PARTICLE MODEL OF MATTER

density

- A measure of the 'compactness' of an object
- Density depends on the material and how the particles are arranged
- Dense material -> particles packed tightly together
- Less dense material -> particles more spread out
- If less dense material is compressed its particles would move closer together and it would become more dense

P = M/V
DENSITY(KG/M^3) = MASS(KG) / VOLUME(M^3)

Three states of matter:

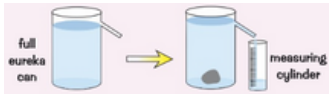
- Solid
- Strong forces of attraction hold particles close together in a fixed regular arrangement
- Particles don't have much energy so can only vibrate about their fixed positions
- Generally highest density

- Liquid
- Weaker forces of attraction so particles move past each other in irregular arrangement
- Have more energy than solid so move in random directions at low speeds
- Generally less dense than solids

- Gas
- Almost no forces of attraction
- Most energy so free to move and travel in random directions at high speeds
- Generally less dense than liquids and solids

To find density of regular solid object:
- Use balance to find mass
- Measure length width & height
- Calculate volume then work out density

To find density of irregular solid object:
- Use balance to find mass
- Submerge in eureka can filled with water
- Water displaced by object will be transferred to measuring cylinder
- Record volume of water in cylinder (this is volume of object) then use to work out density



To find density of liquid:
- Place measuring cylinder on balance and zero the balance
- Pour 10ml of liquid into cylinder and record mass
- Pour another 10ml into cylinder, repeating process and recording volume and mass each time
- Work out density for each measurement
- Calculate average density

TEMPERATURE

- The particles in a gas are constantly moving in random directions at random speeds
- If you increase the temperature of a gas, energy is transferred into the kinetic energy stores of the particles
- The temperature of a gas is related to the average energy in the kinetic energy stores of the particles in the gas
- The higher the temperature, the higher the average energy
- As temperature increases, average speed of particles increases

INTERNAL ENERGY

- Particles in a system vibrate -> have energy in their kinetic energy stores
- Also have energy in their potential energy stores due to their positions
- Energy is stored in a system by its particles

- The internal energy of a system is the total energy its particles have in their kinetic and potential energy stores
- Heating the system transfers energy to its particles (they gain energy in kinetic stores and move faster), which increases internal energy
- This leads to a change in temperature or state
- If temperature changes, the size of this change depends on mass of substance, its specific heat capacity and energy input
- Change in state occurs if substance is heated enough - the particles will have enough energy in kinetic stores to break bonds holding them together

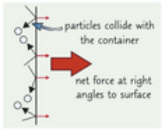
DOING WORK

- If you transfer energy by applying a force, then you do work
- Doing work on a gas increases its internal energy which increases its temperature
- You can do work on a gas mechanically, eg with a bike pump
- The gas applies pressure to the plunger of the pump, and so exerts a force on it
- Work has to be done against this force to push down the plunger
- This transfers energy to the kinetic energy stores of the gas particles, increasing the temperature
- If the pump is connected to a tyre, you should feel it getting warmer

particle motion in gases

PRESSURE

- As gas particles move about at high speeds, they collide into each other and exert a force (and so a pressure) on each other
- In a sealed container, the outward gas pressure is the total force exerted by all the particles in the gas on a unit area of the container walls



- Faster particles and more frequent collisions lead to an increase in net force, and so gas pressure
- Increasing temperature will increase the speed and so the pressure (if volume is kept constant)
- If temperature is constant, increasing the volume of a gas means the particles get more spread out and hit the walls of the container less often, so gas pressure decreases
- Pressure and volume are inversely proportional

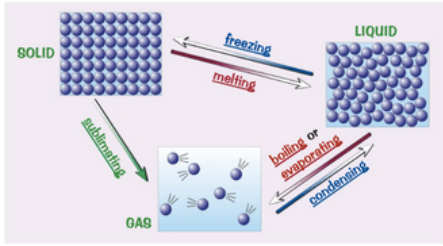
PV = CONSTANT
PRESSURE(PA) X VOLUME(M^3) = CONSTANT

- The pressure of a gas causes a net outwards force at right angles to the surface of the container
- There is also a force on the outside of the container due to the pressure of the gas around it
- If a container can easily change its size (eg balloon), then any change in these pressures will cause the container to compress or expand due to the overall force

internal energy & changes of state

CHANGES OF STATE

- A change of state is a physical change, meaning you don't end up with a new substance -> it is the same substance you started with just in a different form
- If you reverse a change of state, the substance will return to its original form and get back its original properties
- The number of particles doesn't change, they are just arranged differently
- This means mass is conserved -> none is lost when the substance changes state

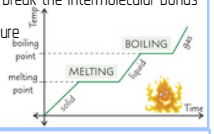


specific latent heat

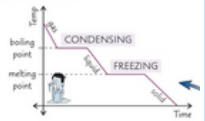
- The specific latent heat is the amount of energy need to change the state of 1kg of a substance without changing its temperature
- For heating, specific latent heat is the energy taken in for a change in state
- For cooling, specific latent heat is the energy released by a change in state
- Specific latent heat is different for different materials, and for changing between different states
- The specific latent heat for changing between a solid and a liquid (melting or freezing) is called the specific latent heat of fusion
- The specific latent heat for changing between a liquid and a gas (evaporating, boiling or condensing) is called the specific latent heat of vaporisation

E = ML
ENERGY(J) = MASS(KG) X SPECIFIC LATENT HEAT(J/KG)

- When a substance is melting or boiling, you are still putting in energy and so increasing the internal energy
- This energy is being used to break the intermolecular bonds rather than raise the temperature
- This is shown as a flat spot on a heating graph



- When a substance is condensing or freezing, bonds are forming between particles, which releases energy
- This means the internal energy decreases, but the temperature doesn't go down until all the substance has turned to liquid (condensing) or a solid (freezing)
- The flat parts of the graph show this energy transfer



- The energy needed to change the state of a substance is called latent heat

- If a helium balloon is released, it rises
- Atmospheric pressure decreases with height, so the pressure outside the balloon decreases
- This causes the balloon to expand until the pressure inside drops to the same as the atmospheric pressure