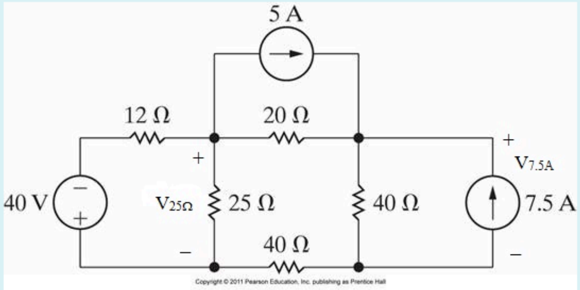
1



Q1d

a) Find the voltage across the 7.5A current source.

$V_{7.5A}$ = 216 ✔ Volts

b) Find the voltage across the 25 Ω (Ohm) resistor.

$V_{25\Omega}$ = -10 ✔ Volts

I_1: $-40 - 12I_1 - 25(I_1 - I_2) = 0$

$-40 - 12I_1 - 25I_1 + 25I_2 = 0$

$-37I_1 + 25I_2 = 40$

I_2: $25(I_1 - I_2) - 20(I_2 - I_4) - 40(I_2 - I_3) - 40I_2 = 0$

$25I_1 - 125I_2 + 100 - 300 = 0$

$25I_1 - 125I_2 = 200$

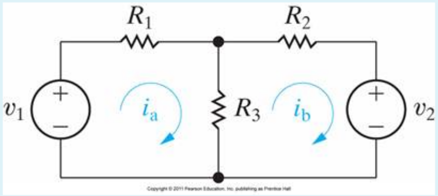
$I_1 - 5I_2 = 8$

$$\left.\begin{aligned} -37I_1 + 25I_2 &= 40 \\ I_1 - 5I_2 &= 8 \end{aligned}\right] \quad I_1 = -2.5\text{ A}, \quad I_2 = -2.1\text{ A}$$

$V_{25} = 25(I_1 - I_2) = 25(-2.5 + 2.1) = -10\text{ V}$

$V_{7.5} = 40(I_2 - I_3) = 40(-2.1 - (-7.5)) = 216\text{ V}$

2



Q2b

Given:

v_1 = 14 Volts v_2 = 7 Volts

R_1 = 10 Ω (Ohms) R_2 = 20 Ω (Ohms) R_3 = 40 Ω (Ohms)

Find the currents i_a and i_b.

i_a = 400 ✔ mA (milli Amp)

i_b = 150 ✔ mA (milli Amp)

i_a: $V_1 - R_1 i_a - R_3(i_a - i_b) = 0$

$14 - 10i_a - 40i_a + 40i_b = 0$

$-50i_a + 40i_b = -14$

i_b: $R_3(i_a - i_b) - R_2 i_b - V_2 = 0$

$40i_a - 40i_b - 20i_b - 7 = 0$

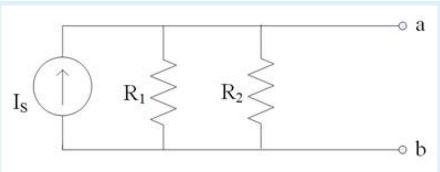
$-50i_a + 40i_b = -14$

$40i_a - 60i_b = 7$

$i_a = 0.40\text{ A} \approx 400\text{ mA}$

$i_b = 0.150\text{ A} \approx 150\text{ mA}$

3



Q3f

Given: I_s = 10 A R_1 = 10 Ω (Ohms) R_2 = 40 Ω (Ohms)

Perform a source transformation and find the voltage transform equivalent.

this circuit.

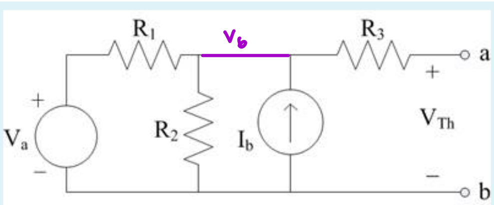
$V_{transform}$ = 80 ✔ V

$R_{transform}$ = 8 ✔ Ω (Ohm)

$R = R_1 \parallel R_2 = \dfrac{10(40)}{10+40} = 8\Omega$

$V_s = i_s R = (10\text{A})(8\Omega) = 80\text{ V}$

4



Q4e

Given:

V_a = 20 Volts I_b = 6 Amps

R_1 = 40 Ω (Ohm) R_2 = 40 Ω (Ohm) R_3 = 10 Ω (Ohm)

a) Find the Thévenin equivalent voltage V_{Th}.

V_{Th} = 130 ✔ Volts

b) Find the Thévenin equivalent resistance R_{Th}.

R_{Th} = 30 ✔ Ω (Ohms)

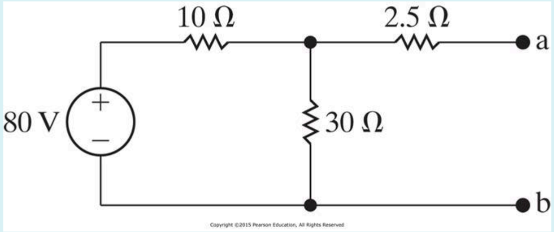
NODE V_b: $\dfrac{V_b - 20}{40} + \dfrac{V_b}{40} - 6\text{A} = 0$

$V_b - 20 + V_b - 240 = 0$

$V_b = 130\text{ V} = V_{TH}$

$R_{TH} = 40 \parallel 40 + 10 = 30\Omega$

5

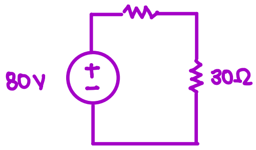


Q5b

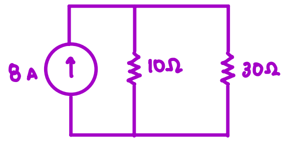
Find the Norton equivalent circuit with respect to terminals ab.

I_N = 6 A

R_{Th} = 10 Ω (Ohm)



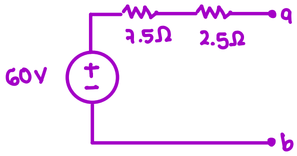
$i_s = \frac{V_s}{R_1} = \frac{80}{10} = 8\text{ A}$



$R = 10 \parallel 30 = 7.5\Omega$

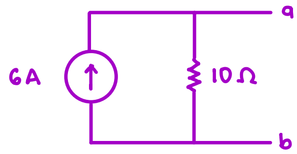
$V_s = i_s R$

$= (8\text{A})(7.5\Omega) = 60\text{ V}$



$R = 7.5 + 2.5 = 10\Omega$

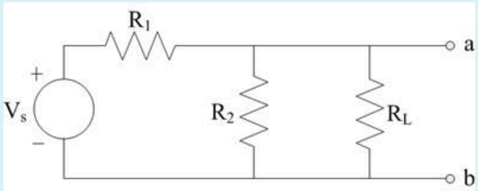
$i_N = \frac{V_s}{R} = \frac{60}{10} = 6\text{ A}$



$I_N = 6\text{A}$

$R_{TH} = 10\Omega$

6



Q6h

Given:

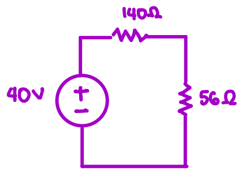
V_s = 40 Volts R_1 = 140 Ω (Ohm) R_2 = 56 Ω (Ohm)

a) Find the value of R_L that results in maximum power being transferred to R_L.

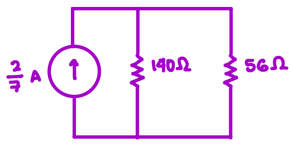
$R_{L,\text{max power}}$ = 40 Ω (Ohms)

b) Find the maximum power that can be delivered to R_L.

$P_{RL,\text{max power}}$ = 0.8163 Watts



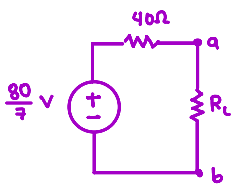
$i_s = \frac{V_s}{R} = \frac{40\text{ V}}{140\Omega} = \frac{2}{7}\text{ A}$



$R = 140 \parallel 56 = 40\Omega$

$V_{TH} = i_s R = (2/7\text{ A})(40\Omega) = 80/7\text{ V}$

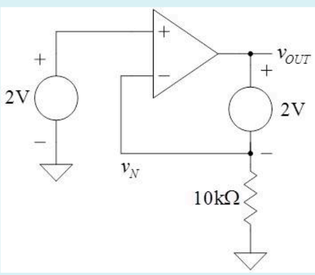
$R_{TH} = 40\Omega$



$R_{TH} = R_L = 40\Omega$

$P = \frac{V_{TH}^2}{4R_L} = \frac{(80/7)^2}{4(40)} = \frac{40}{49} \approx 0.8163\text{ W}$

7.



Q7c

Assume that the operational amplifier is ideal.

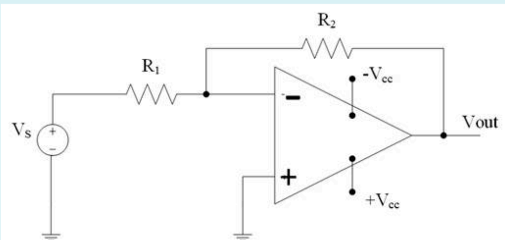
The opamp has two power inputs (not shown) of $+V_{cc}$ = +15V and $-V_{cc}$ = -15V.

Determine the voltage v_{out}. V_{out} = 4 Volts

$V_N = 2\text{V}$

$V_{OUT} = V_N + 2\text{V} = 2\text{V} + 2\text{V} = 4\text{V}$

8.



Q8b

Assume that the operational amplifier is ideal.

The opamp has two power inputs $+V_{cc} = +15V$ and $-V_{cc} = -15V$.

Given: $V_S = 4.0$ Volts $R_1 = 33$ kΩ (kilo Ohm) $R_2 = 180$ kΩ (kilo Ohm)

Determine the voltage V_{out}.

$V_{out} =$ -15 Volts

NODE V_n : $\left[\frac{\overset{0}{\cancel{V_n}} - V_s}{33\,k\Omega} + \frac{\overset{0}{\cancel{V_n}} - V_o}{180\,k\Omega} = 0 \right]$

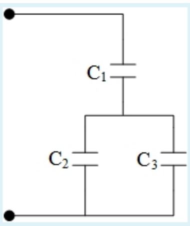
$$-180V_s - 33V_o = 0$$

$$V_o = -\frac{180(4.0)}{33} = -21.82\text{ V}$$

$$-15 \le V_{cc} \le 15$$

$$V_o = -15\text{ V}$$

9



Q9b

Given:

$C_1 = 2$ μF (micro F) $C_2 = 6$ μF (micro F) $C_3 = 3$ μF (micro F)

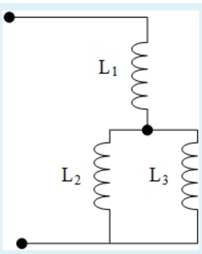
Find the equivalent capacitance C_{Eq}.

$C_{Eq} =$ 1.64 μF (micro F)

$$C_2 \parallel C_3 = C_2 + C_3 = 6\mu F + 3\mu F = 9\mu F$$

$$C_{eq} = \frac{(2\mu F)(9\mu F)}{2\mu F + 9\mu F} = 1.64\,\mu F$$

10



Q10e

Given:

$L_1 = 10$ mH (milli H) $L_2 = 14$ mH (milli H) $L_3 = 26$ mH (milli H)

Find the equivalent inductance L_{Eq}.

$L_{Eq} =$ 19.1 mH (milli H)

$$L_1 + (L_2 \parallel L_3)$$

$$10mH + \frac{(14mH)(26mH)}{14mH + 26mH} = 19.1\text{ mH}$$