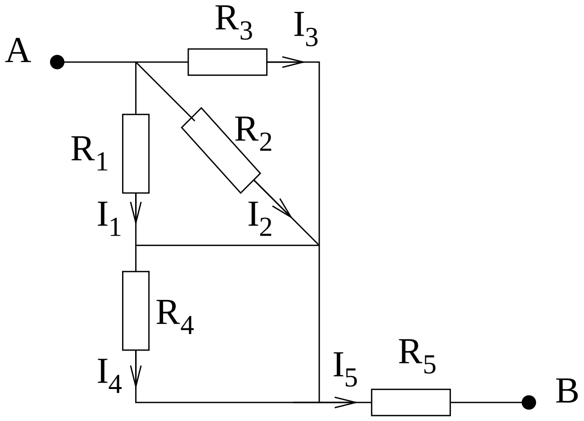
Institutt for fysikk, NTNU
TFY4155/FY1003: Elektrisitet og magnetisme
Vår 2005

Øving 11

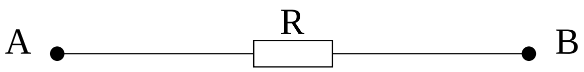
Guidance: Thursday March 31 and Friday April 1
To be delivered by: Monday April 4

Exercise 1

The figure below shows an electric circuit with 5 resistors R_j, $j = 1, .., 5$.



$a)$ Determine the total resistance R between the points A and B, i.e.: Determine the resistance R in the equivalent circuit in the following figure:

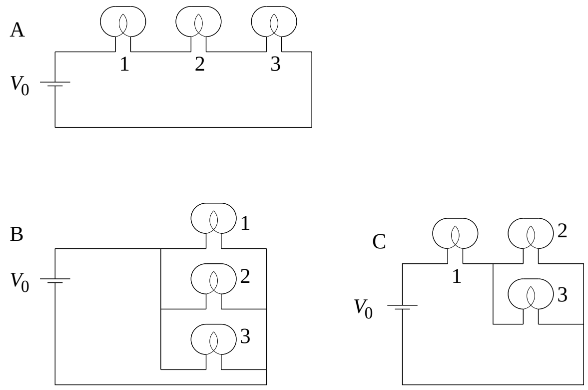


$b)$ An ideal voltage source with electromotive force $\mathcal{E}$ is connected to the circuit so that $\Delta V = V_A - V_B = \mathcal{E}$. Determine the resulting currents I_j through each of the resistors R_j.
(Unless otherwise specified, we always assume, in exercises like this one, that the connecting wires between the various resistors are *perfect conductors*, i.e., with zero resistance.)

$c)$ Determine numerical values for I_j when $\mathcal{E} = 9$ V and $R_j = j\ \Omega$.
[A couple of answers: $I_1 = 0.89$ A, $I_5 = 1.62$ A]

Exercise 2

Three identical light bulbs 1, 2 and 3 are put together in three different circuits A, B and C, as shown in the figure. The light bulbs can be viewed as identical ohmic resistors. Increased current implies increased power, and hence increased light intensity. The voltage source has the same emf V_0 in each of the three circuits.



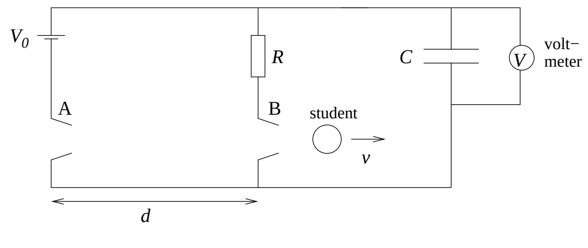
a) Compare the light intensity in bulb nr 1 in the three circuits. In which circuit is the intensity strongest, and where is it weakest?

b) What happens to the light in bulb nr 1 in each of the three circuits if bulb nr 3 is removed?

Explain your reasoning.

Exercise 3

The circuit in the figure is supposed to be used to measure how fast a physics student is running. Before the student starts running, there is a constant current in the circuit. The voltage source is $V_0 = 9.00$ kV, the resistance $R = 1.00$ MΩ, and the capacitance $C = 150$ nF. The distance d is 100 cm. The student cuts the circuit, first in the position A, then in the position B. Now, the volt meter V displays a potential difference of 3.58 kV between the capacitor plates. How fast is the student running?



(An ideal volt meter simply measures the potential difference between two points in a circuit without influencing the circuit in any way. For example, no current runs through an ideal volt meter.)

[Answer: ca 26 km/h]