



LPR **VI** Cup

10.s06.e04

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 task

For several days now, Martin had been tirelessly working on three ill-fated orders. He had sent them to the client multiple times, but each time they were returned along with the courier, who had practically taken up residence in the workshop, he had been there so often these days. The client turned out to be quite "meticulous," but very kind-hearted. Each return was accompanied by a note, where the client, with accounting, like precision, kept track of the number of attempts to complete the order and how far they were from perfection. But what surprised Martin the most was that at the very bottom of the memo, there were always a few lines wishing him good luck and expressing confidence that Martin would succeed.

That morning, the apprentice was once again working on the orders that had been returned in the middle of the night and were waiting for him at the workshop's entrance. He was engrossed in soldering contacts when the door opened with its characteristic chime, and Martin, by now accustomed to the sight, saw the checkered beret floating at counter height.

"Strange, I just received the order for revision," thought Martin. "That puzzled look again," thought the courier, as he placed a heavy wooden box on the floor, extended his hand in greeting, and habitually hopped onto the stool standing nearby.

The apprentice leaned over the box, which was tied with a frayed hemp rope securing a yellowed envelope to it.

"Funny thing, the postmaster said this package has been stored at our office... folevel? No one remembers how it got there, but they do remember it had to be delivered today and specifically here," said the courier, swinging his legs and chewing on a straw sticking out of the corner of his mouth.

Martin half-listened to his new acquaintance while keeping his eyes fixed on the side of the box, which seemed to have come from the past. On it, in an ornate script, was written "Where's Merch?" "Ganz Lmt." The apprentice picked up the letter, on which Hans's neat handwriting spelled out Martin's name, the address of their workshop, and a request to deliver it on this exact day and at this exact time. He took a letter opener and slit the envelope. While the courier grumbled about the imperfections of the delivery service and how great it would be to have a scooter at his disposal, Martin quickly read the even lines of text written by his teacher, unable to believe his eyes.

"He did it..." Martin whispered, either in awe or shock. But what struck him the most was that, despite the scientific breakthrough Hans had achieved, he still found the time (which, judging by the circumstances, he now had plenty of) to help his apprentice tackle his very first order, which he had learned about from someone named Charles.

Inside the envelope, Martin found a strange poster, which, in his teacher's traditional allegorical and humorous style, was meant to hint at how to solve the tasks at hand. There were also instructions with simpler diagrams, which, once assembled, would help Martin grasp the key ideas necessary to complete the Main Order.

The courier had been watching Martin intently the entire time, continuing to swing his legs.

Order 1

Several Important Ideas

Without Proof

In this part of the problem, we invite you to think about several questions, the answers to which do not need to be justified either here or in the Main Problem. You may try to provide justification, but in this case, we recommend relying on intuitive reasoning.

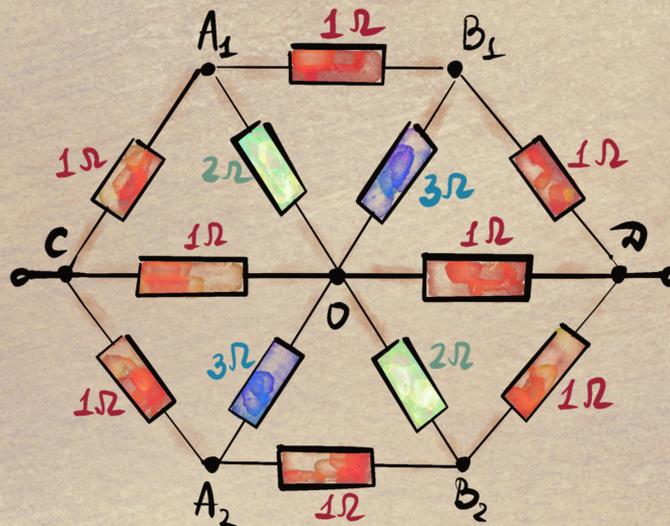
The question is as follows: what will happen to the total resistance of a circuit composed of resistors if:

1. (0 points.) Any resistance is decreased?
2. (0 points.) One of the resistances is removed?
3. (0 points.) Any of the nodes is disconnected?
4. (0 points.) Any two nodes are connected with a jumper?

After answering these questions, try solving three problems on approximate resistance calculations by estimating the upper and lower bounds.

Alternative Order 1.0

Consider the circuit shown in the diagram.

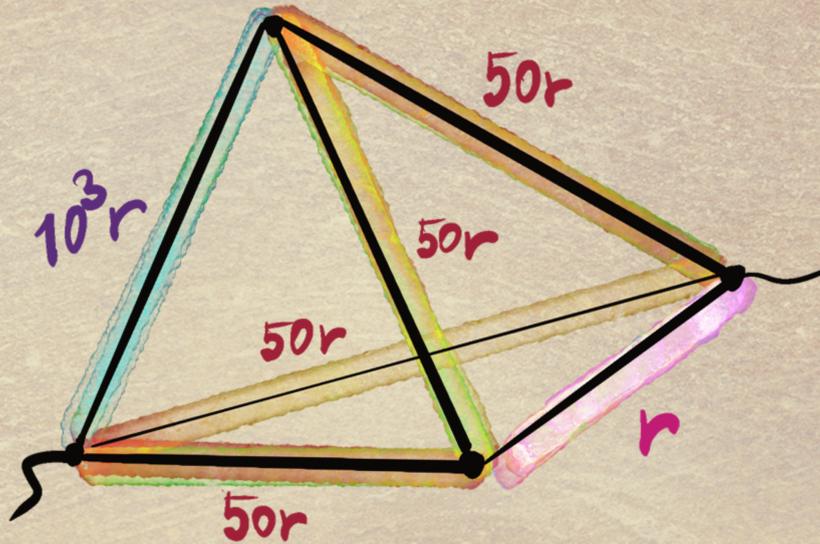


Calculate the resistance if:

1. (0 points) all resistances of 2 Ohms are replaced with resistances of 3 Ohms.
2. (0 points) all resistances of 3 Ohms are replaced with resistances of 2 Ohms.
3. (0 points) the node O is disconnected without changing any resistances.
4. (0 points) without changing any resistances, connect nodes A_1 and A_2 , as well as B_1 and B_2 , with jumpers.

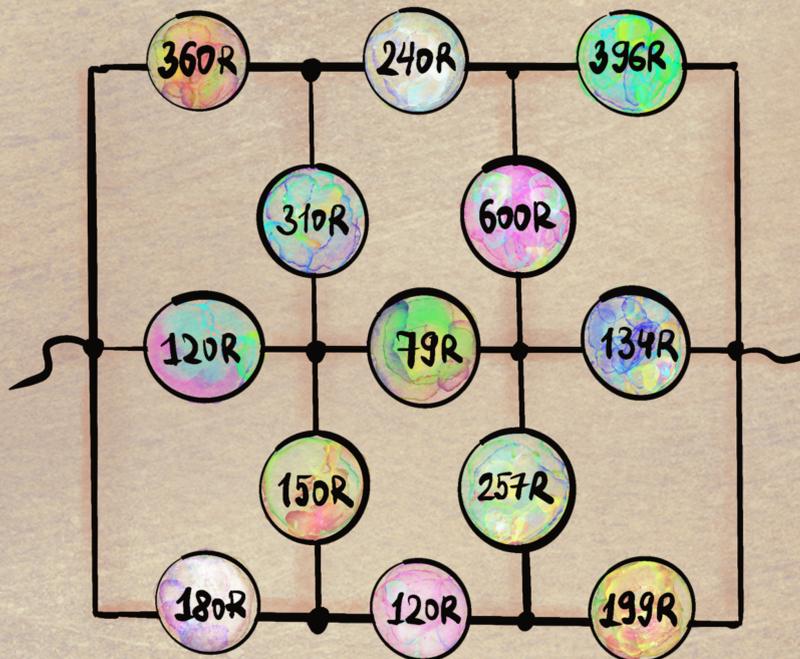
Alternative Order 1.1

1. (2 points) Estimate the resistance of the given circuit with an accuracy of 2%.



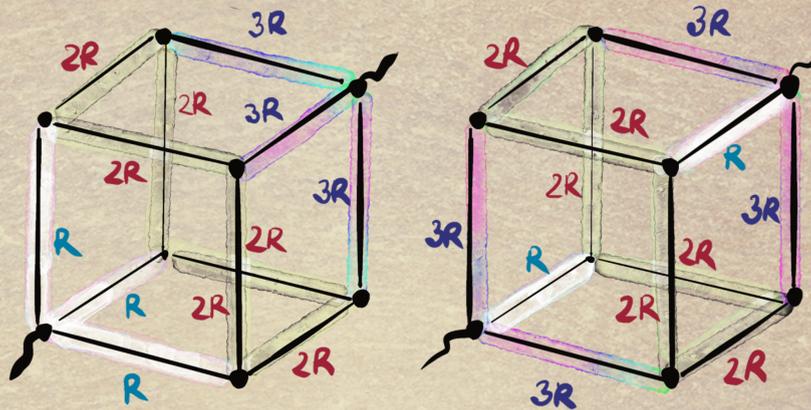
Alternative Order 1.2

1. (3 points) Estimate the resistance of the given circuit with an accuracy of 1%.



Order 2

Find the resistance of the circuits shown in the diagram.



1. (0.5 points) The circuit on the left.
2. (1.5 points) The circuit on the right.

Order 3

1. (3 points) Determine the readings of the instruments in the circuit shown in the diagram.

