- EELE 250 additional Practice Problems
- **T2.2, T2.4, T2.5**
- **P3.6, P3.9, P3.24**

T2.2 The equivalent resistance seen by the voltage source is:

$$R_{eq} = R_1 + \frac{1}{1/R_2 + 1/R_3 + 1/R_4} = 16\ \Omega$$

$$i_s = \frac{V_s}{R_{eq}} = 6\ A$$

Then, using the current division principle, we have

$$i_4 = \frac{G_4}{G_2 + G_3 + G_4} i_s = \frac{1/60}{1/48 + 1/16 + 1/60} 6 = 1\ A$$

T2.4 We can write the following equations:

KVL mesh 1: $R_1 i_1 - V_s + R_3(i_1 - i_3) + R_2(i_1 - i_2) = 0$

KVL for the supermesh obtained by combining meshes 2 and 3:

$$R_4 i_2 + R_2(i_2 - i_1) + R_3(i_3 - i_1) + R_5 i_3 = 0$$

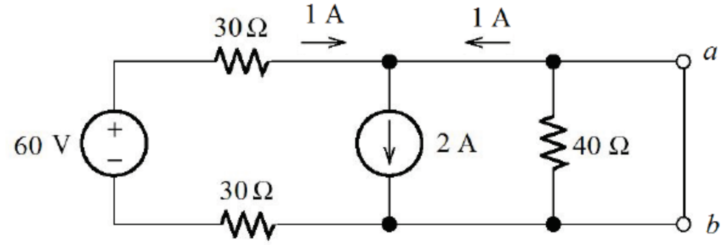
KVL around the periphery of the circuit:

$$R_1 i_1 - V_s + R_4 i_2 + R_5 i_3 = 0$$

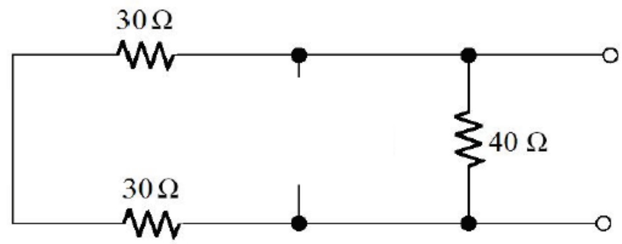
Current source: $i_2 - i_3 = I_s$

A set of equations for solving the network must include the current source equation plus two of the mesh equations. The three mesh equations are dependent and will not provide a solution by themselves.

T2.5 Under short-circuit conditions, the circuit becomes



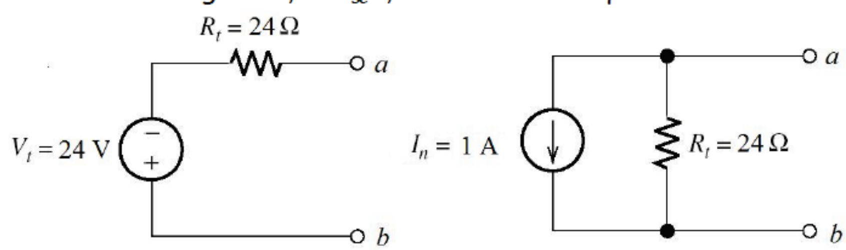
Thus, the short-circuit current is 1 A flowing out of *b* and into *a*.
Zeroing the sources, we have



Thus, the Thévenin resistance is

$$R_t = \frac{1}{1/40 + 1/(30+30)} = 24\ \Omega$$

and the Thévenin voltage is $V_t = I_{sc}R_t = 24\text{ V}$. The equivalent circuits are:



Because the short-circuit current flows out of terminal *b*, we have oriented the voltage polarity positive toward *b* and pointed the current source reference toward *b*.

P3.6* $i = C\dfrac{dv}{dt}$

$$\frac{dv}{dt} = \frac{i}{C} = \frac{100\times10^{-6}}{2000\times10^{-6}} = 0.05\text{ V/s} \qquad \Delta t = \frac{\Delta v}{dv/dt} = \frac{100}{0.05} = 2000\text{ s}$$

P3.9 The net charge on each plate is $Q = CV = (5 \times 10^{-6}) \times 100 = 500\ \mu C$. One plate has a net positive charge and the other has a net negative charge so the net charge for both plates is zero.

P3.24* (a) $C_{eq} = 1 + \dfrac{1}{1/2 + 1/2} = 2\ \mu\text{F}$

(b) The two 4-μF capacitances are in series and have an equivalent capacitance of $\dfrac{1}{1/4 + 1/4} = 2\ \mu\text{F}$. This combination is a parallel with the 2-μF capacitance, giving an equivalent of 4 μF. Then the 12 μF is in series, giving a capacitance of $\dfrac{1}{1/12 + 1/4} = 3\ \mu\text{F}$. Finally, the 5 μF is in parallel, giving an equivalent capacitance of $C_{eq} = 3 + 5 = 8\ \mu\text{F}$.