

EENG 203 - Week 1 Homework

Bryan SebaRaj

January 21, 2025

Homework for January 14, 2025

7.3

7.3 Determine the time constant for the circuit in Fig. 7.83.

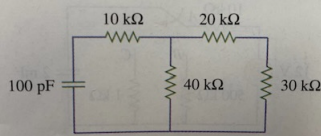


Figure 7.83
For Prob. 7.3.

The circuit above is an RC circuit, comprised of a non-polarized capacitor and resistors. Therefore,

$$\tau = RC$$

$$R = 10k\Omega + (40k\Omega || (20k\Omega + 30k\Omega))$$

$$R = 10k\Omega + (40k\Omega || 50k\Omega) = 10k\Omega + \frac{40k\Omega \cdot 50k\Omega}{40k\Omega + 50k\Omega}$$

$$R = 32.22 k\Omega$$

Substituting the values of R and $C = 100pF$ into the equation for τ ,

$$\tau = 32.22k\Omega \cdot 100pF = 3.222 \mu s$$

7.22

7.22 Find $i(t)$ and $v(t)$ for $t > 0$ in the circuit of Fig. 7.102 if $i(0) = 10 A$.

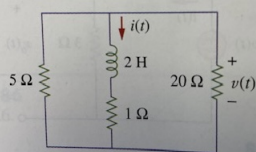


Figure 7.102
For Prob. 7.22.

In an RL circuit, $i(t) = i(0)e^{-\frac{t}{\tau}}$, where $\tau = \frac{L}{R}$. Calculating R ,

$$R = (5\Omega || 20\Omega) + 1\Omega = \frac{5\Omega \cdot 20\Omega}{5\Omega + 20\Omega} + 1\Omega = 5 \Omega$$

Since $L = 2$, $\tau = \frac{L}{R} = \frac{2}{5}$. Substituting τ and the given $i(0) = 10 A$,

$$i(t) = 10e^{-2.5t} A$$

Using current division, $i_0 = \frac{5}{5+20}(-i) = -\frac{i}{5} = -\frac{10e^{-2.5t}A}{5} = 2e^{-2.5t} A$

Homework for January 14, 2025

5.30

5.30 In the circuit shown in Fig. 5.68, find i_x and the power absorbed by the $20\text{-k}\Omega$ resistor.

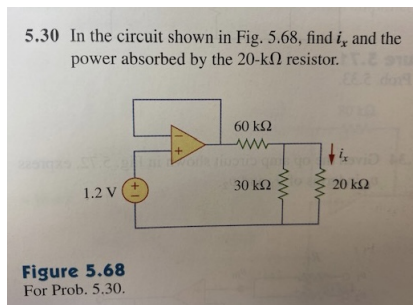


Figure 5.68
For Prob. 5.30.

The volate output, $v_o = v_i = 1.2V$

The two parallel resistors, $R_1 = 20k\Omega$ and $R_2k\Omega$, can be combined to form a single resistor,

$$R_{eq} = (20k\Omega || 30k\Omega) = \frac{20k\Omega \cdot 30k\Omega}{20k\Omega + 30k\Omega} = 12k\Omega$$

By volatage division,

$$v_x = \frac{R_{eq}}{R_{eq} + 60k\Omega} v_i = \frac{12k\Omega}{12k\Omega + 60k\Omega} 1.2V = 0.2V$$

$$i_x = \frac{v_x}{R} = \frac{0.2V}{20k\Omega} = 10\mu A$$

$$p = \frac{v_x^2}{R} = \frac{(0.2V)^2}{20k\Omega} = 2\mu W$$

7.71

7.71 For the op amp circuit in Fig. 7.136, suppose $v_o = 0$ and $v_s = 3V$. Find $v(t)$ for $t > 0$.

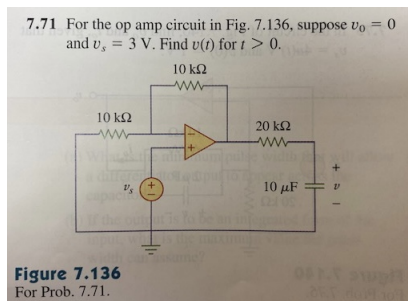


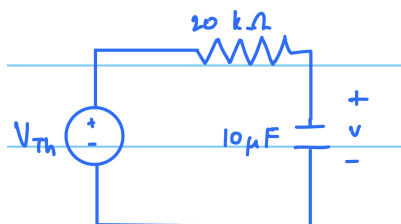
Figure 7.136
For Prob. 7.71.

Assuming that the op amp is noninverting, its gain can be calculated as

$$A_v = 1 + \frac{R_2}{R_1} = 1 + \frac{20k\Omega}{10k\Omega} = 3$$

Therefore, the Thevenin equivalent circuit (see below), has a voltage source

$$V_{th} = A_v v_s = 3 \cdot 3V = 9V$$



$$v(t) = v_{Th} + [v(0) - v_{Th}]e^{-\frac{t}{\tau}}$$

$$v(t) = 6 + [0 + 6]e^{-\frac{t}{\tau}} = 6(1 - e^{-\frac{t}{\tau}}) \text{ V}, \forall t > 0$$

In an RC circuit,

$$\tau = RC = 30k\Omega \cdot \frac{1000\Omega}{1k\Omega} \cdot 10\mu F \cdot \frac{1F}{10^{-6}\mu F} = 0.2 \text{ s}$$

Therefore, $v(t) = 6(1 - e^{-5t}) \text{ V}, \forall t > 0$