- EELE 250 Practice Problems

- **P2.57, P2.59, P2.91 <--note that these involve controlled source**
- **P3.26, P3.28, P3.48, P3.49**

P2.57* First, we can write: $i_x = \frac{v_1 - v_2}{5}$.

Then, writing KCL equations at nodes 1 and 2, we have:

$$\frac{v_1}{10} + i_x = 1 \text{ and } \frac{v_2}{20} + 0.5i_x - i_x = 0$$

Substituting for i_x and simplifying, we have

$$0.3v_1 - 0.2v_2 = 1$$
$$-0.1v_1 + 0.15v_2 = 0$$

Solving, we have $v_1 = 6$ and $v_2 = 4$.

Then, we have $i_x = \frac{v_1 - v_2}{5} = 0.4\ A$.

P2.59 First, we can write:

$$i_x = \frac{5i_x - v_2}{10}$$

Simplifying, we find $i_x = -0.2v_2$.

Then write KCL at nodes 1 and 2:

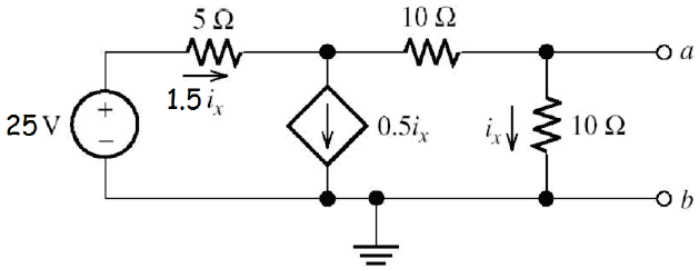
$$\frac{v_1 - 5i_x}{5} = 4 + 2 \qquad \frac{v_2}{10} - i_x = -6$$

Substituting for i_x and simplifying, we have

$$v_1 + v_2 = 30 \quad \text{and} \quad 0.3v_2 = -6$$

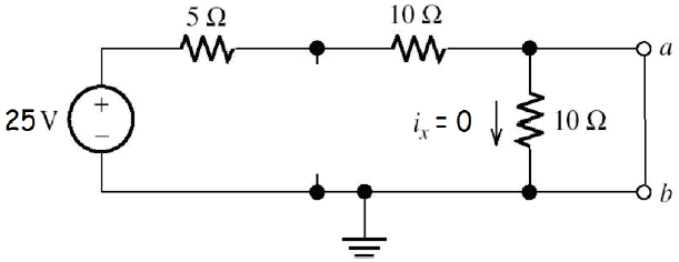
which yield $v_1 = 50\ V$ and $v_2 = -20\ V$.

P2.91 Open-circuit conditions:

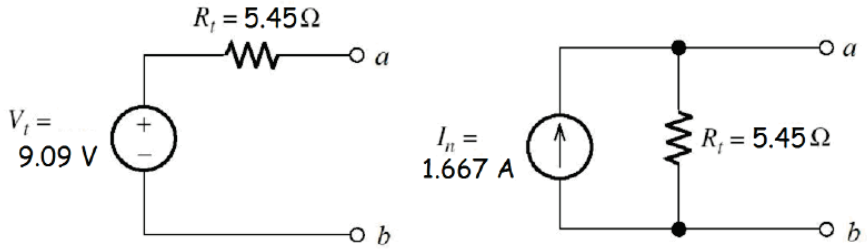


Using KVL, we have $25 = 5(1.5i_x) + 10i_x + 10i_x$ Solving, we find $i_x = 0.90909$ A and then we have $V_t = v_{oc} = 10i_x = 9.0909$ V.

Under short-circuit conditions, we have $i_x = 0$ and the controlled source becomes an open circuit:



$i_{sc} = \dfrac{25}{15} = 1.667$ A. Then, we have $R_t = v_{oc}/i_{sc} = 5.45\,\Omega$. Thus, the equivalents are:



P3.26 (a) $C_{eq} = 3 + \dfrac{1}{1/2 + 1/1} + \dfrac{1}{1/2 + 1/(1+1)} = 4.667\ \mu\text{F}$

(b) $C_{eq} = \dfrac{1}{1/(2+1) + 1/(4+2)} = 2\ \mu\text{F}$

P3.28 $C_{eq} = \dfrac{1}{1/C_1 + 1/C_2} = 6\ \mu\text{F}$

The charges stored on each capacitor and on the equivalent capacitance are equal because the current through each is the same.

$$Q = C_{eq} \times 50\ \text{V} = 300\ \mu\text{C}$$

$$v_1 = \frac{Q}{C_1} = 20\ \text{V}$$

$$v_2 = \frac{Q}{C_2} = 30\ \text{V}$$

As a check, we verify that $v_1 + v_2 = 50\ \text{V}$.

P3.48 Because we have $v_L(t) = L\dfrac{di_L(t)}{dt}$, the voltage is zero when the current is constant. Thus, we say that inductors act as short circuits for steady dc currents.

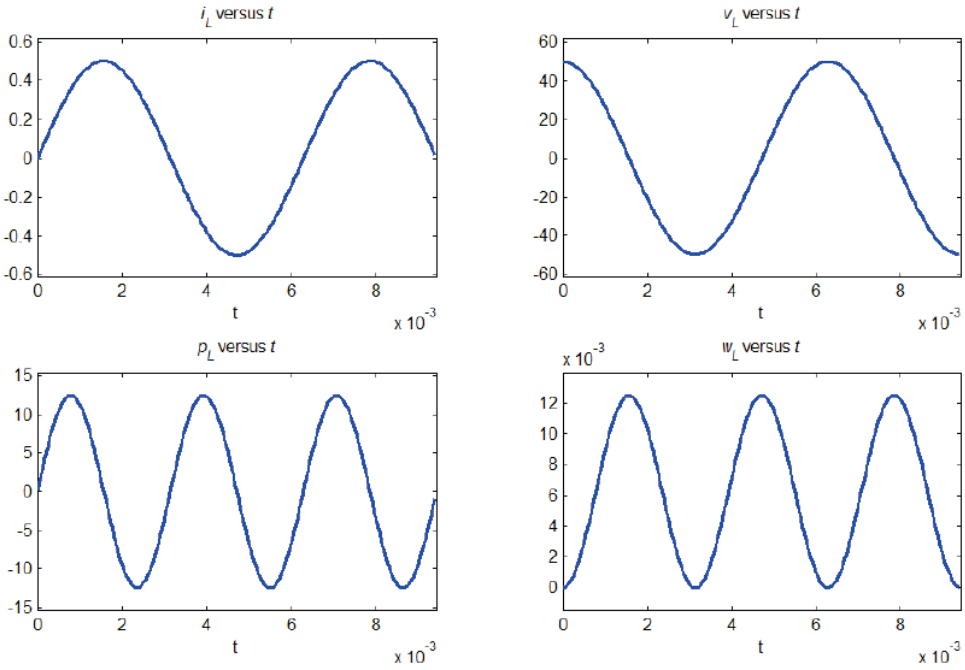
P3.49 $L = 0.1\,\text{H} \qquad i_L(t) = 0.5\sin(1000t)\,\text{A}$

$$v_L(t) = L\frac{di_L(t)}{dt} = 50\cos(1000t)\,\text{V}$$

$$p(t) = v_L(t)i_L(t) = 25\cos(1000t)\sin(1000t) = 12.5\sin(2000t)\,\text{W}$$

$$w(t) = \frac{1}{2}L[i_L(t)]^2 = 0.0125\sin^2(1000t)\,\text{J}$$

The sketches should be similar to the following plots. The units for the quantities in these plots are A, V, W, J and s.


i_L versus t
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
2
4
6
8
t
x 10^-3
v_L versus t
60
40
20
0
-20
-40
-60
0
2
4
6
8
t
x 10^-3
p_L versus t
15
10
5
0
-5
-10
-15
0
2
4
6
8
t
x 10^-3
w_L versus t
x 10^-3
12
10
8
6
4
2
0
0
2
4
6
8
t
x 10^-3