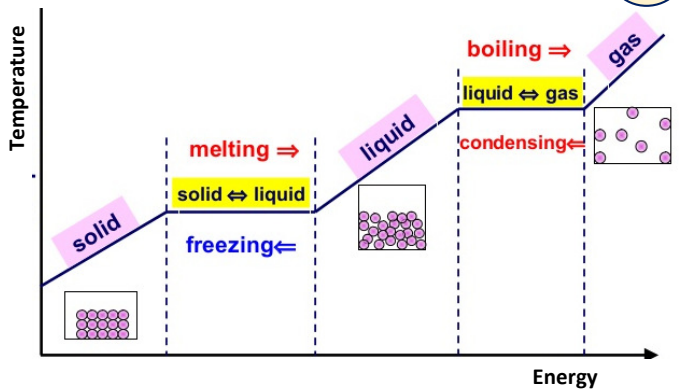



Increasing the potential energy of the particles in a substance will alter the intermolecular forces, leading to a change of state.

There is no change in motion of the particles, so no increase in temperature.

## Pa 04-06. Changes in State & Internal energy

B




- Specific Heat Capacity relates to the points on a cooling graph where the temperature changes.
- Specific Latent Heat relates to the points on a cooling graph where the temperature doesn't change – changes of state.

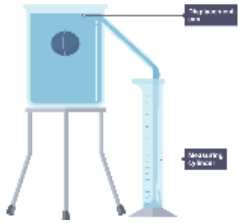
- The **latent heat of fusion** relates to the state change between solid and liquid phases.
- The **latent heat of vaporization** relates to the change between liquid and gas phases.

## Pa 02 & 03. Density

There is 1 equation which you will need to be able to recall and apply.

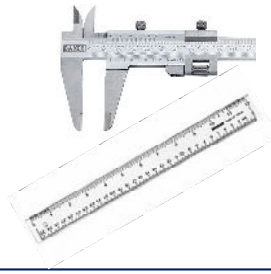
Density

$\rho = m \times v$



- A displacement (Eureka) can can be used to determine the volume of both regular and irregularly shaped objects.
- A measuring cylinder can be used to determine the volume of a fluid displace by the object.

- The mass of the object you are working with can be determined using a top pan balance or equivalent.



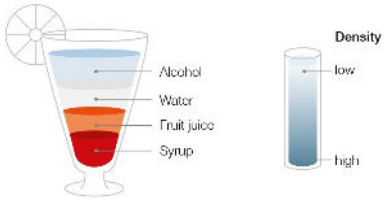
- The volume of regular shaped objects can be determined by measuring the base, height, and depth with either a ruler or Vernier-calipers, then multiplying them together.

## Pa 02-03. Density

Key Point

Density is a measure of how much matter (how many particles there are in a fixed volume.

The more space between the particles in a substance, the lower the density. In a mixture, substances with a lower density will float on those with higher density.
Increasing the kinetic energy of the particles will increase the space between them, therefore reducing the density of the substance.



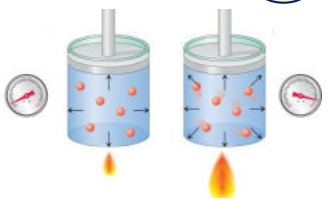

## Pa 07. Gas Pressure & Temperature

C

Particles in a gas exert pressure by colliding with the sides of a container.

Increasing the temperature (kinetic energy) of the particles will increase the force of the collisions with the surface.

This increases the pressure inside the container.



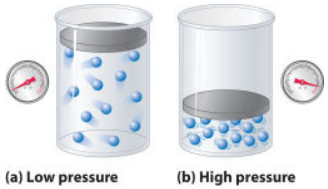

## Pa 08. Gas Pressure & Volume

C

Particles in a gas exert pressure by colliding with the sides of a container.

Reducing the volume of the container increases the frequency of particle collisions with the side of the container.

This increases the pressure inside the container.




TPS

## Required Practical:

*Density*

## Mathematical Skills:

- *Be prepared to interpret graphs showing the temperature of a substance against the energy it has been provided; being able to describe the state of matter / changes of state at various points.*

There are 3 equations which you should be able to apply from the Physics Equation Sheet.

Specific Heat Capacity

$\Delta E_T = m \times C \times \Delta\theta$

Specific Latent Heat

$E = m \times L$

Pressure in Gasses

$\rho \times V = Constant$

## Relevant Modules:

- Energy Changes in systems
- Atomic Structure

## Useful YouTube links:

Density | Internal Energy | Latent Heat