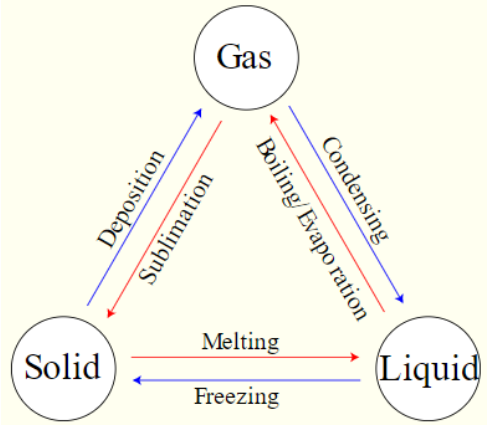
CP12, Particle model, forces and matter

1. Particles and density

State of matter	Solid, liquid or gas.
Solid	Particles touching, neatly ordered, vibrating around a fixed point.
Liquid	Particles touching, random order, moving slowly.
Gas	Particles widely spaced, random order, moving fast.
Changing state	Increasing temperature gives particles more (kinetic) energy, allowing them to break the forces of attraction.
Density	The mass of 1 m^3 of a substance. Units = kg / m^3 (but could be g / cm^3)
Density and state	Solid > liquid > gas, due to particles being closer together.

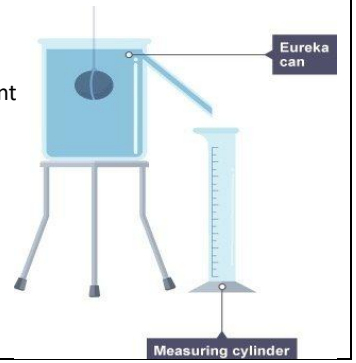


2. Core practical – investigating densities

Core Practical - Aim	To measure the density of some solids and liquids
Core Practical – Density of liquids	Place a measuring cylinder on a balance and zero it. Add some liquid and record the mass and volume, Repeat with different liquids.

Core Practical – Density of solids

Displacement can

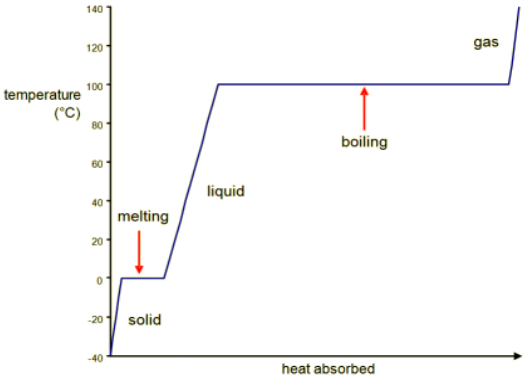


3. Energy and changes of state

Thermal energy and motion	The hotter an object is, the faster its particles are moving (**more kinetic energy**).
Temperature	A measure of the average kinetic energy of the particles.
Temperature vs thermal energy	A very small hot object has less thermal energy than a very large cold object, because thermal energy is the energy of all the particles added up.
Specific heat capacity, Q	The amount of energy required to increase the temperature of 1 kg of a substance by 1 ^oC.
Specific latent heat, L	The amount of energy required to change 1 kg of a substance from one state to another
Temperature change	$\Delta\Theta$ - difference between temperature before and after the change

5. Core practical – investigating water

Core Practical - Aim	To investigate the temperature change as ice melts, and measure specific heat capacity of water.
Core Practical – Melting ice	Place some ice in a boiling tube, measure the temperature then place the tube in a beaker of hot water from a kettle, kept warm by Bunsen, and measure temperature every 60s until fully melted.
Core Practical – Melting ice results	Temperature rises steadily at first but levels out during melting.
Core Practical – finding the specific heat capacity	Place a polystyrene cup on a balance, zero it, mostly fill with water then measure the mass. Measure the temp. Use an immersion heater connected to a Joulemeter to warm the water for 5 minutes and measure the temperature again.
Core Practical - problems	Use **insulation** and **lids** to stop this happening



6. Gas temperature and pressure

Gas pressure	Every time a gas particle hits a surface it pushes with a small force; gas pressure is the sum of these forces.
Increasing gas pressure	Gas pressure increases with temperature and number of particles.
Gas pressure and temp	Gas pressure is directly proportional to temperature in K.
Pascals, Pa	The unit of pressure: 1 Pa = 1 N / m^2
Absolute zero, 0 K	The coldest possible temperature when particles completely stop moving.
Kelvins, K	Measures temperatures relative to absolute zero: 0 K = absolute zero.
Kelvins and degrees Celsius	A kelvin is the same size as a degree Celsius, but 0 K = -273^oC, 273 K = 0 ^oC
Converting K to ^oC	subtract 273 (add 273 to go ^oC to K)

density = mass ÷ volume	$\rho = \frac{m}{V}$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = m \times L$