There's no point in being grown up
if you can't act a little childish sometimes
Doctor Who

Clue

Entering the workshop, Martin habitually tore off another page from the calendar and, crumpling it, sent it flying in a beautiful parabolic arc into the wastebasket standing in the corner. There was no trace left of the mess that had reigned not long ago, although the apprentice was still not entirely sure he had put all the tools in their proper places.

Martin sat down at the workbench, looked around, and felt lonely. Both the workshop and the apprentice had been waiting far too long for the Master's return. To distract himself from his gloomy thoughts, the young man returned to the broken ellipsograph, the riddle of which he had been trying to solve for a week.

After a couple of hours of persistent and intense work, when it seemed the mechanism was finally fully repaired, a sudden piercing sound made Martin flinch, causing the hinge system to snap shut with a loud click, painfully pinching his fingers. The sound had come from the entrance door, above which hung an improvised "bell," hastily made from chipped and bent wrenches suspended inside the metal horn of a gramophone.

Jumping up from his seat, Martin almost reflexively blurted out, "Welcome to Hans's workshop! How can I..."—and broke off mid-sentence, surprised to see no one there. Rubbing his bruised fingers, the apprentice stepped closer to the counter and saw, right by the entrance, a short boy in a dark, dusty, many-times-mended coat, a beret slipped to the back of his head, and a bag slung over his shoulder, almost dragging on the floor. "A messenger," Martin thought. "An applentice," the boy thought.

Martin had often seen Hans accept orders or refuse dubious and unreliable ones ~~with the words «nah don't want now»~~. But he had never had to take them himself, and he felt a slight nervousness—unlike the messenger, who noisily set his bag on the floor, pulled out a crumpled telegram, and began to read it aloud.

«If you finith by Monday, thele's a bonus for speed. If it's done by Wesneday, thele's no penlity. But if you're still not done by then, Fliday is the absolute deadline.» the boy rattled off, then, standing on tiptoe, placed the scrap of paper on the counter. Looking at the stunned apprentice, the messenger sighed loudly and added in a lecturing tone, "Keep in mind, the client is vely stlict. He always sends evelything back for lework. So be as caleful as possible, okay? I'm leally tired of all these delivelies, checks, and so on." the boy said, and unsuccessfully (due to his height and build) tried to push the parcel onto the counter. Martin silently watched this struggle with gravity for a while, then came around the counter and helped the boy lift the load with one hand.

Opening the bag, Martin looked inside with interest and saw a large number of wires and

electrical appliances. «Unfortunately, Hans is not here right now, but...» - Martin's sentence was cut off again by the sound of wrenches hitting the tin surface of the gramophone. Raising his head, the young man saw a beret proudly swaying and floating away at the windowsill level.
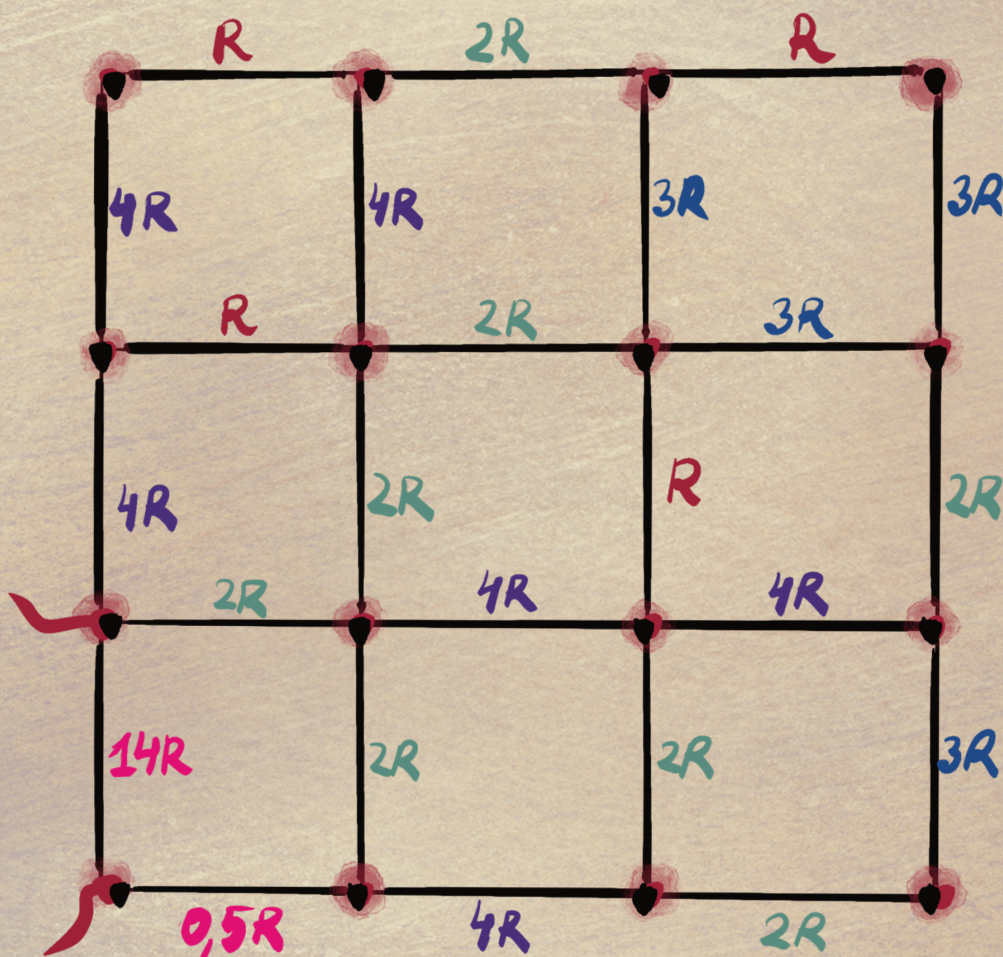
Martin looked at the clock and sighed deeply. Where was Hans?

Order 1. Network

The figure shows an electrical circuit.

1. *(5 points)* Find the total resistance with an accuracy of 0.1%. In your answer, provide the boundaries, the mean value, and the relative error.
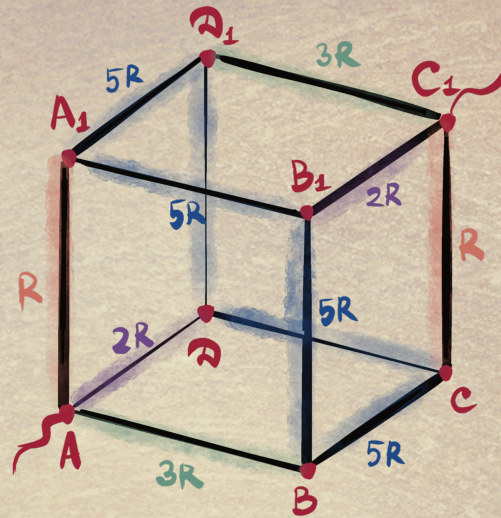
In this problem, we ~~ask~~ require an analytical solution and justification.

Order 2. Cube

12 resistors form a cube. The edges AA_1 and CC_1 have resistance R, AB and C_1D_1 have resistance $3R$, AD and B_1C_1 have resistance $2R$, and the remaining edges have resistance $5R$ (see the figure).

1. *(2 points)* Find the resistance of the cube when connected between points A and C_1.

Order 3. Fractal

Three identical sources with known $\mathcal{E}$ and internal resistance R are located at the vertices of an equilateral triangle, formed by three ideal bridges (shown in black in the figure). Between the bridges is a fractal consisting of resistors with resistance $3R$ (blue in the figure), $5R$ (red in the figure), and $2R$ (violet in the figure).
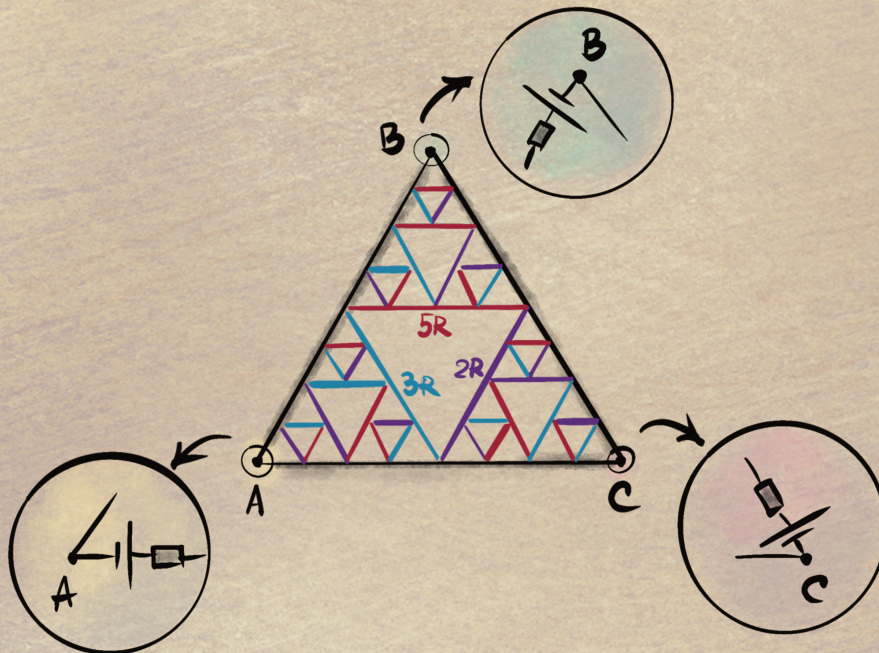
The first triangle, oriented with its vertex down, is located in the center (its linear dimensions are half those of the triangle formed by the bridges), and each triangle oriented with its vertex up contains the following structure:

- In the left triangle, the $3R$ resistor is at the top, $2R$ on the left, $5R$ on the right;

- In the right triangle, the $2R$ resistor is at the top, $5R$ on the left, $3R$ on the right;

- In the upper triangle, the $5R$ resistor is at the top, $3R$ on the left, $2R$ on the right;

The sizes and positions of the sources are such that they do not touch the fractal structure.

2. *(3 points)* By what factor will the current through vertex A change if the resistance of each element of the fractal is increased by a factor of 2?

First hint — 19.05.2025 20:00 (Moscow time)
Second hint — 21.05.2025 12:00 (Moscow time)

Final of the fourth round — 30.05.2025 20:00 (Moscow time)