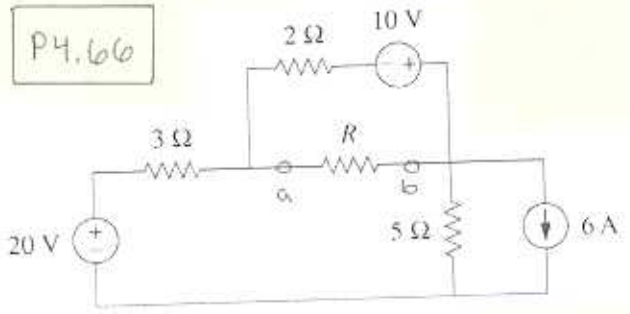
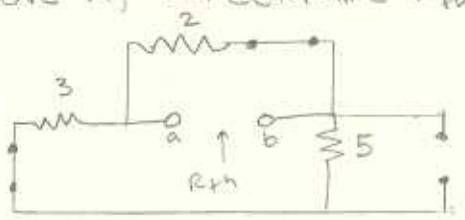
PS7 | P 4.66, 4.67

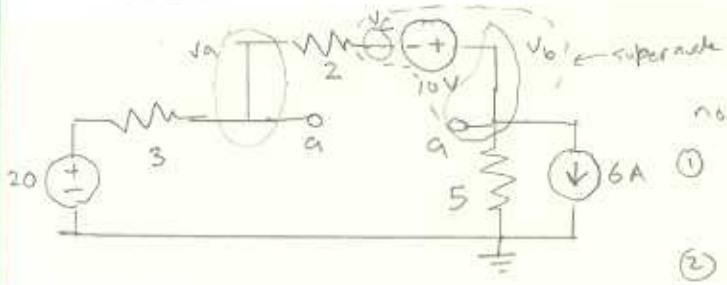
P4.66



remove R, and determine R_{th}



$R_{th} = 2 \| (3+5) = 2 \| 8 = \boxed{1.6\,\Omega}$



nodal analysis:

① $\frac{V_a - 20}{3} + \frac{V_a - V_c}{2} = 0 \qquad 5V_a + 0V_b - 3V_c = 40$

② $\frac{V_c - V_a}{2} + \frac{V_b}{5} = -6 \qquad -5V_a + 2V_b + 5V_c = -60$

③ $V_c + 10 = V_b \qquad 0V_a - V_b + V_c = -10$

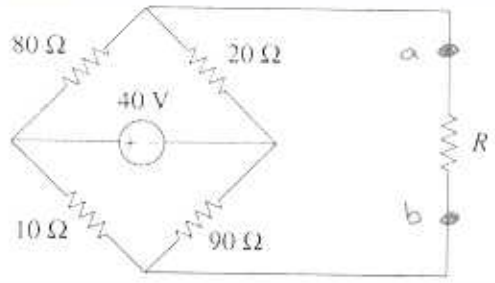
$$\begin{bmatrix} 5 & 0 & -3 \\ -5 & 2 & 5 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 40 \\ -60 \\ -10 \end{bmatrix}$$

$V_a = 2$
$V_b = 0$
$V_c = -10$

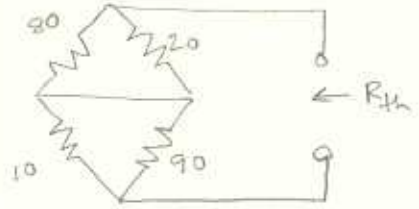
$V_{th} = V_a - V_b$
$= 2 - 0 = 2\,V$

$P_{L\,max} = \frac{V_{th}^2}{4 R_{th}} = \frac{(2)^2}{4 \cdot 1.6\,\Omega} = 5/8 = \boxed{0.625\,W}$

P4.67

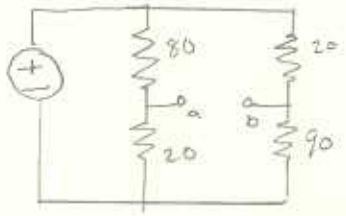


ⓐ compute R_{th}



$R_{th} = 20 \| 80 + 10 \| 90$
$= 16 + 9 = \boxed{25\,\Omega}$

V_{th}



$V_a = \frac{20}{20+80} \cdot 40 = 8\,V$

$V_b = \frac{90}{90+10} \cdot 40 = 36\,V$

$V_{th} = V_a - V_b$
$= 8 - 36$
$= -28\,V$

$P_{L\,max} = \frac{V_{th}^2}{4 R_{th}} = \frac{(-28)^2}{4 \cdot 25} = \boxed{7.84\,W}$