

Solve the following thermal physics problems. Show all work.

1. How much energy is required to change a 40 g ice cube from ice at $-15\text{ }^{\circ}\text{C}$ to steam at $111\text{ }^{\circ}\text{C}$? The specific heat of ice is $2090\text{ J/kg }^{\circ}\text{C}$. The specific heat of water is $4186\text{ J/kg }^{\circ}\text{C}$. The specific heat of steam is $2010\text{ J/kg }^{\circ}\text{C}$. The heat of fusion is $3.33 \times 10^5\text{ J/kg}$. The heat of vaporization is $2.26 \times 10^6\text{ J/kg}$.

2. A 0.012 kg cube of ice at $0.0\text{ }^{\circ}\text{C}$ is added to 0.445 kg of soup at $79.7\text{ }^{\circ}\text{C}$. Assuming the soup has the same specific heat capacity as water, find the final temperature of the soup after the ice has melted. The specific heat of water is $4186\text{ J/kg }^{\circ}\text{C}$ and water's latent heat of fusion is $3.33 \times 10^5\text{ J/kg}$. Answer in units of $^{\circ}\text{C}$.