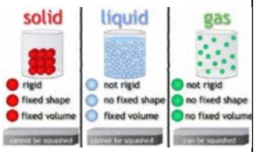
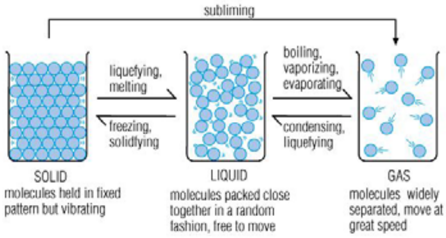
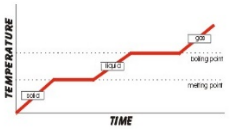
Physics 4.3 Particle model of matter

4.3.1	Changes of state and the particle model
4.3.1.1 Density of materials  	The density of a material is defined by the equation: ***density* = $\frac{mass}{volume}$** $\quad$ $p = \frac{m}{v}$ density, ρ, in kilograms per metre cubed, kg/m^3 mass, *m*, in kilograms, kg ,volume, *V*, in metres cubed, m^3 The particle model can be used to explain • the different **states of matter – solids, liquids and gases** • differences in density – solids are more dense as particles are closely packed together Required practical - calculate density
4.3.1.2 Change of state	When substances **change state (melt, freeze, boil, evaporate, condense** or **sublimate**), mass is conserved.  Changes of state are physical changes which differ from chemical changes because the material recovers its original properties if the change is reversed.
4.3.2	Internal energy and energy transfers
4.3.2.1 Internal energy	Energy is **stored inside a system** by the particles (atoms and molecules) that make up the system. This is called **internal energy**. **Internal energy** is the total **kinetic energy** and **potential energy** of **all the particles** (atoms and molecules) that make up a system. **Heating changes** the **energy stored** within the system by **increasing the energy of the particles** that make up the system. This either **raises the temperature** of the system or produces a **change of state.**
4.3.2.2 Temperature changes in a system and specific heat capacity	If the temperature of the system increases, the increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system. You need to use the following equation: ***change in thermal energy = mass × s peci fic heat ca pacity × tem perature change*** $\Delta E = m\, c\, \Delta \vartheta$ change in thermal energy, ΔE, in joules, J mass, *m*, in kilograms, kg specific heat capacity, *c*, in joules per kilogram per degree Celsius, J/kg °C temperature change, $\Delta\vartheta$, in degrees Celsius, °C. The **specific heat capacity** of a substance is the **amount of energy** required to **raise the temperature** of **one kilogram** of the substance by **one degree Celsius.**
4.3.2.3 changes of heat and specific latent heat	If a change of state happens: The **energy needed for a substance to change state** is called **latent heat**. When a change of state occurs, the energy supplied changes the energy stored (internal energy) but not the temperature. The **specific latent heat** of a substance is the amount of energy required to **change the state of one kilogram** of the substance with no change in temperature

	***energy for a change of state = mass × specific latent heat*** ***E = m L*** energy, *E*, in joules, J mass, *m*, in kilograms, kg specific latent heat, *L*, in joules per kilogram, J/kg Specific latent heat of **fusion** – change of state from **solid to liquid** Specific latent heat of **vaporisatio**n – change of state from **liquid to vapour**
4.3.3	Particle model and pressure
4.3.3.1 Particle motion in gases	The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules. Changing the temperature of a gas, held at constant volume changes the pressure exerted by the gas. Increasing temperature increases pressure.
4.3.3.2 Pressure in gases (physics only)  (a) Low pressure (b) High pressure	A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container (or any surface). Increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure For a fixed mass of gas held at a constant temperature: ***pressure × volume = constant*** *p V = constant* pressure, *p*, in pascals, Pa volume, *V*, in metres cubed, m^3
4.3.3.3 increasing the pressure of a gas (physics HT only)	Work is the transfer of energy by a force. Doing work on a gas increases the internal energy of the gas and can cause an increase in the temperature of the gas e.g. Using a bicycle pump, doing work on an enclosed gas leads to an increase in the temperature of the gas, because the pressure is increased.