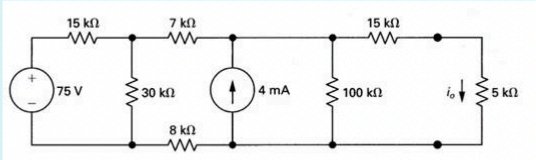
①



P4.51_6ed

Use source transformations to:

a) Find the current i0 through the 5 kΩ (kilo Ohm) resistor.

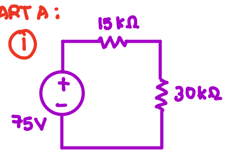
i_0 = 3 ✔ mA (milli Amp)

b) Find the power absorbed/delivered by the 75V voltage source.

P_{75V} = -105 ✔ mW (milli Watt)

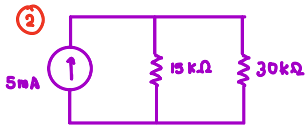
PART A :

①



$$i_s = \frac{V_s}{R} = \frac{75V}{15000\Omega} = 0.005 A \approx 5mA$$

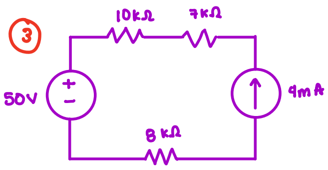
②



$$R = 15 \| 30 = \frac{15 \cdot 30}{15+30} = 10k\Omega$$

$$V_s = i_s R = (0.005A)(10k\Omega) = 50V$$

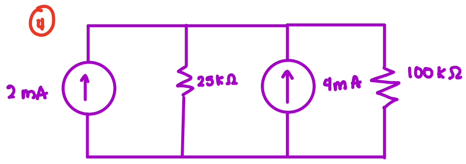
③



$$R = 10+7+8 = 25k\Omega$$

$$i_s = \frac{V_s}{R} = \frac{50V}{25k\Omega} = 2mA$$

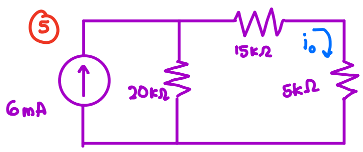
④



$$R = 25 \| 100 = 20 k\Omega$$

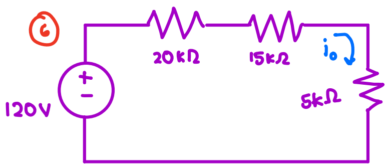
$$i = 2 \| 4 = 6 mA$$

⑤



$$V_s = i_s R = (6mA)(20k\Omega) = 120V$$

⑥

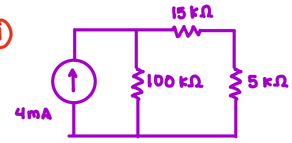


$$R = 20+15+5 = 40k\Omega$$

$$i_o = \frac{V_s}{R} = \frac{120V}{40k\Omega} = \boxed{3mA}$$

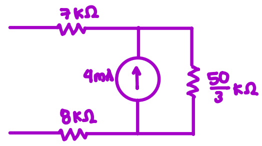
PART B :

①



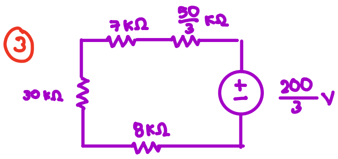
$$R = (15+5) \| 100 = 50/3 \ k\Omega$$

②



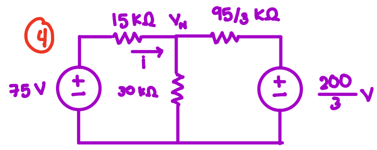
$$V_s = i_s R = (4mA)(\tfrac{50}{3}k\Omega) = \frac{200}{3} V$$

③



$$R = 7 + 50/3 + 8 = 95/3 \ k\Omega$$

④



NODE V_N: $\left[\frac{75 - V_N}{15k} - \frac{V_N}{30k} + \frac{200/3 - V_N}{95/3 \, k} = 0\right] k$

$$\frac{75}{15} + V_N\left[-\frac{1}{15} - \frac{1}{30} - \frac{3}{95}\right] + \frac{200}{95} = 0$$

$$\frac{5}{38} V_N = \frac{135}{19}$$

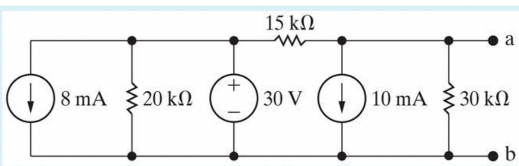
$$V_N = 54 V$$

$$i = \frac{75 - V_N}{15k} = \frac{75-54}{15k} = 1.4mA$$

$$P_{75V} = iV = (1.4mA)(75V) = 0.105W$$

$$\approx \boxed{105 mW \ (-) \text{ DELIVERED}}$$

②

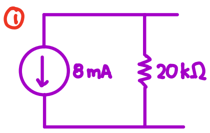


P4.66_8ed

Find the Norton equivalent with respect to the terminals a,b.

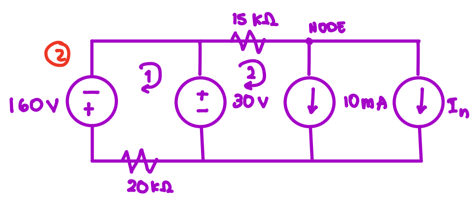
I_N = -8 ✔ mA (milli A) RTh = 10 ✔ kΩ (kilo Ohm)

①



$$V_s = i_s R = (8mA)(20k\Omega) = 160V$$

②



LOOP 2: $30 - (15k)i_2 = 0$

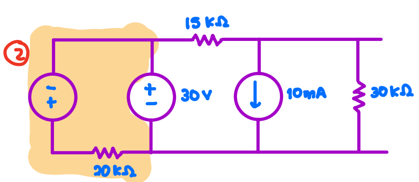
$i_2 = 2mA$

NODE: 2mA → I_n, ↓ 10mA

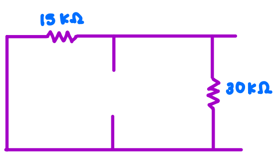
$$2 - 10 - I_n = 0$$

$$I_n = -8mA$$

②

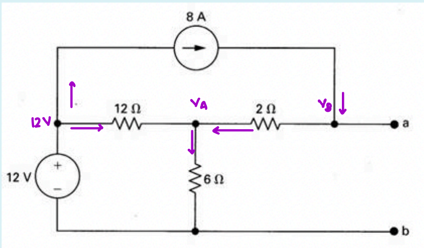


NOT INCLUDED



$$R_{TH} = 15 \| 30 = 10k\Omega$$

3



P4.59_6ed

Find the Thévenin equivalent circuit with respect to the terminals a,b for this circuit.

V_{Th} = 52 ✔ V

R_{Th} = 6 ✔ Ω (Ohm)

NODE V_A: $\left[\frac{12-V_A}{12} - \frac{V_A}{6} + \frac{V_B-V_A}{2} = 0\right]12$

$12 - V_A - 2V_A + 6V_B - 6V_A = 0$

$-9V_A + 6V_B + 12 = 0$

$9V_A - 6V_B = 12$

$3V_A - 2V_B = 4$

NODE V_B: $\left[-\frac{V_B - V_A}{2} + 8 = 0\right]2$

$-V_B + V_A + 16 = 0$

$-V_A + V_B = 16$

$3V_A - 2V_B = 4$

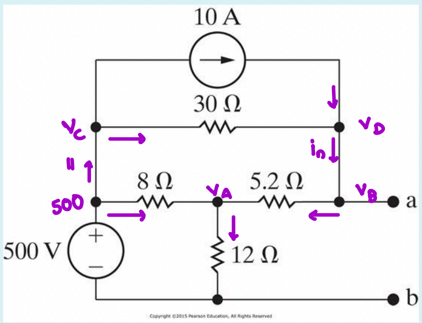
$\left[-V_A + V_B = 16\right]3$

$V_B = 52V \leftarrow V_{TH}$

$R_{TH} = 12\|6 + 2$

$= 4 + 2 = 6\Omega$

4



P4.67_10ed

Find the Thévenin equivalent circuit with respect to the terminals a,b for this circuit.

V_{Th} = 425 ✔ V

R_{Th} = 7.5 ✔ Ω (Ohm)

NODE V_A: $\frac{500-V_A}{8} - \frac{V_A}{12} + \frac{V_B - V_A}{5.2} = 0$

$\left[\frac{500-V_A}{8} - \frac{V_A}{12} + \frac{5(V_B-V_A)}{26} = 0\right]312$

$39(500-V_A) - 26V_A + (12)(5)(V_B - V_A) = 0$

$19500 - 39V_A - 26V_A + 60V_B - 60V_A = 0$

$[-125V_A + 60V_B + 19500 = 0]\ 1/5$

$25V_A - 12V_B = 3900$

- $i_n = 10 + \frac{500 - V_D}{30}$
- $V_D = V_B$

NODE V_B: $-\frac{V_B - V_A}{5.2} + i_n = 0$

$\left[-\frac{V_B - V_A}{26/5} + 10 + \frac{500 - V_B}{30} = 0\right]780$

$-150V_B + 150V_A + 7800 + 13000 - 26V_B = 0$

$[150V_A - 176V_B + 20800 = 0]\ 1/2$

$75V_A - 88V_B = -10400$

$[25V_A - 12V_B = 3900]\ -3$

$-52V_B = -22100$

$V_B = 425V$

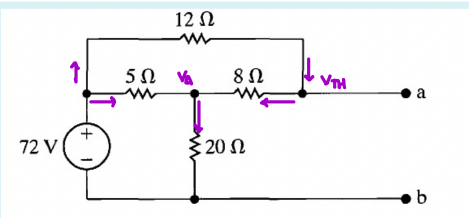
$R_{TH} = (8\|12 + 5.2)\|30$

$= (4.8 + 5.2)\|30$

$= 10\|30$

$R_{TH} = 7.5\Omega$

5



AP4.16_9ed

Find the Thévenin equivalent circuit with respect to the terminals a,b for the circuit shown

V_{Th} = 64.8 ✔ V

R_{Th} = 6 ✔ Ω (Ohms)

NODE V_A: $\left[\frac{72-V_A}{5} - \frac{V_A}{20} + \frac{V_{TH}-V_A}{8} = 0\right]40$

$576 - 8V_A - 2V_A + 5V_{TH} - 5V_A = 0$

$15V_A - 5V_{TH} = 576$

NODE V_{TH}: $\left[\frac{72 - V_{TH}}{12} - \frac{V_{TH} - V_A}{8} = 0\right]24$

$144 - 2V_{TH} - 3V_{TH} + 3V_A = 0$

$-3V_A + 5V_{TH} = 144$

$(-3V_A + 5V_{TH} = 144)5$

$15V_A - 5V_{TH} = 576$

$20V_{TH} = 1296$

$V_{TH} = 64.8\ V$

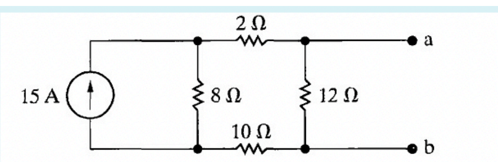
$R_{TH} = (5\|20 + 8)\|12$

$= (4+8)\|12$

$= 12\|12$

$R_{TH} = 6\Omega$

6



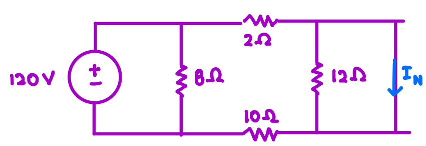
AP4.17_9ed

Find the Norton equivalent circuit with respect to the terminals a,b for the circuit.

I_N = 6 ✔ A (current directed toward terminal a)

$R_N = R_{Th}$ = 7.5 ✔ Ω (Ohm)

$V_s = (15A)(8\Omega) = 120\ V$

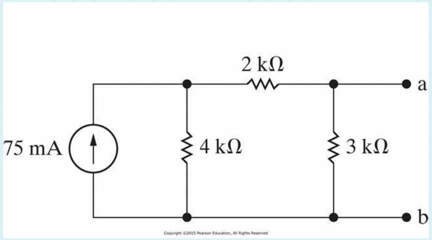


$R_{TH} = (2+8+10)\|12$

$= 20\|12$

$= 7.5\Omega$

7



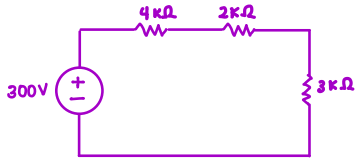
P4.65_10ed

Find the Norton equivalent circuit with respect to the terminals a,b for this circuit.

I_N = 50 ✔ mA (milli Amp)

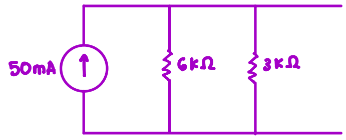
R_{Th} = 2000 ✔ Ω (Ohm)

$V_s = (75mA)(4k\Omega) = 300\ V$

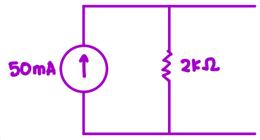


$R = 4+2 = 6k\Omega$

$i_s = 300/6k = 50mA$



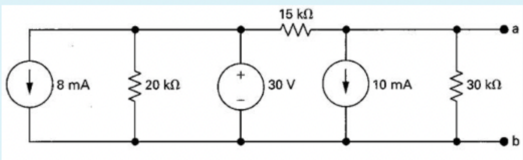
$R = 6 \| 3 = 2k\Omega$



$I_N = 50mA$

$R_{TH} = 2k\Omega$

8

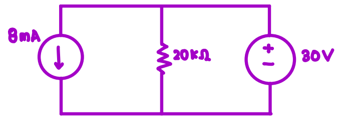


P4.62_6ed

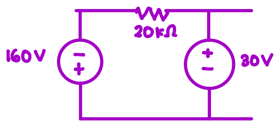
Find the Norton equivalent circuit with respect to the terminals a,b for this circuit. The Norton equivalent current should "point up".

I_N = -8 ✔ mA (milli Amp)

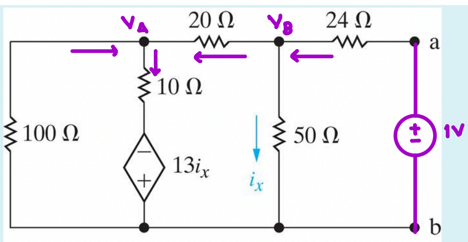
R_{Th} = 10 ✔ kΩ (kilo Ohm)



$V_s = (8mA)(20k\Omega) = 160V$



9



P4.80_10ed

Find the Thévenin equivalent circuit with respect to the terminals a,b for the circuit shown.

Hint: Note that there are no independent sources in this circuit! You will have to provide an excitation to get a response.

V_{Th} = 0.049 ✔ V

R_{Th} = 40.12 ✔ Ω (Ohm)

NODE V_A: $\left[\frac{V_A}{100} - \frac{V_A - 13i_x}{10} - \frac{V_B - V_A}{20} = 0\right] 100$

$V_A - 10V_A + 130i_x - 5V_B + 5V_A = 0$

$-4V_A - 5V_B + 130i_x = 0$ • $i_x = \frac{V_B}{50}$

$-4V_A - 5V_B + 130(V_B/50) = 0$

$[-4V_A + 5V_B + 13V_B/5 = 0]5$

$-20V_A + 38V_B = 0$

NODE V_B: $\left[\frac{V_B - V_A}{20} - \frac{V_B}{50} + \frac{1 - V_B}{24} = 0\right] 1200$

$60V_B - 60V_A - 24V_B + 50 - 50V_B = 0$

$60V_B - 134V_A + 50 = 0$

$67V_A - 30V_B = 25$

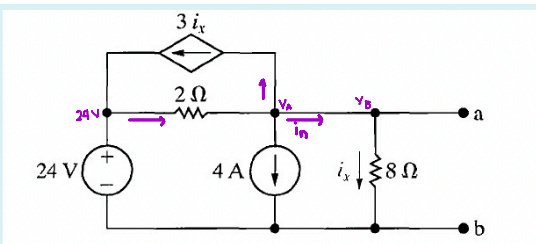
$[-20V_A + 38V_B = 0]\ 67$

$[67V_A - 30V_B = 25]\ 20$

$1946V_B = 500$

$V_B =$

10.



AP4.19_9ed

Find the Thévenin equivalent circuit with respect to the terminals a,b for the circuit shown

V_{Th} = 8 ✔ V

R_{Th} = 1 ✔ Ω (Ohm)

NODE V_A: $\frac{24 - V_A}{2} - 3i_x - 4 - i_n = 0$

NODE V_B: $i_n = \frac{V_B}{8}$

$i_x = \frac{V_B}{8}$

$\left[\frac{24 - V_A}{2} - 3\left[\frac{V_B}{8}\right] - 4 - \frac{V_B}{8} = 0\right] 8$

$96 - 4V_A - 3V_B - 32 - V_B = 0$

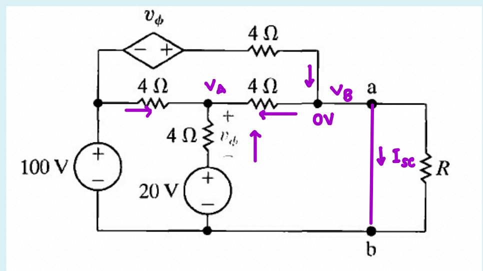
$-4V_A - 4V_B + 64 = 0$

$V_A = V_B$

$8V_A = 64$

$V_A = 8 = V_{TH}$

11.



AP4.21_9ed

a) Find the value of R that enable the circuit to deliver maximum power to the terminals a,b

R = 3 ✔ Ω (Ohm)

b) Find the maximum power delivered to R

P_R = 1200 ✔ W

Node V_A: $\frac{V_A-100}{4}+\frac{V_A-20}{4}+\frac{V_A-V_B}{4}=0$

$V_A-100+V_A-20+V_A-V_B=0$

$3V_A-V_B=120$

NODE V_B: $\frac{V_B-V_\phi-100}{4}-\frac{V_A-V_B}{4}=0$

$V_B-V_\phi-100-V_A+V_B=0$

$-V_A+2V_B-V_\phi=100$

$-V_A+2V_B-(V_A-20)=100$

$-2V_A+2V_B=80$

$(3V_A-V_B=120)\,2$

$(-2V_A+2V_B=80)\,3$

$4V_B=480$

$V_B=120=V_{TH}$

WHEN $V_B=0$:

NODE V_A: $\frac{V_A-100}{4}+\frac{V_A-20}{4}+\frac{V_A}{4}=0$

$3V_A=120 \longrightarrow V_A=40$

$V_\phi=V_A-20V=40V-20V$
$=20V$

NODE V_B: $\left[\frac{0-100-V_\phi}{4}+\frac{0-V_A}{4}+I_{sc}=0\right]4$

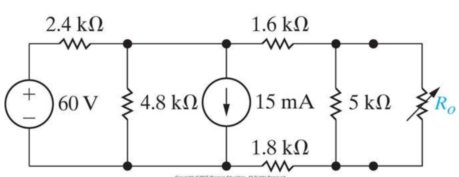
$-100-20-V_A+4I_{sc}=0$

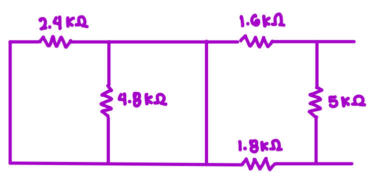
$I_{sc}=\frac{100+20+40}{4}=40\ A$

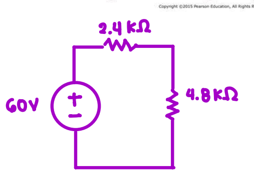
$R_{TH}=\frac{V_{TH}}{I_{sc}}=\frac{120\ V}{40\ A}=3\Omega$

$P_{Rmax}=I^2R=\left(\frac{V_{TH}}{R_{TH}+R_L}\right)^2R_L=\left(\frac{120\ V}{3\Omega+3\Omega}\right)^2(3\Omega)=1200\ W$

12.

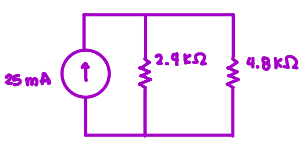






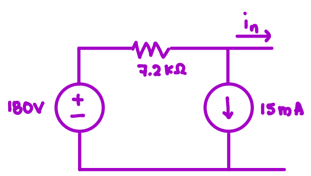
$i_s=V_s/R=60/2.4k=25\ mA$

$R_{TH}=[(2.4\,||\,4.8)+1.6+1.8]\,||\,5$
$=(1.6+1.6+1.8)\,||\,5$
$=5\,||\,5=2.5\,k\Omega$

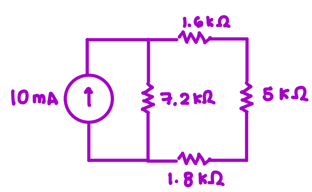


$R=2.4+4.8=7.2k\Omega$

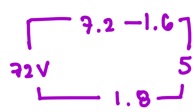
$V_s=i_sR=(25mA)(7.2k\Omega)$
$=180\ V$



$i_n=\frac{180}{7.2k}-15mA=10mA$



$V_s=(10mA)(7.2\,k\Omega)=72\ V$



15.6