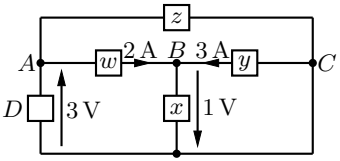
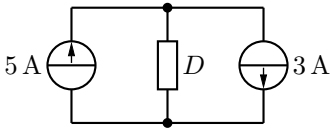
Problem Set 5

Problem 1. The one-port D absorbs the power of 6 W. Solve the circuit for the currents, the voltages and the powers.



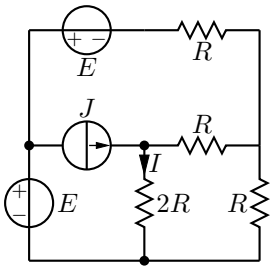
Answer. $U_{AB} = 4\,\mathrm{V}$, $U_{CB} = 1\,\mathrm{V}$, $U_{AC} = 3\,\mathrm{V}$; currents through one-ports: 5 A through x downward, 2 A through D downward, 4 A through z to the left; powers deliverd: 6 W to D, 8 W to w, -5 W to x, 3 W to y, -12 W to z.

Problem 2. The source of 5 A current generates the power of 10 W. Find the values of the power absorbed by the other source and by the one-port D.



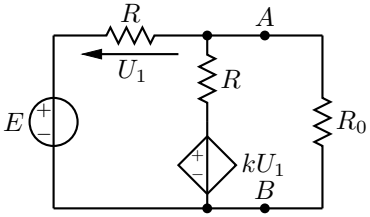
Answer. 4 W by D, 6 W by the current source.

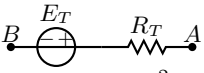
Problem 3. Using superposition rule, find the value of the current I. Determine the power for the resistor $2R$.



Answer. $I = \frac{3}{7}J - \frac{E}{7R} + \frac{E}{7R} = \frac{3}{7}J$, $P = \frac{18}{49}J^2R$.

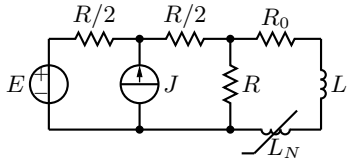
Problem 4. Find the Thévenin equivalent source of the subcircuit to the left of the terminals A, B. Compute the power for R_0. For what value of R_0 the power for R_0 is maximal.



Answer. 

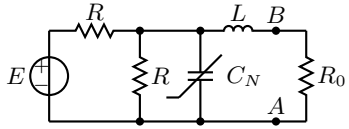
, $E_T = E(k+1)/(k+2)$, $R_T = R/(k+2)$,
$P_{R_0} = (E_T/(R_T+R_0))^2\, R_0$, max. power fo $R_0 = R_T$.

Problem 5. For what R_0 the energy stored in inductor L equals the energy stored in non-linear inductor L_N?
$E = 1\,\mathrm{V}$, $J = 2\,\mathrm{mA}$, $R = 1\,\mathrm{k\Omega}$, $L_N\colon \psi = ai|i|$, $a = 1\,\mathrm{Wb/A^2}$, $L = \frac{4}{3}\,\mathrm{mH}$.



Answer. $R_0 = \frac{1}{2}\,\mathrm{k\Omega}$.

Problem 6. Find the energy stored in the inductor and the capacitor provided that resistor R_0 is matched for maximum power transfer.
$R = 1\,\mathrm{k\Omega}$, $E = 8\,\mathrm{V}$, $L = 2\,\mathrm{H}$, $C_N\colon q = C_0 u + \beta u|u|$, $C_0 = 1\,\mathrm{\mu F}$, $\beta = 3\,\mathrm{\mu F/V}$.



Answer. $w_L = 16\,\mathrm{\mu J}$, $w_C = 18\,\mathrm{\mu J}$.