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Physics Paper 1 Topic 3: Particles

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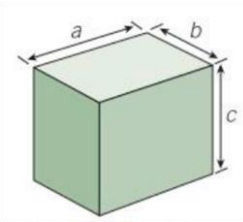
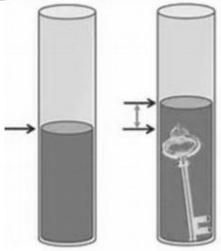
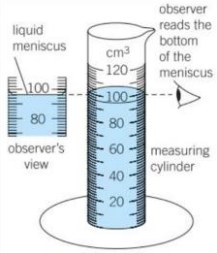
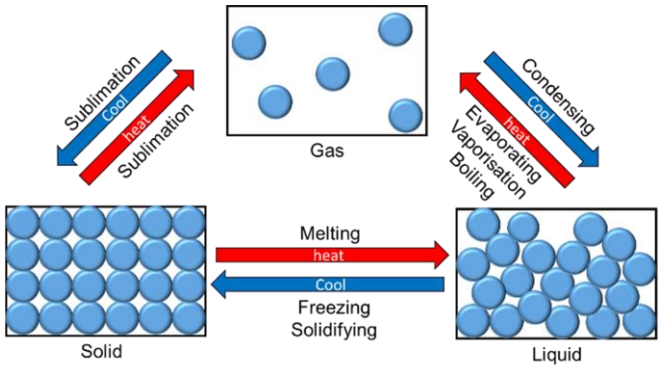
Section 1: Key Terms and Definitions

1	Density	How much mass a substance contains compared to its volume. Solids are usually dense because the particles are closely packed. Measured in kg/m^3 (or g/cm^3).
2	Volume	The amount of space a liquid takes up. Measured in cm^3.
3	Mass	A measure of how many particles are in a substance. Measured in kg (or g).
4	Float	Objects float on water if the density of the object is less than 1000kg/m^3 (1 g/cm^3).
5	Sink	Objects sink in water if the density of the object is more than 1000kg/m^3 (1 g/cm^3).
6	State of Matter	The way in which the particles are arranged – solid, liquid or gas
7	Change of State	When a substance changes from one state of matter to another (e.g. melting is the change from a solid to a liquid) Energy changes the state, not the temperature.
8	Physical Change	A change that can be reversed to recover the original material. e.g. a change of state.
9	Chemical Change	A change that creates new products. It cannot be reversed. e.g. a chemical reaction
10	Internal Energy	The energy stored inside a system by the particles (atoms and molecules) that make up the system. Internal energy is the total kinetic energy and potential energy of all the particles.
11	Kinetic Energy	Energy stored within moving objects (e.g. particles)
12	Potential Energy	Energy stored in particles because of their position. The further apart the particles are, the greater the potential energy.
13	Specific Heat Capacity	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.
14	Temperature	The average kinetic energy of the particles.
15	Specific Latent Heat	The amount of energy required to change the state of one kilogram of the substance with no change in temperature.
16	Latent Heat of Fusion	Energy required to change state from solid to liquid.
17	Latent Heat of Vaporisation	Energy required to change state from liquid to gas.
18	Work Done on a Gas	When a gas is compressed, a force is used to compress it. Energy is transferred in compressing the gas, so work is done on the gas.

Section 2: Techniques for Measuring Density

Measuring a Regular Solid	Measuring an Irregular Solid	Using a Measuring Cylinder Correctly
		
Measure volume of a cuboid = a x b x c	Volume of an irregular object can be found by dropping in a liquid and measuring Displacement.	When reading a meniscus the observer must read the bottom of the meniscus.

Section 3: States of Matter



Condensation	Process in which a gas turns into a liquid
Evaporation	Process in which a liquid turns into a gas
Freezing	Process in which a liquid turns into a solid
Melting	Process in which a solid turns into a liquid
Sublimation	Process in which a solid turns into a gas without going through a liquid stage

Solid

Particles held in fixed pattern but vibrating

Liquid

Particles packed together in a random fashion, free to move

Gas

Particles widely separated, moving freely at speed

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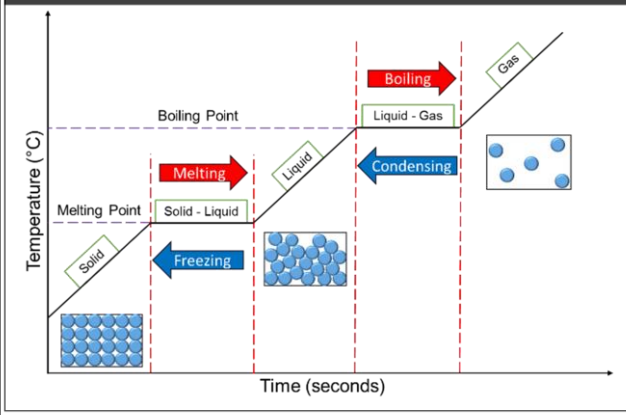
Section 4: The Heating Curve



Solid	Particles are closely packed, fixed and arranged in regular layers. As more energy is absorbed the kinetic energy and therefore the internal energy of the material increases.
Melting	Temperature doesn't change. Energy is used to weaken the forces between particles. As more energy is absorbed the potential energy and therefore the internal energy of the material increases.
Liquid	Particles are touching but no longer arranged regularly. They are able to move past each other. As more energy is absorbed the kinetic energy and therefore the internal energy of the material increases.
Evaporation	Temperature doesn't change. Energy is used to weaken the forces between particles. As more energy is absorbed, the potential energy and therefore the internal energy of the material increases.
Boiling Point	The temperature at which a liquid boils and turns to vapour
Melting Point	The temperature at which a solid melts and turns to a liquid
Gases	Gas particles have the most energy, they have chaotic random movements in all directions. They can be compressed.

Section 5: Properties of Solids, Liquids and Gases

State	Particle Arrangement	Distance between particles	Strength of forces	Movement of Particles	Internal Energy
Solid	Fixed	Closely packed together	Strong	Vibrates about fixed position	Lowest Internal Energy
Liquid	Not fixed	Touching but irregularly arranged	Weak	Move past each other	More than solids, less than gases
Gas	Not fixed	Far apart	Very Weak (Insignificant)	Moves freely	Highest Internal Energy

Section 6: Internal Energy

The energy stored by the particles of a substance is called the substance's internal energy.
This is the energy of the particles that is caused by their individual motion and positions.
The internal energy of the particles is the sum of:

- the kinetic energy they have due to their individual motions relative to each other,

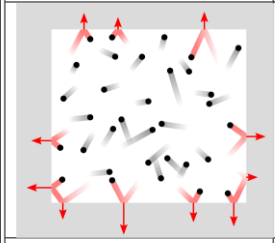
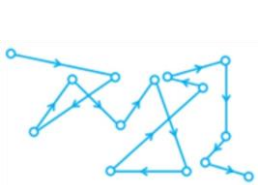
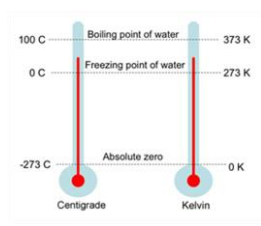
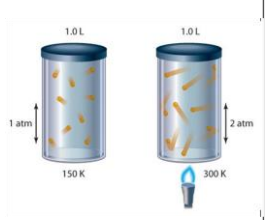
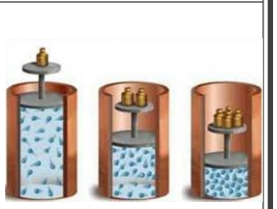
and;

- the potential energy they have due to their individual positions relative to each other.

Heating the substance can increase the internal energy in one of two ways:

- Increasing the temperature increases the kinetic energy of each particle.
- Changing the state of the substance (melting or boiling), increases the potential energy of the substance.

Section 7: Gas Pressure

Collisions	Brownian Motion	Temperature	Guy-Lussac's Law	Boyles's Law
				
The force exerted by gases on a surface as the particles collide with it. The greater the number of collisions with a surface, the greater the pressure.	The unpredictable motion of smoke particles is evidence of the random motion of gas particles. Each change of direction is caused by a collision with another particle.	For Gas Laws, temperature should always be measured in Kelvin (Celsius + 273)	For a fixed mass of gas at a constant volume, the pressure is proportional to the temperature. Increasing the temperature increases the volume.	For a fixed mass of gas at a constant temperature, the pressure is inversely proportional to the volume. Decreasing the volume increases the pressure.