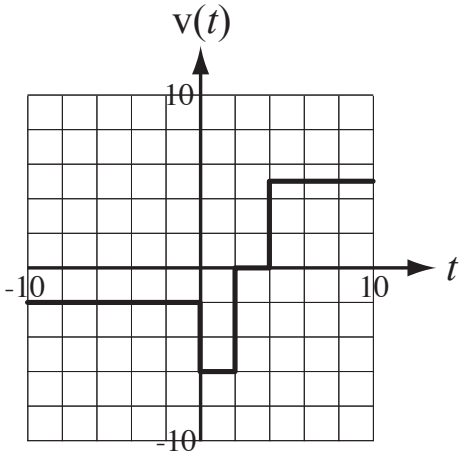
Solution of ECE 300 Test 8 F09

1. In the space provided graph this voltage versus time. Put a scale on the vertical axis so that actual voltages could be read from the graph.

$$v(t) = 4\,u(-t) - 6\,u(2-t) + 5\,u(t-4)$$



2. Find the numerical values of the capacitor current and voltage and the switch current at the times indicated.

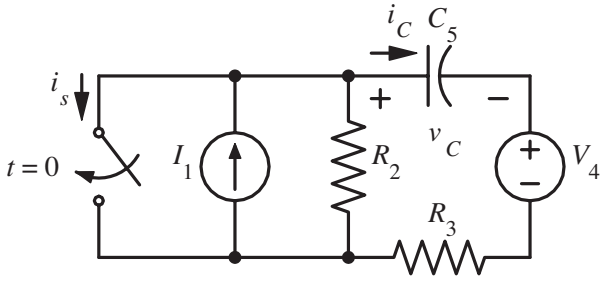
$v_C(0^-) =$ _____ V $v_C(0^+) =$ _____ V $v_C(\infty) =$ _____ V

$i_C(0^-) =$ _____ mA $i_C(0^+) =$ _____ mA $i_C(\infty) =$ _____ mA

$i_s(0^-) =$ _____ mA $i_s(0^+) =$ _____ mA $i_s(\infty) =$ _____ mA

What is the numerical time constant of this circuit after the switch is closed. τ = _____ s

$I_1 = 2\text{mA}$, $R_2 = 5\text{k}\Omega$, $R_3 = 10\text{k}\Omega$, $V_4 = 15\text{V}$, $C_5 = 4\mu\text{F}$



The circuit has been in the configuration with the switch open for a very long time and all currents and voltages are constant.

For the current source only:

The current source current must all flow through resistor R_2 developing a voltage of 10V (positive on top). Then the capacitor voltage would also be 10V. The switch current is zero.

For the voltage source only:

No current flows anywhere in the circuit so the capacitor voltage must be -15V.

Overall:

The capacitor voltage is -5V and the capacitor current is zero.

At time $t = 0^+$:

The capacitor voltage remains at -5V. All the current source current now flows through the switch. The voltage across R_3 is 10V (positive on the left). Therefore the current through the capacitor, voltage source and R_3 is 1mA (counter-clockwise). This current also flows through the switch along with the current from the current source for a total of 3 mA.

At $t \to \infty$:

All currents and voltages are constant. The capacitor current is again zero. The only current through the switch is the current source current of 2 mA. The capacitor voltage must be -15V.

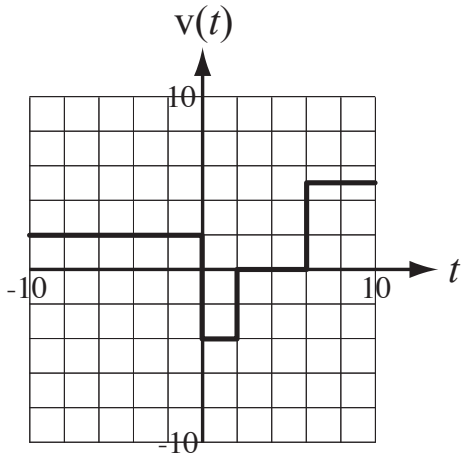
$$\begin{array}{lll} v_C(0^-) = -5\text{V} & v_C(0^+) = -5\text{V} & v_C(\infty) = -15\text{V} \\ i_C(0^-) = 0\text{ mA} & i_C(0^+) = -1\text{ mA} & i_C(\infty) = 0\text{ mA} \\ i_s(0^-) = 0\text{ mA} & i_s(0^+) = 3\text{ mA} & i_s(\infty) = 2\text{ mA} \end{array}$$

After the switch is closed the time constant is $\tau = R_3 C_5 = (10\text{k}\Omega)(4\mu\text{F}) = 40\text{ ms}$.

Solution of ECE 300 Test 8 F09

1. In the space provided graph this voltage versus time. Put a scale on the vertical axis so that actual voltages could be read from the graph.

$$v(t) = 6\,u(-t) - 4\,u(2-t) + 5\,u(t-6)$$



2. Find the numerical values of the capacitor current and voltage and the switch current at the times indicated.

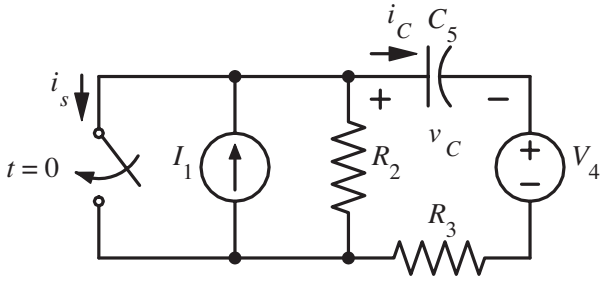
$v_C(0^-) =$ _____ V $v_C(0^+) =$ _____ V $v_C(\infty) =$ _____ V

$i_C(0^-) =$ _____ mA $i_C(0^+) =$ _____ mA $i_C(\infty) =$ _____ mA

$i_s(0^-) =$ _____ mA $i_s(0^+) =$ _____ mA $i_s(\infty) =$ _____ mA

What is the numerical time constant of this circuit after the switch is closed. $\tau =$ _____ s

$I_1 = 2\text{mA}$, $R_2 = 5\text{k}\Omega$, $R_3 = 5\text{k}\Omega$, $V_4 = 20\text{V}$, $C_5 = 4\mu\text{F}$



The circuit has been in the configuration with the switch open for a very long time and all currents and voltages are constant.

For the current source only:

The current source current must all flow through resistor R_2 developing a voltage of 10V (positive on top). Then the capacitor voltage would also be 10V. The switch current is zero.

For the voltage source only:

No current flows anywhere in the circuit so the capacitor voltage must be -20V.

Overall:

The capacitor voltage is -10V and the capacitor current is zero.

At time $t = 0^+$:

The capacitor voltage remains at -10V. All the current source current now flows through the switch. The voltage across R_3 is 10V (positive on the left). Therefore the current through the capacitor, voltage source and R_3 is 2mA (counter-clockwise). This current also flows through the switch along with the current from the current source for a total of 4 mA.

At $t \to \infty$:

All currents and voltages are constant. The capacitor current is again zero. The only current through the switch is the current source current of 2 mA. The capacitor voltage must be -20V.

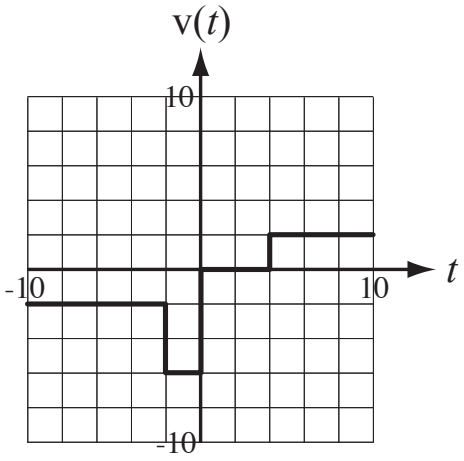
$$\begin{array}{lll} v_C(0^-) = -10\text{V} & v_C(0^+) = -10\text{V} & v_C(\infty) = -20\text{V} \\ i_C(0^-) = 0\text{ mA} & i_C(0^+) = -2\text{ mA} & i_C(\infty) = 0\text{ mA} \\ i_s(0^-) = 0\text{ mA} & i_s(0^+) = 4\text{ mA} & i_s(\infty) = 2\text{ mA} \end{array}$$

After the switch is closed the time constant is $\tau = R_3 C_5 = (5\text{k}\Omega)(4\mu\text{F}) = 20\text{ ms}$.

Solution of ECE 300 Test 8 F09

1. In the space provided graph this voltage versus time. Put a scale on the vertical axis so that actual voltages could be read from the graph.

$$v(t) = 4\,u(-t-2) - 6\,u(-t) + 2\,u(t-4)$$



2. Find the numerical values of the capacitor current and voltage and the switch current at the times indicated.

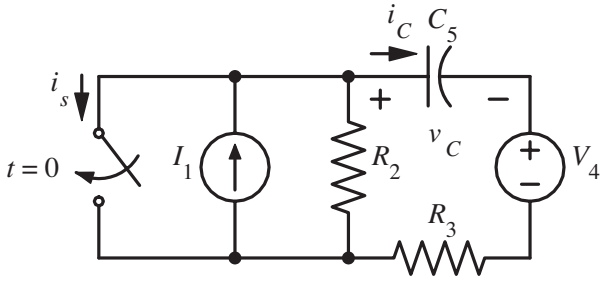
$v_C(0^-) =$ _____ V $v_C(0^+) =$ _____ V $v_C(\infty) =$ _____ V

$i_C(0^-) =$ _____ mA $i_C(0^+) =$ _____ mA $i_C(\infty) =$ _____ mA

$i_s(0^-) =$ _____ mA $i_s(0^+) =$ _____ mA $i_s(\infty) =$ _____ mA

What is the numerical time constant of this circuit after the switch is closed. $\tau =$ _____ s

$I_1 = 2\text{mA}$, $R_2 = 10\text{k}\Omega$, $R_3 = 5\text{k}\Omega$, $V_4 = 10\text{V}$, $C_5 = 4\mu\text{F}$



The circuit has been in the configuration with the switch open for a very long time and all currents and voltages are constant.

For the current source only:

The current source current must all flow through resistor R_2 developing a voltage of 20V (positive on top). Then the capacitor voltage would also be 20V. The switch current is zero.

For the voltage source only:

No current flows anywhere in the circuit so the capacitor voltage must be -10V.

Overall:

The capacitor voltage is 10V and the capacitor current is zero.

At time $t = 0^+$:

The capacitor voltage remains at 10V. All the current source current now flows through the switch. The voltage across R_3 is 20V (positive on the left). Therefore the current through the capacitor, voltage source and R_3 is 4mA (counter-clockwise). This current also flows through the switch along with the current from the current source for a total of 6 mA.

At $t \to \infty$:

All currents and voltages are constant. The capacitor current is again zero. The only current through the switch is the current source current of 2 mA. The capacitor voltage must be -10V.

$$\begin{array}{lll} v_C(0^-) = 10\text{V} & v_C(0^+) = 10\text{V} & v_C(\infty) = -10\text{V} \\ i_C(0^-) = 0\text{ mA} & i_C(0^+) = -4\text{ mA} & i_C(\infty) = 0\text{ mA} \\ i_s(0^-) = 0\text{ mA} & i_s(0^+) = 6\text{ mA} & i_s(\infty) = 2\text{ mA} \end{array}$$

After the switch is closed the time constant is $\tau = R_3 C_5 = (5\text{k}\Omega)(4\mu\text{F}) = 20\text{ ms}$.