

34. (a) The water (of mass m) releases energy in two steps, first by lowering its temperature from 20°C to 0°C , and then by freezing into ice. Thus the total energy transferred from the water to the surroundings is

$$Q = c_w m \Delta T + L_F m = (4190 \text{ J/kg}\cdot\text{K})(125 \text{ kg})(20^\circ\text{C}) + (333 \text{ kJ/kg})(125 \text{ kg}) = 5.2 \times 10^7 \text{ J} .$$

- (b) Before all the water freezes, the lowest temperature possible is 0°C , below which the water must have already turned into ice.