KIT - International Department GmbH

**Pre-Semester Physics - Exercises** **Summer 2010**

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**Extra Sheet VI**
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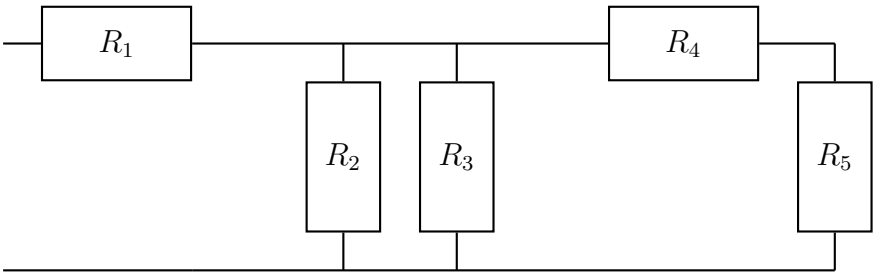
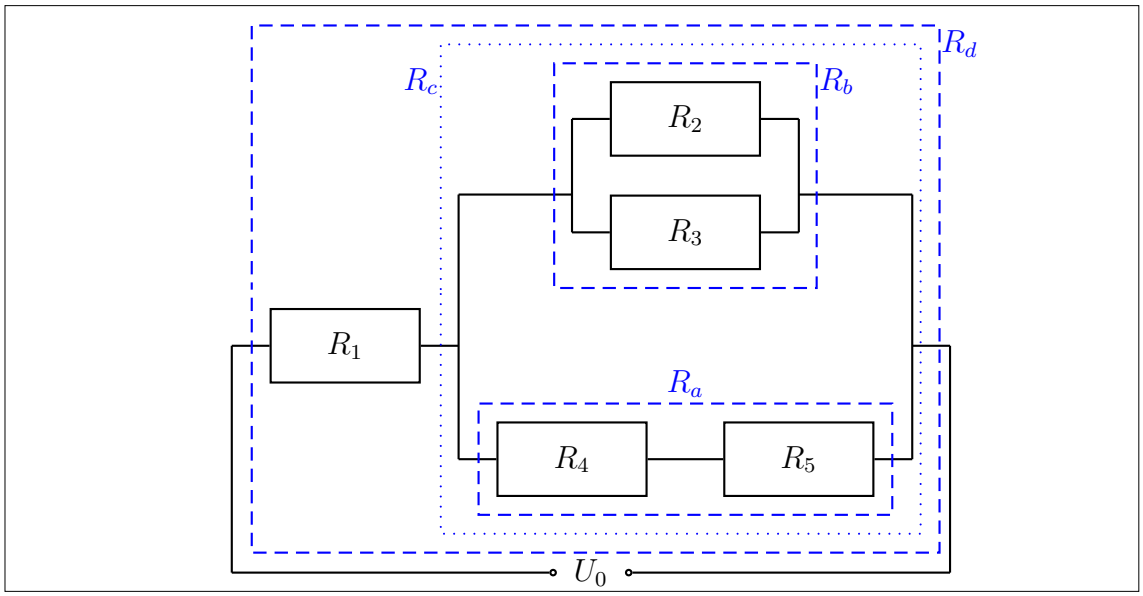
## 1. Exercise:




Consider the above resistor network with resistances of $R_1 = 2.5\,\Omega$, $R_2 = 2\,\Omega$, $R_3 = 4\,\Omega$, $R_4 = 0.2\,\Omega$ and $R_5 = 0.6\,\Omega$. On it a voltage of $U_0 = 3.0\,\mathrm{V}$ is applied. The goal is to calculate the power dissipated in the resistor $R_5$.

(a) Redraw the circuit so that parallel and series connections are more apparent (e.g. when all resistors are positioned horizontally).




(b) Specify therein the substitution resistances $R_a$ (containing (not only) the resistor $R_4$), $R_b$ (containing (not only) the resistor $R_3$), $R_c$ (which do not contain the resistor $R_1$) and $R_d$ (containing (not only) the resistor $R_1$) which are given either by pure series or parallel connection.

(c) How are the substitution resistances connected to the ones given?

$$\boxed{R_a = R_4 + R_5 = \tfrac{4}{5}\,\Omega}$$

$$\boxed{R_b = \tfrac{R_2 R_3}{R_2 + R_3} = \tfrac{4}{3}\,\Omega}$$

$$\boxed{R_c = \tfrac{R_a R_b}{R_a + R_b} = 0.5\,\Omega}$$

$$\boxed{R_d = R_1 + R_c = 3.0\,\Omega}$$

(d) Use Ohm's law to calculate the current $I_0$ provided by the voltage source.

$$\boxed{I_0 = \tfrac{U_0}{R_d} = 1\,\mathrm{A}}$$

(e) Now consider the components of $R_d$. What current flows through each of them?

$$\boxed{I_1 = I_0 = 1\,\mathrm{A}}$$

$$\boxed{I_c = I_0 = 1\,\mathrm{A}}$$

(f) Use again Ohm's law to determine the voltage drop on its components.

$$\boxed{U_1 = R_1 I_1 = 2.5\,\mathrm{V}}$$

$$\boxed{U_c = R_c I_c = 0.5\,\mathrm{V}}$$

(g) Next focus on the components of $R_c$. What voltage drop on each of its components?

$$\boxed{U_a = U_c = 0.5\,\mathrm{V}}$$

$$\boxed{U_b = U_c = 0.5\,\mathrm{V}}$$

(h) Find the current through each of its components.

$$\boxed{I_a = \frac{U_a}{R_a} = 0.625\,\mathrm{A}}$$

$$\boxed{I_b = \frac{U_b}{R_b} = 0.375\,\mathrm{A}}$$

(i) Finally consider the components of $R_a$ and state the current which flows through them.

$$\boxed{I_4 = I_a = 0.625\,\mathrm{A}}$$

$$\boxed{I_5 = I_a = 0.625\,\mathrm{A}}$$

(j) Calculate the voltage drop along its components.

$$\boxed{U_4 = R_4 I_4 = 0.125\,\mathrm{V}}$$

$$\boxed{U_5 = R_5 I_5 = 0.375\,\mathrm{V}}$$

(k) Use your results to give the power dissipated in the resistor $R_5$.

$$\boxed{\underline{\underline{P_5}} = U_5 I_5 = \tfrac{15}{64}\,\mathrm{W} = \underline{\underline{0.234\,\mathrm{W}}}}$$