



As energy is added to solid matter, it changes its state. The figure to the left shows what happens to water as it changes from solid ice (A to B), to a mixture of cold water and 'ice cubes' (B to C) and then finally to pure liquid water (C to D).

The energy required to change a kilogram of solid ice by one degree Celsius is called the **Specific Heat**. The energy needed to change a kilogram of solid ice at 0°C into 100% liquid water at 0°C is called the **Latent Heat of Fusion**.

Problem 1 - The Specific Heat of ice is 2090 Joules/kg C . How many Joules of energy do you need to raise the temperature of 1 kg of ice from -20°C to 0°C along the path from A to B on the graph?

Problem 2 - The Latent Heat of Fusion for water is 333 Joules/gram . How many Joules of energy do you need to melt all the ice into a pure liquid along the path from B to C on the graph?

Problem 3 - The Specific Heat of liquid water is 4180 Joules/kg C . How much energy is needed to raise the temperature of 100 grams of liquid water to $+60^{\circ}\text{C}$ for a nice warm cup of tea along the path from C to D in the graph?

Problem 1 - The Specific Heat of ice is 2090 Joules/kg C. How many Joules of energy do you need to raise the temperature of 1 kg of ice from -20°C to 0°C along the path from A to B on the graph?

Answer: The temperature difference is 20°C , so for 1 kg of ice we need $2090 \text{ Joules/kgC} \times (1 \text{ kg}) \times (20^{\circ}\text{C}) = \mathbf{41,840 \text{ Joules}}$.

Problem 2 - The Latent Heat of Fusion for water is 333 Joules/gram. How many Joules of energy do you need to melt all the ice into a pure liquid along the path from B to C on the graph?

Answer: For 1 kilogram of ice ,which equals 1000 grams, we need $333 \text{ Joules/gram} \times 1000 \text{ grams} = \mathbf{333,000 \text{ Joules}}$.

Problem 3 - The Specific Heat of liquid water is 4180 Joules/kg C. How much energy is needed to raise the temperature of 100 grams of liquid water to $+60^{\circ}\text{C}$ for a nice warm cup of tea along the path from C to D in the graph?

Answer: $4180 \text{ Joules/kgC} \times 0.1 \text{ kg} = \mathbf{418 \text{ Joules}}$.