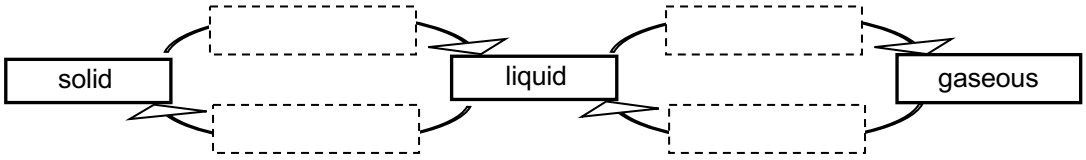
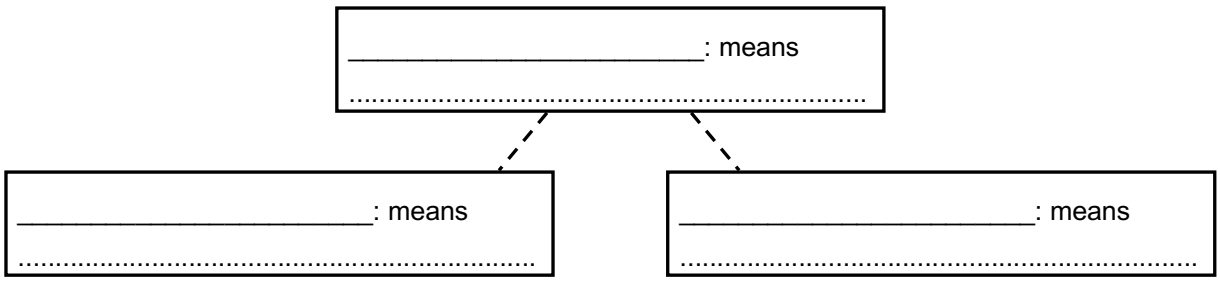
Vaporization und condensation A40

1. Fill in the terms *vaporize*, *condense*, *melt* and *freeze*.



2. The terms *boiling*, *vaporizing* and *evaporating* are related to each other. One of them signifies a change of state in general, while the other two describe in more detail two different ways for this transition to occur. Write the terms in the corresponding boxes and write their meanings on the dotted lines.



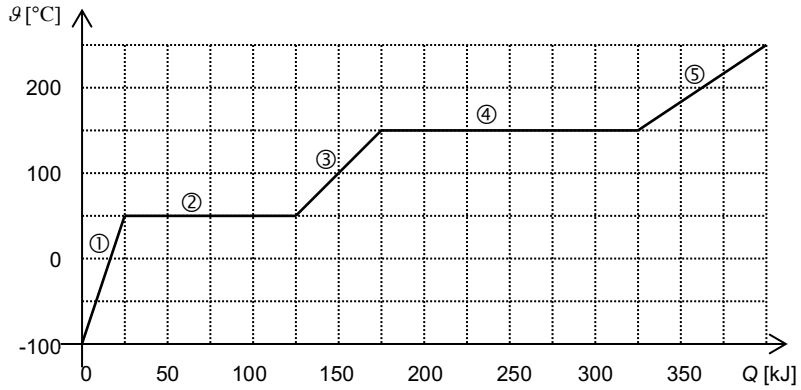
3. If you put a pot of water on the stove and supply heat until the water boils, bubbles are formed which rise to the surface.
   What is inside the bubbles? (*oxygen? nitrogen? air? helium? hydrogen? water vapor? nothing?)*

4. Complete the following sentence:

   The lower the external pressure is, the ..... the boiling point is.

5. 450 g of alcohol are to be vaporized.
a) What is the boiling point of alcohol at a pressure of 1'013 mbar?
b) How much heat is needed to boil away all of the alcohol at boiling point?

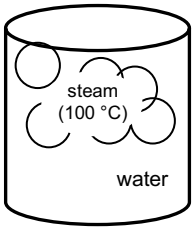
6. Here is a graph of an imaginary substance (m = 300.0 g) which is solid at – 100 °C. Heat was supplied to the substance while the temperature was being measured.
a) Describe what's happening in ①, ②, ③, ④ and ⑤. Does the temperature and / or the state of matter change? If yes, in what way?
b) What is the melting point of the substance?
c) What is the boiling point of the substance?
d) Determine the latent heat of fusion and the latent heat of vaporization of the substance.
e) Determine the specific heat capacity of the substance in the solid state, the liquid state and the gaseous state.



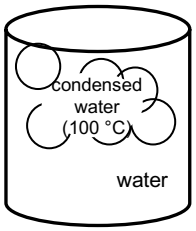
7. A kettle contains 2.5 kg of water at room temperature ϑ = 19 °C and pressure p = 1'013 mbar. The water is heated on a stove of power P = 2.0 kW until all the water has turned into steam. Assume no heat goes to the surroundings.

a) What is the boiling point of water?
b) How much heat needs to be supplied to the water to raise the temperature from room temperature to the boiling point?
c) How much heat is needed to boil away the whole 2.5 kg of water at boiling point?
d) What is the total heat needed?
e) How long does the whole process take?

8. During condensation a large amount of heat is released. Therefore, introducing steam into cold water or milk allows for a fast way of heating your beverage. While the steam condenses, heat flows from the steam to the beverage, and the temperature of the beverage goes up. Analyse the two processes which occur and fill in the table.



	process	temperature (goes up / goes down / no change)	heat (gain/loss)	formula (for Q)
water				
steam				



	process	temperature (goes up / goes down / no change)	heat (gain/loss)	formula (for Q)
water				
condensed water (from steam)				

9. Using steam of 100 °C, 2.3 dℓ of tea water is to be heated from 19 °C to 85 °C.

a) How much heat needs to be supplied to the tea water to achieve the desired increase in temperature?
b) The required heat is released by the steam. What are the two processes involved?
c) How many grams of steam are needed in order to heat the tea water?

10. An open bowl contains 100.0 g of water of ϑ = 21 °C. 1.0 g of the water evaporates. Suppose there is no further exchange of energy with the surroundings.

a) What is the amount of heat needed for the evaporation of 1.0 g of water?
b) How much heat is lost by the remaining 99 g of water by supplying heat for the evaporation of the 1.0 g that leaves the liquid?
c) What is the temperature of the remaining 99 g of water, after 1.0 g has evaporated?

11. Why do you feel cold if you don't dry yourself off when you get out of the water after swimming in an outdoor swimming pool?

solutions:
5.a) 78.3 °C b) 378 kJ
6.b) 323 K c) 423 K d) L_f = 333 $\frac{kJ}{kg}$, L_v = 500 $\frac{kJ}{kg}$ e) c_{solid} = 560 $\frac{J}{kg \cdot K}$, c_{liquid} = 1'670 $\frac{J}{kg \cdot K}$, $c_{gaseous}$ = 2'500 $\frac{J}{kg \cdot K}$
7. a) 100 °C b) 847 kJ c) 5'640 kJ d) 6'487 kJ e) 54 min 3 s
9. a) 63 kJ c) 27 g
10.a) 2.3 kJ b) 2.3 kJ c) 16 °C