Physics 6.3 Particle Model of Matter

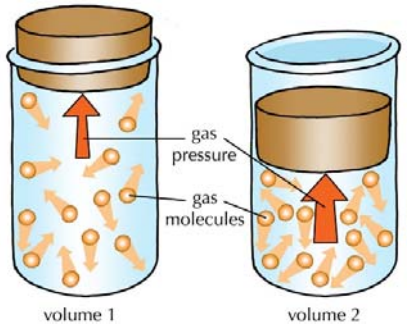
Section 1: Key terms	
Heat	Energy transferred from hot to cold objects.
Temperature	A measure of how hot or cold an object is.
Density	The density of a substance is defined as its mass per unit volume.
Physical changes	Changes in which no new substances are produced and the substance can recover its original properties.
Conservation of mass	When a substance changes state, the number of particles in the substance stay the same.
Internal energy	The total energy in the kinetic and potential energy stores of all the particles in a substance.
Specific heat capacity	The amount of energy required to raise the temperature of 1kg of a substance by 1°C
Specific latent heat of fusion	The energy needed to change the state of 1kg of the substance from solid to liquid
Specific latent heat of vaporisation	The energy needed to change the state of 1kg of the substance from liquid

Section 2: Symbols and units of different properties

Property	Symbol	Unit
mass	m	kilograms, kg
volume	V	metres cubed, m^3
density	d or ρ	Kg/m^3
Energy	E	Joules, J
Temperature	T or θ	Celsius, °C
Specific heat capacity	c	J/kg°C
Specific latent heat of fusion	L_F	J/kg
Specific latent heat of vaporisation	L_V	J/kg

Section 4: Gas pressure

Pressure of a gas is caused by the random impacts of gas molecules on surfaces in contact with the gas

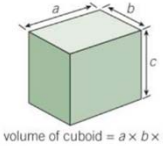


Section 3: Required Practical in Density

Calculating the **density** of **regular** objects:

1) Measure its mass in kg using a weighing balance
2) Measure its volume in m^3 using a meter ruler (Volume=length x width x height)
3) Calculate density using the equation:

$$density = \frac{mass}{volume}$$



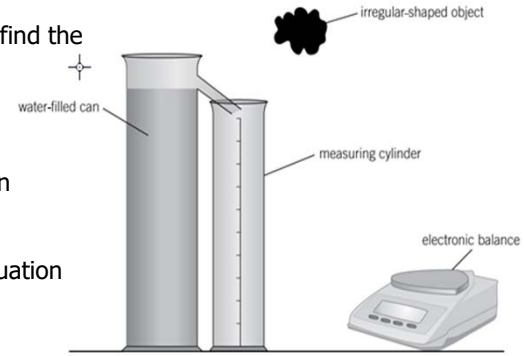
volume of cuboid = $a \times b \times c$

Calculating the **density** of liquids:

1) Use a measuring cylinder to measure the volume of a particular amount of the liquid
2) Measure the mass of an empty beaker using a balance
3) Remove the beaker and pour the liquid into the beaker
4) Use the balance again to measure the total mass of the beaker and the liquid
5) Calculate the mass of the liquid by substracting the mass of the empty beaker from the total mass of the beaker and the liquid
6) Calculate density using the equation

Calculating the **density** of **irregular** objects:

1) Weigh the irregular object (to find the mass)
2) Tie it with a piece of cotton
3) Lower it into the water in the displacement can
4) Collect the water that has been displaced
5) Measure the volume
6) Calculate density using the equation



Always remember to show your calculations and use the correct units! Density is measured in kg/m^3.

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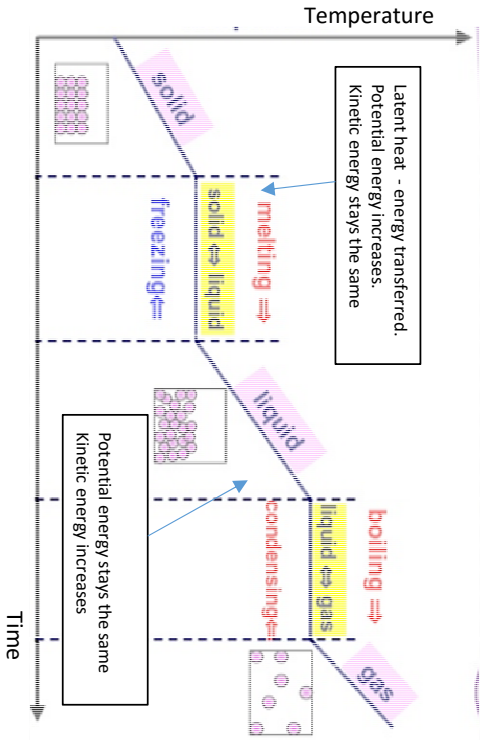
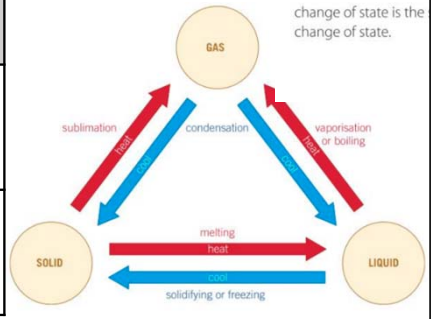
Section 4: Comparing particles in solids, liquids and gases

	Solid	Liquid	Gas
Arrangement of particles	Close together Fixed positions	Close together Random arrangement	Far apart Random arrangement
Movement of particles	Vibrate on the spot	Move around each other	Move quickly in all directions
Forces between the particles	Strong	Stronger than a gas weaker than a solid	Weak
Density	Much higher than a gas	Much higher than a gas, lower than a solid	Lower than a solid or a liquid
Internal Energy	Less than a liquid or a gas	More than a solid, less than a gas	More than a liquid or a gas



Section 5: Changes of State

Change of state	Initial and final state	Temperature
Melting	Solid to liquid	Melting point
Freezing (or solidification)	Liquid to solid	
Boiling (or vaporisation)	Liquid to gas	Boiling point
Condensation	Gas to liquid	



Section 6: Equations you should be able to apply, no need to memorize

Word equation	Symbol equation
Change in thermal energy= mass x specific heat capacity x temperature change	$\Delta E = m \times c \times \Delta\theta$
Energy for a change of state from a solid to a liquid =mass x specific latent heat of fusion	$E = m \times L_F$
Energy for a change of state from a liquid to a gas =mass x specific latent heat of vaporisation	$E = m \times L_V$

Section 7: Ten facts to remember

1. We measure **mass** using a balance, we measure **volume** using; a ruler for regular objects, a volumetric cylinder for liquids, a displacement can for irregular objects.
2. We calculate density by **dividing mass by volume** (Units: kg/m^3).
3. Particles in **solids** are close together and do not move/Particles in **liquids** are close together, but can move/Particles in **gases** are far apart and move randomly in all directions.
4. I**nternal energy**= Potential Energy + Kinetic Energy of the particles of a substance
5. Heating a substance changes the internal energy by increasing the energy of its particles. This change in energy results in the changes of state.
6. At melting and boiling points, the temperature stays the same until the change of state happens.
7. More heating means increased movement of the particles, increased kinetic and internal energy.
8. As the temperature increases, gas particles move more quickly, and bump more into each other, hitting the walls of a container and causing higher pressure.
9. Remember-in gases: **Temperature increase→ Kinetic energy increase→ Pressure increase**
10. We use **specific heat capacity** to calculate the energy needed to heat up a certain substance, while we use **specific latent heat** to calculate the energy needed for a substance to change state.