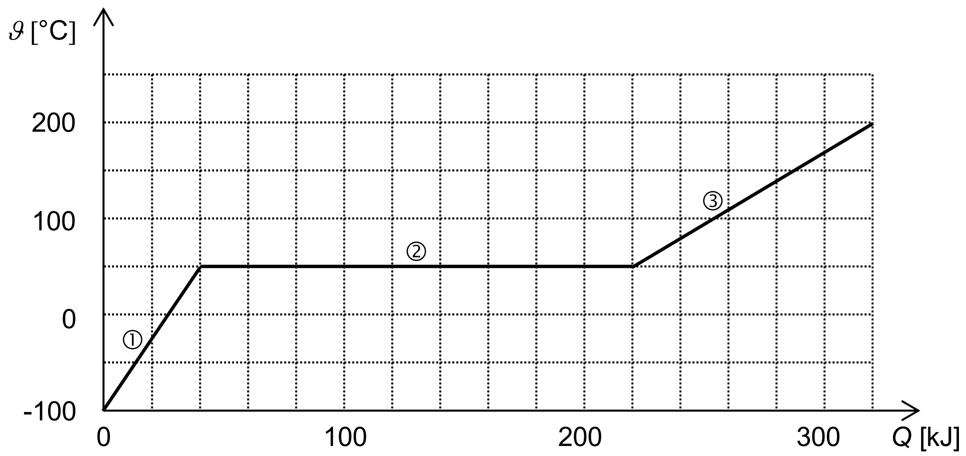
1. An iron block of 3.80 kg is to be melted.
a) At what temperature does iron melt?
b) How much heat is needed to melt the whole iron block at its melting point?

2. This graph shows how the temperature of a hypothetical substance (m = 632 g) depends on the heat absorbed by it. At – 100 °C the substance is in its solid state.

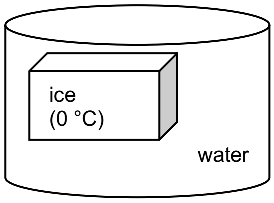


a) Describe what's happening in ①, ② and ③. Does the temperature and / or the state of matter change? If yes, in which way?
b) How much heat is absorbed by the substance if its temperature increases from –100 ° C to the melting point?
c) What is the increase in temperature?
d) At what temperature does the substance melt?
e) How much heat is absorbed by the substance for the entire melting process?
f) What is the increase in temperature during the melting process?
g) How much heat is absorbed by the substance if its temperature increases from the melting point to + 200 °C?
h) What is the increase in temperature?
i) Determine the latent heat of fusion.
j) Calculate the specific heat capacity at the solid state.
k) Calculate the specific heat capacity at the liquid state.

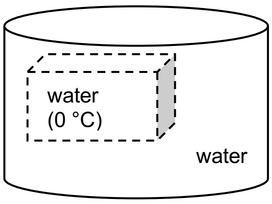
3. Sam wants to melt an aluminium tube (m = 340.0 g) which initially is at room temperature (ϑ = 22.0 °C).
a) What is the melting point of aliminium?
b) What is the increase in internal energy, if the temperature of the aliminium tube increases from room temperature to its melting point?
c) How much heat needs to be supplied in order to increase the tube's temperature from room temperature to its melting point?
d) How much heat needs to be supplied in order to completely melt the tube at its melting point?
e) What is the total heat needed?

4. Elimir is on a mountain tour, very high up, at a temperature of ϑ = –19.4 °C. For dinner, he wants to cook a soup with hot water. He prepares a fire, places 472 g of ice into a copper kettle (m = 326 g) and heats it until the temperature reaches 83.5 °C. Unrealistically, we assume that no energy flows to the surroundings.
How many grams of wood does he burn?
(1.0 kg of wood contains 8.0 MJ of chemical energy).

5. Melting ice requires a lot of energy. For that reason, it is very feasible to use ice for cooling a drink nicely. Heat flows from the drink to the ice, and while the ice melts, the temperature of the drink goes down.
   Analyse the two processes which occur and fill in the table.



	process	temperature (goes up / goes down / no change)	heat (gain/loss)
water			
ice			



	process	temperature (goes up / goes down / no change)	heat (gain/loss)
water			
melted water (from ice)			

6. Cleopatra wishes to cool 200.0 mℓ of water from 32 °C to 0.0 °C. She takes a little ice cube of 0.0 °C and places it in the water. (1.0 ℓ of water has a mass of 1.0 kg)

a) Calculate the water's decrease in internal energy, if the temperature goes down from 32 °C to 0.0 °C.
b) What is the heat lost by the water during the cooling process?
c) What is the heat gained by the ice cube?
d) How many grams of ice can be melted using the heat from c)? This is the amount of ice needed for cooling Cleopatra's drink to 0.0 °C.

7. Betty pours ice cubes of – 5.00 °C into a bucket which is filled with 4.50 ℓ of water of temperature + 14.0 °C. She stirs well until all the ice is melted and the final temperature at equilibrium is 0.00 °C (assuming, as usual, that no heat is being exchanged with the surroundings ☺).

a) Calculate the amount of heat lost by the water as it cools down from 14.0 °C to 0.00 °C.
b) What is the heat gained by the ice cubes?
c) What two processes does the ice cubes undergo?
d) How many grams of ice did Betty pour into the bucket?

solutions:

1. a) 1535 °C	b) 1.05 MJ			
2. b) 40 kJ	c) 150 K	d) 50 °C; 323 K	e) 180 kJ	f) 0
g) 100 kJ	h) 150 K	i) $2.85 \cdot 10^5\ \frac{J}{kg}$	j) $422\ \frac{J}{kg \cdot K}$	k) $1.05 \cdot 10^3\ \frac{J}{kg \cdot K}$
3. a) 660 °C	b) 194 kJ	c) 194 kJ	d) 135 kJ	e) 329 kJ
4. 44 g				
6.a) 27 kJ	b) 27 kJ	c) 27 kJ	d) 81 g	
7.a) 263 kJ	b) 263 kJ	d) 766 g		