DC - Combining resistors

Total resistance:

a) $R = 2.\overline{3}\ \mathrm{k\Omega}$
b) $R = 4.4\ \mathrm{k\Omega}$
c) From the left handed side $R = 1550\ \Omega$, right handed side $R = 1950\ \Omega$
d) $R = 2\ \mathrm{k\Omega}$
e) It is necessary to use tranfiguration, $R = 2094.\overline{594}\ \Omega$

Special values of circuit variables (average and rms values)

1) 1:3 $\quad U_s = \frac{1}{4}U_m = 3\,\mathrm{V}, U = U_m\sqrt{\frac{1}{4}} = 6\,\mathrm{V}$

   3:1 $\quad U_s = \frac{3}{4}U_m = 9\,\mathrm{V}, U = U_m\sqrt{\frac{3}{4}} = 10.39\,\mathrm{V}$

2) $U_m = 325.27\,\mathrm{V}$

   Sinusoidal waveform: $U_{sar} = \frac{2U_m}{\pi} = 207.07\,\mathrm{V}$

   Full way rectified: $U = 230\,\mathrm{V}$, $U_s = U_{sar} = 207.07\,\mathrm{V}$

   Half way rectified: $U = \frac{U_m}{2} = 162.635\,\mathrm{V}$, $U_{sar} = \frac{U_m}{\pi} = 103.535\,\mathrm{V}$

3) $U = 208.05\,\mathrm{V}$

Fundamental passive and active circuit elements

1. $C = 8\ \mathrm{F}$.
   a. $V = 1600\,\mathrm{cm}^3$.
   b. $t = 16\,\mathrm{s}$.
   c. Current.

2. $U = 4216\,\mathrm{V}$.
   a. $V = 377\,\mathrm{cm}^3$.
   b. Price.

3.
   a. $Q = 1 \cdot 10^{-6}\ \mathrm{C}$
   b. $U = 10\ \mathrm{V}$
   c. $W_C = 5 \cdot 10^{-6}\ \mathrm{J}$
   d. Waveforms have equations $q(t) = It + q(0) = 10^{-3}\,t\,[\mathrm{C}]$, $u(t) = \frac{q(t)}{C} = 10^4\,t\,[\mathrm{V}]$, $W_C(t) = \frac{1}{2}Cu^2(t) = \frac{1}{2C}q^2(t) = 5t^2\,[\mathrm{J}]$.

4. $I = 2.4\ \mathrm{A}$

5. $U = -R \cdot I = -200 \cdot 2.4 = -480\ \mathrm{V}$

6.

a. $C = 8\,\mu\mathrm{F}$
b. $U_1 = 160\,\mathrm{V}, U_2 = 40\,\mathrm{V}$.
c. $U_1 = 36.36\,\mathrm{V}, U_2 = 54.54\,\mathrm{V}, U_3 = 109.09\,\mathrm{V}$.
d. At $t \to \infty$ will be the same. At $t = 0$ the voltage on capacitors is zero, and capacitors will be gradually charged.
e. $Q = 1.6\,\mathrm{mC}$.
f. $U_1 = 40 + 124 = 164\,\mathrm{V}, U_2 = 5 + 31 = 36\,\mathrm{V}$.

7.

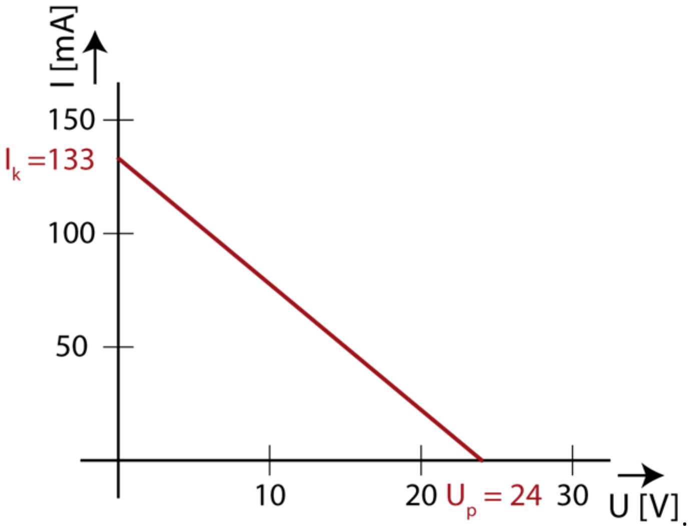
a. $L = 8\,\mathrm{mH}$.
b. $I_1 = 1.6\,\mathrm{A}$, $I_2 = 0.4\,\mathrm{A}$.

Basic laws and theorems, simple circuits excited by one and several independent sources

1.

a. $I = 0.123\ \mathrm{A}$.
b. $U_{R_1} = 22.154\ \mathrm{V}, U_{R_2} = 1.846\,\mathrm{V}$
c. $P_{R_1} = 2.736\ \mathrm{W}$ - power rating at least 3 W, ceramic or metal oxide resistor, $P_{R_2} = 0.23\ \mathrm{W}$ - power rating at least 250 mW, metal film or carbon film resistor, $P = 2.954\ \mathrm{W}$

2.

a. $U_{R_2} = 1.154\ \mathrm{V}$.
b. $U_2 = 0\,\mathrm{V}, I = 0.133\,\mathrm{A}$.
c. 

.
d. $U_i = U_{R_2} = 1.846\ \mathrm{V}, R_i = 13.88\,\Omega$.
e. $I_z = 0.00667\,\mathrm{A}$.

3. Arrangement 2 / 2.
a) $R_p = 7.14\,\Omega$, $P_z = 16.8\,\mathrm{W}$.
b) $P_R = 7\,\mathrm{W}$.

4.

a. $U = 1.11\,\mathrm{V}$.

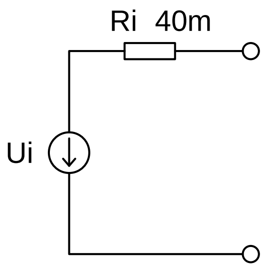
b. No, the source with higher voltage discharges in the source with lower voltage, part of energy converts in heat
c. $I_1 = 6\,\mathrm{A}$, $I_2 = 4\,\mathrm{A}$, $I = 10\,\mathrm{A}$.
d. $U_i = 1.11\,\mathrm{V}$, $R_i = 0.11\,\Omega$.
e. $I_{max} = 1\,\mathrm{A}$.

5.
a. Yes.

6.
a. No.
b. $U_v = 9.375\,\mathrm{V}$.
c. $I = 110\,\mathrm{A}$.

7.
a. $I = 0.39\,\mathrm{A}$.
b. $P_{U_1} = 1.95\,\mathrm{W}$, $P_{U_2} = -0.429\,\mathrm{W}$, $P_{R_1} = 1.521\,\mathrm{W}$

8. Yes,



$U_i = 12\,\mathrm{V}$. Load line has parameters $U_i = 12\,\mathrm{V}$ and $I_k = 300\,\mathrm{A}$.

9. No, it acts like ideal current source.
10. No, it acts like ideal voltage source.

Kirchhoff's laws

1)
a) $I_1 = 10\,\mathrm{mA}, I_2 = 15\,\mathrm{mA}, I_4 = 20\,\mathrm{mA}$
b) $R_1 = 900\,\Omega, R_2 = 400\,\Omega, R_4 = 150\,\Omega, V_2 = 6\,\mathrm{V}$
c) $P_U = 300\,\mathrm{mW}, P_I = -30\,\mathrm{mW}$

2)
a) $I_1 = 5\,\mathrm{mA}, I_2 = 10\,\mathrm{mA}, I_3 = 0\,\mathrm{mA}, I_4 = 5\,\mathrm{mA}$
b) $U_2 = 5\,\mathrm{V}, R_2 = 700\,\Omega$

3)
a) $I_B = 4.37\,\mu\mathrm{A}$
b) $U_x = -8.91\,\mathrm{V}$

4)
a) $U_x = 9\,\mathrm{V}$
b) $U_T = 9\,\mathrm{V}, R_T = 3\,\mathrm{k}\Omega$

5) $U_x = 10.929\,\mathrm{V}$

Source transformation

1) $U_T = 5.6\,\mathrm{V}, R_T = 0.8\,\Omega$
2) $U_x = -2.05\,\mathrm{V}$

Circuit Theorems and Basic Laws

1)
   a) $U_d = 2.86\,\mathrm{mV}$
   b) $R_{load} = 349.997\,\Omega, U_d = 1.43\,\mathrm{mV}$. Maximum power transfer condition maximizes power transfer, however, the output voltage is twice less, which has no meaning for voltage measuring. Contrarily, less voltage may cause less accuracy.
2) $U_x = 6\,\mathrm{V}$
3) $U_x = 18\,\mathrm{V}$
4) $U_x = 24.6\,\mathrm{V}$
5) $U_x = 60.968\,\mathrm{V}$
6) $U_x = 68.71\,\mathrm{V}$
7) $I_{U_1} = 30\,\mathrm{mA}, I_{U_2} = 25\,\mathrm{mA}, U_x = 0\,\mathrm{V}$
8)
   a) $U_{R_1} = 0\,\mathrm{V}, U_{R_2} = 0\,\mathrm{V}, U_{R_3} = 20\,\mathrm{V}, U_{R_4} = -80\,\mathrm{V}$
   b) $P_U = 0\,\mathrm{W}, P_I = 20\,\mathrm{W}, P_R = 4 + 16 = 20\,\mathrm{W}$

Circuit equations

1) $I_x = -24.\overline{4}\,\mathrm{mA}$
2) $I_x = 2.5\,\mathrm{mA}$
3) $U_x = -30.\overline{30}\,\mathrm{mV}$