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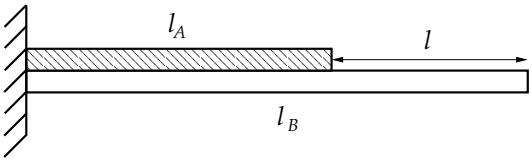
Exercises and Complements for the Introduction to Physics I for Students of Biology, Pharmacy and Geoscience

Sheet 12 / November 19, 2019 Discussion of the Exercises: **10.12.2019/11.12.2019**

Exercise 56.

A way, to keep the distance between two points regardless of temperature constant, is shown in the figure: Two rods of different lengths and of different material are tightly connected to each other at one end. With an appropriate choice of length and material for the rods, the distance between the two ends of the rods l (see figure) should be constant.



If rod A is out of copper and 20 cm long, how long does the iron rod B have to be, so that l is independent of the temperature?

Exercise 57.

A 2 m long, round copper stick has a diameter of 2 cm. The temperature at the ends is kept at 100°C and 0°C, respectively. The surface of the stick is isolated so that no heat exchange with the environment can take place. Calculate:

(a) the heat flow rate
(b) the thermal gradient
(c) the thermal resistance (temperature difference per heat flow rate) of the stick.

Exercise 58.

We pour 200 cm^3 tea with a temperature of 95°C in a 150 g glass cup which initially has a temperature of 20°C. What is the equilibrium temperature of the system, assuming that no heat exchange with the environment takes place?

Exercise 59.

A system in a lab is cooled by a heat exchanger. 50 liter of water per hour flow through the heat exchanger. The inlet of the exchanger is at 18°C and at the outlet at 25°C. How big is the cooling power, respectively how much energy per time gets transported by the water?

Exercise 60.

An ideal, monatomic gas (isentropic expansion factor $\gamma = 1.66$) expands slowly until its pressure has decreased to exactly half of its original value. By what factor does the volume change, when the change of state is (a) isothermal, and (b) adiabatic?

Solutions.

Exercise 56. 28.0 cm

Exercise 57. (a) 6.1 W, (b) 50 K/m, (c) 16.3 K/W

Exercise 58. 86.5°C

Exercise 59. 406.6 W

Exercise 60. (a) 2.0, (b) 1.52