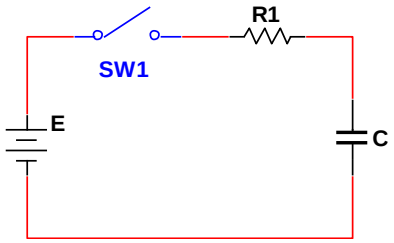
Capacitor Charging with Initial Conditions (26:41)

Capacitor Charging Circuit 1 (0:00 to 7:18)



Given:

E = 12V
R_1 = 200Ω
C = 15µF
V_C starts the charging process at 2V

Assume the following polarities:

positive I_1 travels in to out left to right
positive V_1 appears positive to negative left to right
positive I_C travels in to out top to bottom
positive V_C appears positive to negative top to bottom

Determine the time constant for capacitor charging circuit 1. Determine the time necessary for a full charge.

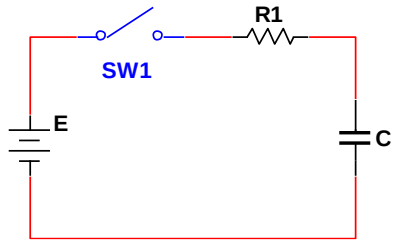
Determine the initial conditions for V_C, I_C, V_{R1}, and I_{R1}. Assume the capacitor has an initial voltage of +2V.

Determine the final conditions for V_C, I_C, V_{R1}, and I_{R1}.

Derive the time variant expressions for $i_c(t)$, $v_c(t)$, $i_{R1}(t)$, and $v_{R1}(t)$, and plot these properties for a full charge.

Determine the time V_C has risen to 5V. At this same time determine the instantaneous values of I_C, V_{R1}, and I_{R1}.

Capacitor Charging Circuit 2 (7:18 to 15:22)



Given:

E = 24V
R_1 = 500Ω
C = 47µF
V_C starts the charging process at -2V

Assume the following polarities:

positive I_1 travels in to out left to right
positive V_1 appears positive to negative left to right
positive I_C travels in to out top to bottom
positive V_C appears positive to negative top to bottom

Determine the time constant for capacitor charging circuit 2. Determine the time necessary for a full charge.

Determine the initial values for V_C, I_C, V_{R1}, and I_{R1}. Assume the capacitor has an initial voltage of -6V.

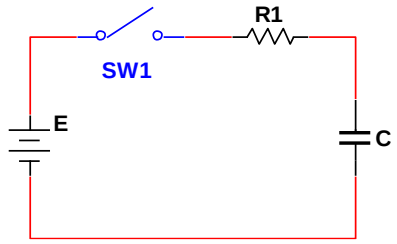
Determine the final values for V_C, I_C, V_{R1}, and I_{R1}.

Derive the time variant expressions for $i_c(t)$, $v_c(t)$, $i_{R1}(t)$, and $v_{R1}(t)$, and plot these properties for a full charge.

Determine the instantaneous values of V_C, I_C, V_{R1}, and I_{R1} at t = 20ms.

Determine the time V_C has risen to 0V. At this same time determine the instantaneous values of I_C, V_{R1}, and I_{R1}.

Capacitor Charging Circuit 3 (15:22 to END)



Given:

E = 8V
R_1 = 250Ω
C = 2µF
V_C starts the charging process at +10V

Assume the following polarities:

positive I_1 travels in to out left to right
positive V_1 appears positive to negative left to right
positive I_C travels in to out top to bottom
positive V_C appears positive to negative top to bottom

Determine the time constant for capacitor charging circuit 3. Determine the time necessary for a full charge.

Determine the initial conditions for V_C, I_C, V_{R1}, and I_{R1}. Assume the capacitor has an initial voltage of +10V.

Determine the final conditions for V_C, I_C, V_{R1}, and I_{R1}.

Derive the time variant expressions for $i_c(t)$, $v_c(t)$, $i_{R1}(t)$, and $v_{R1}(t)$, and plot these properties until V_C reaches a steady state value.

Determine the instantaneous values of V_C, I_C, V_{R1}, and I_{R1} at t = 600µs.

Determine the time V_C has risen to 0V. At this same time determine the instantaneous values of I_C, V_{R1}, and I_{R1}.

Is capacitor charging circuit 3 really a charging circuit?