RQC Russian Quantum Center · HIGHLAND GOLD · NQL National Quantum Laboratory

LPR Cup 2023

10.s04.e01

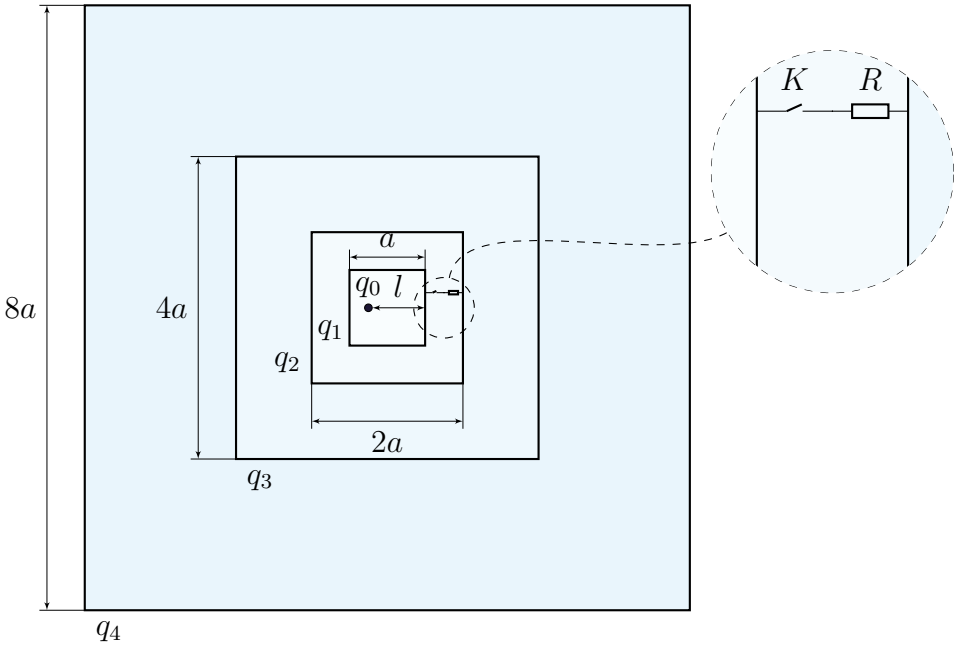
We've got some rough times ahead,
but it's going to be ok, because we're family.
Dominic Toretto, "F9"

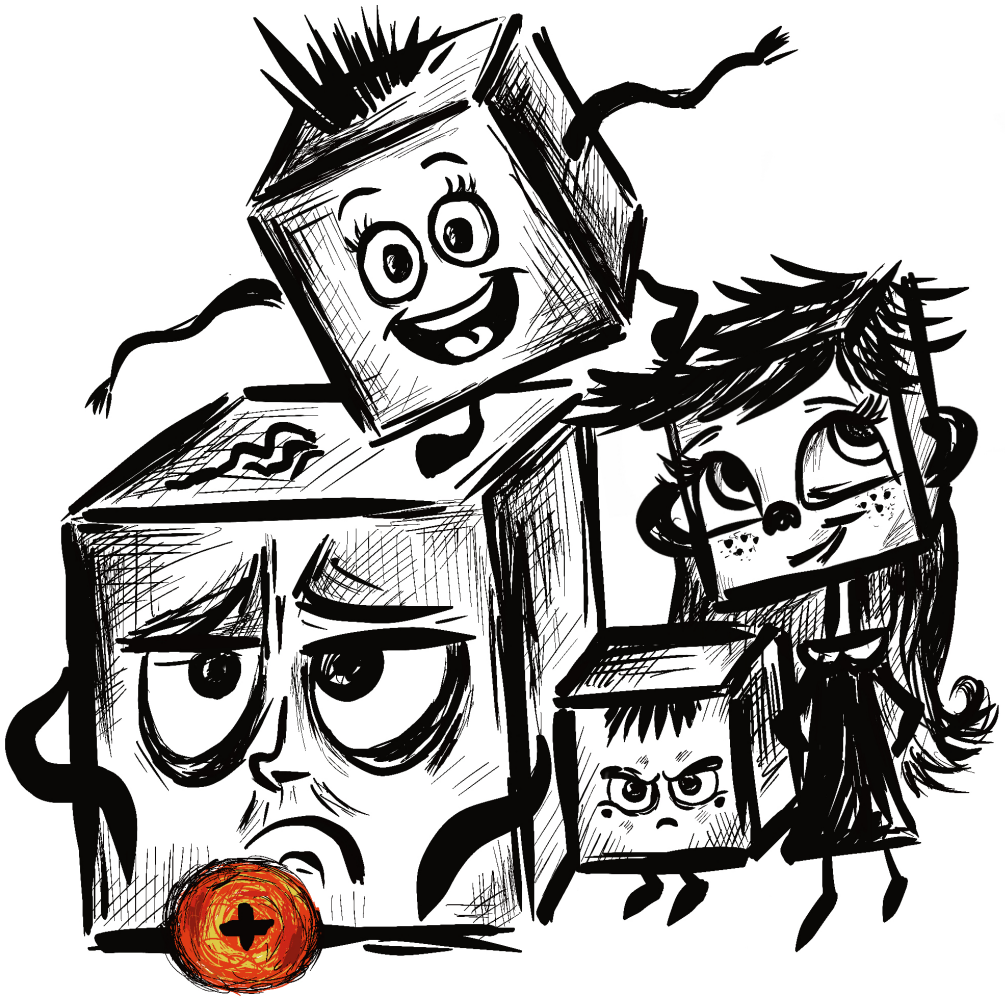
Cubic Matryoshka

Thin-walled hollow conducting concentric Cubie, Cube, Cubess and Cuborg with sides a, $2a$, $4a$, $8a$ charged with $q_1 = q$, $q_2 = 4q$, $q_3 = 4q$ and $q_4 = 10q$ respectively. Inside Cubie on the axis passing through the centers of opposite faces, at a distance $l = 3a/4$ from the center of the Cubie's face there is a point charge $q_0 = q$ (see fig.). Let the potential be zero at infinity. Then the potential of the Cuborg is φ_{out}, and Cubie's potential is φ_{in}.

1. *(4 points)* What is the current through the resistor R immediately after closing the key K?
2. *(2 points)* How much charge will flow through the key K after its closure?
3. *(4 points)* How much heat will be released during this process?

The resistance R is much greater than the resistance of the Cubes.



First hint — 24.04.2023 20:00 (Moscow time)
Second hint — 26.04.2023 12:00 (Moscow time)

Final of the first round — 28.04.2023 20:00 (Moscow time)