Answer on Question 57735, Physics, Molecular Physics | Thermodynamics

Question:

Substance A has a higher specific heat than substance B. With all other factors equal, which requires the most energy to heat equal masses of A and B to the same temperature?

Solution:

By the definition, the specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius. Let's write the relationship between heat and temperature change:

$$Q = cm\Delta T,$$

here, c is the specific heat, m is the mass of the substance, ΔT is temperature change.

As we can see from the formula, less heat is required to heat a substance with a low specific heat and more for a substance with a high specific heat.

Let's take as the substance A aluminum ($c_1 = 910\,\frac{J}{kg°\text{C}}$) and as the substance B – copper ($c_2 = 390\,\frac{J}{kg°\text{C}}$). We also assume that all other factors equal ($m_1 = m_2 = 1\ kg$) and we heat equal masses of A and B to the same temperature of, say, 50 degrees Celsius. Then, we get:

$$Q_1 = m_1 c_1 \Delta t_1 = 910\ \frac{J}{kg°\text{C}} \cdot 1\ kg \cdot 50°\text{C} = 45500\,J,$$

$$Q_2 = m_2 c_2 \Delta t_2 = 390\ \frac{J}{kg°\text{C}} \cdot 1\ kg \cdot 50°\text{C} = 19500\,J.$$

Therefore, we can convince from the calculations, that the substance A requires more energy to heat to $50°\text{C}$.

Answer:

Substance A.