Homwork 3 جواب سوالات

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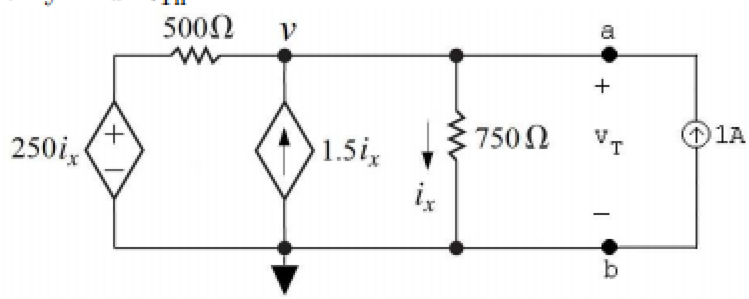
$V_{\mathrm{Th}} = 0$ since there are no independent sources in the circuit. Thus we need only find R_{Th}.



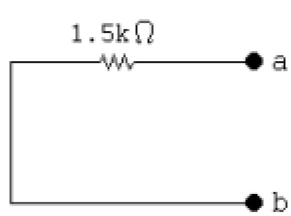
$$\frac{v - 250i_x}{500} - 1.5i_x + \frac{v}{750} - 1 = 0$$

$$i_x = \frac{v}{750}$$

Solving,

$$v = 1500\,\mathrm{V}; \qquad i_x = 2\,\mathrm{A}$$

$$R_{\mathrm{Th}} = \frac{v}{1\,\mathrm{A}} = 1500 = 1.5\,\mathrm{k\Omega}$$



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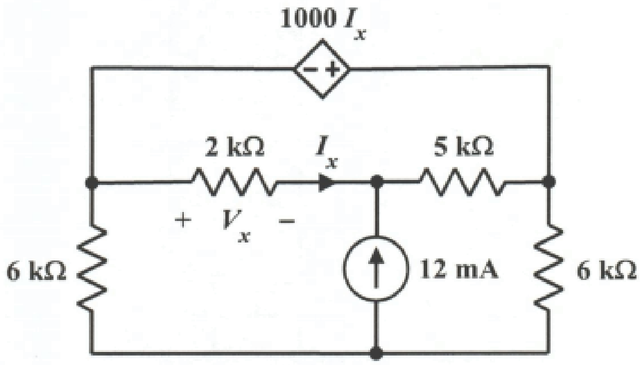
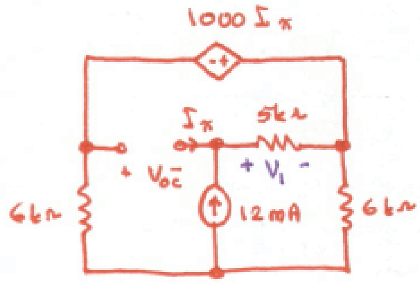
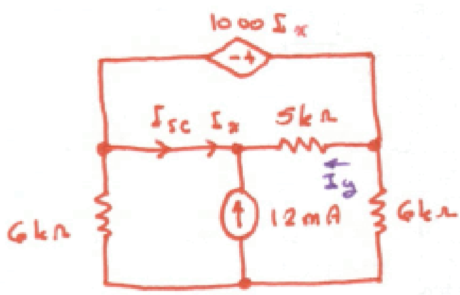




$I_x = 0 \Rightarrow V_1 = (5k\Omega)(12mA) = 60V$

$\Rightarrow 1000\, I_x = 0 \Rightarrow V_{oc} = -V_1 = -60V$



$I_y = \dfrac{1000\, I_x}{5k\Omega} = \frac{1}{5} I_x$

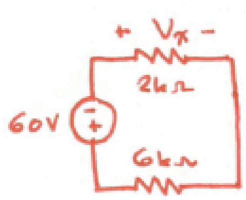
$I_y + I_x = -12mA \Rightarrow 1.2\, I_x = -12\,mA$

$\therefore\ I_x = -10\,mA$

$I_{sc} = I_x = -10\,mA$

$V_T = V_{oc} = -60V$

$R_T = \dfrac{V_{oc}}{I_{sc}} = \dfrac{-60V}{-10\,mA} = 6k\Omega$



$V_x = -\dfrac{2k\Omega}{2k\Omega + 6k\Omega}(60V) = -15V$

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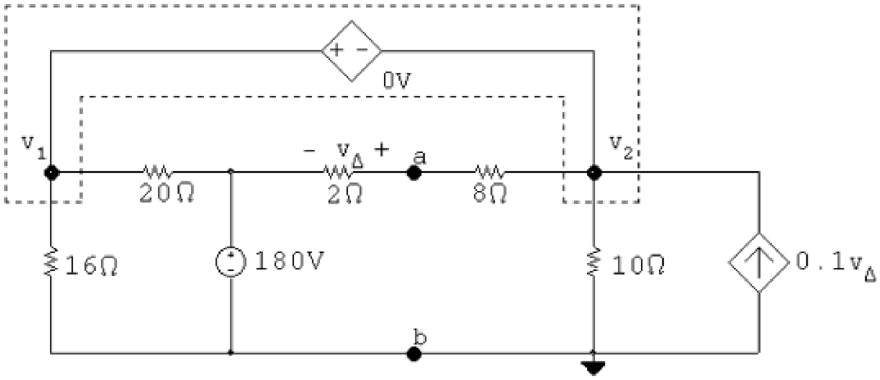
[a] First find the Thévenin equivalent with respect to R_o.

Open circuit voltage: $i_\phi = 0$; $184\phi = 0$



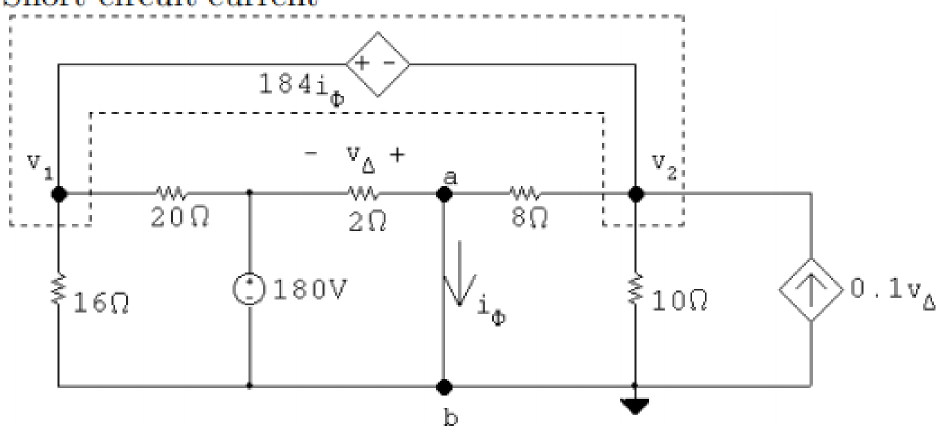
$$\frac{v_1}{16} + \frac{v_1 - 180}{20} + \frac{v_1 - 180}{10} + \frac{v_1}{10} - 0.1v_\Delta = 0$$

$$v_\Delta = \frac{v_1 - 180}{10}(2) = 0.2v_1 - 36$$

$$v_1 = 80\,\text{V}; \qquad v_\Delta = -20\,\text{V}$$

$$V_{\text{Th}} = 180 + v_\Delta = 180 - 20 = 160\,\text{V}$$

Short circuit current



$$\frac{v_1}{16} + \frac{v_1 - 180}{20} + \frac{v_2}{8} + \frac{v_2}{10} - 0.1(-180) = 0$$

$$v_2 + 184i_\phi = v_1$$

$$i_\phi = \frac{180}{2} + \frac{v_2}{8} = 90 + 0.125v_2$$

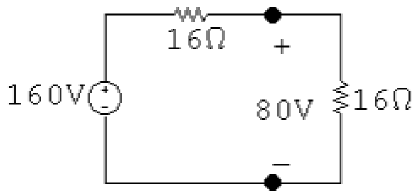
$$v_2 = -640\,\text{V}; \qquad v_1 = 1200\,\text{V}$$

$i_\phi = i_{sc} = 10\,\text{A}$

$R_{Th} = V_{Th}/i_{sc} = 160/10 = 16\,\Omega$

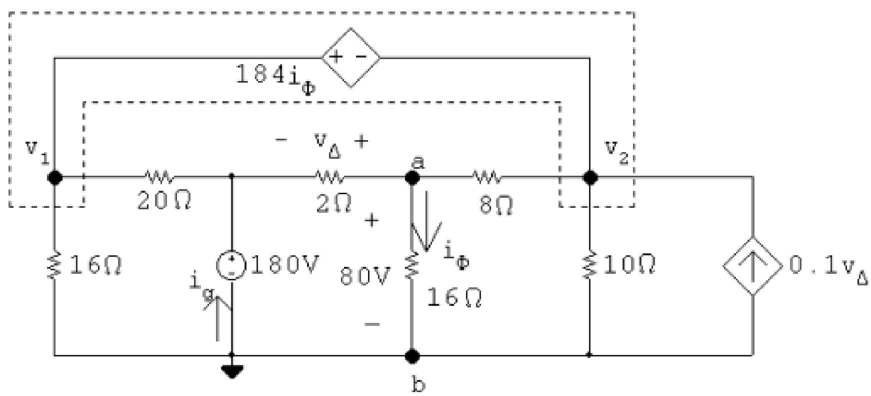
$\therefore \quad R_o = 16\,\Omega$

[b]



$$p_{max} = (80)^2/16 = 400\,\text{W}$$

[c]



$$\frac{v_1}{16} + \frac{v_1 - 180}{20} + \frac{v_2 - 80}{8} + \frac{v_2}{10} - 0.1(80 - 180) = 0$$

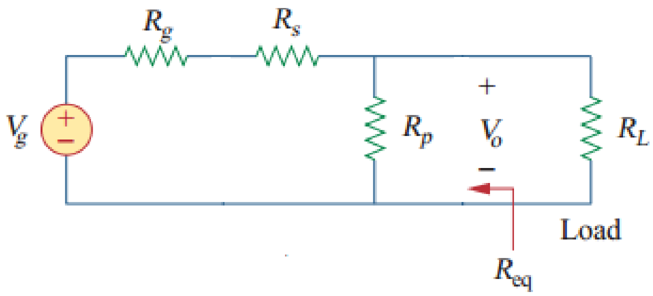
$v_2 + 184 i_\phi = v_1; \qquad i_\phi = 80/16 = 5\,\text{A}$

Therefore, $v_1 = 640\,\text{V}$ and $v_2 = -280$ V; thus,

$$i_g = \frac{180 - 80}{2} + \frac{180 - 640}{20} = 27\,\text{A}$$

p_{180V} (dev) $= (180)(27) = 4860\,\text{W}$

400*100/4860= 8.23 %



(a) $$V_o/V_g = R_p/(R_g + R_s + R_p) \qquad (1)$$

$$R_{eq} = R_p||(R_g + R_s) = R_g$$

$$R_g = R_p(R_g + R_s)/(R_p + R_g + R_s)$$

$$R_gR_p + R_g^2 + R_gR_s = R_pR_g + R_pR_s$$

$$R_pR_s = R_g(R_g + R_s) \qquad (2)$$

From (1), $$R_p/\alpha = R_g + R_s + R_p$$

$$R_g + R_s = R_p((1/\alpha) - 1) = R_p(1 - \alpha)/\alpha \qquad (1a)$$

Combining (2) and (1a) gives,

$$R_s = [(1 - \alpha)/\alpha]R_{eq} \qquad (3)$$

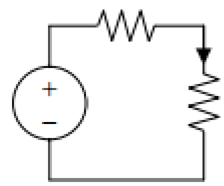
$$= (1 - 0.125)(100)/0.125 = \underline{\textbf{700 ohms}}$$

From (3) and (1a),

$$R_p(1 - \alpha)/\alpha = R_g + [(1 - \alpha)/\alpha]R_g = R_g/\alpha$$

$$R_p = R_g/(1 - \alpha) = 100/(1 - 0.125) = \underline{\textbf{114.29 ohms}}$$

(b)

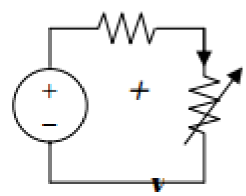


$$V_{Th} = V_s = 0.125V_g = 1.5 \text{ V}$$

$$R_{Th} = R_g = 100 \text{ ohms}$$

$$I = V_{Th}/(R_{Th} + R_L) = 1.5/150 = \underline{\mathbf{10\ mA}}$$

We replace the box with the Thevenin equivalent.



$$V_{Th} = v + iR_{Th}$$

When $i = 1.5$, $v = 3$, which implies that $V_{Th} = 3 + 1.5R_{Th}$ (1)

When $i = 1$, $v = 8$, which implies that $V_{Th} = 8 + 1xR_{Th}$ (2)

From (1) and (2), $R_{Th} = 10$ ohms and $V_{Th} = 18$ V.

(a) When $R = 4$, $i = V_{Th}/(R + R_{Th}) = 18/(4 + 10) =$ **1.2857 A**

(b) For maximum power, $R = R_{TH}$

$$P_{max} = (V_{Th})^2/4R_{Th} = 18^2/(4x10) = \underline{\mathbf{8.1\ watts}}$$

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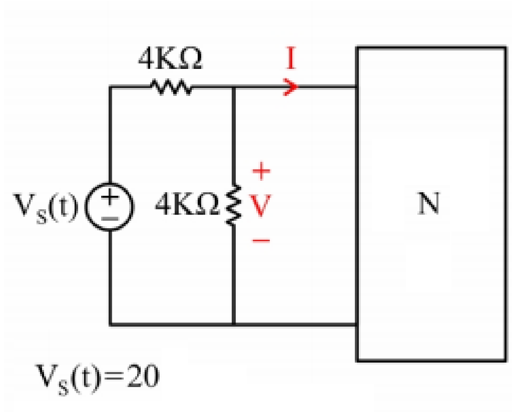
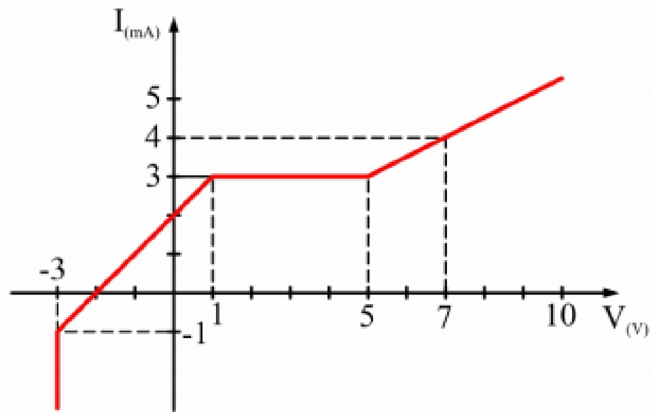
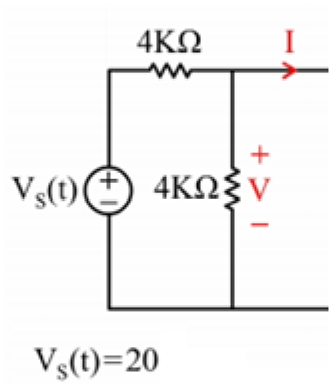




First find the Thévenin equivalent

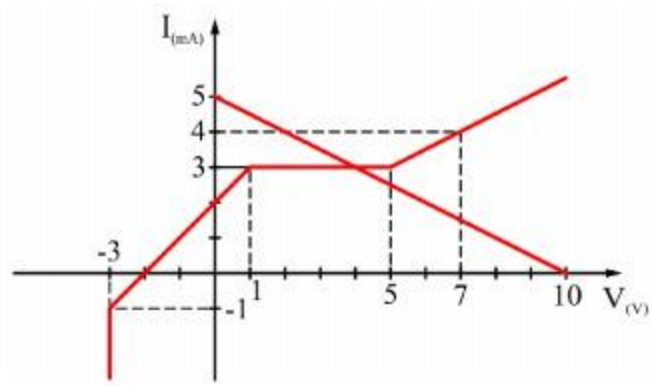


$$R_{th} = 2K\Omega \quad , \quad e_{oc} = \frac{V_s}{2} \quad \Rightarrow \quad V = 2I + \frac{V_s}{2}$$

The relationship between voltage and current for the above figure is obtained as follows

$$V = -2I + 10$$

Then we obtain the intersection point of this equation with the V-I diagram of bipolar N:



$$\Rightarrow \quad i=3 \quad \Rightarrow \quad V=-2\times 3+10=4$$