RC Circuits Practice Problems

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0.1 Problem 1

A 1500 Ω resistor and a 25 μF capacitor are connected to form a circuit. The capacitor has been previously charged to 35 Volts. How long does it take for the capacitor's voltage to drop to 15 V?

Solution. We know that the charge on the plates at any time t is given by

$$Q = Q_0 e^{-t/RC}$$

and using the rule for capacitance $C = Q/V$, we have

$$\frac{V}{V_0} = e^{-t/RC}.$$

Then taking the natural logarithm, we have

$$t = -RC \log(\frac{V}{V_0}) = -1500(25 \times 10^{-6}) \log(\frac{15}{35}) = 3.2 \times 10^{-2}\ s.$$

0.2 Problem 2

A 1500 μF capacitor is charged through a 25 kΩ resistor by a 12 V battery. How much time will pass before the capacitor is charged to 8 V?

Solution. We know that the charge on the plates of the capacitor is

$$Q = CV$$

so we can write

$$V = V_0(1 - e^{t/RC}).$$

We rearrange terms, and take the log of both sides to isolate t. Then, we have

$$t = -RC \log(1 - \frac{V}{V_0}) = -(25000)(1500 \times 10^{-6}) \log(1 - \frac{8}{12})$$

and we have

$$t = 41s.$$