Example: Calculate the heat required to convert 3 kg of ice at −12 °C kept in a calorimeter to steam at 100 °C at atmospheric pressure. Given specific heat capacity of ice = 2100 J kg^{-1} K^{-1}, specific heat capacity of water = 4186 J kg^{-1} K^{-1}, latent heat of fusion of ice = 3.35 × 10^5 J kg^{-1} and latent heat of steam = 2.256 ×10^6 J kg^{-1}. [NCERT] [Ans: 9.1×10^6 J]

$m_i = 3kg$

$T_1 = -12°C$

$S_i = 2100 J/kg-K$

$S_w = 4186 J/kg-K$

$L_f = 3.35 \times 10^5 J/kg$

$L_v = 2.256 \times 10^6 J/kg$

ice at −12°C ⟶ ice at 0°C ⇒ $Q_1 = m_i S_i \Delta T$; $\{\Delta T = 0-(-12) = 12°C\}$

ice at 0°C ⟶ water at 0°C ⇒ $Q_2 = m_i L_f$

water at 0°C ⟶ water at 100°C ⇒ $Q_3 = m_i S_w \Delta T'$; $\{\Delta T' = 100-0 = 100°C\}$

water at 100°C ⟶ steam at 100°C ⇒ $Q_4 = m_i L_v$

$Q_1 = 3 \times 2100 \times 12 = 756000 J = 0.0756 \times 10^6 J$

$Q_2 = 3 \times 3.35 \times 10^5 = 10.05 \times 10^5 J = 1.05 \times 10^6 J$

$Q_3 = 3 \times 4186 \times 100 = 12558 \times 10^2 J = 1.2558 \times 10^6 J$

$Q_4 = 3 \times 2.256 \times 10^6 = 6.768 \times 10^6 J$

Total heat taken = $Q_1 + Q_2 + Q_3 + Q_4$