Hint 2

IMPORTANT! The next task is both a hint and an alternative to the main task. Three important points:

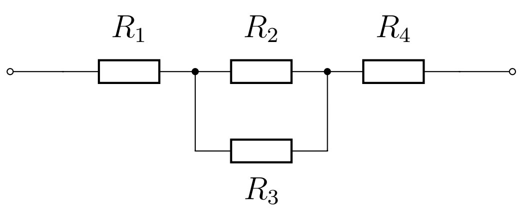
1. You can continue to send the solution to the main problem.
2. At any moment before the final deadline you can start to solve the Alternative problem. If you do so, at the beginning of the solution write: *I am doing the Alternative problem!* In this case a penalty coefficient for the Alternative problem is

$$0{,}7 \cdot \sum_i \frac{k_i \cdot p_i}{10},$$

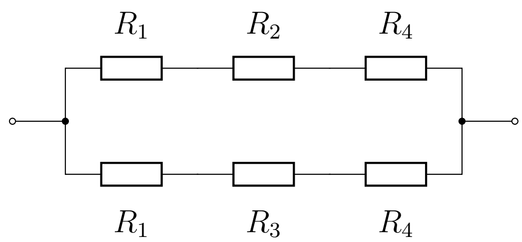
   where p_i is a point for the problem item, and k_i is a penalty coefficient for the corresponding problem's item at the moment of moving to the Alternative problem. In other words, maximal points for the alternative problem equals to the maximal points you can gain at the moment of moving to the alternative one multiplied by 0,7. Also, we remind you that a penalty coefficient can't be less than 0,1. Solutions of the main problems from that moment will not be checked. Be careful!
3. The task consists of several items. The penalty multiplier earned **before** is applied to all points. In the future, each item is evaluated as a separate task. If you send a solution without any item, this item's solution is considered as Incorrect. For more information about scoring points for composite tasks, see the rules of the Cup.

Alternative problem

1. Find the equivalent resistance of the circuits.

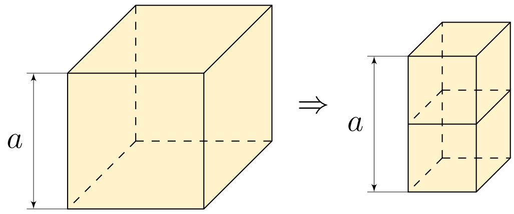


a) *(0,5 points)*



b) *(0,5 points)*

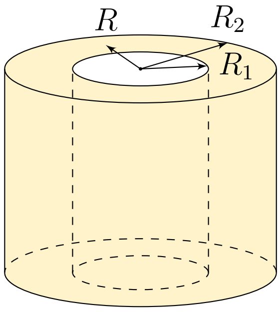
2. *(1 point)* The detail made of cast iron has a thermal resistance R_0 and has the shape of a cube with side a. The piece is replaced by two cast-iron cubes with side $a/2$. Find the thermal resistance of the new system.



3. *(4 points)* A piece made of a material with variable thermal conductivity has the shape of a cylinder of radius R_2 and of hight H with a cylinder of radius R_1 cut out of it. The thermal conductivity depends on the radius as follows:

$$\varkappa(R) = \varkappa_1 \cdot \frac{R^2}{R_1^2}.$$

Cylinders R_1 and R_2 are maintained at temperatures T_1 and T_2 respectively. Find the distribution $T(R)$ and the total power transferred from the inner cylinder to the outer one.



4. *(4 points)* In the street $T_{st} = 10°C$. Pasha Shishkin pumps water through the pipe into the dorm. The pipe is round, $R = 1$ m. The pipe has thermal insulation on the surface with thickness h with $\varkappa = 200$ W$/(m \cdot K)$. The water in the pipe moves with a speed of $v = 1$ m/s. The dependence of temperature on the coordinate is given on the graph. Plot the temperature dependence of $\Delta T/\Delta x$ and determine the wall thickness h from it. The initial temperature of the water in the pipe is $T_1 = 90°C$.