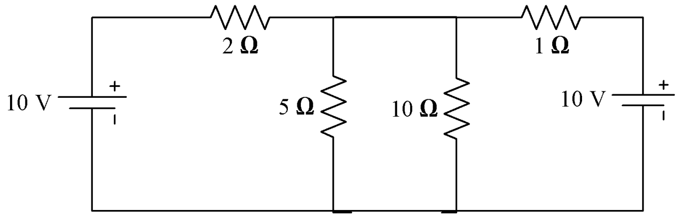
Module: 3 : Network Theorem

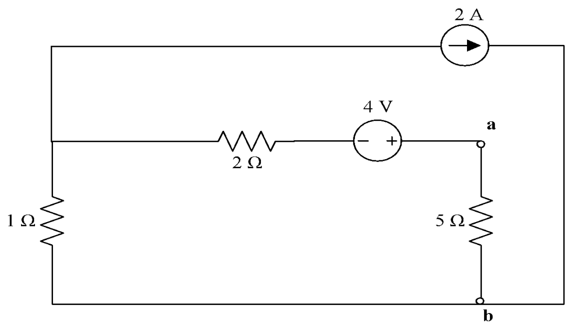
Tutorial Sheet Set 1

THEVENIN'S THEOREM

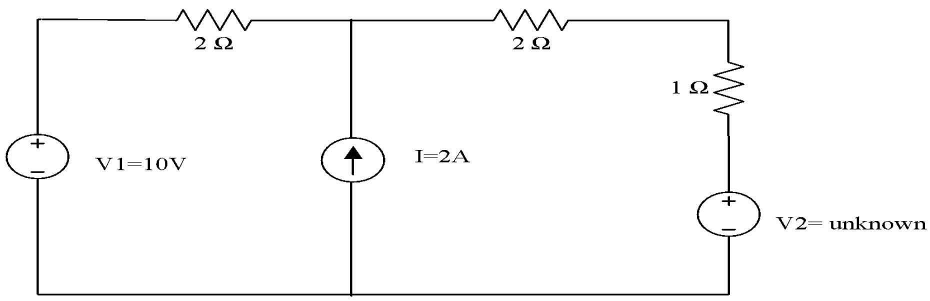
1. In the below network, find the current flowing through the 10 Ω resistor utilising Thevenin's theorem. [Ans: I = 1.2 A]



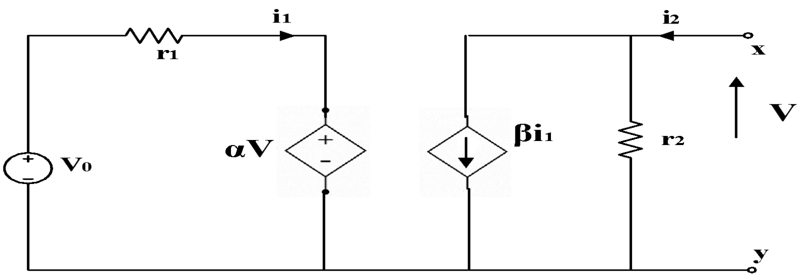
2. In the below circuit, find the power loss in r_L = 5 Ω utilising Thevenin's theorem. [Ans: P_L = 0.31 W]



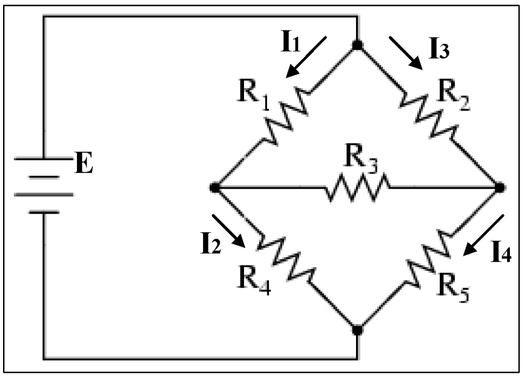
3. Find Thevenin's voltage across a-b terminal in the circuit of below fig. Also find the internal resistance across open circuit a-b terminal. [Ans: V_{th} = , R_{th} =]



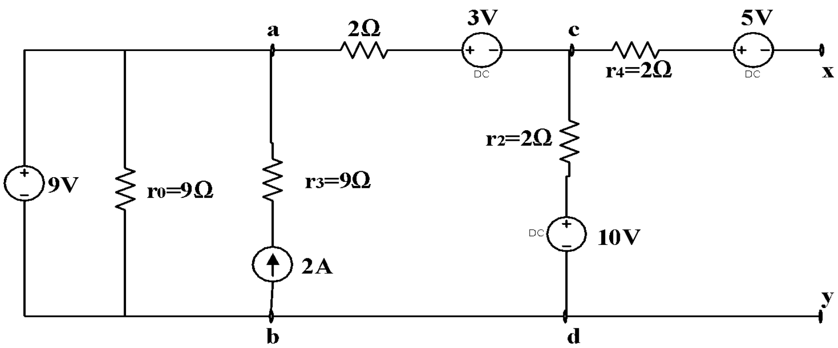
4. Find the Thevenin's equivalent impedance of the given circuit in fig. Looking from x-y terminals. [Ans: $Z_{int} = r_1 / (r_1 - r_2)$]



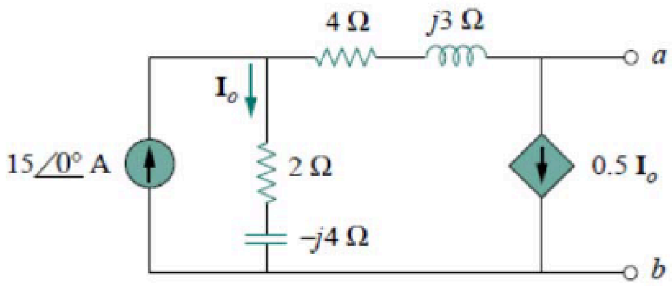
5. Thevenised the bridge circuit across a-b in figure.
[Ans: $R_{int} = (r_1 r_2 r_3 + r_1 r_2 r_3 + r_1 r_2 r_3 + r_1 r_2 r_3) / (r_1 + r_2) (r_2 + r_3)$]



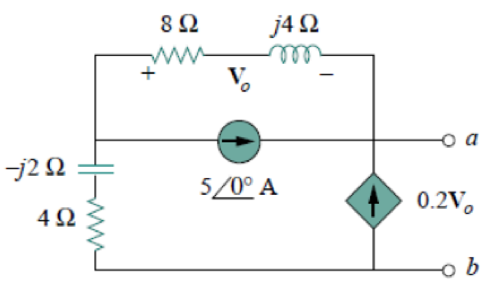
6. Obtain Thevenin's equivalent circuit across x-y in the figure.
   [R_{th} = 4 Ω]



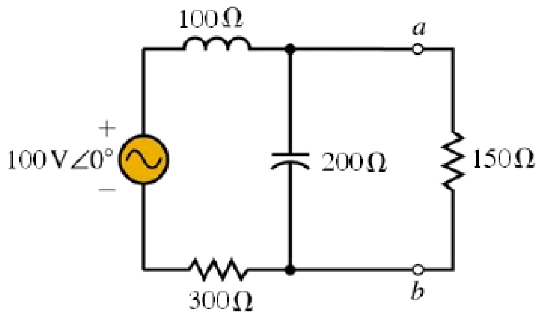
7. Find the Thevenin equivalent of the circuit in Fig as seen from terminals a-b.
   [Ans: $V_{th}=55\angle -90^0$ V, Z_{th}=4-j0.6667 Ω]



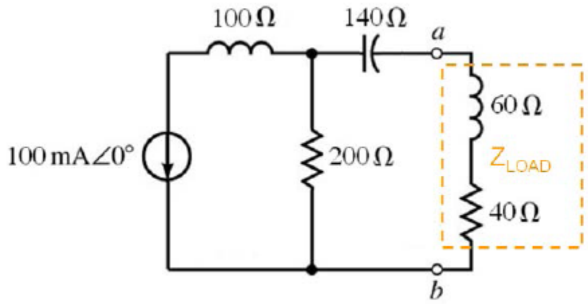
8. Determine the Thevenin equivalent of the circuit in Fig. as seen from the terminals a-b. [Ans: $Z_{th}=12.166\angle 136.3^0\Omega$, Vth= $7.35\angle 72.9^0$ V



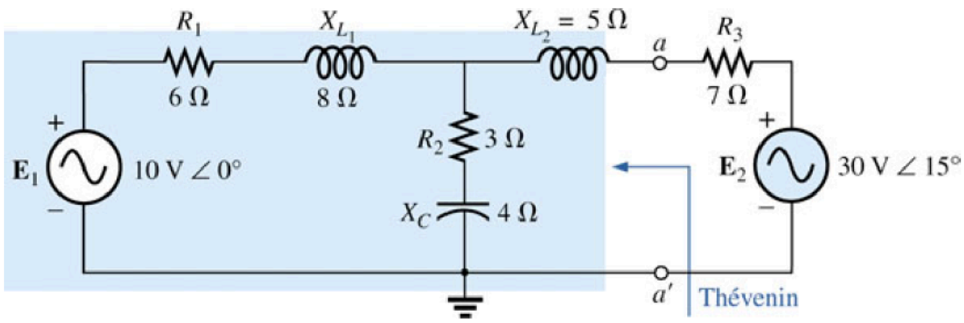
9. Convert the source below into a Thèvenin equivalent and determine the current I_{ab} through the load resistor.



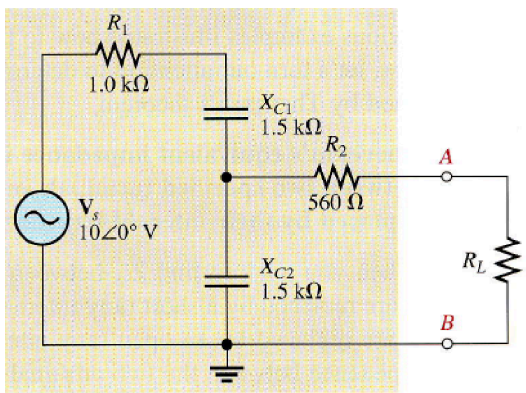
10. Convert the source below into a Thèvenin equivalent.



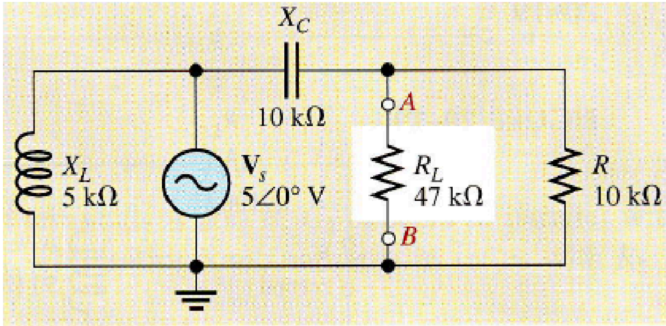
11. Find the Thevenin equivalent circuit for the network external to the branch *a-a*'.
    [Ans: Boylestad, *Introductory Circuit Analysis*, 12th ed., Prentice Hall, 2010]



12. For the circuit in below Figure, determine the Thevenin voltage as seen by R_L.
    [Ans: V_{th}=4.75 ∠-18.4°]

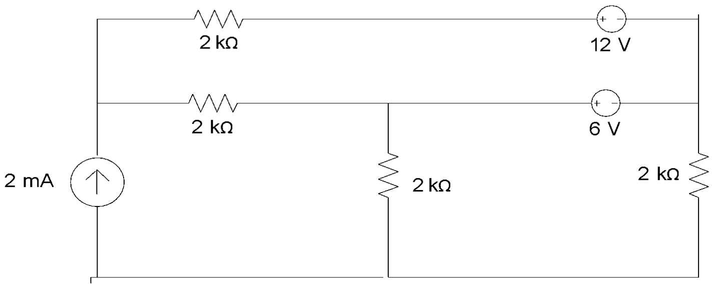


13. For Figure, find V_{th} for the circuit external to R_L. [Ans: 3.54∠45^0]

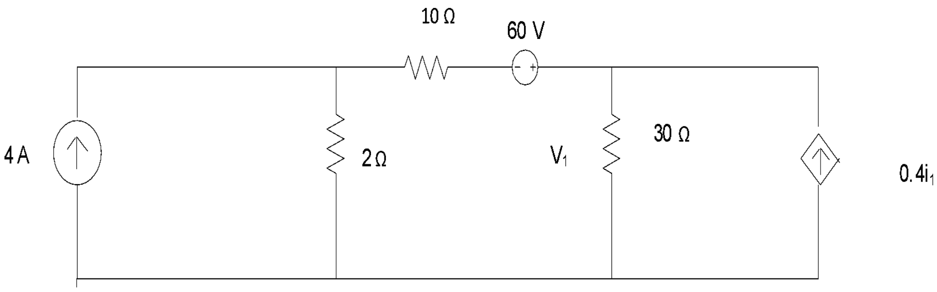


SUPERPOSITION THEOREM

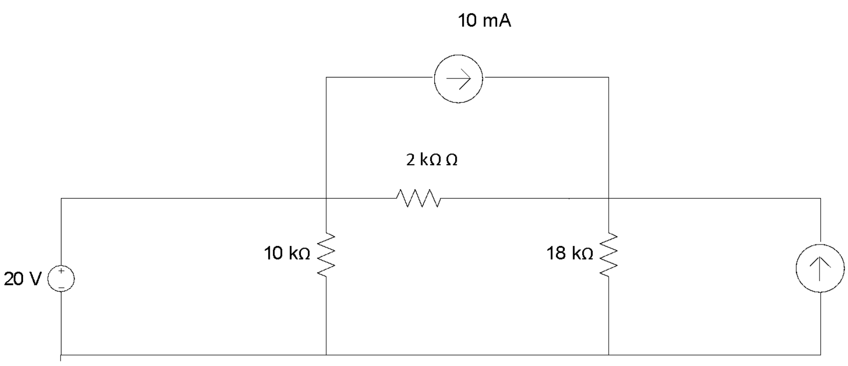
1. Use superposition to find $\boldsymbol{i}_o$ in the circuit in figure. [Ans: i_o = 2.5 mA]



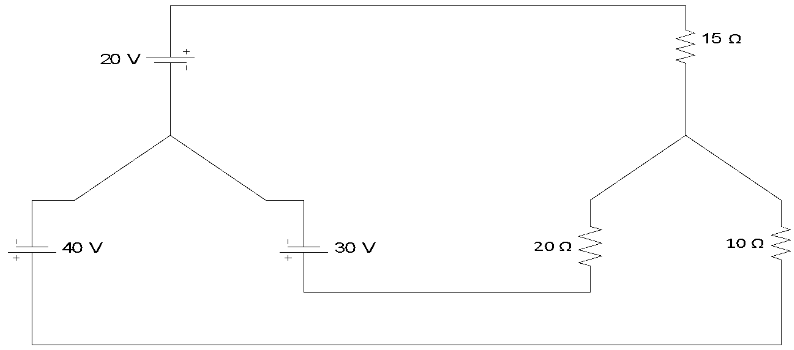
2. Find the voltage V_1 using the superposition principle. [Ans: V_1 = 82.5 V]



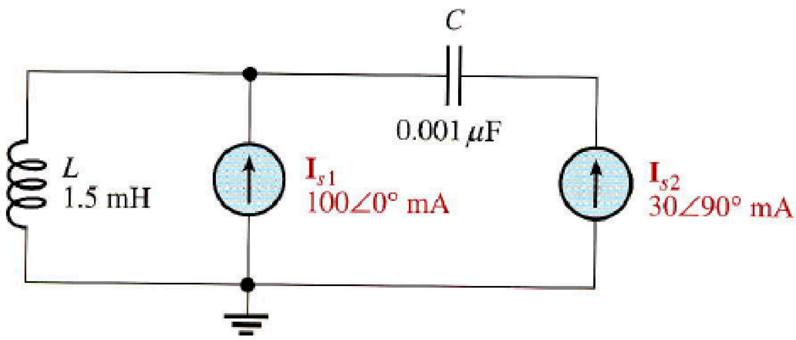
3. Refer to the circuit shown below. Before the 10 mA current source is attached to terminals x-y, the current $\boldsymbol{i}_a$ is found to be 1.5 mA. Use the superposition theorem to find out the value of $\boldsymbol{i}_a$ after the current source is connected.
   Verify your solution by finding i_a , when all the three source are acting simultaneously.
   [Ans: $\boldsymbol{i}_a$ =]



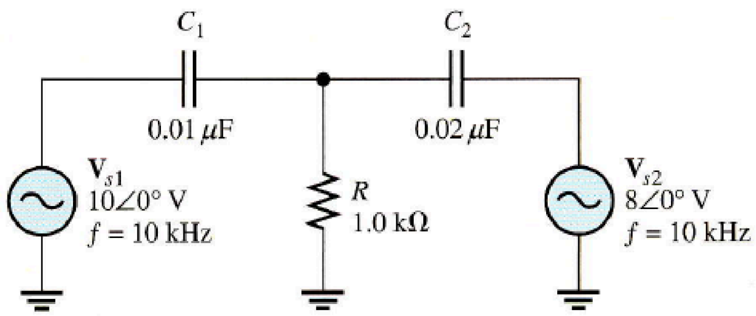
4. Using superposition theorem, find the current in each branch of the network shown. [Ans. -0.768, -0.074, -0.842]



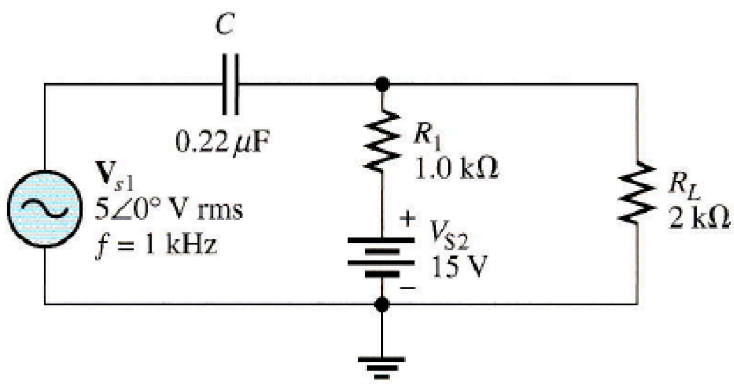
5. Find the coil current in Figure. Assume the sources are ideal [Ans: 104∠16.70 mA]



6. Find the current in R of Figure internal source impedances are zero. using the superposition theorem. Assume the internal source impedances are zero. [Ans: Ir=7.64∠27.9º mA]



7. Find the total current (by using Superposition Theorem) in the resistor R_L in Figure. Assume the sources are ideal. [Ans: 1.69∠47. 3º mA]



MAXIMUM POWER TRANSFER THEOREM

1. Find the value of R in the circuit of fig.1 such that maximum power transfer takes place. What is the amount of this power? [Ans: $R_{th} = 0.85\ \Omega$, $P_{max} = 12$ W]

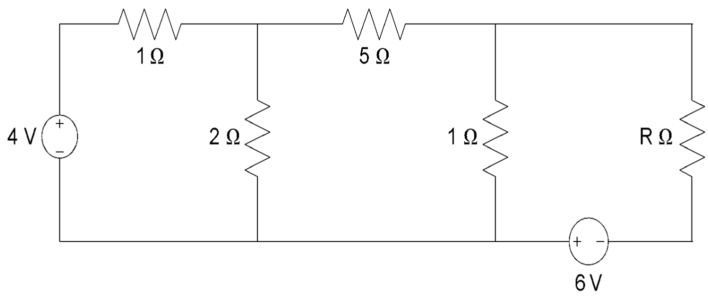


Fig. 1.

2. What should be the value of R such that maximum power transfer can take place from the rest of the network to R in the fig.2? Obtain the amount of this power.
[Ans: $R = 5.33\ \Omega$, $P_{max} = 188$ mW]

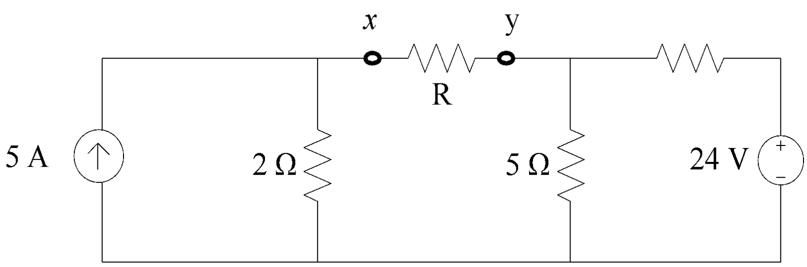


Fig. 2.

3. What resistance should be connected across x-y in the circuit shown in fig.3 such that maximum power is developed across this load resistance? What is the amount of this maximum power? [Ans: $R_{th} = 421/\ 65\ \Omega$, $P_{max} = 3.34$ W]

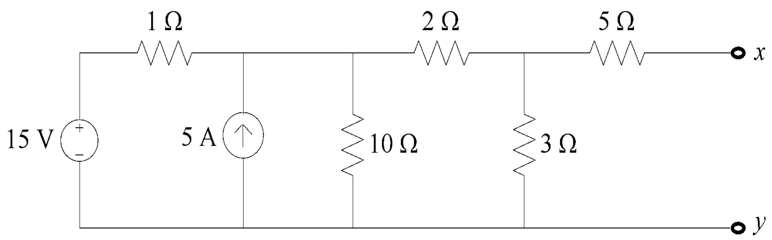


Fig. 3.

4. Find R to have maximum power transfer in the circuit of fig.4. Also obtain the amount of maximum power. [Ans: $R_{th} = 1.765\ \Omega$, $P_{max} = 19.221$ W]

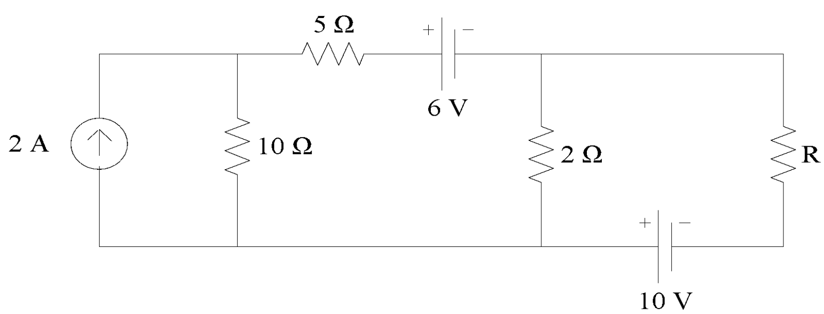


Fig. 4.

5. Assuming maximum power transfer find the source to R, find the value of this amount of power in the circuit of fig. 5. [Ans: R = 8.33 Ω, P_{max} = 33.34 W]

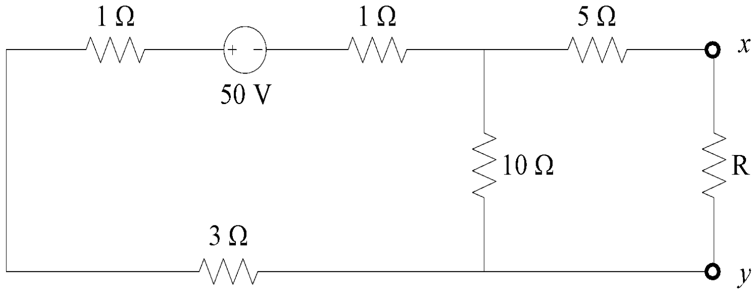
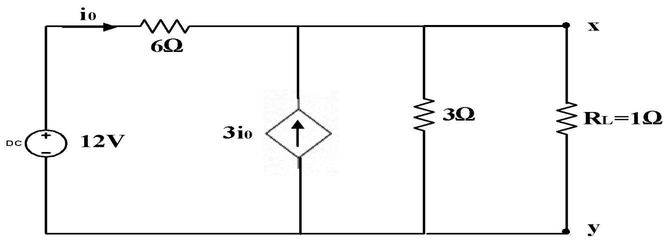


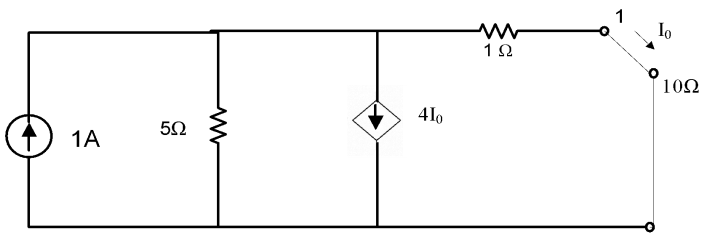
Fig. 5.

NORTON'S THEOREM

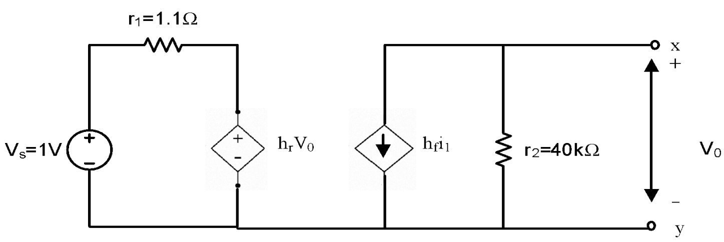
1. Find the current through R_L in the circuit shown below using Norton's theorem.
[Ans: I = 4A]



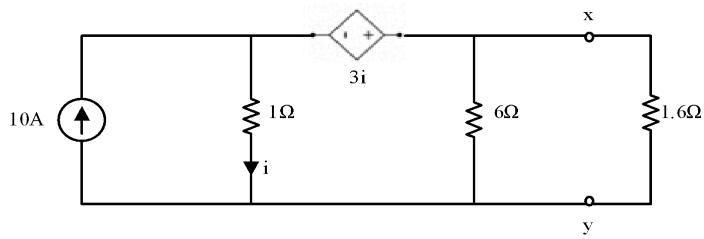
2. Find the power loss in 10 Ω resistor in the circuit of below fig. Using Norton's theorem. [Ans: P_L = 0.195 W]



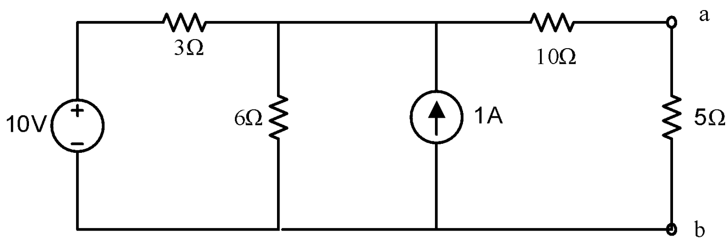
3. Find Norton's equivalent to the left of x-y terminals for the CE configuration of transistor equivalent circuit shown in fig. Assume $h_r = 2 \times 10^{-4}$; $h_f = 50$.
[Ans: R_{int} = 62.82 kΩ I_N = -45.45 mA]



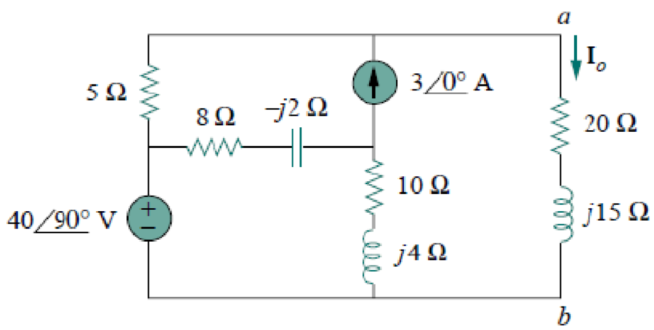
4. Find the current through 1.6 Ω resistor in the circuit in the below fig. [Ans: 6 A]



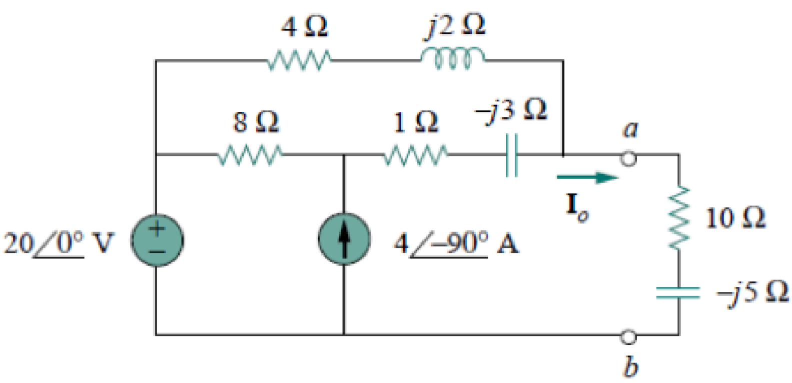
5. Find the current in the 5 Ω resistor for the circuit shown in fig. [Ans: I = 509.6 mA]



6. Obtain current Io in Fig. using Norton's theorem.
   [Ans: Z_n=5Ω, I_n=(3+j8 A), I_0=1.465∠38.48^0 A]



7. Determine the Norton equivalent of the circuit in Fig. as seen from terminals a-b. Use the equivalent to find Io. [Ans: Z_n=3.176+j0.706 Ω, I_n=8.396∠-32.68° A, I_o=1.971∠-2.101° A]



8. Show the complete Norton equivalent circuit for the circuit in Figure.
   [Ans: I_n=344∠121° mA, Z_n=(24.8-j28) Ω]