Heat

Heat may be looked upon as an external agency or energy whose absorption turns a body hot and extraction turns a body cold.

Heat flows from a body at high temperature to a body of low temperature. Heat flow stops when two bodies are in thermal equilibrium.

units of heat:
S.I. unit → Joule
CGS unit → calorie

1 calorie = 4.18 J
or 1 calorie = 4.2 J

Factors determining the quantities of heat absorbed or given out by a body

(a) mass
(b) difference of temperature
(c) specific heat capacity of the material.

specific heat capacity: The amount of heat needed to raise the temperature of unit mass of a substance by unit degree rise in temperature is called the specific heat capacity of the substance.

SI unit of specific heat capacity is $\frac{J}{kg\,K}$

and CGS unit is $\frac{\text{calorie}}{g\,^\circ C}$

specific heat capacity of water is $\frac{1 \text{ calorie}}{g\,^\circ C}$ (in CGS)

and $\frac{4200\ J}{kg\,K}$ (in SI)

Heat needed to raise the temperature of a substance from $t_1\,^\circ C$ to $t_2\,^\circ C$ is

$Q = ms(t_2 - t_1)$ calorie where

m = mass of the body

s = specific heat of the body

Principle of calorimetry: The principle of calorimetry states that for an insulated system, the heat energy lost by the hot body is equal to the heat gained by the cold body

Q A piece of copper heated to 35°C is dropped into 140 g of water at 15°C. Mass of copper is 150 g and specific heat of copper is $400 \frac{J}{Kg\,K}$. Find the final temperature. (Take specific heat of water = $4200 \frac{J}{kg\,K}$)

Sol:

m_1 = mass of copper = 150 g

$= \frac{150}{1000}$ kg

$= 0.15$ kg

S_1 = specific heat of copper

$= 400 \frac{J}{kg\,K}$

Initial temperature of copper = t_1

$= 35^\circ C$

Mass of water = $m_2 = 140\,g$

$= 0.14\,kg$

Specific heat of water = S_2

$= 4200\,\frac{J}{kg\,K}$

initial temperature of water = t_2

$= 15^\circ C$

Let, final temperature = $t^\circ C$

$\therefore$ Heat lost by copper = Heat gained by water

$\therefore \quad m_1 s_1 (t_1 - t) = m_2 s_2 (t - t_2)$

$0.15 \times 420 (35 - t) = 0.14 \times 420 (t - 15)$

$63 (35 - t) = 58.8 (t - 15)$

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$2205 - 63t = 58.8t - 882$

$2205 + 882 = 58.8t + 63t$

$3087 = 121.8t$

$t = \frac{3087}{121.8}$

$= 25.34^\circ C$