



Box 1: Keywords

Word	Definition
Condensation	The changing from vapour state to a liquid state, when a substance is cooled.
Evaporation	The changing from liquid state to a vapour state, when a substance is heated.
Freezing	The changing from a liquid state to a solid state, when a substance is cooled.
Internal Energy	Energy stored by the atoms and molecules that make up a system. Equal to the sum of the total kinetic and potential energies of the particles.
Melting	The changing from solid state to liquid state, when a substance is heated.
Physical Changes	Changes to physical properties of a substance which can be reversed e.g. changes of state
Specific Latent Heat	The amount of energy needed to change the state of one kilogram of a substance, whilst held at constant temperature.
Sublimation	The changing of a substance from a solid state to a vapour state, without passing through the liquid phase.

Box 2: Key skills

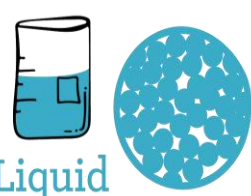
Use and evaluate models; Interpret results; draw graphs; explain observations; manipulate data; rearrange equations.

Box 3: States of matter



Solid

- Particles in a solid are tightly packed usually in a regular pattern.
- Particles in a solid will vibrate but cannot move past each other.
- Solids retain their shapes.



Liquid

- Particles in a liquid are close together with no regular pattern.
- Particles in a liquid flow and can easily move or slide past one another.
- Liquids assume the shape of their containers.



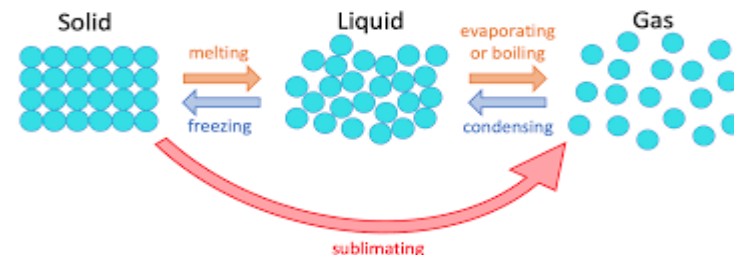
Gas

- Particles in a gas are well separated with no regular pattern.
- Particles in a gas vibrate freely at high speeds.
- Gases assume the shapes of their containers.

Properties	Solids	Liquids	Gases
Mass	Definite	Definite	Definite
Shape	Definite	Acquires the shape of the container	Acquires the shape of the container
Volume	Definite	Definite	Indefinite
Compressibility	Not possible	Almost Negligible	Highly Compressible
Fluidity	Not possible	Can flow	Can flow
Rigidity	Highly rigid	Less rigid	Not rigid
Diffusion	Slow	Fast	Very fast
Space between particles	Most closely packed	Less closely packed	Least closely packed

Box 4: Changes of state

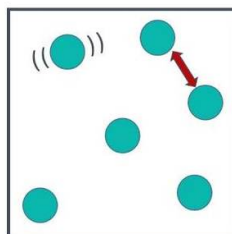
Changes of state are **physical** changes; when the temperature of a substance changes, the **kinetic energy store** changes with it. If the change is great enough, a **change of state** may occur



Box 5: Internal energy

Internal energy is the sum of:

The kinetic energy of the particles due to their individual motions relative to each other.



The potential energy of the particles due to their individual positions relative to each other.

Box 6: Specific Latent Heat

The **specific latent heat** of a substance is the amount of **energy** needed to **change the state** of 1 kg of the substance without changing its **temperature**.

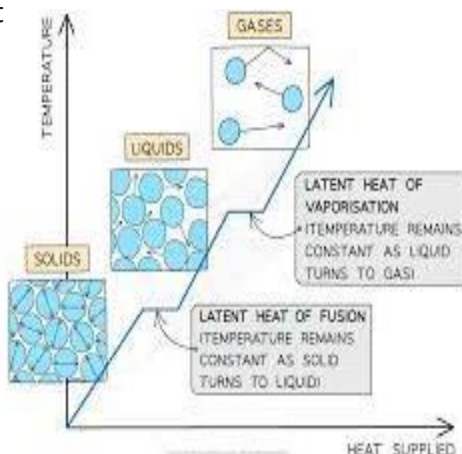
Substances have two specific latent heats:

Latent heat of fusion:

The amount of energy needed to **freeze** or **melt** the substance at its **melting point**.

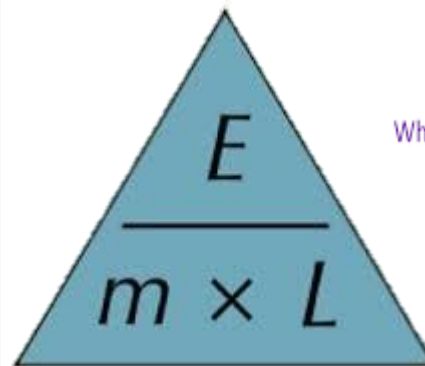
Latent heat of vaporisation:

The amount of energy needed to **evaporate** or **condense** the substance at its **boiling point**.



The latent heat of vaporisation for a substance is usually greater than its latent heat of fusion because bonds between particles need to be broken (or made) and not just loosened (or strengthened).

Box 7: Specific Latent Heat Equation



$$E = m \times L_v$$

Where, m =mass of substance in kg
 L_v = latent heat of vaporisation in J/kg
 E = Energy in J

$$E = m \times L_f$$

Where, m =mass of substance in kg
 L_f = latent heat of fusion in J/kg
 E = Energy in J

Box 8: Pathway

Previous knowledge:

KS3 Particle Theory and Energy

Future links:

KS4: Specific heat capacity; **KS5:** Thermal Physics and Gas Laws; Quantum Physics; Particle model

Careers:

Product designers; heating engineers; materials scientists

Box 9: Cross curricular links

