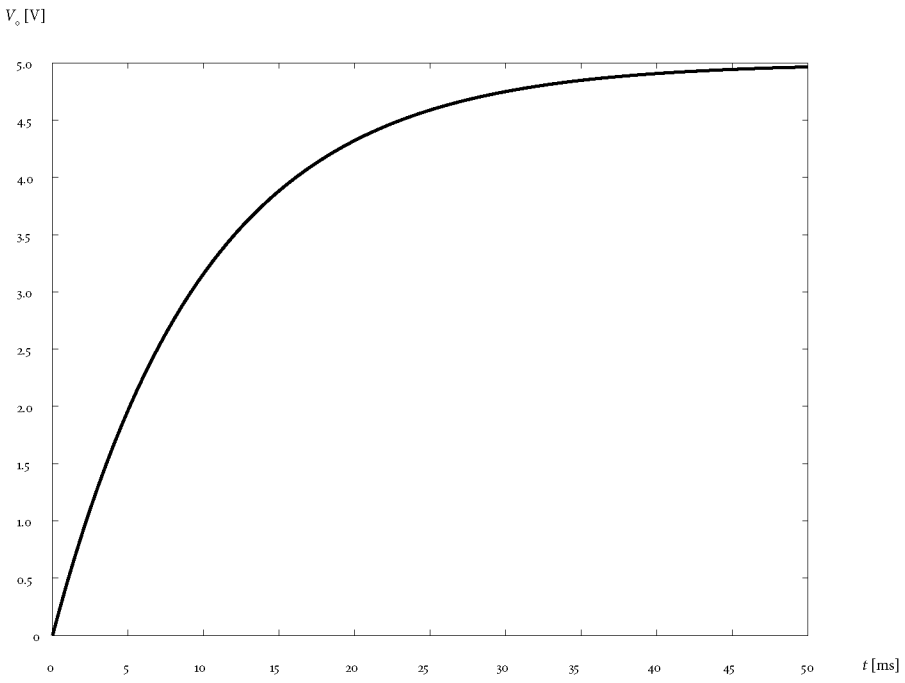
RC Circuits

Basic Problems

1. A capacitor with capacitance 100 μF is discharged through a resistor with resistance 330 kΩ. How long does it take until the voltage across the capacitor has decreased to one fourth of its initial value?
2. An empty capacitor and a resistor with resistance 15 kΩ are connected in series to a 50 V voltage supply. The half life for the charging process is measured to be 0.4 s. Calculate the current flowing 0.2 s after the charging process has started.
3. A capacitor is charged on a voltage of 100 V through a resistor. After 4 s the voltage across the capacitor is 75 V. How long does it take to charge the capacitor to the same voltage if it is connected to 150 V?
4. The half lives for discharging two different capacitors through the same resistor are 2 s and 4 s, respectively. Calculate the half life when the two capacitors are connected in series or in parallel.
5. A capacitor is charged to 5 V through a resistor with resistance 100 Ω. The charging process is recorded with an oscilloscope. The result of this measurement is displayed in the graph below.
   a) Determine the half life of the charging process and calculate the time constant and the capacitance.
   b) Derive a formal expression for the slope of the graph at the time $t = 0$. Read the slope from the diagram and use this expression to calculate the capacitance. Compare the results of a) and b).



Additional Problems

6. A capacitor with capacitance C is discharged through a resistor with resistance R. In analogy to the half life derive a formal expression for the „tenth life".
7. The energy stored in the capacitor of an RC circuit drops to 23 % in 1.3 μs. How long does it take the voltage across the capacitor to drop to 31 % of the initial value?
8. A simple flashing light consists of a capacitor with capacitance 2 μF which is charged on 100 V through a resistor with resistance 1 MΩ. A neon bulb is connected in parallel to the capacitor. When the voltage across the capacitor reaches the neon bulb's ignition voltage $V_I = 80$ V, the bulb lights up and the capacitor is quickly discharged until the bulb goes out at the extinguish voltage $V_E = 70$ V.
   a) Sketch the voltage across the capacitor vs. time for several periods.
   b) How long does it take until the neon bulb lights up for the first time? Calculate the flashing frequency.

Solutions: 1. 46 s; 2. 2.4 mA; 3. 2 s; 4. 1.3 s and 6 s; 5. 98 nF, 9.8 μs; 0.5 V/μs; 6. $R\,C \cdot \ln 10$; 7. 2.1 μs; 8. 3.2 s, 1.25 Hz