PHY1014

# Heat

**Heat transfer and temperature change**

$Q=cmΔT=cm (T\_{2}-T\_{1})$,

$Q$ is heat, $c$ is specific heat (depends on the material and phase), $m$ is mass, $ΔT$ is change in temperature.

SI units of $Q$ is J (joule), SI units of $T$ is K (kelvin), SI units if $m$ is kg, SI units of $c$ is J/kg \*C.

Specific heat value can be found in a table with values for specific heat for various materials.

**NOTE**: in this case we will use temperature in degrees C.

**Phase change and latent heat**

**Melting/freezing**

$Q=mL\_{f}$,

$Q$ is heat, $m$ is mass, $L\_{f}$ is latent heat of fusion.

**Vaporization/condensation**

$Q=mL\_{v}$,

$Q$ is heat, $m$ is mass, $L\_{v}$ is latent heat of vaporization.

NOTE: latent heat of fusion and latent heat of vaporization can be found in a table with values for various materials.

**Heat transfer methods:**

* Conduction
* Convection
* Radiation

**Rate of conductive heat transfer**

$\frac{Q}{t}=\frac{kA(T\_{2}-T\_{1})}{d}$,

$ Q$ is heat, $t$ is time, $k$ is the thermal conductivity, $A$ is surface area, $d$ is thickness, $T$ is temperature.

This formula will be used in case we need to find the rate of conductive heat transfer through a slab of material.

Thermal conductivity can be found in a table with values for various materials.

The SI unit of the rate of heat conduction is W (watt).

**Rate of heat transfer by emitted radiation**

**The Stefan-Boltzmann law of radiation**

$\frac{Q}{t}=σeAT^{4}$,

$Q$ is heat, $t$ is time, σ = 5.67 x 10-8 J/s m2 K4 is the Stefan-Boltzmann constant, $A$ is the surface area of the object, $e$ is emissivity, $T$ is absolute temperature in K.

**Emissivity** is a measure how well an object radiates.

**Net rate of heat transfer by emitted radiation**

$\frac{Q}{t}=σeA(T\_{2}^{4}-T\_{1}^{4})$,

$Q$ is heat, $t$ is time, σ = 5.67 x 10-8 J/s m2 K4 is the Stefan-Boltzmann constant, $A$ is the surface area of the object, $e$ is emissivity, $T$ is absolute temperature in K;

$T\_{1}$ is the temperature of an object, $T\_{2}$ is the temperature of the environment.