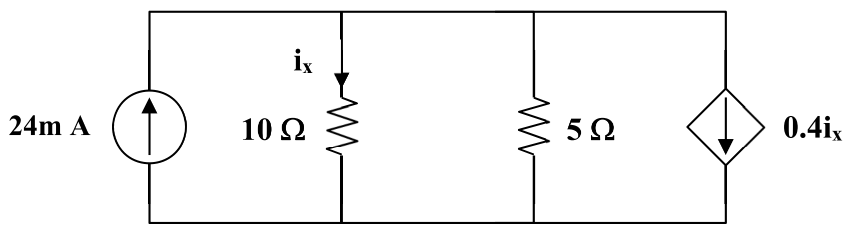
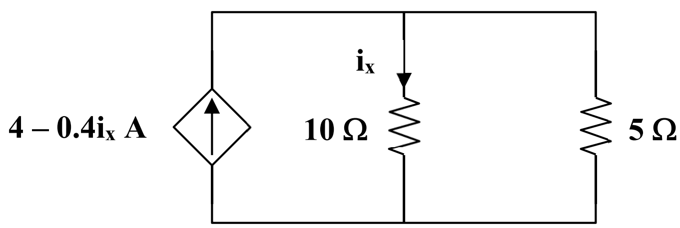
P.P.4.7 We transform the dependent voltage source as shown in Fig. (a). We combine the two current sources in Fig. (a) to obtain Fig. (b). By the current division principle,

$$i_x = \frac{5}{15}\left(0.024 - 0.4 i_x\right) \longrightarrow i_x = \mathbf{7.059\ mA}$$

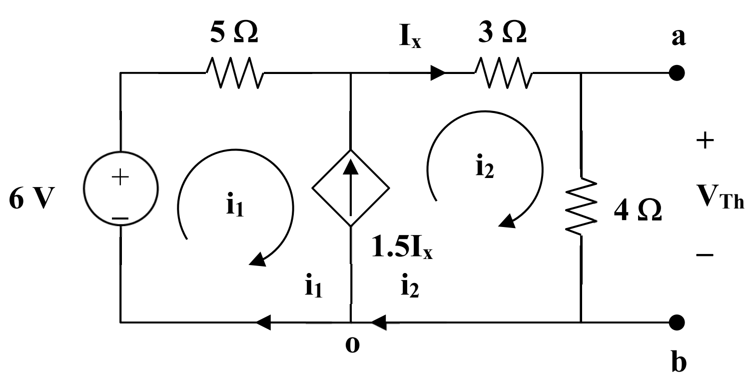


(a)

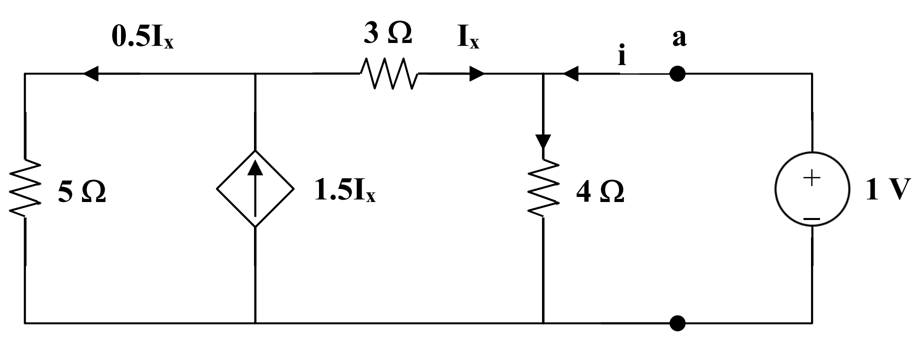


(b)

P.P.4.9 To find V_{Th}, consider the circuit in Fig. (a).



(a)



(b)

$I_x = i_2$

$i_2 - i_1 = 1.5I_x = 1.5i_2 \longrightarrow i_2 = -2i_1$ (1)

For the supermesh, $-6 + 5i_1 + 7i_2 = 0$ (2)

From (1) and (2), $i_2 = 4/(3)$A

$V_{Th} = 4i_2 =$ **5.333V**

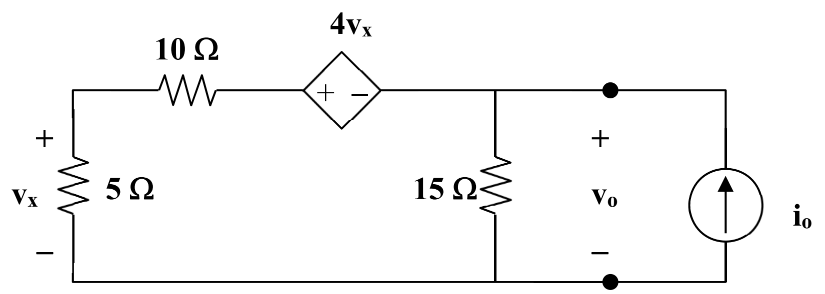
To find R_{Th}, consider the circuit in Fig. (b). Applying KVL around the outer loop,

$$5(0.5I_x) - 1 - 3I_x = 0 \longrightarrow I_x = -2$$

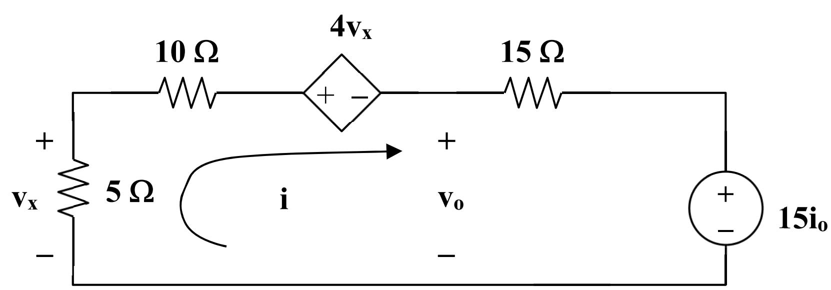
$$i = \frac{1}{4} - I_x = 2.25$$

$$R_{Th} = \frac{1}{i} = \frac{1}{2.25} = \mathbf{444.4\ m\Omega}$$

P.P.4.10 Since there are no independent sources, $V_{Th} = 0$



(a)



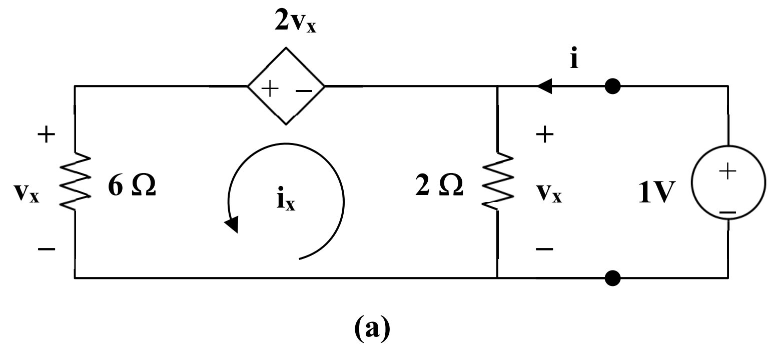
(b)

To find R_{Th}, consider Fig.(a). Using source transformation, the circuit is transformed to that in Fig. (b). Applying KVL,).

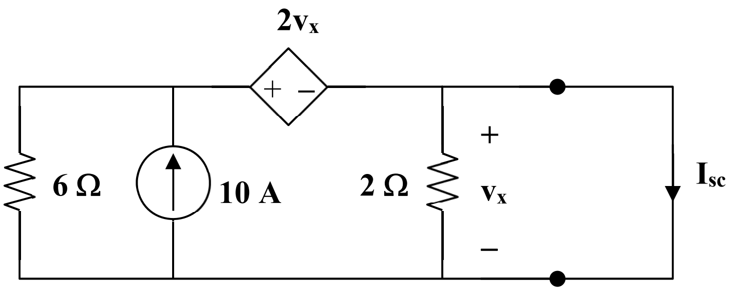
But $v_x = -5i$. Hence, $30i - 20i + 15i_o = 0 \longrightarrow 10i = -15i_o$

$v_o = (15i + 15i_o) = 15(-1.5i_o + i_o) = -7.5i_o$
$R_{Th} = v_o/(i_o) =$ **-7.5Ω It needs to be noted that this negative resistance indicates we must have an active source (a dependent source).**

P.P.4.12



(a)



(b)

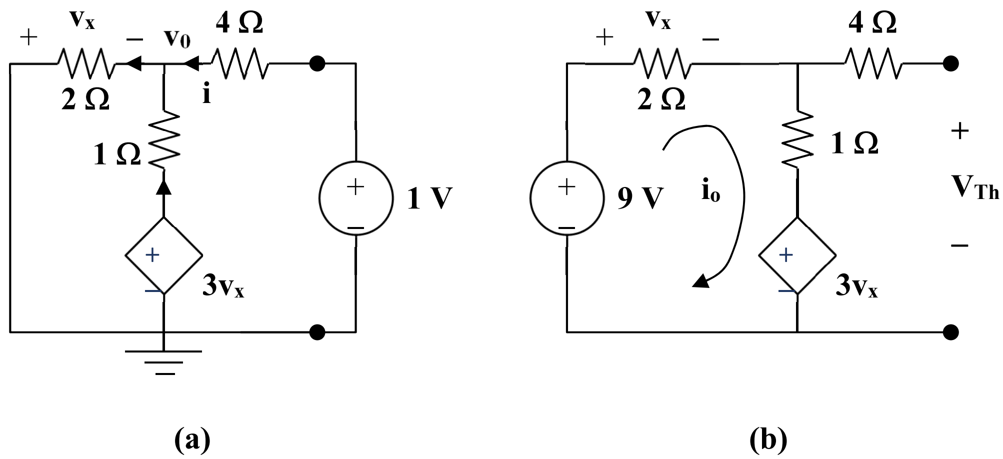
To get R_N consider the circuit in Fig. (a). Applying KVL, $6i_x - 2v_x - 1 = 0$
But $v_x = 1$, $\quad 6i_x = 3 \longrightarrow i_x = 0.5$

$$i = i_x + \frac{v_x}{2} = 0.5 + 0.5 = 1$$

$$R_N = R_{Th} = \frac{1}{i} = \mathbf{1\Omega}$$

To find I_N, consider the circuit in Fig. (b). Because the 2Ω resistor is shorted, $v_x = 0$ and the dependent source is inactive. Hence, $I_N = i_{sc} =$ **10A**.

P.P.4.13 We first need to find R_{Th} and V_{Th}. To find R_{Th}, we consider the circuit in Fig. (a).



Applying KCL at the top node gives

$$\frac{1-v_o}{4}+\frac{3v_x-v_o}{1}=\frac{v_o}{2}$$

But $v_x = -v_o$. Hence

$$\frac{1-v_o}{4}-4v_o=\frac{v_o}{2} \longrightarrow v_o = 1/(19)$$

$$i=\frac{1-v_o}{4}=\frac{1-\frac{1}{19}}{4}=\frac{9}{38}$$

$R_{Th} = 1/i = 38/(9) = \mathbf{4.222\Omega}$

To find V_{Th}, consider the circuit in Fig. (b),

$$-9 + 2i_o + i_o + 3v_x = 0$$

But $v_x = 2i_o$. Hence,

$$9 = 3i_o + 6i_o = 9i_o \longrightarrow i_o = 1A$$

$$V_{Th} = 9 - 2i_o = 7V$$

$R_L = R_{Th} = \mathbf{4.222\ \Omega}$

$$P_{max}=\frac{v_{Th}^2}{4R_L}=\frac{49}{4(4.222)}=\mathbf{2.901\ W}$$