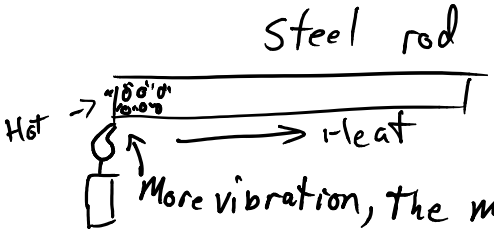
Thermal Transfer & Equilibrium

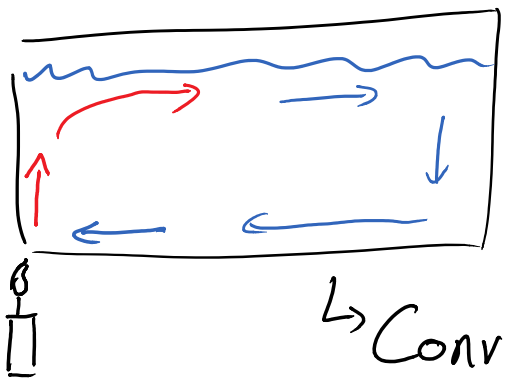
April-04-16 10:14 AM

How thermal energy transfers:



Conduction (solids)

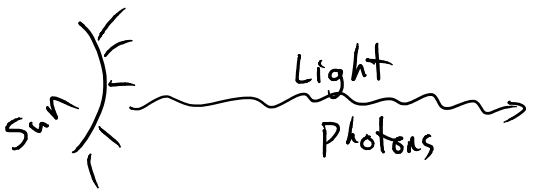
More vibration, the molecules will collide with nearby molecules, and transfer some energy

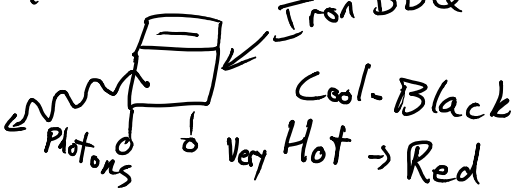


Remember → When something heats up it expands.
∴ less dense ∴ Float

↳ Convection (liquid & gas)

Energy transfer that doesn't pass through a medium is called radiation.





Thermal Energy always transfers from an area of high concentration to low concentration
(high temperature) → (low temperature)

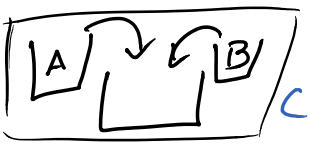
Equilibrium: the state where a sample/systems is stable

Equilibrium Temperature: the temperature that

Equilibrium Temperature: the temperature that two objects stabilize at when brought together.

Two 50g cups of water. Cup A is 50°C. Cup B is 0°C. What is the temperature they will reach when mixed?

Prediction: 25°C



Cup A will lose energy

$\Delta E \rightarrow Q \Rightarrow$ negative

Cup B will gain energy

$Q \Rightarrow$ positive

What would the ΔE_T be for the system: 0

$$\Delta E_T = Q_A + Q_B$$

$Q = mc\Delta T$ (mass, 4180 J/kg°C)

$$\Rightarrow \quad 0 = Q_A + Q_B \quad \Leftarrow \qquad T_{F_A} = T_{F_B}$$

$$0 = m_A \cdot C_A \cdot (T_F - T_{i_A}) + m_B C_B (T_F - T_{i_B})$$

$$0 = 0.050\,kg \times 4180\,J/kg°C\,(T_F - 50°C) + 0.050 \cdot 4180 \cdot (T_F - 0)$$

$$0 = 209(T_F - 50) + 209(T_F - 0)$$

$$0 = 209T_F - 10450 + 209T_F - 0$$

$$\frac{10450}{418} = \frac{418T_F}{418}$$

$$T_F = 25°C$$

A 100g cup of water is 51°C. It is poured into a -13°C piece of sponge with mass 74g ($c_s = 1735$). What is the equilibrium temperature?

$$0 = Q_w + Q_s$$

$$0 = m_w c_w \Delta T_w + m_s c_s \Delta T_s$$

$$0 = 0.1(4180)(T_f - 51) + (0.074)(1735)(T_f - (-13))$$

$$0 = 418(T_f - 51) + 128.39(T_f + 13)$$

$$0 = 418T_f - 21318 + 128.39T_f + 1669.07$$

$$0 = 546.39T_f - 19648.93$$

$$T_f = \frac{19648.93}{546.39}$$

$$\boxed{T_f = 36°C}$$