PROBLEMS 1

1-1 *How much charge is represented by 6400 electrons?*

1-2 *An energy source forces a constant current of 2A for 10s to flow through a lightbulb. If 4.6 Kj is given off in the form of light and heat energy, calculate the voltage drop across the bulb.*

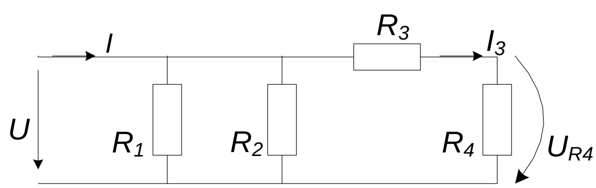
1-3 *How much energy does an 80 W electric bulb consume in three hours?*

1-4 *A device draws 10 A when connected to a 230 V line. How long does it take to consume 80 Kj?*

1-5 *The charge entering the positive terminal of an element is* $\mathrm{q(t) = 10\sin 4\pi t\ mC}$ *while the voltage across the element is* $\mathrm{u(t) = 2\cos 4\pi t\ V}$. *a) Find the power to the element at t=0.3s; b) Calculate the energy delivered to the element between 0 and 0.8s.*

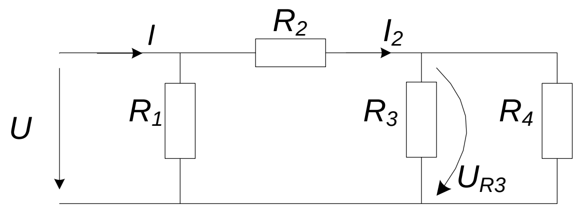
1-6 *A 12V car battery supported a current of 150 mA to a bulb. Calculate: a) the power absorbed by the bulb; the energy absorbed by the bulb over one interval of 30 minutes.*

1-7 *For the circuit below we know:* $R_1=15\Omega$, $R_2=10\Omega$, $R_3=7\Omega$, $R_4=5\Omega$ *and supplying voltage U=24V. Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e; *b) the total current absorbed by the resistances, I; c) the current through the resistance* R_3, I_3; *d) the voltage on the resistance* R_4, U_{R4}; *the power dissipated in the resistance* R_2, P_{R2}.



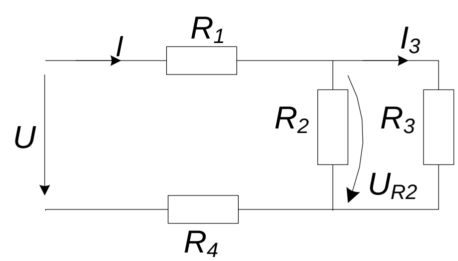
Problem 1-7

1-8 *For the circuit below we know:* $R_1=10\Omega$, $R_2=9\Omega$, $R_3=15\Omega$, $R_4=10\Omega$ *and supplying voltage* $U=60V$. *Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e; *b) the total current absorbed by the resistances,* I; *c) the current through the resistance* R_2, I_2; *d) the voltage on the resistance* R_3, U_{R3}; *the power dissipated in the resistance* R_4, P_{R4}.



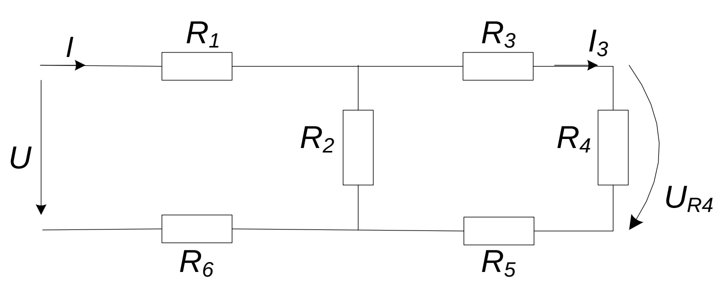
Problem 1-8

1-9 *For the circuit below we know:* $R_1=4\Omega$, $R_2=10\Omega$, $R_3=15\Omega$, $R_4=5\Omega$ *and supplying voltage* $U=75V$. *Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e; *b) the total current absorbed by the resistances,* I; *c) the current through the resistance* R_3, I_3; *d) the voltage on the resistance* R_2, U_{R2}; *the power dissipated in the resistance* R_4, P_{R4}.



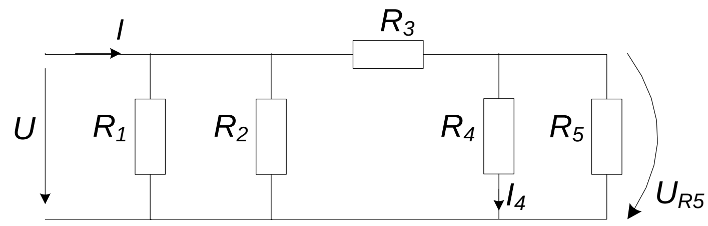
Problem 1-9

1-10 *For the circuit below we know:* $R_1=5\Omega$, $R_2=3\Omega$, $R_3=2\Omega$, $R_4=1\Omega$, $R_5=3\Omega$, $R_6=3\Omega$ *and supplying voltage* $U=30V$. *Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e; *b) the total current absorbed by the resistances,* I; *c) the current through the resistance* R_3, I_3; *d) the voltage on the resistance* R_4, U_{R4}; *the power dissipated in the resistance* R_5, P_{R5}.



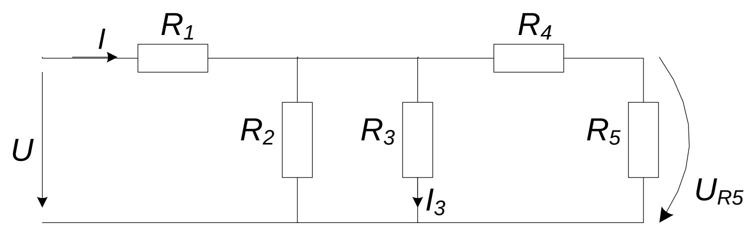
Problem 1-10

1-11 *For the circuit below we know:* $R_1=60\Omega$, $R_2=20\Omega$, $R_3=8\Omega$, $R_4=3\Omega$, $R_5=6\Omega$ *and supplying voltage* $U=120V$. *Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e*; b) the total current absorbed by the resistances,* I*; c) the current through resistance* R_4, I_4*; d) the voltage on resistance* R_5, U_{R5}*; the power dissipated in resistance* R_2, P_{R2}.



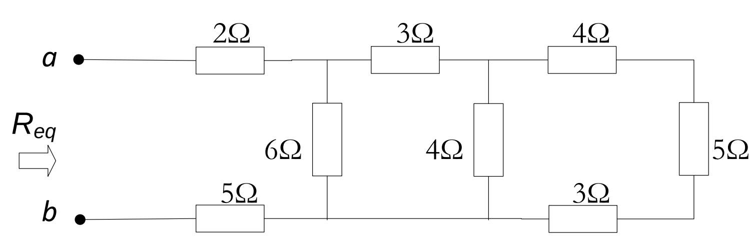
Problem 1-11

1-12 *For the circuit below we know:* $R_1=9\Omega$, $R_2=60\Omega$, $R_3=20\Omega$, $R_4=6\Omega$, $R_5=4\Omega$ *and supplying voltage* $U=150V$. *Calculate: a) the equivalent resistance regarding the supplying terminals,* R_e*; b) the total current absorbed by the resistances,* I*; c) the current through the resistance* R_3, I_3*; d) the voltage on resistance* R_5, U_{R5}*; the power dissipated in resistance* R_4, P_{R4}.



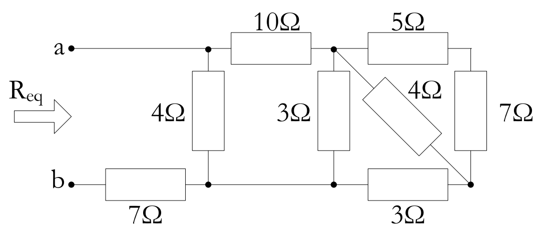
Problem 1-12

1-13 *Find the value of the equivalent resistance,* R_{eq}*, between terminals a and b, for the sub-circuit shown below.*



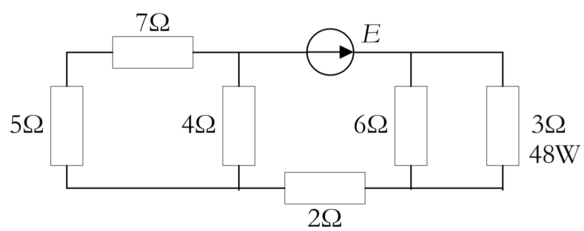
Problem 1-13

1-14 *Find the value of the equivalent resistance, R_{eq}, between terminals a and b, for the sub-circuit shown below.*



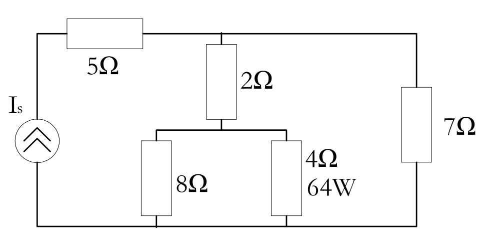
Problem 1-14

1-15 *Determine the voltage of source E, for the circuit below if the power dissipated in the 3Ωs resistance is 48W.*



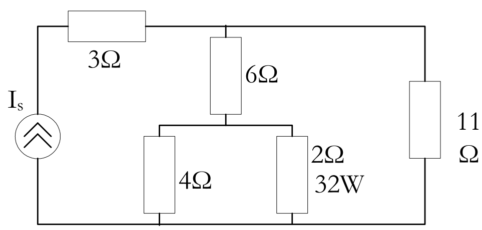
Problem 1-15

1-16 *Determine the current I_s generated by the current source in the circuit below if the power dissipated in the 4Ωs resistance is 64W.*



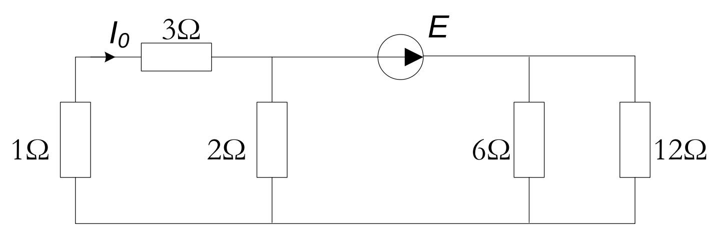
Problem 1-16

1-17 *Determine the current I_s generated by the current source in the circuit below if the power dissipated in the 2Ωs resistance is 32W.*



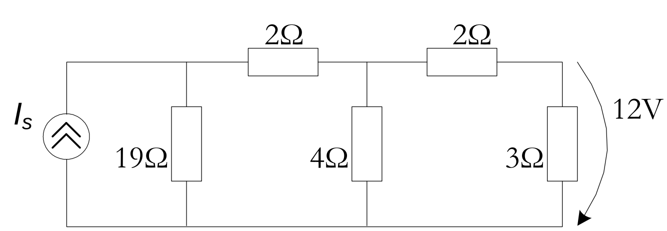
Problem 1-17

1-18 *Determine the voltage E generated by the voltage source in the circuit below if the current flow to the 3Ωs resistance is I_0=4A.*



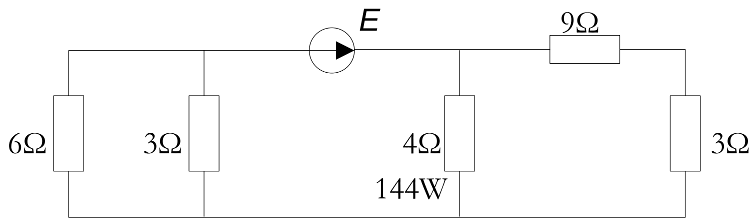
Problem 1-18

1-19 *Determine the current I_s generated by the current source in the circuit below if the voltage drop on the 3Ωs resistance is 12V.*



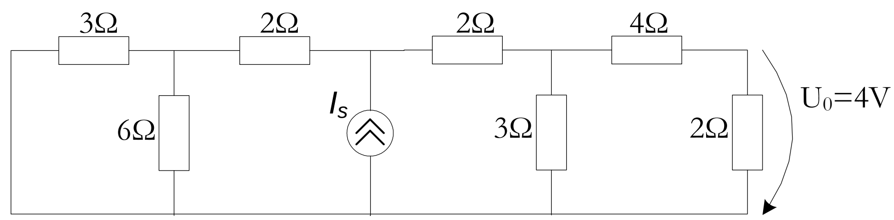
Problem 1-19

1-20 *Determine the voltage E generated by the voltage source in the circuit below if the power dissipated in the 4Ωs resistance is 144W.*



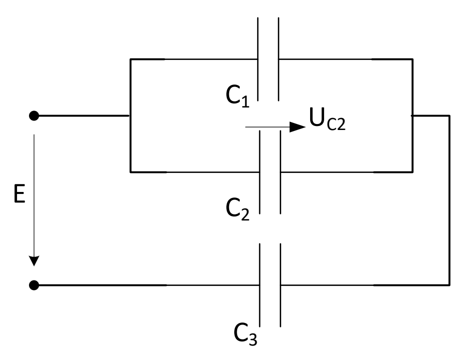
Problem 1-20

1-21 *Determine the current I_s generated by the current source in the circuit below if the voltage drop on the 2Ωs resistance is 4V.*



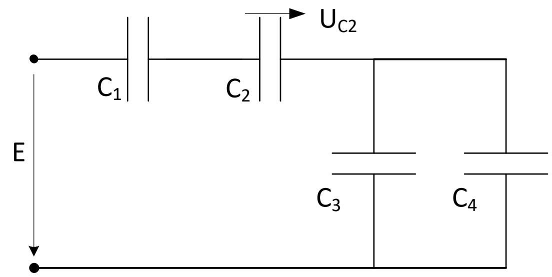
Problem 1-21

1-22 *For the circuit below we know: C_1=3μF, C_2=9μF, C_3=6μF and the supplying voltage U=60V. Find: a) equivalent capacitance regarding the supplying voltage terminals, C_e; b) total charge absorbed by the capacitors, Q_e; c) voltage on the capacitor C_2, U_{C2}; d) charge on the capacitor C_1; e) energy of the capacitor C_3, W_{C3}.*



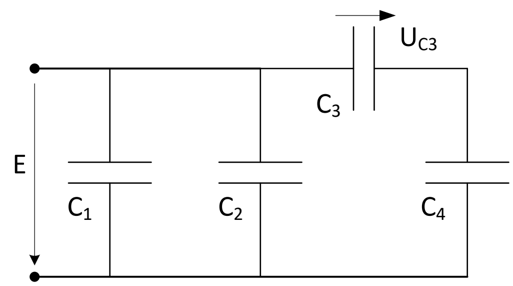
Problem 1-22

1-23 *For the circuit below we know: C_1=12µF, C_2=4µF, C_3=1µF, C_4=5µF and the supplying voltage U=24V. Find: a) equivalent capacitance regarding the supplying voltage terminals, C_e; b) total charge absorbed by the capacitors, Q_e; c) voltage on capacitor C_2, U_{C2}; d) charge on capacitor C_4; e) energy of capacitor C_3, W_{C3}.*



Problem 1-23

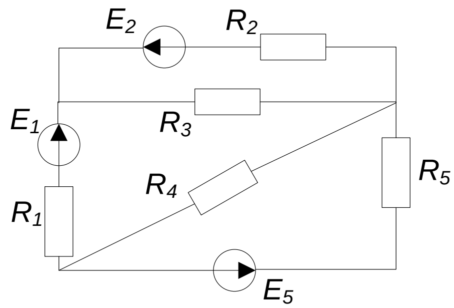
1-24 *For the circuit below we know: C_1=5µF, C_2=7µF, C_3=12µF, C_4=4µF and the supplying voltage U=20V. Find: a) equivalent capacitance regarding the supplying voltage terminals, C_e; b) total charge absorbed by the capacitors, Q_e; c) voltage on capacitor C_3, U_{C3}; d) charge on capacitor C_1; e) energy of capacitor C_4, W_{C4}.*



Problem 1-24

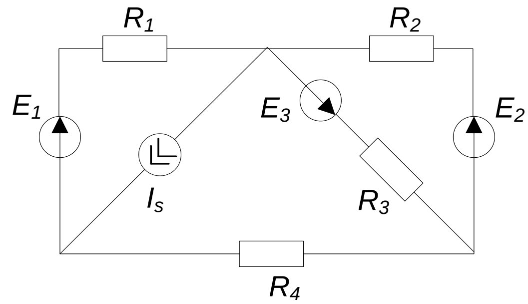
PROBLEMS 2

2-1 *For the circuit below we know: R_1=5Ω, R_2=10Ω, R_3=6Ω, R_4=3Ω, R_5=2Ω, E_1=10V, E_2=5V, E_5=5V. Identify the number of nodes and circuit branches and calculate the branch currents using: a) the Kirchhoff Laws; b) the nodal analysis; c) the mesh analysis. Calculate the generated and removed power in the circuit and verify the power conservation theorem.*



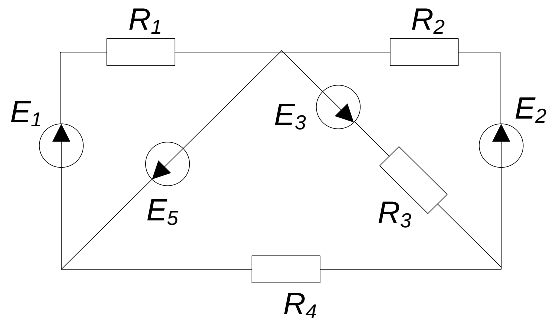
Problem 2-1

2-2 *For the circuit below we know: R_1=2Ω, R_2=2Ω, R_3=6Ω, R_4=2Ω, E_1=12V, E_3=6V, I_S=4A. Identify the number of nodes and circuit branches and calculate the branch currents using: a) the Kirchhoff Laws; b) the nodal analysis; c) the mesh analysis. Calculate the generated and removed power in the circuit and verify the power conservation theorem.*



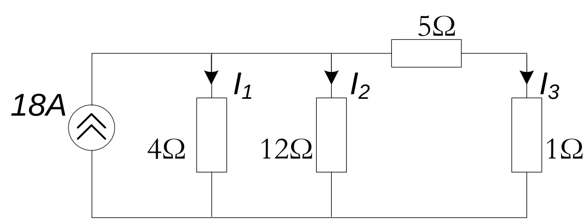
Problem 2-2

2-3 *For the circuit below we know: R_1=2Ω, R_2=2Ω, R_3=6Ω, R_4=2Ω, E_1=12V, E_3=6V, E_5=10V. Identity the number of nodes and circuit branches and calculate the branch currents using: a) the Kirchhoff Laws; b) the nodal analysis; c) the mesh analysis. Calculate the generated and removed power in the circuit and verify the power conservation theorem.*



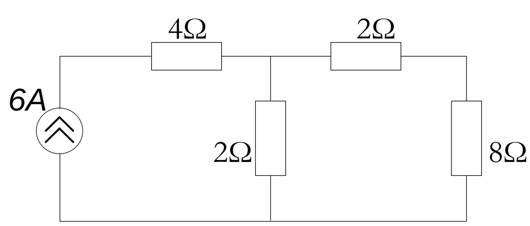
Problem 2-3

2-4 *Find the currents I_1, I_2, I_3 for the circuit below and verify the power conservation theorem.*



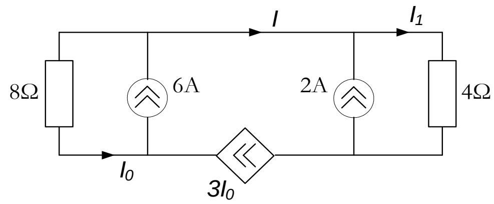
Problem 2-4

2-5 *For the circuit below calculate the dissipated power in the 8Ω's resistance.*



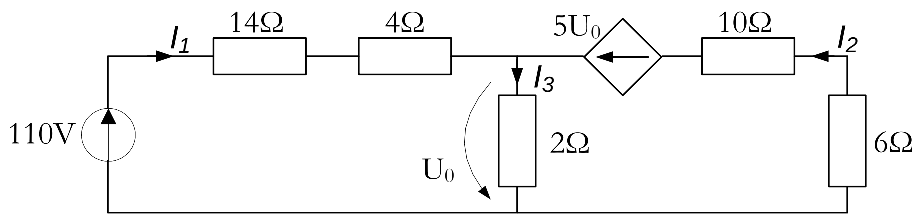
Problem 2-5

2-6 *Find the currents I, I_0, I_1 for the circuit below and verify the power conservation theorem.*



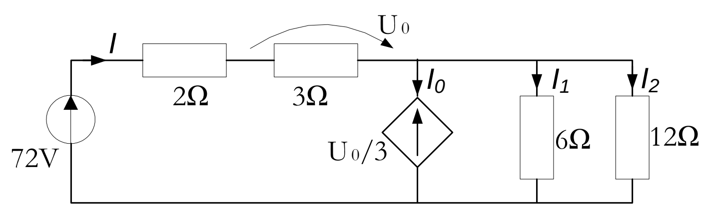
Problem 2-6

2-7 *Find the currents I_1, I_2, I_3 for the circuit below and verify the power conservation theorem.*



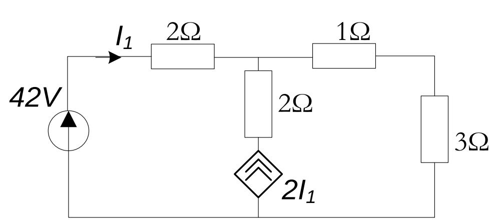
Problem 2-7

2-8 *Find the currents I, I_1, I_2, I_0 for the circuit below and verify the power conservation theorem.*



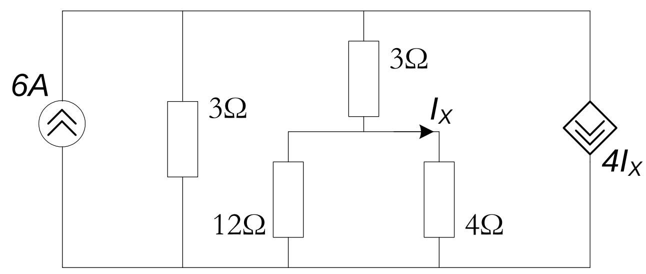
Problem 2-8

2-9 *Find the currents I_1 for the circuit below and verify the power conservation theorem.*



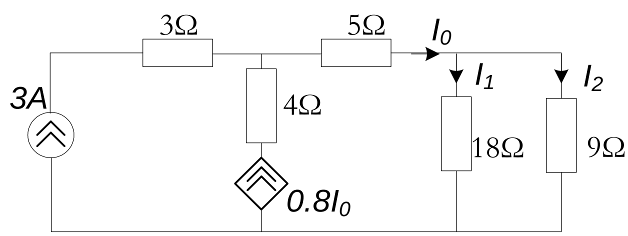
Problem 2-9

2-10 *Find the currents I_X for the circuit below and verify the power conservation theorem.*



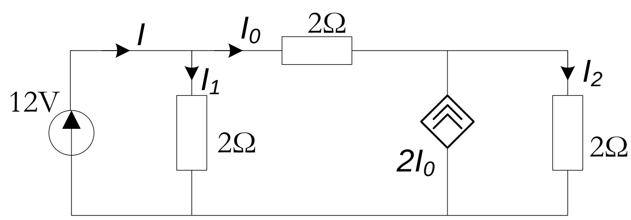
Problem 2-10

2-11 *Find the currents I_0, I_1, I_2 for the circuit below and verify the power conservation theorem.*



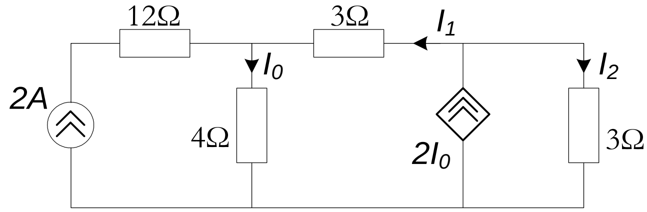
Problem 2-11

2-12 *Find the currents I_0, I_1, I_2, I for the circuit below and verify the power conservation theorem.*



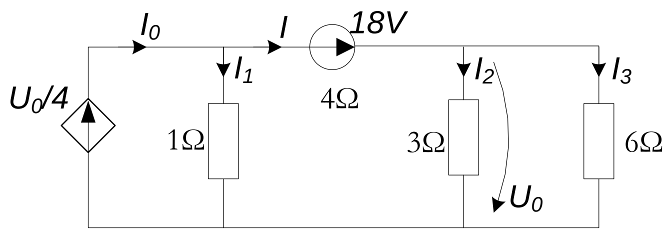
Problem 2-12

2-13 *Find the currents I_0, I_1, I_2 for the circuit below and verify the power conservation theorem.*



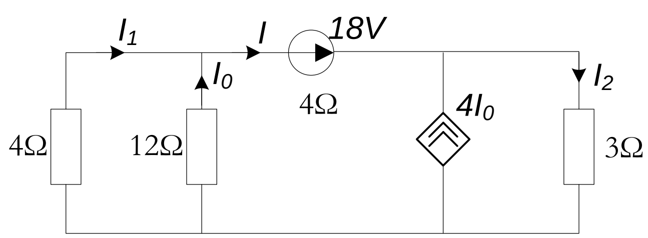
Problem 2-13

2-14 *Find the currents I_0, I_1, I_2, I_3, I for the circuit below and verify the power conservation theorem.*



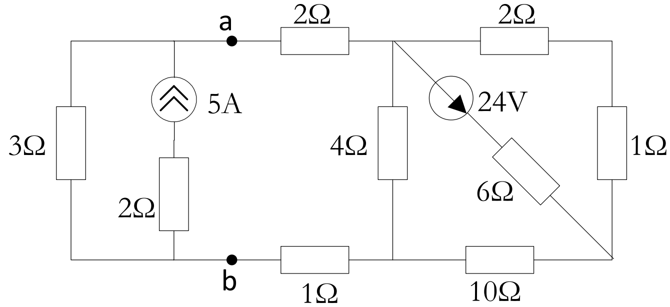
Problem 2-14

2-15 *Find the currents I_0, I_1, I_2, I for the circuit below and verify the power conservation theorem.*



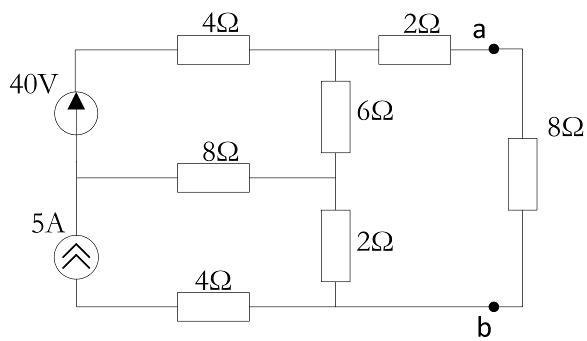
Problem 2-15

2-16 *Suppress all the sources in the circuit below and calculate the equivalent resistance, R_{eq}, regarding to the terminals a and b.*



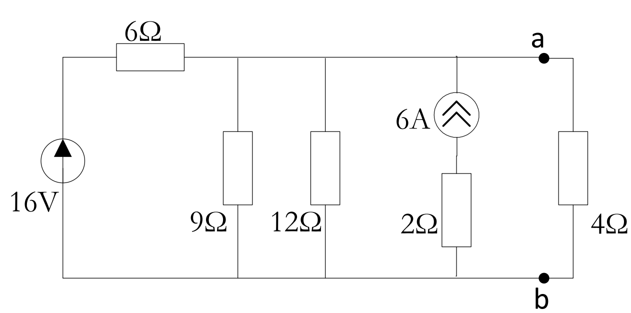
Problem 2-16

2-17 *Suppress all the sources in the circuit below and calculate the equivalent resistance, R_{eq}, regarding to the terminals a and b.*



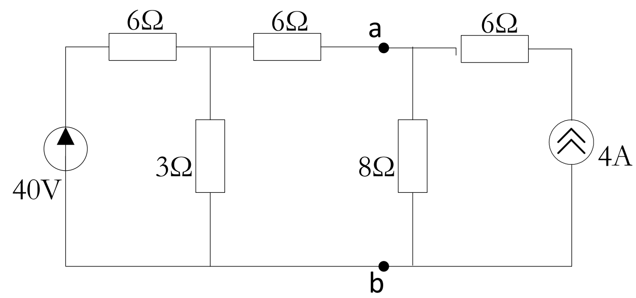
Problem 2-17

2-18 *Suppress all the sources in the circuit below and calculate the equivalent resistance, R_{eq}, regarding to the terminals a and b.*



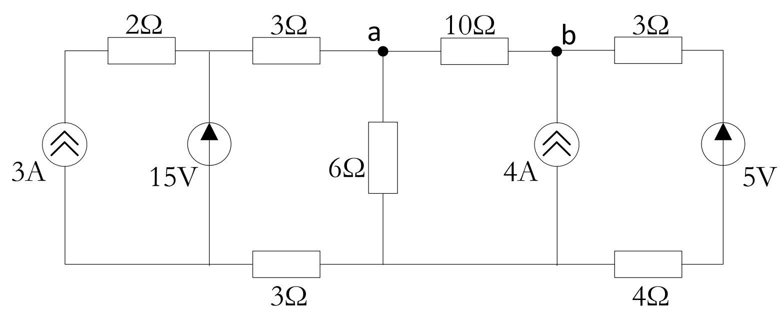
Problem 2-18

2-19 *Suppress all the sources in the circuit below and calculate the equivalent resistance, R_{eq}, regarding to the terminals a and b.*



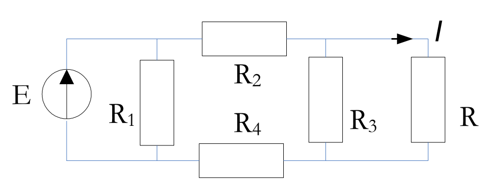
Problem 2-19

2-20 *Suppress all the sources in the circuit below and calculate the equivalent resistance, R_{eq}, regarding to the terminals a and b.*



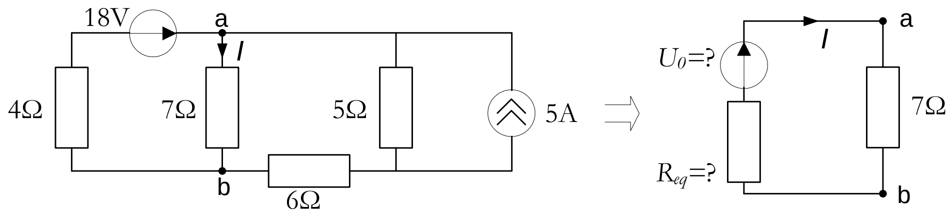
Problem 2-20

2-21 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the resistance R for the circuit below. Find the current I through the resistance R. Circuit parameters: E=15V, R1=220Ω, R2=150Ω, R3=R4=R=100Ω.*



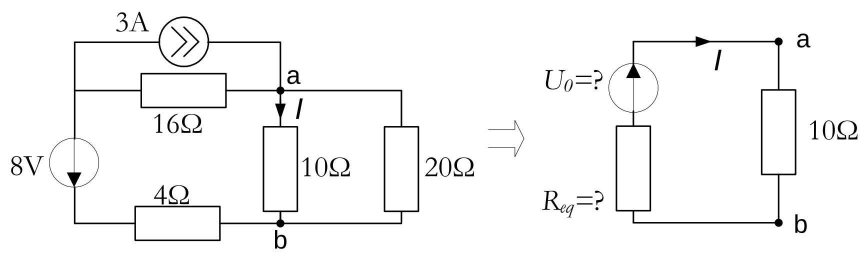
Problem 2-21

2-22 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 7Ωs resistance (terminals a and b) for the circuit below. Find the current I through the 7Ωs resistance.*



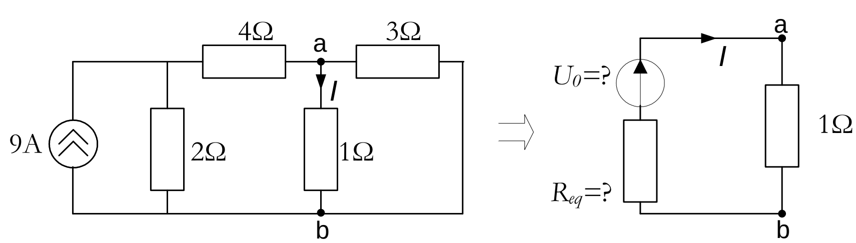
Problem 2-22

2-23 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 10Ωs resistance (terminals a and b) for the circuit below. Find the current I through the 10Ωs resistance.*



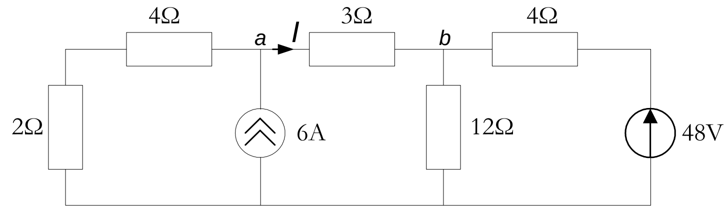
Problem 2-23

2-24 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 1Ωs resistance (terminals a and b) for the circuit below. Find the current I through the 1Ωs resistance.*



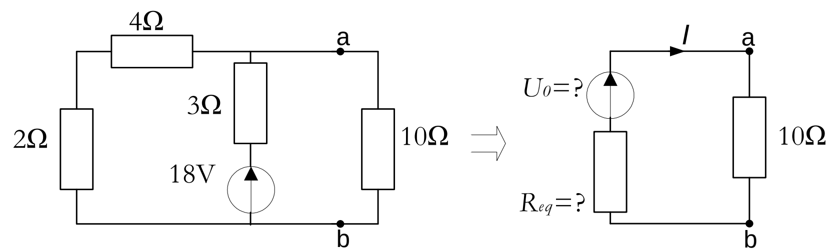
Problem 2-24

2-25 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 3Ωs resistance (terminals a and b) for the circuit below. Find the current I through the 3Ωs resistance.*



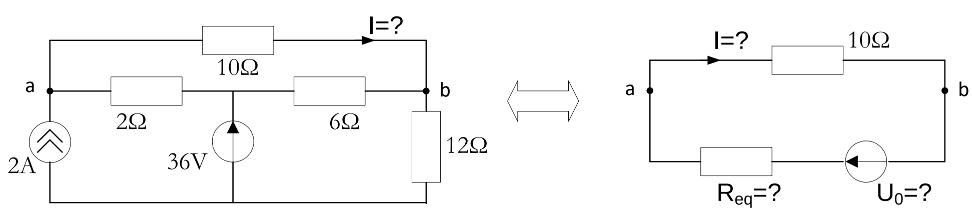
Problem 2-25

2-26 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 10Ω's resistance (terminals a and b) for the circuit below. Find the current I through the 10Ω's resistance.*



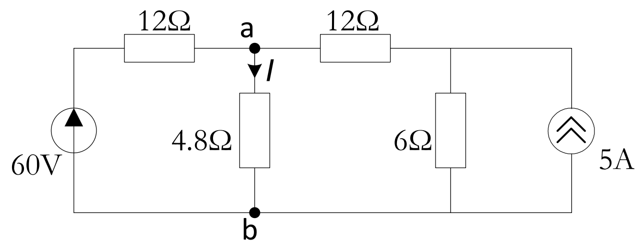
Problem 2-26

2-27 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 10Ω's resistance (terminals a and b) for the circuit below. Find the current I through the 10Ω's resistance.*



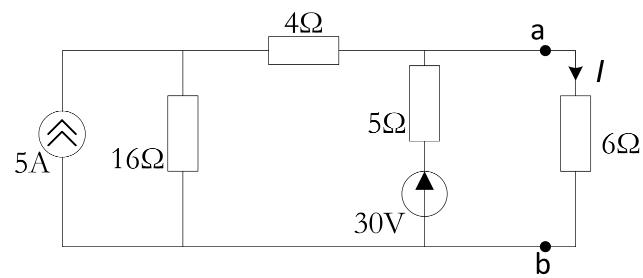
Problem 2-27

2-28 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 4.8Ω's resistance (terminals a and b) for the circuit below. Find the current I through the 4.8Ω's resistance.*



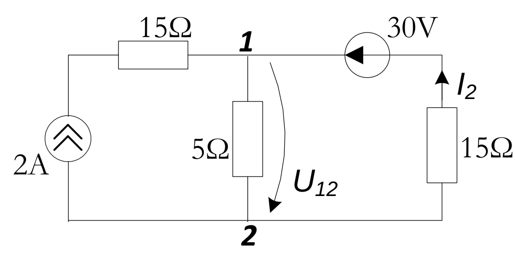
Problem 2-28

2-29 *Determine the Thevenin equivalent circuit (R_{eq}, U_0), viewed by the 6Ω's resistance (terminals a and b) for the circuit below. Find the current I through the 6Ω's resistance.*



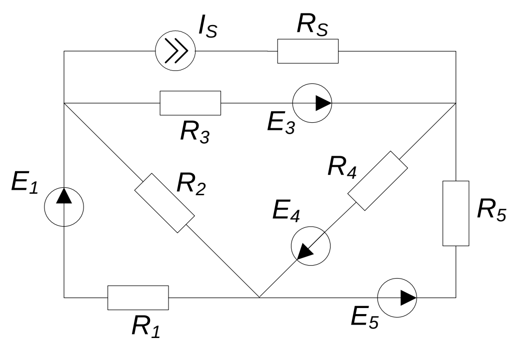
Problem 2-29

2-30 *For the circuit below, determine: a) the currents in the circuit; b) the current I_2 using the Thevenin's theorem; the voltage on the 5Ω's resistance, U_{12}. Verify the power conservation theorem.*



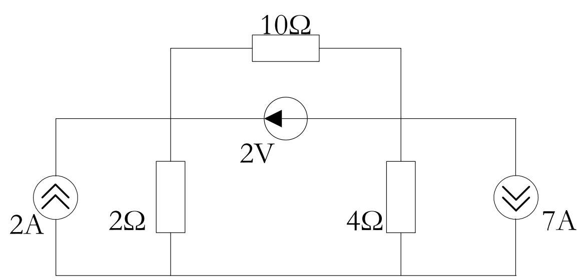
Problem 2-30

2-31 *For the circuit below, use the nodal analysis to calculate the potential of the nodes. Find the currents in the circuit. The circuit parameters are:* $R_1 = R_4 = 4\Omega$, $R_2 = 2\Omega$, $R_3 = 6\Omega$, $R_5 = 3\Omega$, $R_s = 10\Omega$, $E_1 = E_3 = 6V$, $E_4 = 3V$, $E_5 = 4V$, $I_s = 2A$.



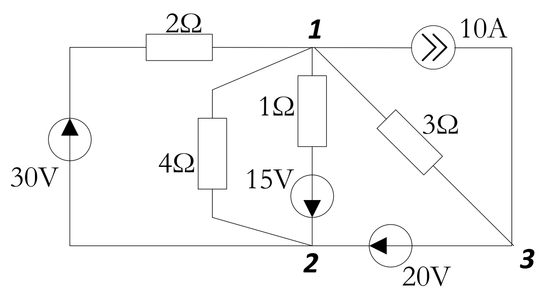
Problem 2-31

2-32 *For the circuit below, use the nodal analysis to calculate the potential of the nodes. Find the currents in the circuit.*



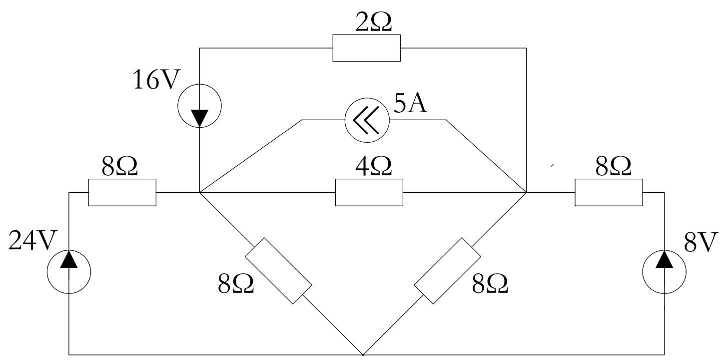
Problem 2-32

2-33 *For the circuit below, use the nodal analysis to calculate the potential of the nodes. Find the currents in the circuit.*



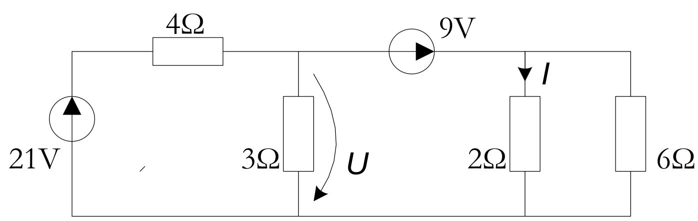
Problem 2-33

2-34 *For the circuit below, use the nodal analysis to calculate the potential of the nodes. Find the currents in the circuit.*



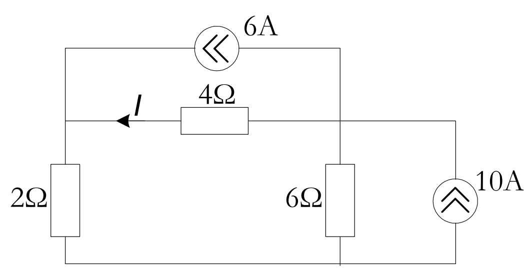
Problem 2-34

2-35 *For the circuit below, calculate the voltage U using: a) Norton's theorem; b) the nodal analysis. Calculate the current I using Thevenin's theorem.*



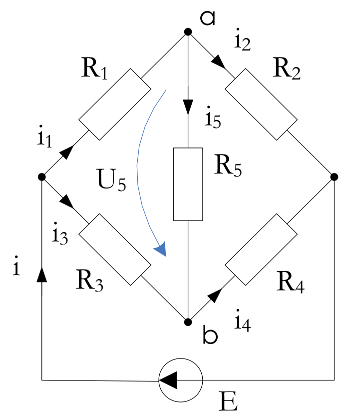
Problem 2-35

2-36 *For the circuit below, calculate the currents through the circuit using: a) the Kirchhoff laws; b) the nodal analysis; c) the mesh analysis. Verify the current I by using Thevenin's theorem. Verify the power conservation theorem.*



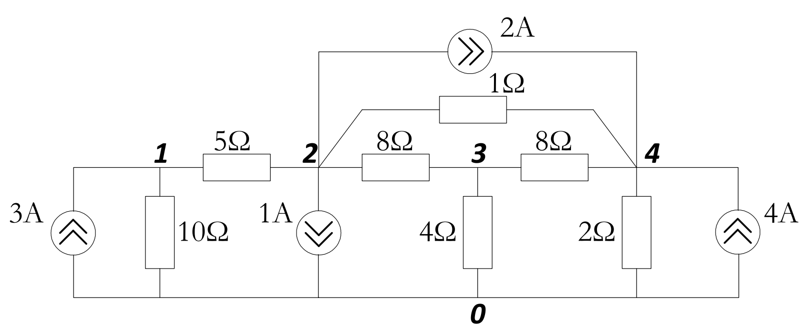
Problem 2-36

2-37 *For the circuit below, calculate: a) the current i_5 using the Thevenin's theorem; the voltage U_5 using Norton's theorem.*



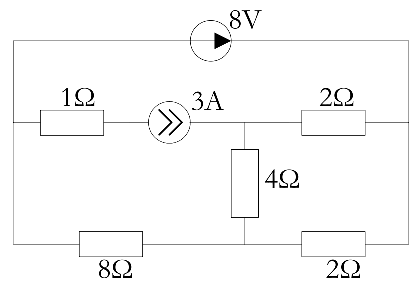
Problem 2-37

2-38 *For the circuit below, use the nodal analysis to calculate the potential of the nodes. Find the currents in the circuit.*



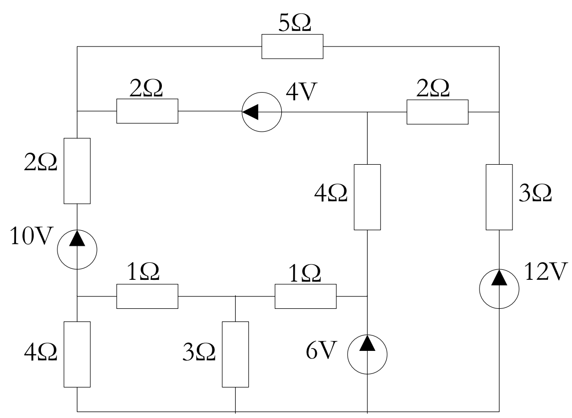
Problem 2-38

2-39 *For the circuit below, use the mesh analysis to find the currents in the circuit.*



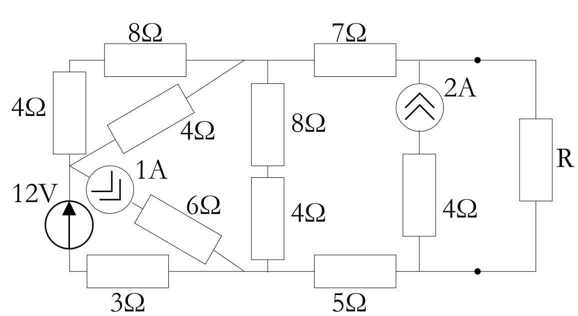
Problem 2-39

2-40 *For the circuit below, use the mesh analysis to find the currents in the circuit.*



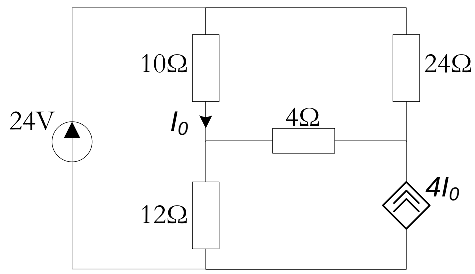
Problem 2-40

2-41 *For the circuit below, determine the value of the resistance R which will absorb the greatest power from the circuit.*



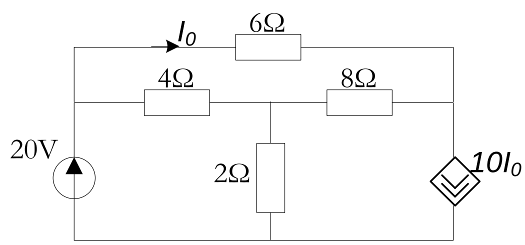
Problem 2-41

2-42 *For the circuit below, use the mesh analysis to find the currents in the circuit*



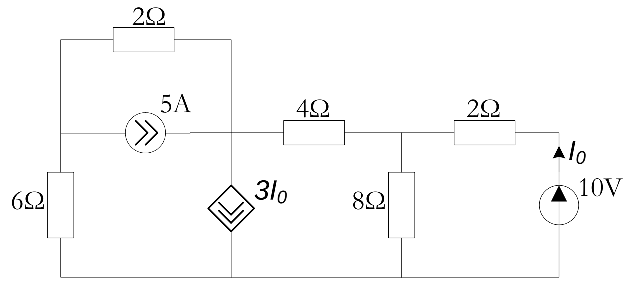
Problem 2-42

2-43 *For the circuit below, use the mesh analysis to find the currents in the circuit*



Problem 2-43

2-44 *For the circuit below, use the mesh analysis to find the currents in the circuit.*



Problem 2-44

PROBLEMS 3

3-1 *Given the sinusoid* $10\ \sin(10\pi t - 45^0)$, *calculate its amplitude, rms value, angular frequency, period, frequency and phase angle.*

3-2 *Find the phase angle between* $u_1(t) = 200\sqrt{2}\ \sin(5t + 30^0)$ *and* $u_2(t) = 50\cos(5t)$. *Does u_1 leads or lags u_2?*

3-3 *Find the phase angle between* $i_1(t) = -4\ \sin(417t + 30^0)$ *and* $i_2(t) = -7\cos(417t - 35^0)$. *Does i_1 leads or lags i_2?*

3-4 *Given* $i_1(t) = 2\sqrt{2}\ sin(\omega t + 45^0)\,A$ *and* $i_2(t) = 2\sqrt{2}\,cos(\omega t - 45^0)\,A$, *find their sum* $i(t) = i_1(t) + i_2(t)$.

3-5 *Given* $u_1(t) = 20\sqrt{2}\ sin(\omega t + 45^0)\,V$ *and* $u_2(t) = -10\sqrt{2}\,cos(\omega t - 30^0)\,V$, *find their sum* $u(t) = u_1(t) + u_2(t)$.

3-6 *Find the sinusoids corresponding to these phasors: a)* $\underline{U} = -10\ e^{j30^0}\ V$*; b)* $\underline{I} = 2\sqrt{2}(\cos 45^0 - j\sin 45^0)\ A$*; c)* $\underline{I} = j(5 - j12)\ A$.

3-7 *Using the phasor approach, determine the current i(t) in a circuit described by the integrodifferential equation*

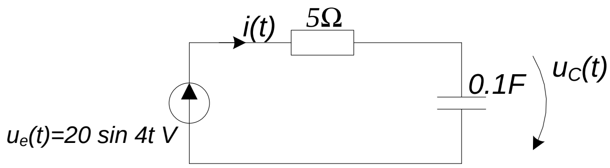
$$4i(t) + 8\int i(t)dt - 3\frac{di(t)}{dt} = 50\sqrt{2}\sin(2t + 75^0).$$

3-8 *Find the voltage u(t) in a circuit described by the integrodifferential equation*

$$2\sqrt{2}\ \frac{du(t)}{dt} + 5\sqrt{2}\,u(t) + 10\sqrt{2}\int u(t)dt -= 50\sqrt{2}\sin(5t - 30^0)$$

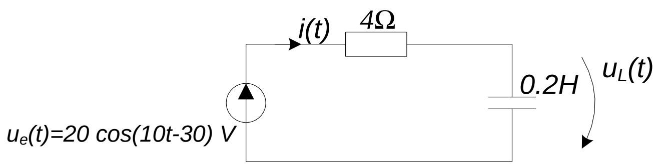
using the phasor approach.

3-9 *Find the circuit current, i(t), and capacitor-voltage, $u_C(t)$, for the circuit below.*



Problem 3-9

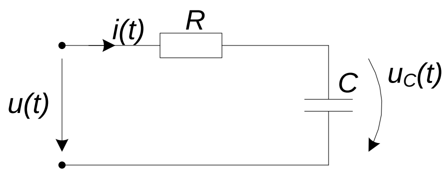
3-10 *Find the circuit current, i(t), and the inductance-voltage, $u_L(t)$, for the circuit below.*



Problem 3-10

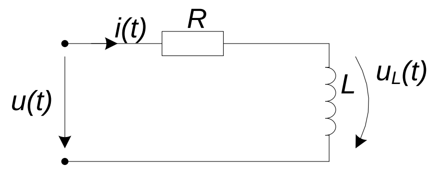
3-11 *Through a circuit branch, a sinusoidal current at t=0, has* $\mathrm{i}(0) = 5\mathrm{A}$, *and at* $\mathrm{t}_1 = 2.5\ \mathrm{ms}$ *reaches the peak value. If the sinusoidal period is* $\mathrm{T} = 20\ \mathrm{ms}$, *find: a) the phase angle of the current; b) the instantaneous form of the sinusoidal current.*

3-12 *The sinusoidal current in the circuit below, has 50Hz frequency and the peak value* $\mathrm{i}_\mathrm{m} = 2.82\mathrm{A}$. *Calculate the instantaneous value of the supplying voltage and the instantaneous value of the capacitance-voltage, when* $\mathrm{R} = 200\Omega$ *and* $\mathrm{C} = 15.9\ \mu\mathrm{F}$. *The current phase angle will be considered zero.*



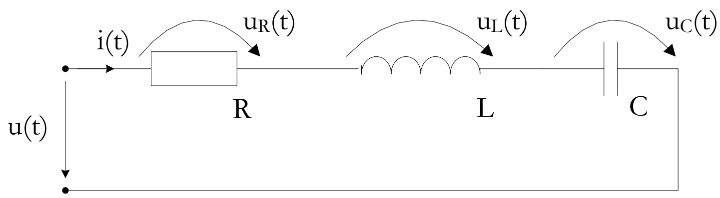
Problem 3-12

3-13 *In the circuit below we know* $\mathrm{R} = 20\Omega$ *and* $\mathrm{L} = 200\mathrm{mH}$. *If the voltage in the inductor is* $\mathrm{u_L(t)} = 200\sin(314\mathrm{t} - 60^0)\ \mathrm{V}$, *find: a) the instantaneous value of the current, i(t); b) the instantaneous value of the supplying voltage, u(t).*



Problem 3-13

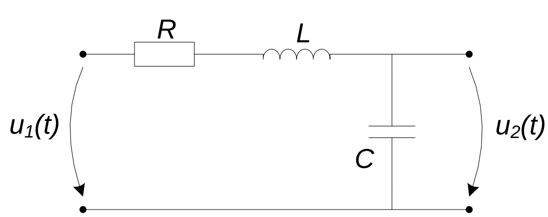
3-14 *The circuit parameters for the RLC series circuit below are R=20Ω,* $L = 40mH$, $C = 50\mu F$, *and the supplying voltage:* $u(t) = 200\ sin(1000t - 30^0)\,V$. *Calculate: a) the inductive and capacitive reactances and the circuit impedance,* X_L, X_C, *Z; b) the rms and the instantaneous value of the current, I, i(t); c) the rms and the instantaneous value of resistance-voltage,* U_R, $u_R(t)$*; d) the rms and the instantaneous value of inductance-voltage,* U_L, $u_L(t)$*; e) the rms and the instantaneous value of capacitance-voltage,* U_C, $u_C(t)$*. Draw the circuit diagram.*



Problem 3-14

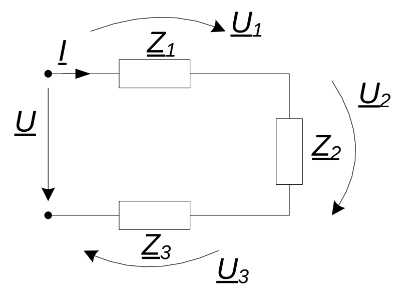
3-15 *For an RLC series circuit we khow* $\mathrm{R} = 30\Omega$, $\mathrm{X_L} = \omega\mathrm{L} = 80\Omega$, $\mathrm{X_C} = \frac{1}{\omega\mathrm{C}} 40\Omega$ *and the supplying voltage* $u(t) = 100\sqrt{2}\ sin(100\pi t - 60^0)\,V$. *Calculate: a) the impedance in phasor form and the circuit impedance,* $\underline{Z}$, *Z; b) the rms and the instantaneous value of circuit current, I, i(t); c) the active, reactive and apparent power, P, Q, S. Verify the conservation of the active and the reactive power. Draw the circuit diagram.*

3-16 *For the circuit below we know* $\mathrm{R} = 10\Omega$, $\mathrm{X_L} = \omega\mathrm{L} = 5\Omega$, $\mathrm{X_C} = \frac{1}{\omega\mathrm{C}} = 15\Omega$ *and the voltage* $u_1(t) = 100\sqrt{2}\ sin\,100\pi t\,V$. *Find the output voltage,* $u_2(t)$.



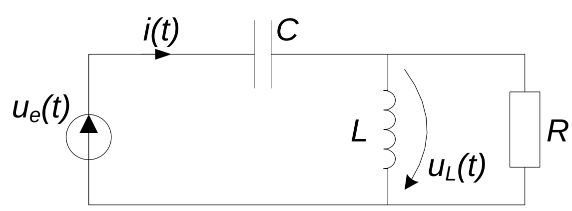
Problem 3-16

3-17 *For the circuit below we know* $\underline{Z}_1 = 3 + j4$, $\underline{Z}_2 = -j6$, $\underline{Z}_3 = 6 + j8$ *and the rms current* $I = 2A$. *Find: a) the rms voltage on each impedance,* U_1, U_2, U_3*; the rms value of the supplying voltage, u(t); c) the active, reactive and apparent power, P, Q, S.*



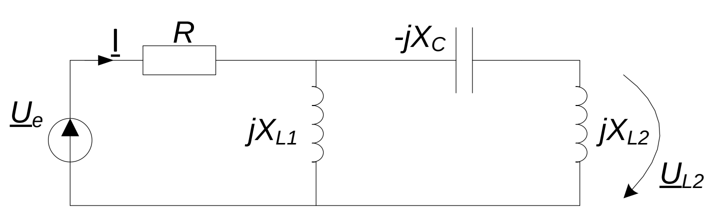
Problem 3-17

3-18 *For the circuit below we know* $R=10\Omega$, $L = \frac{3}{10\pi}$ H, $C = \frac{1}{2.1\pi}$ mF, and the supplying voltage: $u_e(t) = 100\sqrt{2}\,\sin(100\pi t - 60^0)$ V. *Calculate: a) the equivalent impedance and the circuit impedance regarding the source terminals,* $\underline{Z}$, *Z; b) the rms value of the current, I; c) the instantaneous value of the inductor-voltage,* $u_L(t)$*; d) the active, reactive and apparent power, P, Q, S. Verify the active and reactive power conservation.*



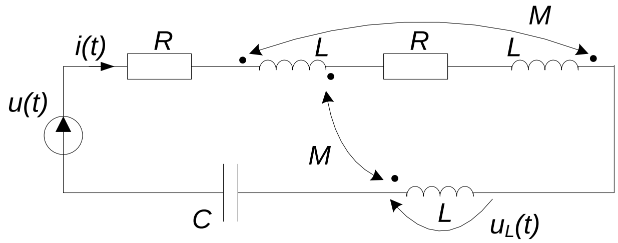
Problem 3-18

3-19 *For the circuit below we know* $R = 8\Omega$, $X_{L1} = \omega L_1 = 2\Omega$, $X_{L2} = \omega L_2 = 1\Omega$, $X_C = \frac{1}{\omega C} 40\Omega$ *and the supplying voltage* $u_e(t) = 100\sqrt{2}\, sin(100\pi t - 60^0)\, V$. *Calculate: a) the equivalent impedance and the circuit impedance regarding the source terminals,* $\underline{Z}$, *Z; b) the rms value of the current, I; c) the instantaneous value of the inductor-voltage indicated in figure,* $u_{L2}(t)$*; d) the active, reactive and apparent power, P, Q, S. Verify the active and reactive power conservation.*



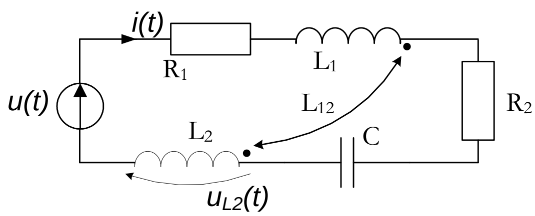
Problem 3-19

3-20 *For the circuit below we know* $R = 15\Omega$, $X_L = \omega L = 30\Omega$, $X_M = \omega M = 20\Omega$, $X_C = \frac{1}{\omega C} = 50\Omega$, *and supplying voltage* $u(t) = 100\sqrt{2}\ sin(100\pi t + 60^0)\,V$ *Determine: a) the phasor form of the equivalent impedance and the circuit impedance,* $\underline{Z}$, *Z; b) the rms and the instantaneous value of the current, I, i(t); the rms and the instantaneous voltage indicated in figure,* U_L, $u_L(t)$.



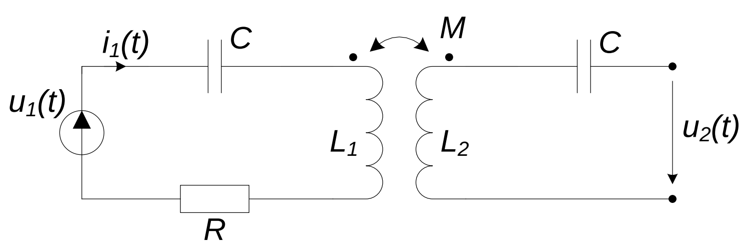
Problem 3-20

3-21 *Determine the rms value of current, I, and the instantaneous value of the voltage drop on the inductance* L_2, $u_{L2}(t)$, *for the circuit below. The circuit parameters are:* $R_1=15\Omega$, $R_2=25\Omega$, $L_1=L_2=2H$, $L_{12}=M=1H$, $C=2mF$, $u(t) = 100\sqrt{2}\,sin\,10t$ *(V).*



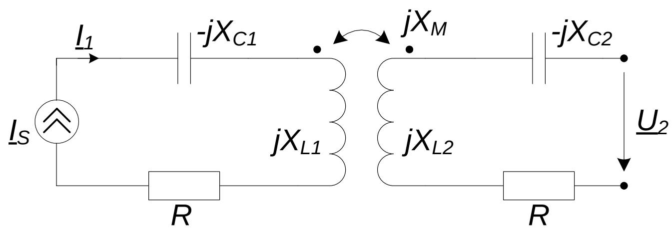
Problem 3-21

3-22 *Determine the instantaneous value of current,* $i_1(t)$, *and the rms output-voltage* U_2 *for the circuit below. The circuit parameters are:* $R = 40\Omega$, $X_{L1} = X_{L2} = 60\Omega$, $X_M = 30\Omega$, $X_C = 20\Omega$ *and the supplying voltage* $u_1(t) = 400\sin(500t - 30^0)$ V.



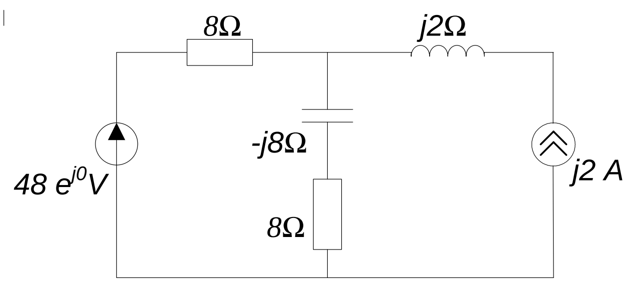
Problem 3-22

3-23 *For the circuit below we know:* $R_1 = R_2 = 50\Omega$, $X_{L1} = \omega L_1 = 10\Omega$, $X_{L2} = \omega L_2 = 40\Omega$, $X_M = \omega M = 20\Omega$, $X_{C1} = \frac{1}{\omega C} = 30\Omega$, $X_{C2} = \frac{1}{\omega C} = 10\Omega$, *and current* $i_s(t) = 3\sqrt{2}\ sin(100\pi t + 30^0)\,V$. *Determine: a) the rms value of voltage on the inductor L_1, U_{L1}; b) the instantaneous value of the outgoing voltage, $u_2(t)$.*



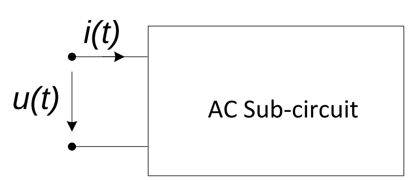
Problem 3-23

3-24 *For the circuit below find the circuit currents. Verify the active and reactive power conservation.*



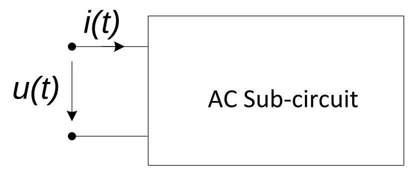
Problem 3-24

3-25 *The voltage and the current absorbed by the sub-circuit below are:* $u(t) = 200\sqrt{2}\ sin(500t - 30^0)\ V$ *and* $i(t) = 5\sin(500t + 60^0)\ A$. *Write the voltage and current phasor operator, $\underline{U}$, $\underline{I}$. Find the impedance phasor operator, $\underline{Z}$, the circuit impedance, Z, the active power, P, and the reactive power, Q, removed by the sub-circuit.*



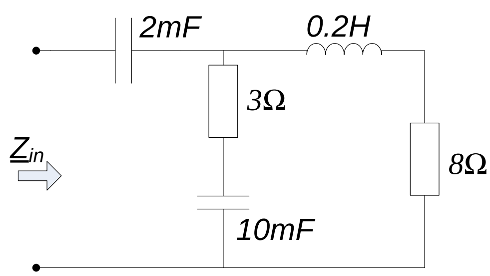
Problem 3-25

3-26 *The terminals voltage and current absorbed by the sub-circuit below are:* $u(t) = 100\ sin(100\pi t + 30^0)\ V$ *and* $i(t) = 2\cos 100\pi t\ \ A$*. Determine: a) the phasor form of the supplying voltage and current,* $\underline{U}$*,* $\underline{I}$*; b) the phasor impedance and sub-circuit impedance,* $\underline{Z}$*, Z; b) the active, reactive and apparent power, P, Q, S.*



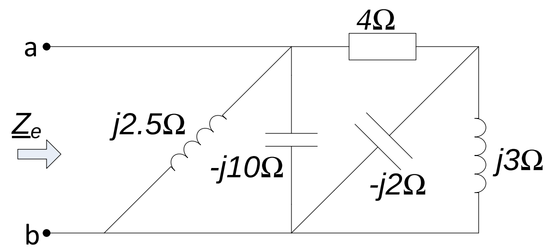
Problem 3-26

3-27 *Find the input impedance of the circuit below. Assume that the circuit operates at* $\omega = 50\frac{\text{rad}}{\text{s}}$.



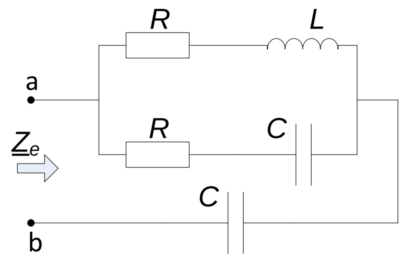
Problem 3-27

3-28 *For the circuit below find the equivalent impedance* $\underline{Z}_e$*, regarding the terminals a and b.*



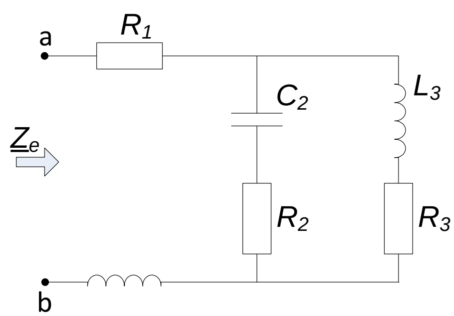
Problem 3-28

3-29 *For the circuit below find the equivalent impedance* $\underline{Z}_e$*, regarding terminals a and b. The circuit parameters are* R=10Ω, $\mathrm{L} = \frac{100}{\pi}\mathrm{mH}$, $\mathrm{C} = \frac{1}{\pi}\mathrm{mF}$, *and* $f = 50Hz$.



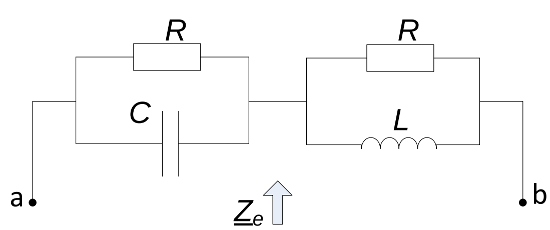
Problem 3-29

3-30 *For the circuit below find the equivalent impedance* $\underline{Z}_e$*, regarding terminals a and b. The circuit parameters are* $R_1 = R_2 = R_3 = 10\Omega$, $\mathrm{L}_3 = \frac{20}{\pi}\mathrm{mH}$, $\mathrm{C}_2 = \frac{5}{\pi}\mathrm{mF}$, *and* $f = 50Hz$.



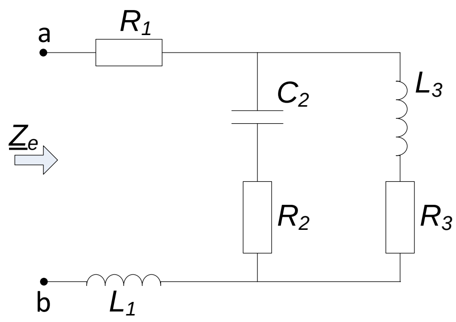
Problem 3-30

3-31 *For the circuit below find the equivalent impedance* $\underline{Z}_e$*, regarding terminals a and b. The circuit parameters are* R=10Ω, $\mathrm{L} = \frac{100}{\pi}\mathrm{mH}$, $\mathrm{C} = \frac{1}{\pi}\mathrm{mF}$, *and* $f = 50Hz$.



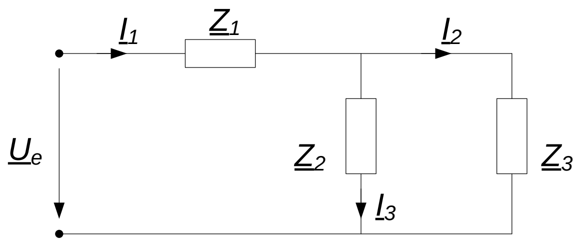
Problem 3-31

3-32 *For the circuit below find the equivalent impedance $\underline{Z}_e$, regarding terminals a and b. The circuit parameters are* $R_1 = 5\Omega$, $R_2 = R_3 = 10\Omega$, $L_1 = \frac{150}{\pi}\,\mathrm{mH}$, $L_3 = \frac{100}{\pi}\,\mathrm{mH}$, $C_2 = \frac{10^3}{\pi}\,\mu\mathrm{F}$, *and* $f = 50Hz$.



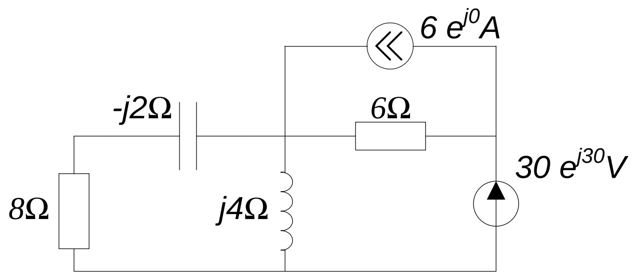
Problem 3-32

3-33 *For the circuit below we know* $\underline{Z}_1 = 10 + j40$, $\underline{Z}_2 = 20 - j20$, $\underline{Z}_1 = 20 + j20$ *and rms current* $I = 4A$. *Find: a) the equivalent impedance regarding the source terminals; b) the rms and instantaneous value of supplying voltage,* U_e, $u_e(t)$*; the active, reactive and apparent power, P,Q, S.*



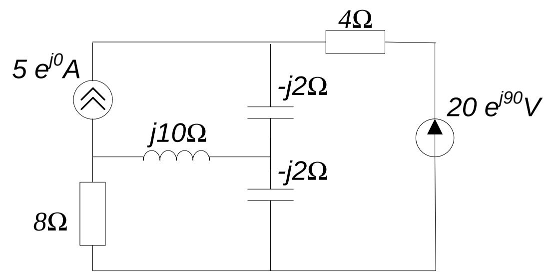
Problem 3-33

3-34 *Determine current* $\underline{I}_0$ *in the circuit below using the mesh analysis.*



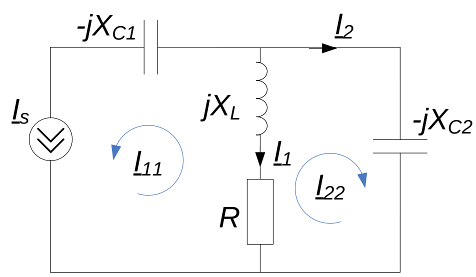
Problem 3-34

3-35 *Determine current $\underline{I}_0$ in the circuit below using the mesh analysis.*



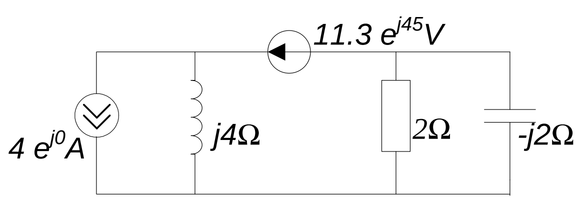
Problem 3-35

3-36 *For the circuit below we know: R=9.3Ω, L=100μH, C_1=1.2nF, C_2=820pF, f=570KHz,* $\underline{I}_s = 3\,e^{-j30^0}$. *Using the loop analysis, determine currents $\underline{I}_1$ and $\underline{I}_2$.*



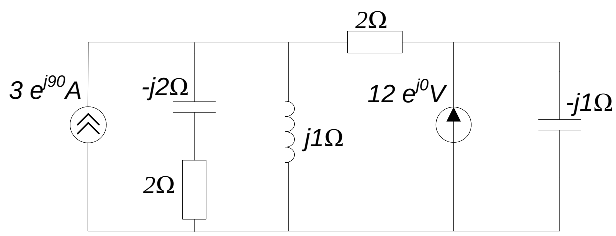
Problem 3-36

3-37 *For the circuit below find the potentials of the circuit nodes. Calculate the circuit currents.*



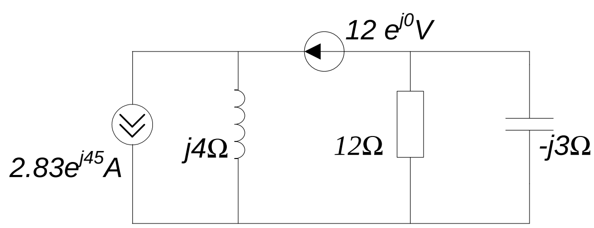
Problem 3-37

3-38 *For the circuit below find the potentials of the circuit nodes. Calculate the circuit currents.*



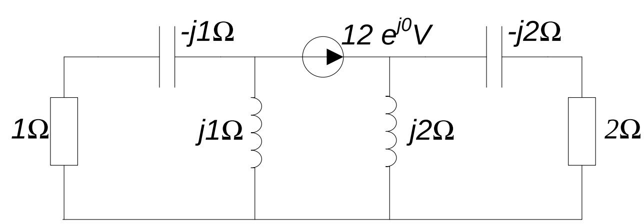
Problem 3-38

3-39 *For the circuit below find the potentials of the circuit nodes. Calculate the circuit currents.*



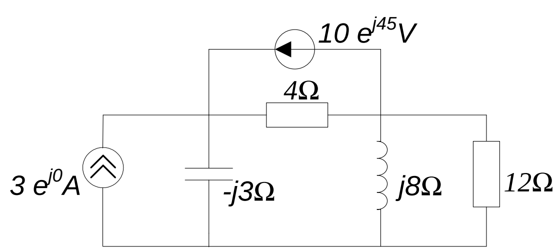
Problem 3-39

3-40 *For the circuit below find the potentials of circuit nodes. Calculate the circuit currents.*



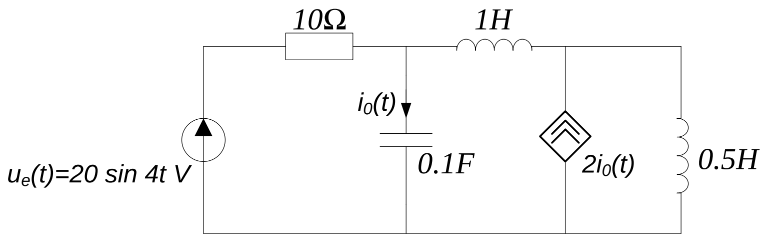
Problem 3-40

3-41 *For the circuit below find the potentials of circuit nodes. Calculate the circuit currents.*



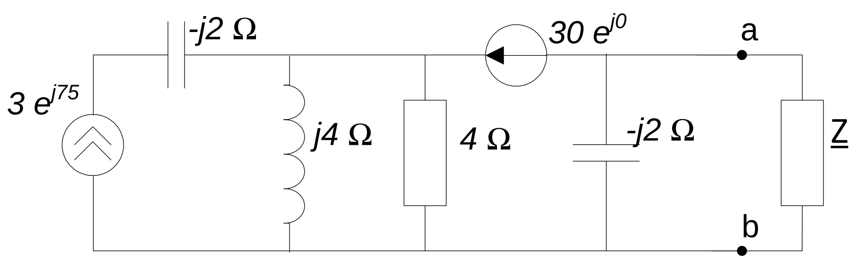
Problem 3-41

3-42 *Find $i_0(t)$ in the circuit below using nodal analysis.*



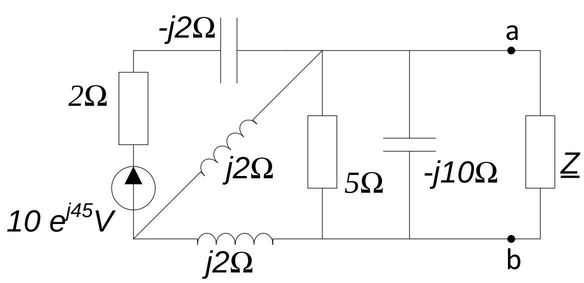
Problem 3-42

3-43 *For the circuit below determine the impedance value Z which will absorb the greatest power from the circuit.*



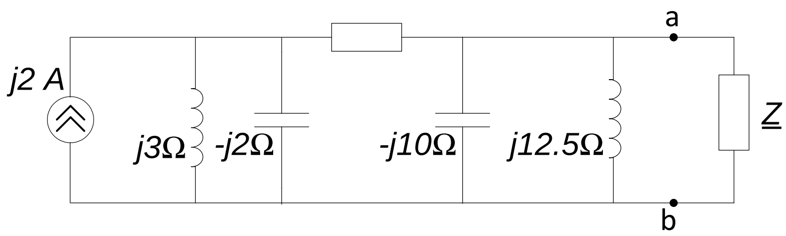
Problem 3-43

3-44 *For the circuit below determine the impedance value Z which will absorb the greatest power from the circuit.*



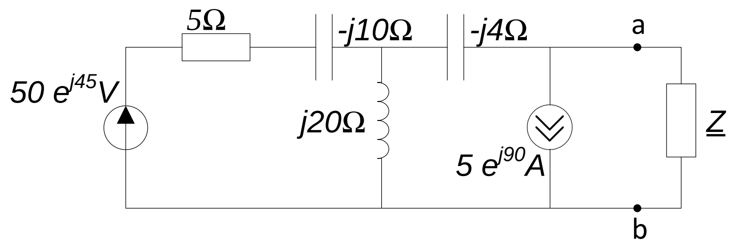
Problem 3-44

3-45 *For the circuit below determine the impedance value* $\underline{Z}$ *which will absorb the greatest power from the circuit.*



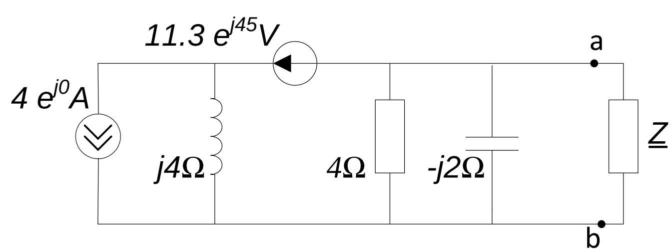
Problem 3-45

3-46 *For the circuit below determine the impedance value* $\underline{Z}$ *which will absorb the greatest power from the circuit.*



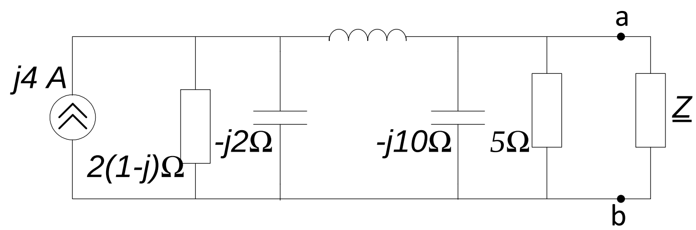
Problem 3-46

3-47 *For the circuit below determine the impedance value* $\underline{Z}$ *which will absorb the greatest power from the circuit.*



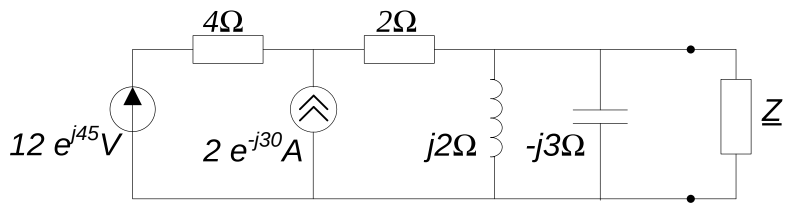
Problem 3-47

3-48 *For the circuit below determine the impedance value* *Z* *which will absorb the greatest power from the circuit.*



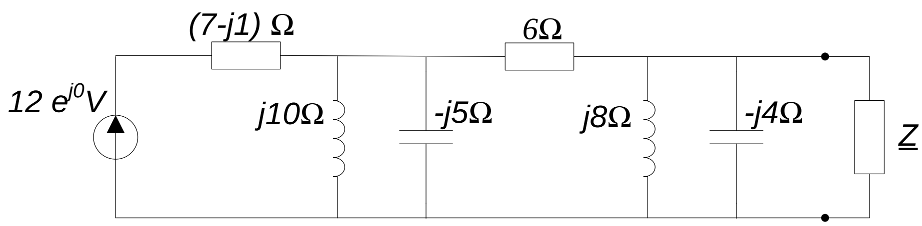
Problem 3-48

3-49 *For the circuit below determine the impedance value* *Z* *which will absorb the greatest power from the circuit.*



Problem 3-49

3-50 *For the circuit below determine the impedance value* *Z* *which will absorb the greatest power from the circuit.*



Problem 3-50