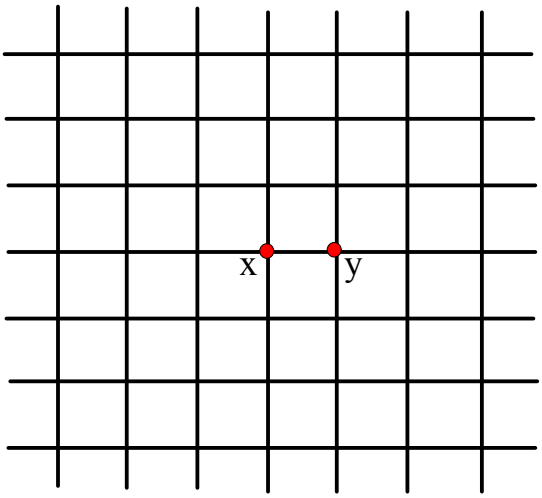
There is an infinite wire grid with square cells. The resistance of each wire between neighbouring joint connections is R. Find the equivalent resistance of the whole grid between points x and y.



Solution

Normally, resistive network problems are solved when steady-state is reached after the battery is connected. However, for this problem let us find equivalent resistance by transient-state analyses. Resistance is not affected whether it is steady-state or transient-state.

Let us place charge Δq at point x alone. This charge will get distributed equally in four directions. Charge that flows towards y = $\frac{\Delta q}{4}$.

Likewise, let us place charge - Δq at point y alone. This charge will get distributed equally in four directions. Charge that flows towards x = - $\frac{\Delta q}{4}$ or charge that flows towards y = + $\frac{\Delta q}{4}$.

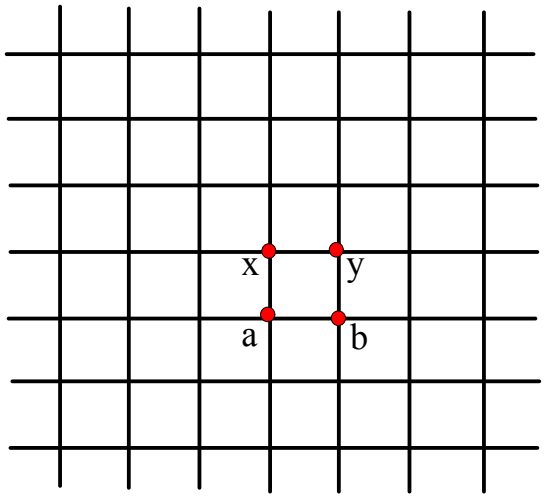
When charge Δq is placed at point x and charge - Δq is placed at point y simultaneously, the charge that flows towards y = $\frac{\Delta q}{4}+\frac{\Delta q}{4}=\frac{\Delta q}{2}$.

$$V_x - V_y = i_{x\to y}R = \frac{\Delta q/2}{\Delta t}R \text{.....(1)}$$

Also, $V_x - V_y = i_{total}R_{eq} = \frac{\Delta q}{\Delta t}R_{eq}$.....(2)

From (1) & (2), we have $R_{eq} = \frac{R}{2}$.

Now, try to do this problem in similar manner by taking alternate route xaby. You are welcome to share your solution via comment.


x
y
a
b