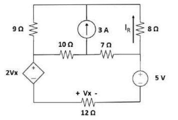
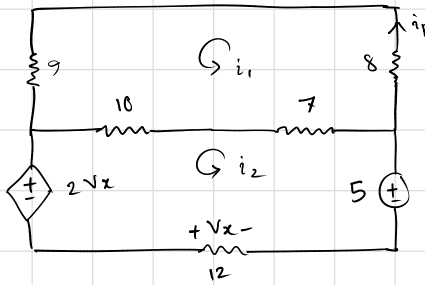
Answer the following questions for the circuit shown in **Figure** 1:
i)Draw the circuit with the Independent Current Source Turned Off. ii)Draw the circuit with the Independent Voltage Source Turned Off. iii)Apply the Superposition Theorem, and find the value of I_R.



current source off:



$i_2 = \frac{V_x}{12}$

loop 1 : $i_1(9+8+10+7) - i_2(10+7) = 0$

$\Rightarrow 34i_1 - \frac{17}{12}V_x = 0$

loop2 : $2V_x + V_x - 5 + i_2(10+7) - i_1(10+7) = 0$

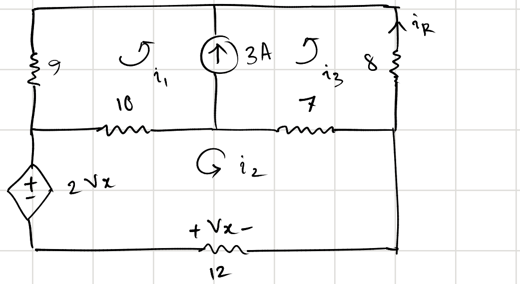
$\Rightarrow 3V_x - 5 + \frac{17}{12}V_x - 17i_1 = 0$

$\Rightarrow -17i_1 + \frac{53}{12}V_x = 5$

$i_1 = \frac{5}{89}$ $\quad V_x = \frac{120}{89}$

$= i_R$

voltage source off:



$i_2 = \frac{V_x}{12}$ $\quad i_1 - i_3 = 3$

loop 2: $2V_x + V_x + i_2(10+7) - 10i_1 - 7i_3 = 0$

$\Rightarrow 3V_x + \frac{17}{12}V_x - 10(3+i_3) - 7i_3 = 0$

$\Rightarrow \frac{53}{12}V_x - 30 - 17i_3 = 0$

$\Rightarrow \frac{53}{12}V_x - 17i_3 = 30$

loop 1+3: $i_1(9+10) + i_3(8+7) - i_2(10+7) = 0$

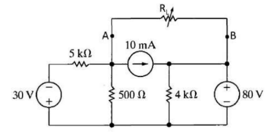
$\Rightarrow (3+i_3)19 + 15i_3 - \frac{17}{12}V_x = 0$

$\Rightarrow -\frac{17}{12}V_x + 34i_3 = -57$

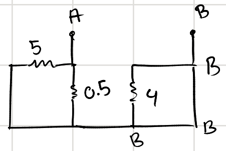
$V_x = \frac{36}{89}$ $\quad i_3 = -\frac{2511}{1513} = i_R$

Superposition $i_R = \frac{5}{89} - \frac{2511}{1513} = -1.6034$ A

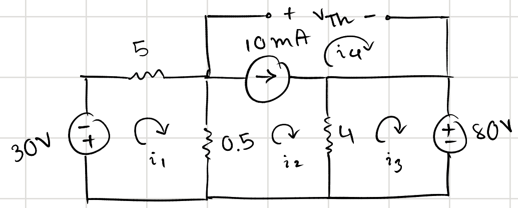
For the circuit shown in **Figure 2**, answer the following questions:
i) Determine the Thevenin equivalent circuit at the A-B terminal.
ii) For any value of R_L, what will be the maximum power delivered to this resistance?
iii) If R_L=1kΩ, then would maximum power be achieved? If not, then what should you do to achieve maximum power?



i)



$R_{Th} = 5 \| 0.5 = \frac{5}{11}$ kΩ



$i_4 = 0$ $\quad i_2 - i_4 = 10 \Rightarrow i_2 = 10$

Loop 2+4: $V_{Th} + i_2(0.5+4) - i_1(0.5) - i_3(4) = 0$

$\Rightarrow V_{Th} + 4.5i_2 - 0.5i_1 - 4i_3 = 0$

$\Rightarrow V_{Th} + 45 - 0.5i_1 - 4i_3 = 0$

$\Rightarrow V_{Th} - 0.5i_1 - 4i_3 = -45$

loop 1: $30 + i_1(5+0.5) - i_2(0.5) = 0$

$\Rightarrow 5.5i_1 - 5 + 30 = 0$

$\Rightarrow i_1 = \frac{-25}{5.5}$

loop 3: $80 + 4i_3 - 4i_2 = 0$

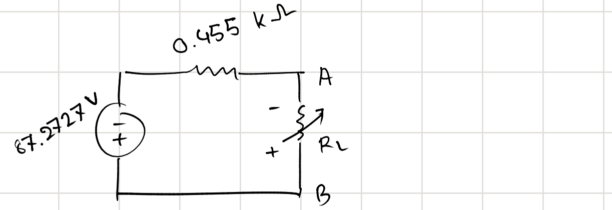
$\Rightarrow 80 + 4i_3 - 40 = 0$

$\Rightarrow i_3 = -10$

$V_{Th} + 0.5 \times \frac{25}{5.5} - 4(-10) = -45$

$\Rightarrow V_{Th} + \frac{25}{11} + 40 = -45$

$\Rightarrow V_{Th} = -87.2727$



ii) $P_{max} = \frac{V_{Th}^2}{4R_{Th}} = \frac{87.2727^2}{4 \times 0.455}$ mW

$= 4184.9034$ mW

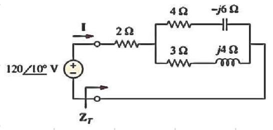
iii) $P = i^2 R_L$

$= \left(\frac{V_{Th}}{R_{Th}+R_L}\right)^2 \times R_L$

$= \left(\frac{87.2727}{454.545+1000}\right)^2 \times 1000$

$= 3.6$ W

Answer the following questions for the circuit shown in **Figure 3**:
i)Determine Z_T. ii) Current, I. iii) Find the currents through 4 Ω and 3 Ω resistors.
iv) Is the source voltage or the current, I leading in this circuit?



i) $Z_T = 2 + (4-j6) \| (3+j4)$

$= 6.9173 \angle 9.1026°$

ii) $I = \dfrac{120\angle 10°}{6.9173\angle 9.1026°} = 17.3478\angle 0.897377°$

iii) $i_4 = I \times \dfrac{3+j4}{(4-j6)+(3+4j)} = 11.9145\angle 69.972875°$

$i_3 = I \times \dfrac{4-6j}{(4-6j)+(3+4j)} = 17.183368\angle -39.467°$

iv) $I = 17.3478 \cos(\omega t + 0.897377°)$

$V = 120 \cos(\omega t + 10°)$

V is leading by 9.1026°

For the circuit shown in **Figure 4a**, determine I_m if the rms value of such current is 5A. Now, determine i_o and average real power absorbed by a 3-ohm resistor using **CDR** in the circuit shown in **Figure 4b** if the angular frequency is 100 rad/s in the circuit.

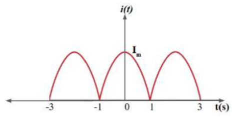


Figure 4a.

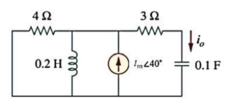


Figure 4b.

$\omega = \dfrac{2\pi}{2} = \pi$

$i(t) = I_m \cos(\pi t), \; -1 < t < 1$

$I_{rms}^2 = \dfrac{1}{T} \int_{-1}^{1} (I_m \cos(\pi t))^2 dt$

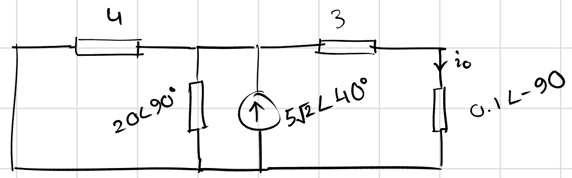
$= \dfrac{I_m^2}{T} \dfrac{1}{2} \int_{-1}^{1} 1 + \cos 2\pi t \; dt$

$= \dfrac{I_m^2}{2T} \left\{ t\Big]_{-1}^{1} + \dfrac{1}{2\pi} \sin 2\pi t \Big]_{-1}^{1} \right\}$

$= \dfrac{I_m^2}{2T} \times 2$

$= \dfrac{I_m^2}{2}$

$\Rightarrow I_m = \sqrt{2 I_{rms}^2} = 5\sqrt{2}$



$i_o = 5\sqrt{2}\angle 40° \times \dfrac{4 \| 20\angle 90°}{(4\| 20\angle 90°) + (3 + 0.1\angle -90°)}$

$= 4.03196\angle 45.7268°$

$P_{avg} = \dfrac{1}{2} i_o^2 \times R$

$= \dfrac{1}{2} i_o^2 \times 3$

$= 24.385$

$P_{avg} = \dfrac{1}{2} i_m^2 \times R$

$= \dfrac{1}{2} \dfrac{V_m^2}{R}$