- A bar of hot iron with a mass of 1.000 kg and a temperature of 100.00 °C is plunged into an insulated tank of water. The mass of water was 2.000 kg and its initial temperature was 25.00 °C. What will the temperature of the resulting system be when it has stabilised? (The specific heat capacities of water and iron are 4.184 J g^{-1} K^{-1} and 0.4498 J g^{-1} K^{-1}, respectively.) **3**

The heat lost by the iron is equal to the heat gained by the water.

The heat change is related to the temperature change through $q = mC\Delta T$ where m is the mass of the substance and C is its specific heat capacity.

For the water,

$$q = m_{H_2O}C_{H_2O}\Delta T_{H_2O} = (2.000 \times 10^3 \text{ g}) \times (4.184 \text{ J g}^{-1} \text{ K}^{-1}) \times ((T_f - 25.00) \text{ K})$$
$$= (8.368 \times 10^3 \text{ J K}^{-1}) \times ((T_f - 25.00) \text{ K})$$

For the iron,

$$q = m_{Fe}C_{Fe}\Delta T_{Fe} = (1.000 \times 10^3 \text{ g}) \times (0.4498 \text{ J g}^{-1}) \times ((T_f - 100.00) \text{ K})$$
$$= (0.4498 \times 10^3 \text{ J K}^{-1}) \times ((T_f - 100.00) \text{ K})$$

Hence, as $q_{water} = - q_{iron}$:

$$(8.368 \times 10^3 \text{ J K}^{-1}) \times ((T_f - 25.00) \text{ K}) = -(0.4498 \times 10^3 \text{ J K}^{-1}) \times ((T_f - 100.00) \text{ K})$$

$$T_f = 28.83 \text{ °C}$$

Answer: **28.83 °C**