جواب سوالات Homwork 3

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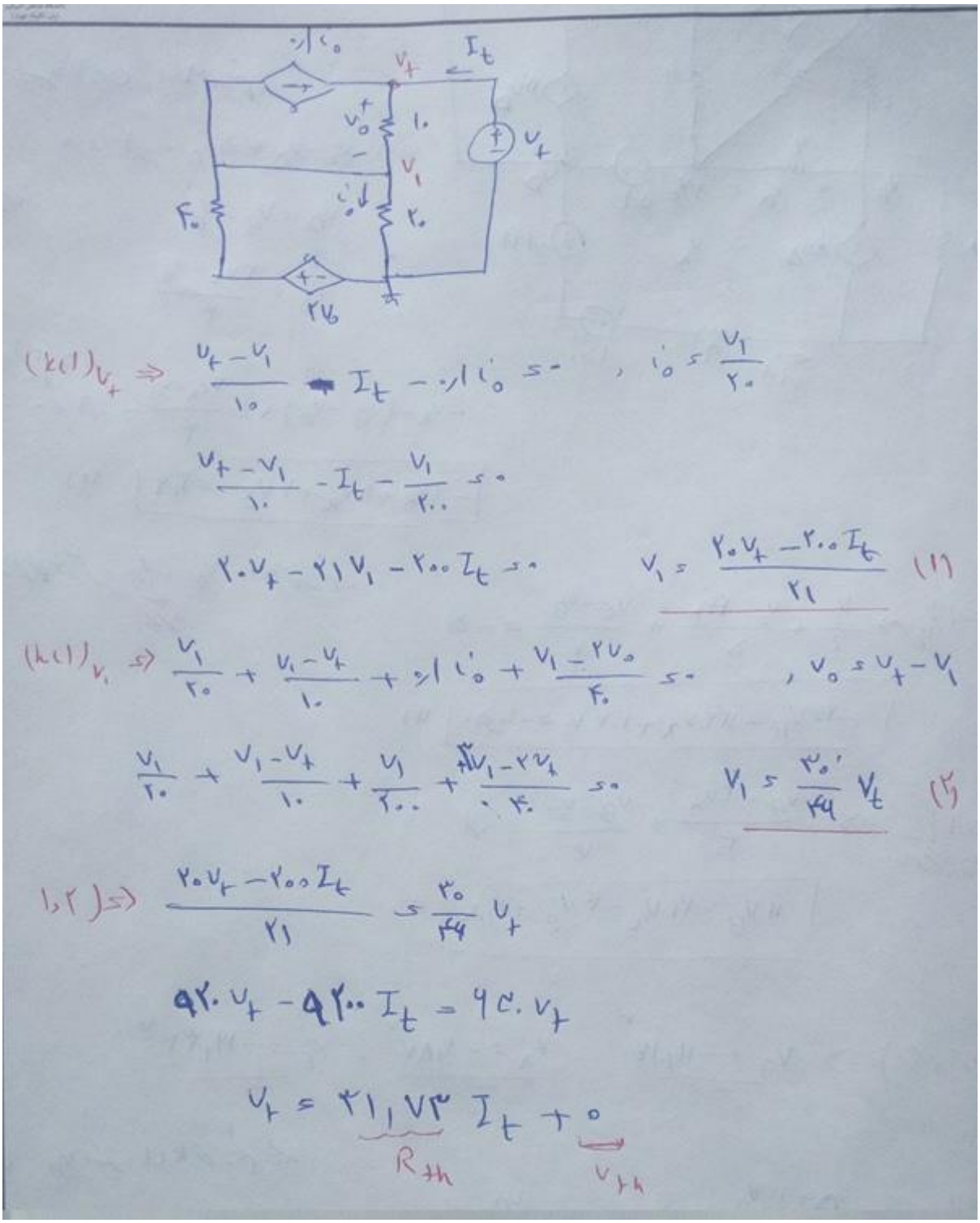


$$(KCL)_{V_t} \Rightarrow \frac{V_t - V_1}{10} - I_t - 0.1 i_0 = 0 \quad , \quad i_0 = \frac{V_1}{20}$$

$$\frac{V_t - V_1}{10} - I_t - \frac{V_1}{200} = 0$$

$$20V_t - 21V_1 - 200 I_t = 0 \qquad V_1 = \frac{20V_t - 200 I_t}{21} \quad (1)$$

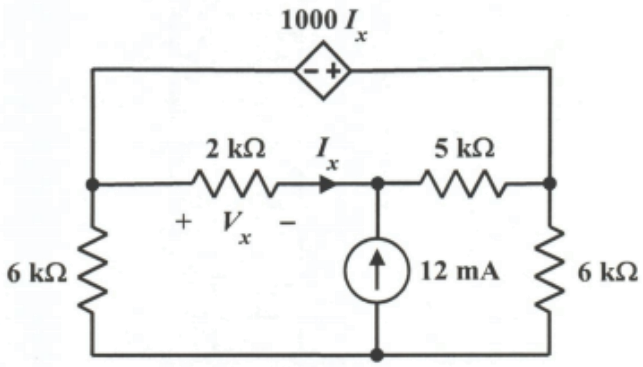
$$(KCL)_{V_1} \Rightarrow \frac{V_1}{20} + \frac{V_1 - V_t}{10} + 0.1 i_0 + \frac{V_1 - 25_0}{40} = 0 \quad , \quad V_0 = V_t - V_1$$

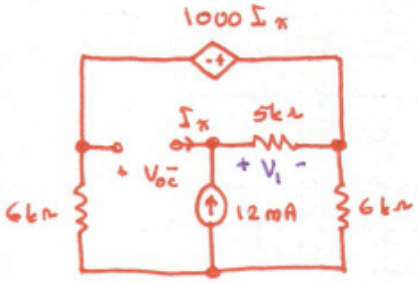
$$\frac{V_1}{20} + \frac{V_1 - V_t}{10} + \frac{V_1}{200} + \frac{4V_1 - 2V_t}{40} = 0 \qquad V_1 = \frac{30}{49} V_t \quad (2)$$

$$(1,2) \Rightarrow \frac{20V_t - 200 I_t}{21} = \frac{30}{49} V_t$$

$$980 V_t - 9800 I_t = 630 V_t$$

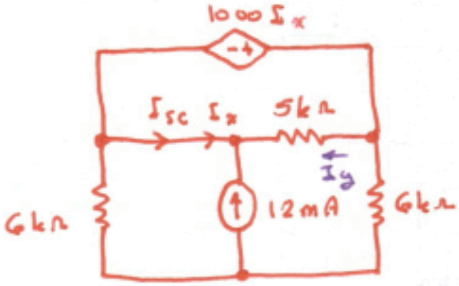
$$V_t = \underbrace{31.34}_{R_{th}} I_t + \underbrace{0}_{V_{th}}$$





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

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



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

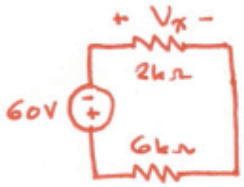
$I_y + I_x = -12mA \Rightarrow 1.2\, I_x = -12mA$

$\therefore I_x = -10mA$

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

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

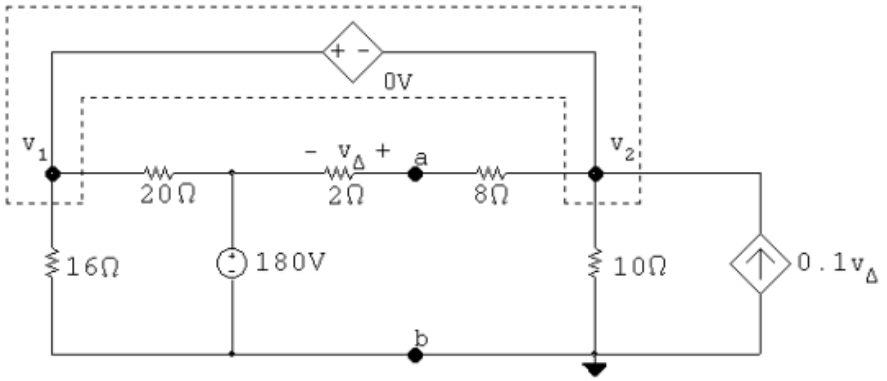
$R_T = \frac{V_{oc}}{I_{sc}} = \frac{-60V}{-10mA} = 6k\Omega$



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

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

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



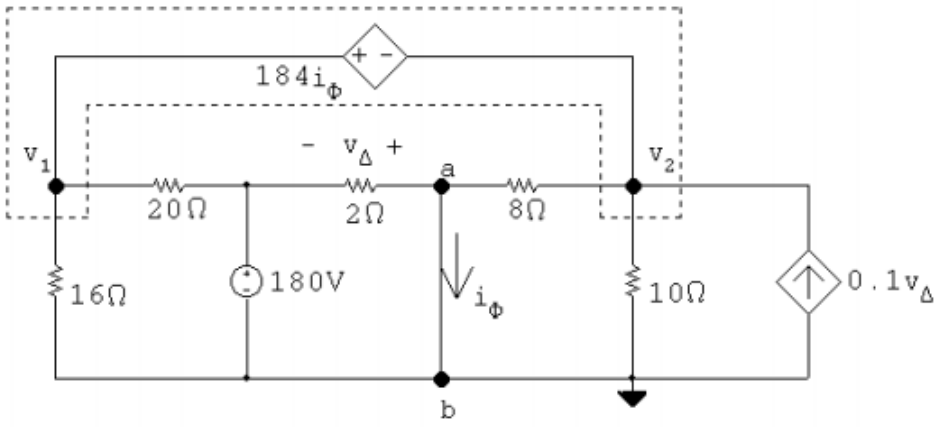
$$\frac{v_1}{16} + \frac{v_1 - 180}{20} + \frac{v_1 - 180}{10} + \frac{v_1}{10} - 0.1v_\Delta = 0$$

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

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

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

Short circuit current



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

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

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

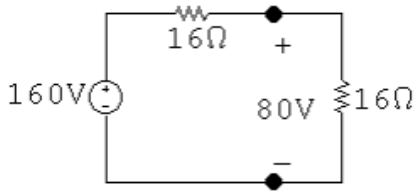
$$v_2 = -640\,\text{V}; \qquad v_1 = 1200\,\text{V}$$

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

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

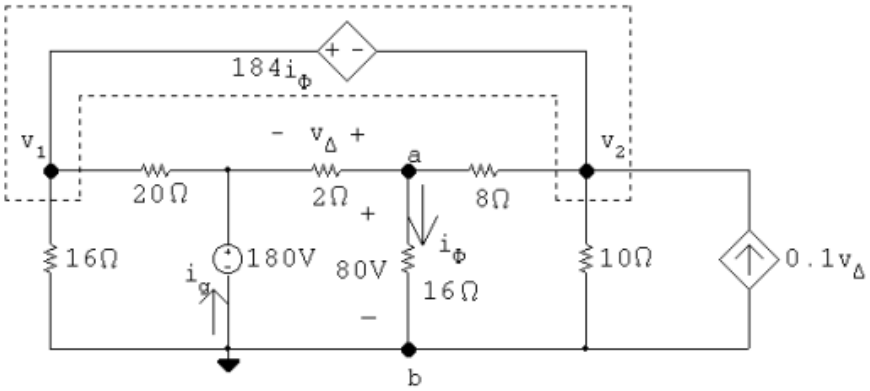
$\therefore \quad R_o = 16\,\Omega$

[b]



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

[c]



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

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

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

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

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

400*100/4860= 8.23 %

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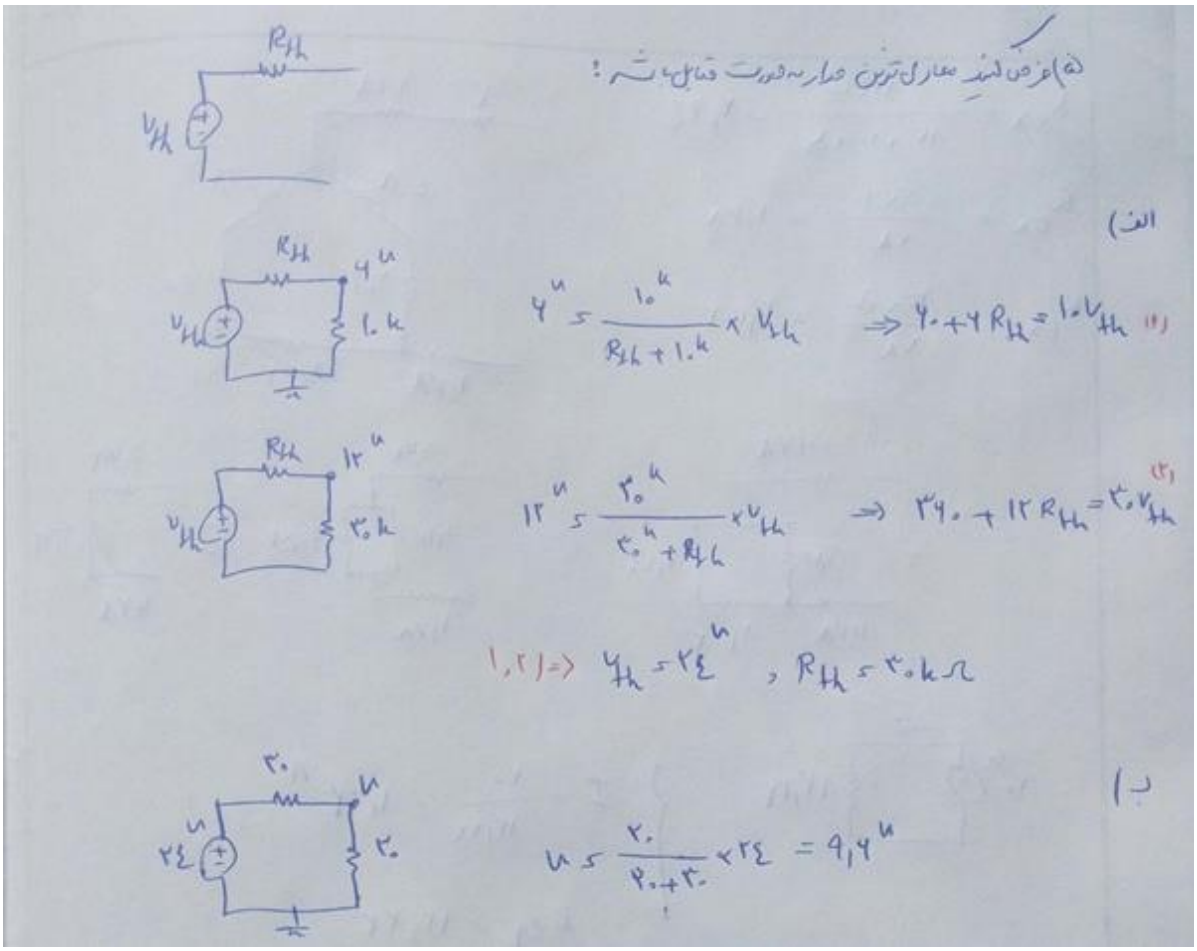
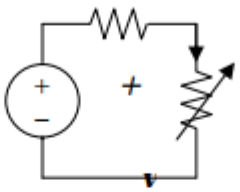

R_{th}
V_{th}
الف)
R_{th}
4^v
V_{th}
$1.k$
$4^v = \frac{1.^k}{R_{th}+1.^k} \times V_{th} \Rightarrow 4.+4R_{th} = 1.V_{th}$ (۱)
R_{th}
12^v
V_{th}
$3.k$
$12^v = \frac{3.^k}{3.^k+R_{th}} \times V_{th} \Rightarrow 360+12R_{th} = 3.V_{th}$ (۲)
$1,2 \Rightarrow V_{th} = 24^v$, $R_{th} = 3.k\Omega$
ب)
$3.$
v
24^v
$3.$
$v = \frac{3.}{3.+3.} \times 24 = 9,4^v$

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)

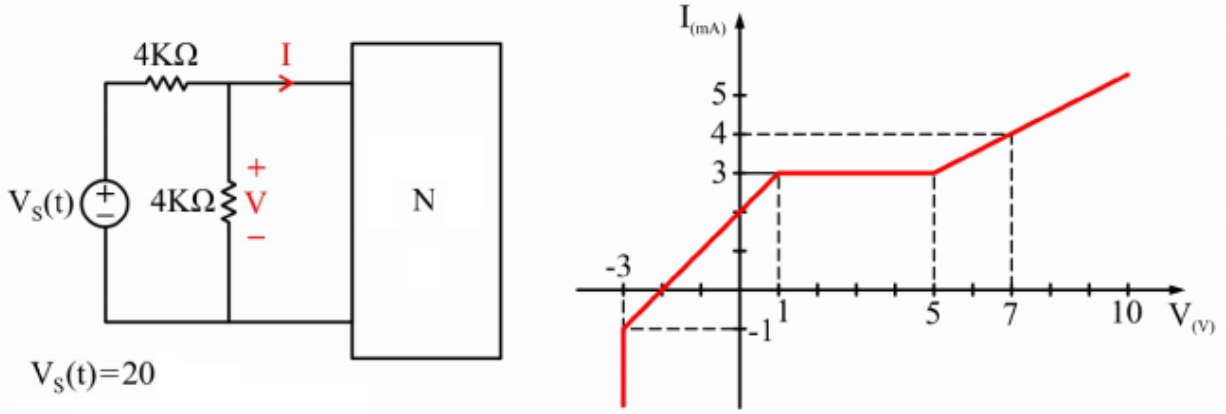
When $i = 1$, $v = 8$, which implies that $V_{Th} = 8 + 1xR_{Th}$ (2)

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

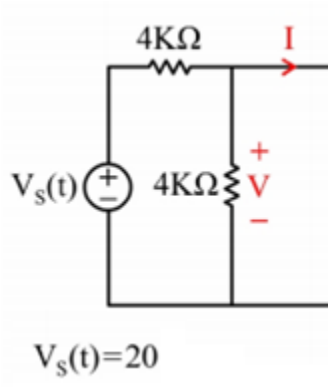
(a) When $R = 4$, $i = V_{Th}/(R + R_{Th}) = 18/(4 + 10) =$ **1.2857 A**

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

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



First find the Thévenin equivalent

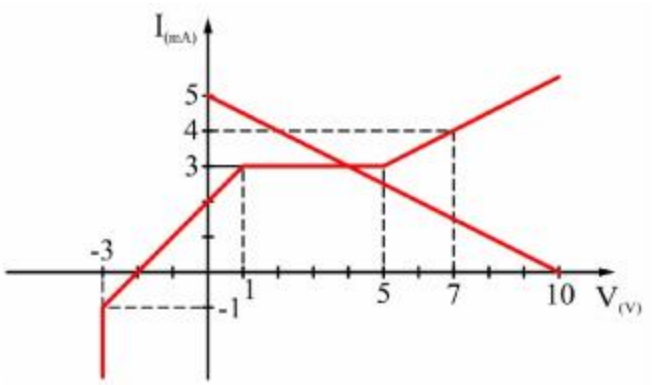


$$R_{th} = 2K\Omega \quad , \quad e_{oc} = \frac{V_s}{2} \quad \Rightarrow \quad V = 2I + \frac{V_s}{2}$$

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:



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