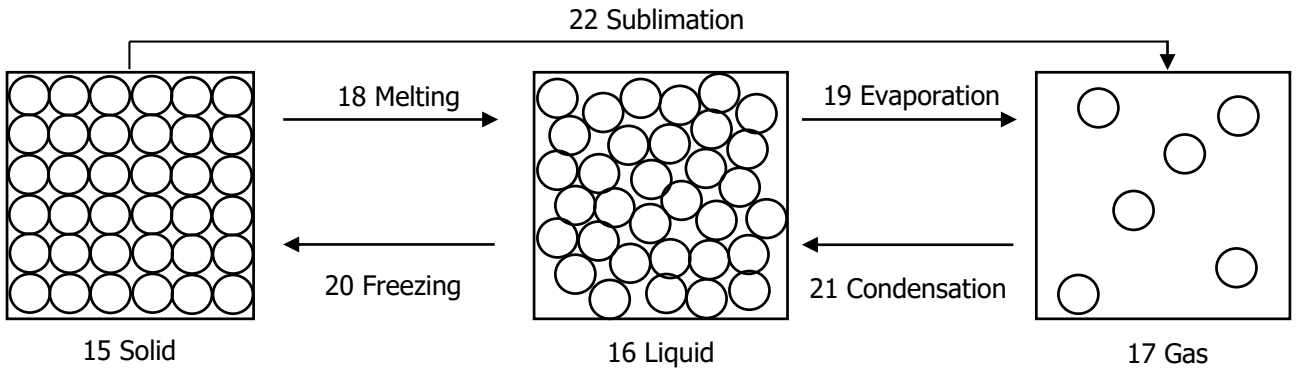
Physics 3: Particle Model of Matter

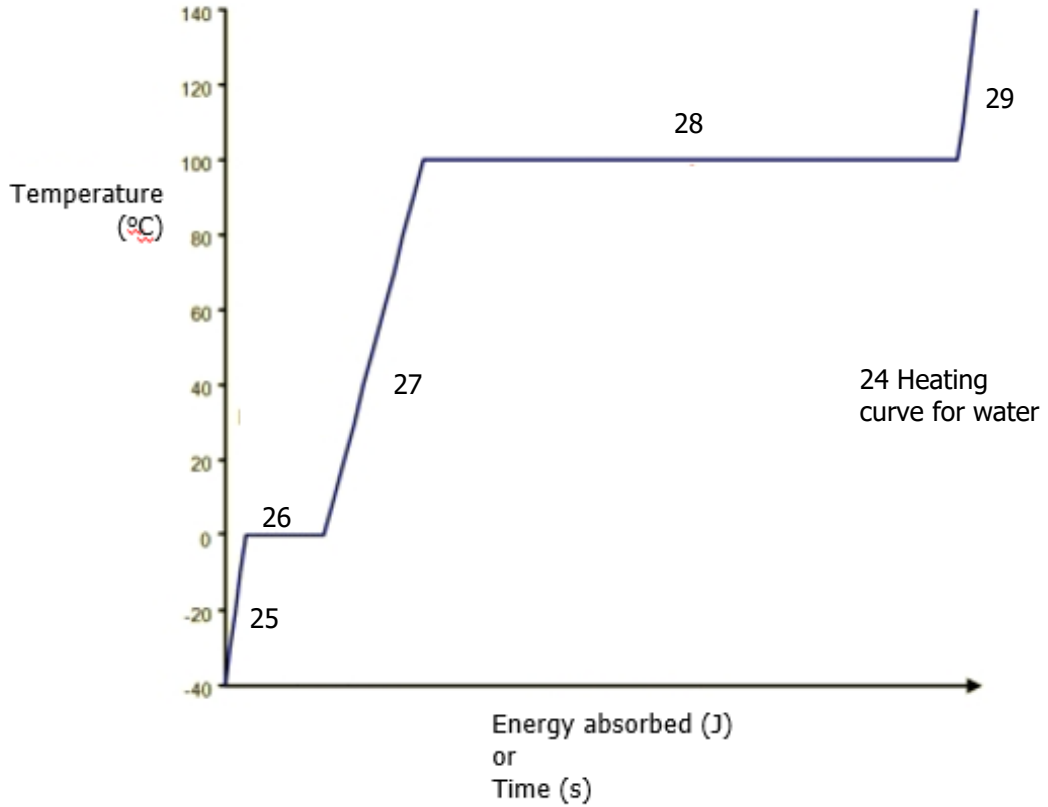
Section 1: Key Terms

1 Density	How much **mass** a substance contains **compared to its volume**. Solids are usually dense because the particles are closely packed.
2 State of matter	The way in which the **particles are arranged** – solid, liquid or gas.
3 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.
4 Physical change	A change that can be **reversed** to recover the original material. **E.g. a change of state.**
5 Chemical change	A change that **creates new products**. It **cannot be revered**. E.g. a chemical reaction.
6 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.**
7 Kinetic energy	**Energy stored** within **moving objects** (e.g. particles).
8 Potential energy	**Energy stored** in **particles** because of their **position.** The **further apart** particles are, **the greater the potential energy.**
9 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**.
10 Temperature	The **average kinetic energy** of the **particles**.
11 Specific latent heat	The **amount of energy** required to **change the state of one kilogram** of the substance with **no change in temperature**.
12 Latent heat of fusion	**Energy required** to change state from **solid to liquid**.
13 Latent heat of vaporisation	**Energy required** to change state from **liquid to vapour**.
14 Gas Pressure	The **force** exerted by gases on surface as the **particles collide** with it. **As temperature increases, gas pressure increases** if the volume stays constant.



Section 2: Equations to learn

Calculation	Equation	Symbol equation	Units
23 Density	Density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{v}$	Density = kilograms / metre^3 (kg/m^3) Mass = kilograms (kg) Volume = metres^3 (m^3)



24 Heating curve for water

Section 3: Explaining a heating curve

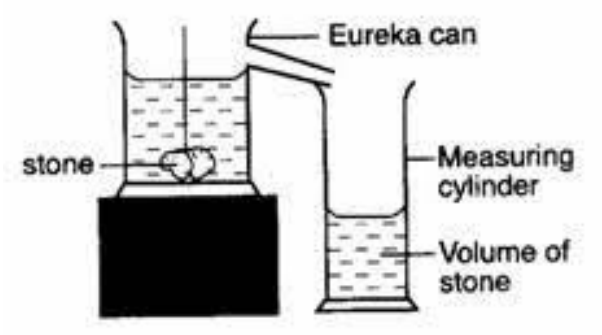
25 Solid	Particles are closely packed, fixed and arranged in regular layers. As more energy is absorbed the kinetic energy and therefore the internal energy of the material increases.
26 Melting	Temperature doesn't change. Energy is used to weaken the forces between particles. As more energy is absorbed the potential energy and therefore the internal energy of the material increases.
27 Liquid	Particles are touching but no longer arranged regularly. They are above to move. As more energy is absorbed the kinetic energy and therefore the internal energy of the material increases.
28 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.
29 Gas	Particles move randomly. As more energy is absorbed the particles move more quickly and the temperature increases.

30) Finding the Density of a Regular Solid Object

- Find the mass using a balance.
- Find the volume using the formula:
  Volume = length x width x height
- Use the formula p = m/v

31) Finding the Density of an Irregular Solid Object

- Find the mass using a balance.
- Find the volume using the formula, large measuring cylinder or a Eureka can.
- If using a Eureka can fill the can up to the spout with water.
- Place a measuring underneath the spout.
- Submerge the object beneath the waters surface, in the can.
- Catch the water that is displaced and drips out of the spout in the measuring cylinder.
- Measure the volume.
- Use the formula p = m/v



32) Finding the Density of a Liquid

- Find the mass of the liquid by placing an empty measuring cylinder on a balance and zeroing the mass
- Then add the liquid to the measuring cylinder to find the mass of the liquid alone.
- Find the volume by reading off the measuring cylinder.
- Use the formula p = m/v

33) Specific Heat Capacity (recap P1)

- Amount of energy required to raise 1kg of a material by 1°C.

- Energy = mass x Specific x change in temp
  Heat Capacity

Units of S.H. C are J/k °C

34) Specific Latent Heat

- The amount of energy needed to change the state of 1Kg of material from one state to another without changing the temperature.

- Energy = mass x specific latent heat

- E = m x L

Units S.L.H are J/kg

35) Internal Energy

- Particles are always moving. The distance between them can change.
- The higher the temperature the faster they move and the bigger the distances between them.
- The particles have:
  - kinetic energy – how much they are moving
  - potential energy – how far apart from each other the particles are.

- Gases have the most potential energy as their particles are furthest apart.
- The **internal energy** of a system is the total kinetic and potential energy of all the particles in the system.

36) Particle Motion In a Gas

Gas particles are moving **randomly** and **freely**. They have high kinetic energy. The higher the temperature the more kinetic energy they move faster.

Gas particles **collide** with each other and the walls of the container creating a **force** at **right angles** to the container.

$$\text{pressure} = \frac{\text{force (N)}}{\text{area } (m^2)}$$

(Pa) or (N/ m^2)

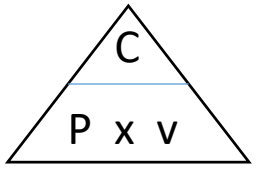
The total force exerted by all the particles is called **gas pressure.**
If the gas **temperature increases** at a constant volume, the pressure will increase as the particles will have more kinetic energy and so **collide** more **frequently** and with more **force**.

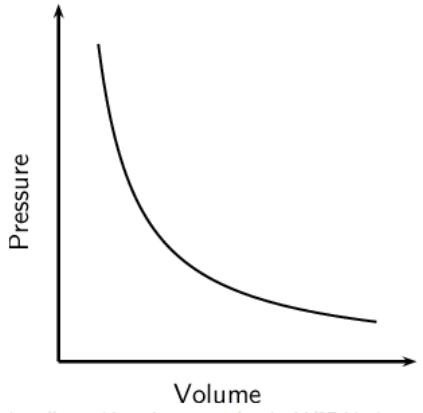
Physics Only
Section 39: - Relationship between Volume and Pressure

- There is an inversely proportional relationship between volume of a gas and it's pressure.
- When the volume increase the pressure decrease.
- When the volume decreases the pressure increase.

- At a fixed mass and temperature of gas this formula can be used:

Pressure x Volume = Gas Constant
(Pa) (m^3)





Physics Only
Section : -Doing Work on a Gas

- Work Done = Force x Distance
- If you apply a force to a gas in a container and move the gas (compress or expand the volume), then work is done and energy is transferred either into or out of the gas.
- Gas pressure increase → transfer energy into kinetic energy store of gas.
  → temperature of gas increases.
- Gas pressure decreases → transfer energy out of kinetic energy store of gas.
  → temperature of gas decrease.

Low Pressure

Higher pressure