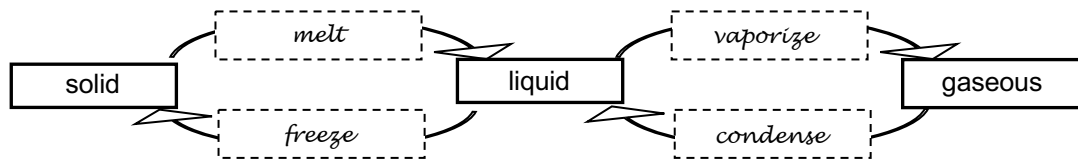
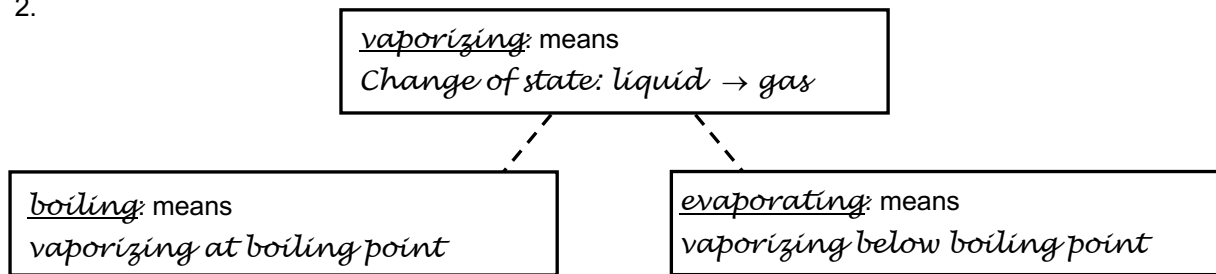


1.



2.



3. Water vapor

4. The less the external pressure is, the *lower* the boiling point is.

5. a) 78.3 °C

b) $Q = L_v \cdot m = 0.840 \cdot 10^6 \frac{\text{J}}{\text{kg}} \cdot 0.45 \text{ kg} = \underline{\underline{378 \text{ kJ}}}$

6. a) ①: warming of the solid substance – ②: melting – ③: warming of the liquid substance – ④: Vaporizing – ⑤: warming of the gaseous substance

b) 323 K

c) 423 K

d) $Q = 125 \text{ kJ} - 25 \text{ kJ} = 100 \text{ kJ}$ $L_f = \frac{Q}{m} = \frac{100'000 \text{ J}}{0.30 \text{ kg}} = \underline{\underline{3.3 \cdot 10^5 \frac{\text{J}}{\text{kg}}}}$

$Q = 325 \text{ kJ} - 175 \text{ kJ} = 150 \text{ kJ}$ $L_v = \frac{Q}{m} = \frac{150'000 \text{ J}}{0.30 \text{ kg}} = \underline{\underline{5.0 \cdot 10^5 \frac{\text{J}}{\text{kg}}}}$

e) solid state: $\Delta U = 25 \text{ kJ}$ $\Delta T = 50 \text{ }^\circ\text{C} - (-100 \text{ }^\circ\text{C}) = 150 \text{ K}$

$$c_{\text{solid}} = \frac{Q_{\text{solid}}}{m \cdot \Delta T_{\text{solid}}} = \frac{25'000 \text{ J}}{0.30 \text{ kg} \cdot 150 \text{ K}} = \underline{\underline{560 \frac{\text{J}}{\text{kg} \cdot \text{K}}}}$$

liquid state: $\Delta U = 175 \text{ kJ} - 125 \text{ kJ} = 50 \text{ kJ}$ $\Delta T = 150 \text{ }^\circ\text{C} - 50 \text{ }^\circ\text{C} = 100 \text{ K}$

$$c_{\text{liquid}} = \frac{Q_{\text{liquid}}}{m \cdot \Delta T_{\text{liquid}}} = \frac{50'000 \text{ J}}{0.30 \text{ kg} \cdot 100 \text{ K}} = \underline{\underline{1.7 \cdot 10^3 \frac{\text{J}}{\text{kg} \cdot \text{K}}}}$$

gaseous state: $\Delta U = 400 \text{ kJ} - 325 \text{ kJ} = 75 \text{ kJ}$ $\Delta T = 250 \text{ }^\circ\text{C} - 150 \text{ }^\circ\text{C} = 100 \text{ K}$

$$c_{\text{gaseous}} = \frac{Q_{\text{gaseous}}}{m \cdot \Delta T_{\text{gaseous}}} = \frac{70'000 \text{ J}}{0.30 \text{ kg} \cdot 100 \text{ K}} = \underline{\underline{2.5 \cdot 10^3 \frac{\text{J}}{\text{kg} \cdot \text{K}}}}$$

7. a) $100 \text{ }^\circ\text{C}$

b) $Q_{\text{warming}} = \Delta U = c \cdot m \cdot \Delta T = 4182 \frac{\text{J}}{\text{kg} \cdot \text{K}} \cdot 2.50 \text{ kg} \cdot 81 \text{ K} = 846'855 \text{ J} = \underline{\underline{847 \text{ kJ}}}$

c) $Q_{\text{vaporizing}} = L_v \cdot m = 2'256 \frac{\text{kJ}}{\text{kg}} \cdot 2.50 \text{ kg} = \underline{\underline{5'640 \text{ kJ}}}$

d) $Q_{\text{total}} = Q_{\text{warming}} + Q_{\text{vaporizing}} = 847 \text{ kJ} + 5640 \text{ kJ} = \underline{\underline{6'487 \text{ kJ}}}$

e) $t = \frac{W}{P} = \frac{6487 \text{ kJ}}{2.0 \text{ kW}} = 3243 \text{ s} = \underline{\underline{54 \text{ min } 3 \text{ s}}}$

8.

	process	temperature (goes up / goes down / no change)	heat (gain/loss)	formula (for Q)
water	<i>warms up</i>	<i>goes up</i>	<i>gain</i>	$Q = c \cdot m \cdot \Delta T$
steam	<i>condenses</i>	<i>no change</i>	<i>loss</i>	$Q = L_v \cdot m$

	process	temperature (goes up / goes down / no change)	heat (gain/loss)	formula (for Q)
water	<i>warms up</i>	<i>goes up</i>	<i>gain</i>	$Q = c \cdot m \cdot \Delta T$
condensed water (from steam)	<i>cools down</i>	<i>goes down</i>	<i>loss</i>	$Q = c \cdot m \cdot \Delta T$

9. a) $Q_{\text{water}} = c_{\text{water}} \cdot m_{\text{water}} \cdot \Delta T_{\text{water}} = 4'182 \frac{\text{J}}{\text{kg}\cdot\text{K}} \cdot 0.23 \text{ kg} \cdot (85 \text{ }^\circ\text{C} - 19 \text{ }^\circ\text{C}) = 63'483 \text{ J} = \underline{63 \text{ kJ}}$

b) ① Steam condenses to liquid water at 100 °C

② Water (from condensed steam) cools down from 100 °C to 85 °C

c) $Q_{\text{water}} = Q_{\text{condensing}} + Q_{\text{cooling (condensed steam)}}$

$$Q_{\text{condensing}} = L_{\text{v(water)}} \cdot m_{\text{steam}}$$

$$Q_{\text{cooling (condensed steam)}} = c_{\text{water}} \cdot m_{\text{steam}} \cdot \Delta T_{\text{condensed steam}}$$

$$Q_{\text{water}} = L_{\text{v(water)}} \cdot m_{\text{steam}} + c_{\text{water}} \cdot m_{\text{steam}} \cdot \Delta T_{\text{condensed steam}}$$

$$Q_{\text{water}} = m_{\text{steam}} \cdot (L_{\text{v(water)}} + c_{\text{water}} \cdot \Delta T_{\text{condensed steam}})$$

$$m_{\text{steam}} = \frac{Q_{\text{water}}}{L_{\text{v(water)}} + c_{\text{water}} \cdot \Delta T_{\text{condensed steam}}} = \frac{63'483 \text{ J}}{2.257 \cdot 10^6 \frac{\text{J}}{\text{kg}} + 4'182 \frac{\text{J}}{\text{kg}\cdot\text{K}} \cdot (100 \text{ }^\circ\text{C} - 85 \text{ }^\circ\text{C})} =$$

$$= 0.0273 \text{ kg} = \underline{27 \text{ g}}$$

10. a) $Q_{\text{evaporating}} = L_{\text{v}} \cdot m_{\text{evaporated water}} = 2.256 \cdot 10^6 \frac{\text{J}}{\text{kg}} \cdot 0.0010 \text{ kg} = 2'256 \text{ J} = \underline{2.3 \text{ kJ}}$

b) $\Delta U_{\text{water}} = Q_{\text{water}} = Q_{\text{evaporating}} = \underline{2.3 \text{ kJ}}$

c) $\Delta T_{\text{water}} = \frac{\Delta U_{\text{water}}}{c_{\text{water}} \cdot m_{\text{water}}} = \frac{2'256 \text{ J}}{4'182 \frac{\text{J}}{\text{kg}\cdot\text{K}} \cdot 0.099 \text{ kg}} = 5.4 \text{ K} \quad \vartheta = 21 \text{ }^\circ\text{C} - 5.4 \text{ K} = \underline{16 \text{ }^\circ\text{C}}$

11. The water on the skin evaporates. The heat required for evaporation flows from your skin to the droplets of water on your skin. While the internal energy of your skin decreases, the temperature drops. If there's a little bit of wind, evaporation is faster, which results in even more cooling.