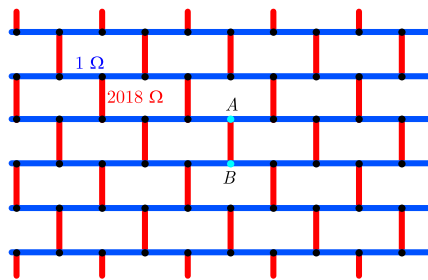


# Physics Cup 2018 - Problem 1. January 14, 2018

Consider infinite lattice of resistors as shown in the figure. Each blue piece of wire between neighbouring nodes has resistance  $R_b = 1\ \Omega$ , and each red piece of wire between neighbouring nodes has resistance  $R_r = 2018\ \Omega$ . (Nodes are marked as black circles.) Let the resistance between the nodes  $A$  and  $B$  (marked in cyan) be  $\rho$ . Find such  $r$  and  $R$  that



$$r \leq \rho \leq R \quad \text{and} \quad R/r \leq 2.$$

(You need to prove that for the values of  $r$  and  $R$  suggested by you, these inequalities hold.)

*Hint 1 (January 7, 2018)* Both the lower and upper bound for the resistance can be found by applying idea 27 from the electrical circuits booklet.

*Hint 2 (January 14, 2018):* Both the lower and upper bound can be found as resistances of ladder-type circuits, cf. idea 18 from the electrical circuits booklet.

*Remark:* if you are unable to download the booklet, please let me know (together with the reason why you aren't able to download); I'll send it by e-mail.

Correct solutions submitted during the first two weeks:

name	school	country	pr1 solved
Siddharth Tiwary	Lakshmipat Singhania Academy	India	01 Jan 03:50
Navneel Singhal	ALLEN Kota	India	01 Jan 05:52
Satoshi Yoshida	The University of Tokyo	Japan	01 Jan 13:35
Konstantine Gagnidze	Komarovi N199	Georgia	02 Jan 11:25
Prathyush Poduval	Canara PU College	India	02 Jan 16:45
Dylan Toh	NUS High School	Singapore	02 Jan 18:40
Tóbiás Marozsák	Óbudai Árpád Gimnázium	Hungary	03 Jan 18:41
Davit Mdinardze	Komarovi Tbilisi N199	Georgia	07 Jan 17:16
Gabriel Capelo	Colégio Ari de Sá Cavalcante	Brazil	07 Jan 20:26
Chiosa Ionel-Emilian	International Computer Highschool	Romania	07 Jan 20:52
Peter Elek	DRK Dóczy Gimnázium	Hungary	09 Jan 17:59
Piotr Godlewski	NA (graduated)	Poland	09 Jan 19:03
Dolteanu Stefan	International Computer Highschool	Romania	11 Jan 21:12