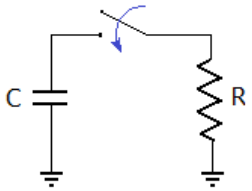
Electronics

RC circuits

Problem 1.- The 6μF capacitor shown in the figure was originally charged to 10 volts. How long after closing the switch, will the voltage reach 5V if the discharge resistance R is 1.67 kΩ?



(A) It will never reach 5V.

(B) 7 s

(C) 700 ms

(D) 70 ms

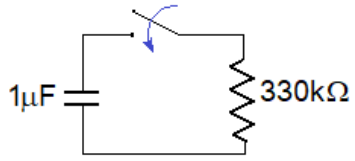
(E) 7 ms

Solution: The capacitor will discharge according to the equation:

$$V = V_o e^{-t/RC} \rightarrow 5 = 10e^{-t/(1.67k\Omega)(6\mu F)} \rightarrow 0.5 = e^{-t/(1.67k\Omega)(6\mu F)} \rightarrow \ln(0.5) = -t/(1.67k\Omega)(6\mu F)$$

$$t = -(1.67k\Omega)(6\mu F)\ln(0.5) = \mathbf{7ms}$$

Problem 1a.- The capacitor in the circuit is initially charged with 15μC. How long will it take for the voltage in the capacitor to drop to 10 volts after closing the switch?



Solution: The initial voltage in the capacitor is $V_o = \frac{15\mu C}{1\mu F} = 15V$ and it will drop after closing the switch according to: $V = V_o e^{-t/RC}$ so to get to 10 volts we need:

$$10V = 15Ve^{-t/RC} \rightarrow 0.667 = e^{-t/RC} \rightarrow \ln(0.667) = -t/RC \rightarrow t = -RC\ln(0.667) = \mathbf{0.134\ s}$$