\[ V_c = 12 - 10e^{-20} \]

If the capacitor is charged to \((12 - 10)\) volts, and we close the switch, we should observe a simulation that should agree with the equations.

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\[ \text{KCL for } V_i \]
\[ \frac{V_i - V_C}{R_1} + \frac{V_i - V}{R_2} + \frac{V_i}{R_3} = 0 \]

Flowing toward cap

\[ i_c = C \frac{dV_c}{dt} = CB \alpha e^{-\alpha t} \]

1. \[ V_i \left[ \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right] = \frac{V_c}{R_1} + \frac{V}{R_2} \]
   \[ V_i \left[ Y_1 + Y_2 + Y_3 \right] = (Y_1) V_c + (Y_2) V \]
   \[ V_i = \frac{(Y_1) V_c + (Y_2) V}{Y_1 + Y_2 + Y_3} \]

\[ V_i = \left[ \frac{(Y_1) A + (Y_2) V}{Y_1 + Y_2 + Y_3} \right] - \left[ \frac{Y_1 (B)}{Y_1 + Y_2 + Y_3} \right] e^{-\alpha t} \]
   \[ i = \frac{V_i - V}{R_2} = \frac{Y_2 (V_i - V)}{R_2} \]

Check \[ i_c + \frac{V_i}{R_3} + i = 0 \]

\[ CB \alpha e^{-\alpha t} + \frac{D - E e^{-\alpha t}}{R_3} + Y_2 \left( D - E e^{-\alpha t} \right) - (Y_2) V \]

\[ \text{Check } e^{-\alpha t} \text{ terms} \]

\[ \left[ CB \alpha \right] - \left[ \frac{(Y_1) (B)}{Y_1 + Y_2 + Y_3} \right] \left[ Y_3 + Y_2 \right] \]

\[ \frac{1}{R_2 + R_3} = \frac{1}{400} + \frac{1}{100} = 0.0125 \]

\[ -0.056 + \frac{0.28}{0.0625} \times 0.0125 = 0 ! \]

\[ \text{Check } \text{NON-} e^{-\alpha t} \text{ terms} \]

\[ D = \frac{D}{R_3 + R_2} - \frac{V}{R_2} = \frac{2.4 + 2.4}{100} - \frac{12}{400} = 0 ! \]

\[ D = \frac{A + V}{R_1 + R_2 + R_3} = \frac{2.4 + 12}{20 + 400} = \frac{0.12 + 0.03}{0.0625} = 2.4 \]
The capacitor voltage in the circuit shown in Figure P 7.2-14 is given by:

\[ v(t) = \frac{V_0}{R Z} e^{-\frac{t}{R Z}} V \] for \( t \geq 0 \)

Determine \( i(t) \) for \( t > 0 \).

\[ i = \frac{v(t)}{R Z} = \frac{V_0}{R Z} e^{-\frac{t}{R Z}} \]

\[ V_C = \frac{A - B e^{-\alpha t}}{R Z} \]

\[ \text{Check: } i(t) = C \frac{dV_C}{dt} = C x B e^{-\alpha t} \]

\[ i(t) = \frac{A - B e^{-\alpha t}}{R Z} \]

\[ i(t) = C x B e^{-\alpha t} + \left[ \frac{A - B e^{-\alpha t}}{R Z} \right] + \frac{A - B e^{-\alpha t}}{R Z} - V_1 \]

\[ = \frac{(20 \times 10^{-3})(5)(8)}{60} - \frac{8}{12} + \frac{-(3-40)}{60} = 0.8 - \frac{48}{60} = 0.8 - 0.8 = 0 \]