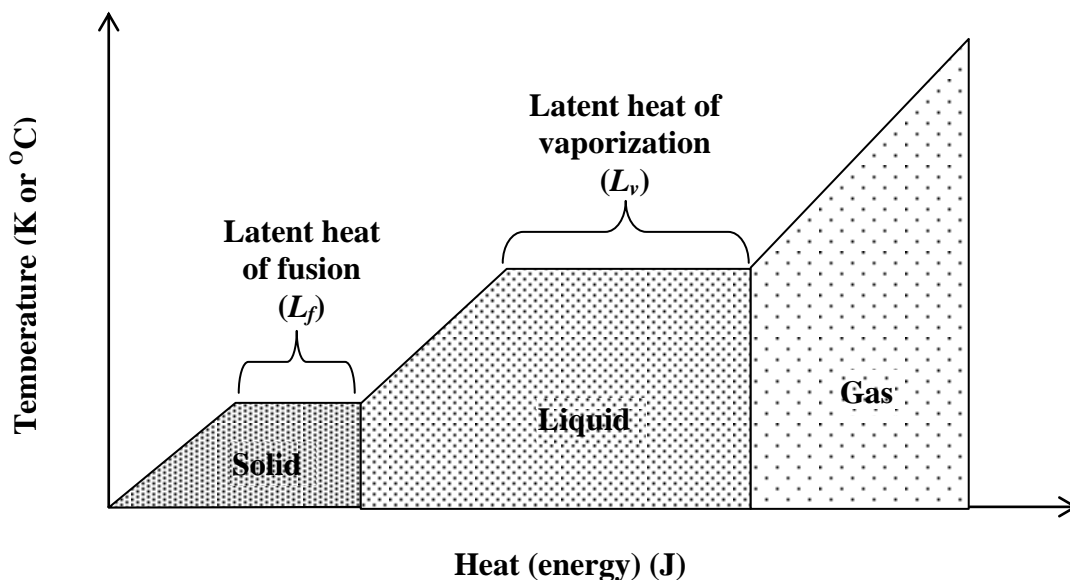


Thermal Energy

Terminology

- Thermal Energy – The kinetic energy due to the motion of the particles that make up the substance.
- Heat (Q) – The transfer of the thermal energy. Heat is not a substance. It is the result of fast moving particles colliding with slower moving particles. This results in a transfer of energy between the particles.
- First Law of Thermodynamics – The law of conservation of energy. The energy change in a system is determined by the amount of work done and heat exchanged with the surroundings. ($\Delta E = W + Q$)
- Second Law of Thermodynamics – Thermal energy is always transferred from an object with more energy (temperature) to an object with lower energy (temperature). An isolated system will always progress toward a state of thermal equilibrium.
- Third Law of Thermodynamics – Systems will tend to move toward disorder or a random state unless energy is invested to maintain order. (Entropy – a measure of a system's state of order.)
- Temperature – The measure of the average kinetic energy of the particles in a substance. Measured in Celsius degrees or Kelvin. ($T_K = T_C + 273.15$)
- Specific Heat Capacity (c) – The amount of energy that must be added to 1.0 kg of a substance to raise its energy by 1.0 Kelvin (or 1.0 °C). (J/kg K or J/kg °C) (Table 6.2 & 6.3 pg. 266)
- Kinetic Molecular Theory – All matter is made up of particles, which are in constant random motion. Hot particles move quicker than cold particles.
- Absolute Zero – The temperature at which a substance has no kinetic energy. (-273.15 °C)
- Phase Change – The change of state in a substance (solid, liquid, and gas). Includes the processes; vaporization, condensation, liquefaction, sublimation, and solidification. The process of state change requires an exchange of energy, but no change in temperature. The energy is needed to change the arrangement of the particles in the substance.



- Latent Heat of Fusion (L_f) – The energy associated with the change from a liquid to a solid or visa versa. The energy is needed to break or form the bonds/associations between particles. (J/kg) (Table 6.4 pg. 271) ($Q = mL_f$)
- Latent Heat of Vaporization (L_v) – The energy associated with the change from a liquid to a vapour or visa versa. (J/kg) (Table 6.4 pg. 271) ($Q = mL_v$)

Heat required for a Temperature Change

$$Q = mc\Delta T$$

Heat required for a Phase Change

$$Q_f = m L_f \quad \text{or} \quad Q_v = m L_v$$