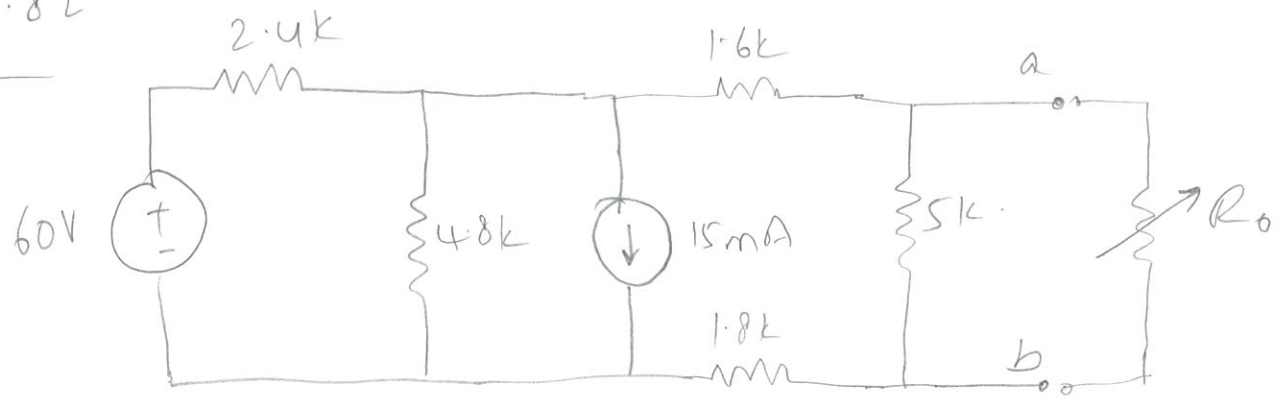
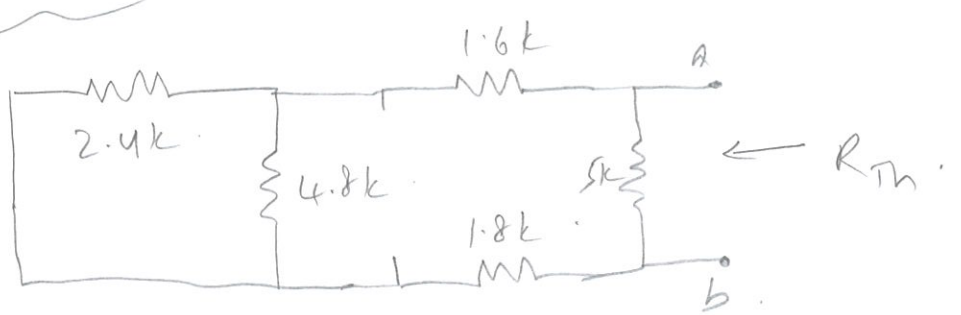
Pr 4.82



(a) Find the value of R_o for max power
(b) Find the value of max power

We have to create the Thevenin Equivalent circuit.
i.e. we have to find V_{Th} & R_{Th}.

a) to find R_{Th}; deactivate the 2 sources:



$R_{Th} = 5k \| (1.6k + 1.8k + 2.4k \| 4.8k)$

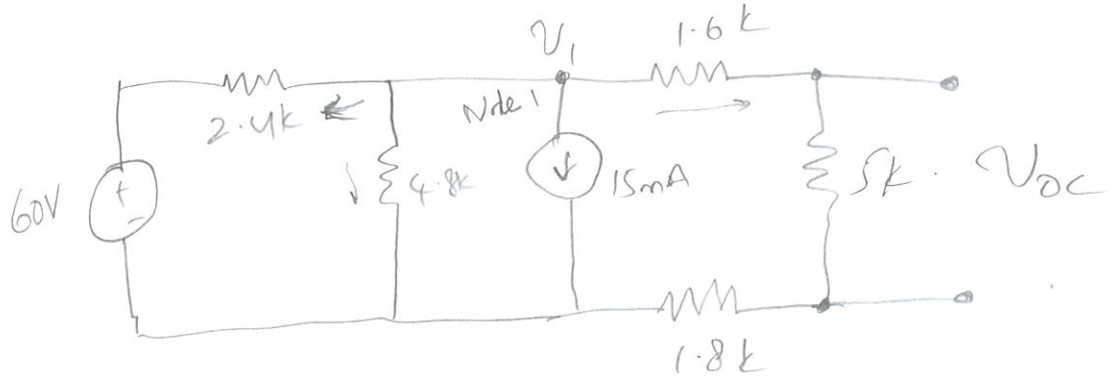
$= 5k \| (3.4k + 1.6k)$

$= 5k \| 5k$

$R_{Th} = 2.5k$ ohms

So, R_o for max power is $R_m = 2.5k\Omega$

b) First find V_{Th} (V_{oc}).



We can calculate V_{oc} by writing the KCL at Node (1).

Then, we can use voltage divider to find the voltage across the 5k resistor.

KCL at Node 1:

$$\frac{V_1 - 60}{2.4k} + \frac{V_1}{4.8k} + \frac{V_1}{(1.6k + 5k + 1.8k)} + 15 \times 10^{-3} = 0$$

or

$$\frac{V_1 - 60}{2.4} + \frac{V_1}{4.8} + \frac{V_1}{8.4} = -15 \times 10^{-3} \times 1000$$

So,

$$\frac{16.8(V_1 - 60) + 8.4V_1 + 4.8V_1}{40.32} = -15$$

$$30V_1 = 403.2$$

$$V_1 = 13.17 \text{ volts}$$

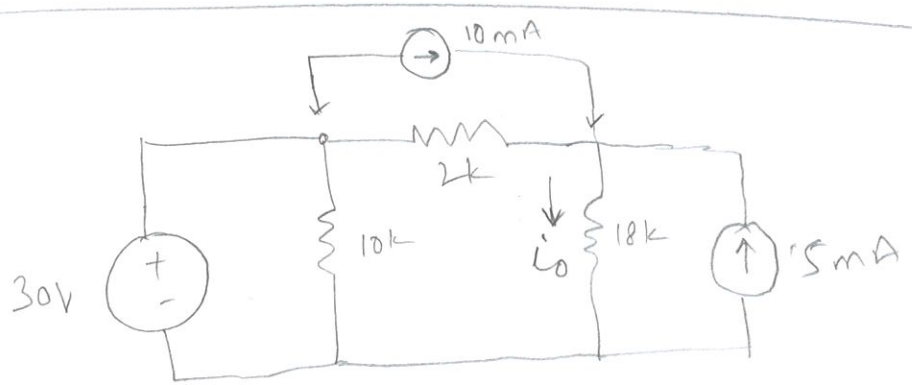
Using voltage divider: $V_{Th} = V_{oc} = \frac{5k}{(5k + 1.6k + 1.8k)} * 13.17 = 8 \text{ volts}$

Hence; $p_{max} = \frac{V_m^2}{4R_L}$

$= \frac{8^2}{4 \times 2.5 \times 10^3}$

$= 6.4$ milliwatts

Pr 4.95



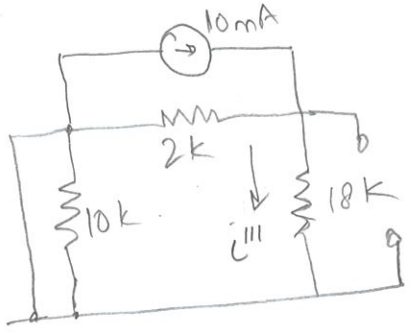
Since there are a total of 3 sources in the network, the current i_o can be written as

$$i_o = i' + i'' + i'''$$

Given that $i' + i'' = 1.5$ mA

To find i''',

By Superposition we deactivate the other 2 sources.



10k resistor is shorted.

Using the Current-divider formula;

$$i''' = i_{18k} = \frac{2k}{(18k+2k)} * 10mA$$

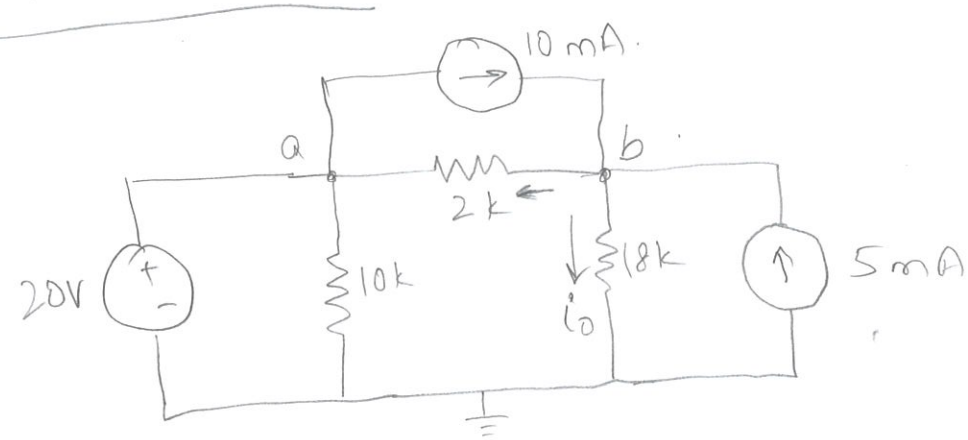
$$= 1\ mA$$

Hence, when all 3 sources are attached,

$$i_o = i' + i'' + i''' = 1.5 + 1$$

$$= 2.5\ mA$$

b) With all 3 sources connected:



Writing KCL at node b:

$$\frac{v_b}{18k} + \frac{v_b - 20}{2k} - 5*10^{-3} - 10*10^{-3} = 0$$

$$\frac{v_b}{18} + \frac{v_b - 20}{2} = 15$$

$$\frac{10v_b}{18} = 15 + 10$$

$$v_b = 45\ volts$$

Hence $i_o = \frac{v_b}{R} = \frac{45}{18k} = 2.5mA$