General Physics 204, Section ... Monday, Feb 16, 2015
Quiz #3 Electric Circuits

Name:

1) CLASS(2)
Alessandro Volta connects a circuit as shown in fig. 1. $\mathcal{E} = 4$ V, $R_1 = R_2 = 4\ \Omega$, and $R_3 = R_4 = 8\ \Omega$.
a) Find V_{AC}.
b) Find I_1.
c) Find V_{AB}.
d) Find all other currents.

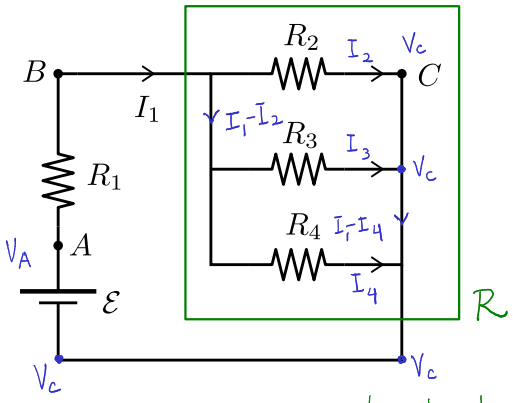


Figure 1: A circuit.

a) Any path from A to C will give us the voltage. Here there is an easy path including only the battery.

$V_{AC} = V_A - V_C = 4$ V.

b) $R_{eq} = R_1 + (R_2 \| R_3 \| R_4)$

$= 4\Omega + 2\Omega = 6\Omega$.

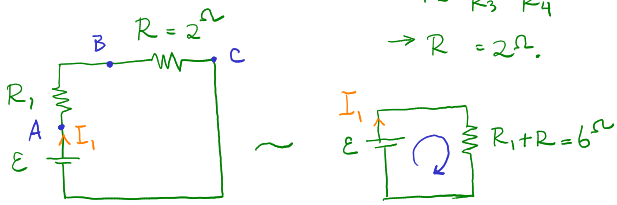
$\mathcal{E} - R_{eq} I_1 = 0 \rightarrow I_1 = \frac{\mathcal{E}}{R_{eq}} = 2/3$ A.

c) $V_{AB} = R_1 I_1 = 8/3$ V.

d) $V_{AC} = V_{AB} + V_{BC} \rightarrow V_{BC} = V_{AC} - V_{AB} = \frac{4}{3}$ V. $\rightarrow$

$I_2 = V_{BC}/R_2 = 1/3$ A.
$I_3 = V_{BC}/R_3 = 1/6$ A.
$I_4 = V_{BC}/R_4 = 1/6$ A.

$\frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \rightarrow R = 2\Omega$.



2) CLASS(2)
Ewald Georg von Kleist uses two $\mathcal{E} = 6$ V batteries and some 100 Ω resistors to make a circuit as shown in fig. 2. Find the power dissipated in the R_4 resistor. **[5 pts]**

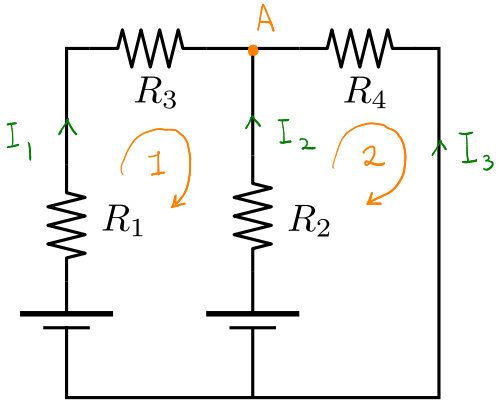


Figure 2: All resistors are equal.

We need to find I_3.

Junction (Node A): $I_1 + I_2 + I_3 = 0$ (i)

Loop 1: $\mathcal{E} - (R_1+R_3) I_1 + R_2 I_2 - \mathcal{E} = 0 \rightarrow I_2 = I_1 \frac{R_1+R_3}{R_2}$ (ii)

Loop 2: $\mathcal{E} - R_2 I_2 + R_4 I_3 = 0$ (iii)

(i), (ii) $\rightarrow I_1 \left(\frac{R_1+R_2+R_3}{R_2} \right) + I_3 = 0$ (iv)

(iii), (iv), (ii) $\rightarrow \mathcal{E} + \left[(R_1+R_3) \frac{R_2}{R_1+R_2+R_3} + R_4 \right] I_3 = 0 \rightarrow I_3 = \frac{-\mathcal{E}}{\left[(R_1+R_3) \frac{R_2}{R_1+R_2+R_3} + R_4 \right]}$

$= -36$ mA.

$P_{R_4} = R_4 I_3^2 = 0.1296$ W.