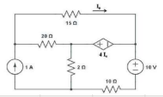
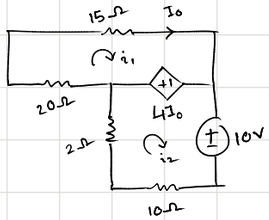
For the above circuit shown in **Figure 1**, determine I_o using Superposition and the power dissipated in 15Ω resistance.



current source off



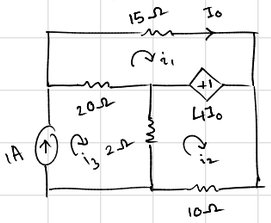
$i_1 = I_o$

loop 1: $i_1(15+20) - 4I_o = 0$

$\Rightarrow 35I_o - 4I_o = 0$

$\Rightarrow I_o = 0$

voltage source off



$i_3 = 1 \quad i_1 = I_o$

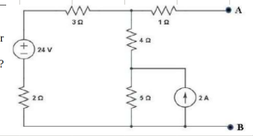
loop 1: $i_1(15+20) - 20i_3 - 4I_o = 0$

$\Rightarrow 35I_o - 20 - 4I_o = 0$

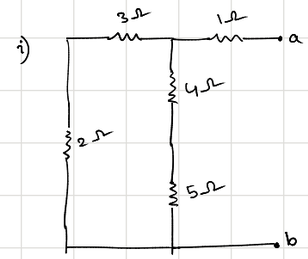
$\Rightarrow I_o = \frac{20}{31}$ A

superposition $I_o = \frac{20}{31}$ A

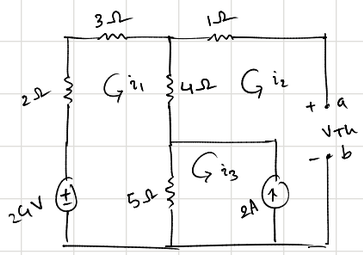
For the circuit shown in **Figure 2**, determine the following questions:
i) For the circuit shown below, find the thevenin equivalent circuit at the **A-B** terminal.
ii) For any resistance connected right to **A-B** terminal, what will be the maximum power delivered to the resistance?
iii) If 10Ω resistance is connected between **A-B**, then would maximum power be achieved? If not then what should you do?



i)



$R_{Th} = 1 + (3+2) \| (4+5) = \frac{59}{14}$



$i_3 = 2 \quad i_2 = 0$

loop 1: $i_1(3+2+4+5) - 4i_2 - 5i_3 + 24 = 0$

$\Rightarrow 14i_1 - 0 - 10 + 24 = 0$

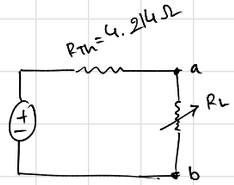
$\Rightarrow i_1 = -1$

loop 2+3: $i_2(1+4) + 5i_3 - i_1(4+5) - V_{Th} = 0$

$\Rightarrow 0 + 10 + 1 \times 9 - V_{Th} = 0$

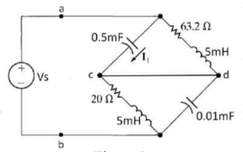
$\Rightarrow V_{Th} = 19$

$V_{Th} = 19V$



ii) $P_{max} = \frac{V_{Th}^2}{4R_{Th}} = 21.4167$

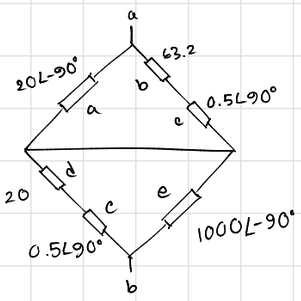
For the circuit shown in **Figure 3**, $V_s(t) = 15\cos(100t + 30°)$. Now, determine the following questions:
(a) Find equivalent impedance at terminals a − b.
(b) Find $I_1(t)$, $V_c(t)$, $V_d(t)$ and $V_{cd}(t)$.



a) $Z = a \| (b+c) + (d+c) \| e$

$= 31.5183 \angle -35.0865°$

b) $i = \frac{V_s}{Z} = 0.4759 \angle 65.0865°$



$I_1 = i \times \frac{b+c}{a+b+e}$

$= 0.45477 \angle 82.687°$

$I_1(t) = 0.45477\cos(100t + 82.687°)$

$V_{ac} = V_s \times \frac{a \| (b+c)}{a \| (b+c) + (d+c) \| e} = 9.09547 \angle -7.31282°$

$V_{ac} = V_s - V_c$

$\Rightarrow V_c = V_s - V_{ac} = 9.5241 \angle 63.37° \quad V_c = V_d \quad V_{cd} = 0$

$V_c(t) = 9.5241\cos(100t + 63.37°)$

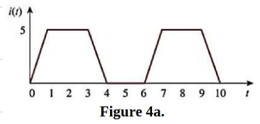


Figure 4a.

$i(t) = \begin{cases} 5t, & 0<t<1 \\ 5, & 1<t<3 \\ -5t+20, & 3<t<4 \\ 0, & 4<t<6 \end{cases}$

$\int_0^6 i(t)^2\,dt$

$= \int_0^1 25t^2\,dt + \int_1^3 25\,dt + \int_3^4 (-5t+20)^2\,dt + 0$

$= \frac{200}{3}$

$i_{rms} = \sqrt{\frac{1}{6} \cdot \frac{200}{3}}$

$= \frac{10}{3}$

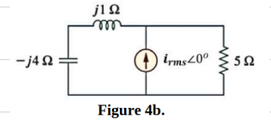


Figure 4b.

$i = \frac{10}{3} \angle 0°$

$i(5) = i \times \frac{-3j}{-3j+5} = 1.71498 \angle -59.036°$

$i(5)_{rms} = \frac{1.71498}{\sqrt{2}} = 1.212678$

$P = i(5)_{rms}^2 \times 5 = 7.3529$ W