

# P3 Particle model of matter

Physics Paper 1 | AQA Combined Science Trilogy | Core knowledge for both tiers

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

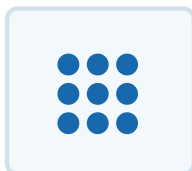
$$\Delta E = mc\Delta\theta$$

Temperature change

$$E = mL$$

Change of state

## 1 Particles and density



**Solid**

**Solid:** close, regular; vibrate in place.

**Liquid:** close; move past neighbours.

**Gas:** far apart; random motion.

Gases compress: the **gaps** get smaller.

**Density:** mass per unit volume.

Same mass: larger volume → lower density.



**Liquid**



**Gas**

## 2 Density practical

**All samples:** use a zeroed balance for mass.  
Density = mass ÷ volume.

**Regular solid:** measure dimensions.

Cuboid volume = length × width × height.

**Irregular solid:** fully submerge an insoluble object that sinks. Volume = final water reading – initial reading.

**Liquid:** mass = filled container mass – empty container mass. Measure volume.

**Check:** eye-level meniscus, no trapped air, dry solids before weighing; repeat.

**Units:** kg/m<sup>3</sup> or g/cm<sup>3</sup>; 1 ml = 1 cm<sup>3</sup>.

## 3 State changes and energy

**Melting:** solid → liquid.

**Freezing:** liquid → solid.

**Boiling / evaporation:** liquid → gas.

**Condensation:** gas → liquid.

**Sublimation:** solid → gas directly.

Evaporation happens at the **surface**, even below the boiling point.

These are physical changes: no new substance. **Mass is conserved.**

**Internal energy** = total kinetic + potential energy of all the particles.

## 4 Heating or changing state?

**Specific heat capacity, c:** energy to raise **1 kg** by **1°C**. Unit: J/kg°C.

$\Delta\theta$  = final temperature – initial temperature.

**Example:**  $2 \times 500 \times 10 = 10,000 \text{ J}$ .

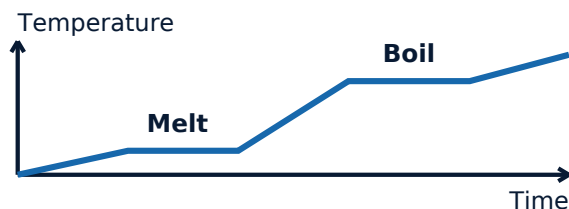
**Specific latent heat, L:** energy to change the state of **1 kg** with **no temperature change**. Unit: J/kg.

Fusion = melting; vaporisation = liquid to gas.

**Example:**  $0.5 \times 200,000 = 100,000 \text{ J}$ .

Use mass in **kg**; 500 g = 0.5 kg.

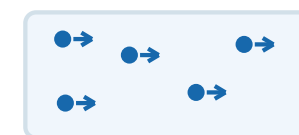
## 5 Read a heating graph



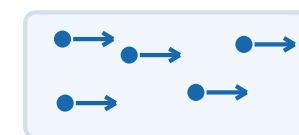
**Slopes:** temperature and average kinetic energy change.

**Flat sections:** temperature is constant; energy changes particle **potential energy**.  
Cooling: energy leaves during condensation and freezing.

## 6 Gas temperature and pressure



**Cooler**



**Warmer**

At **fixed volume** with no gas escaping:

**Heating:** greater average kinetic energy; particles move faster. More frequent, harder **wall collisions** increase pressure.

**Cooling:** pressure falls.

Particle size stays the same.