

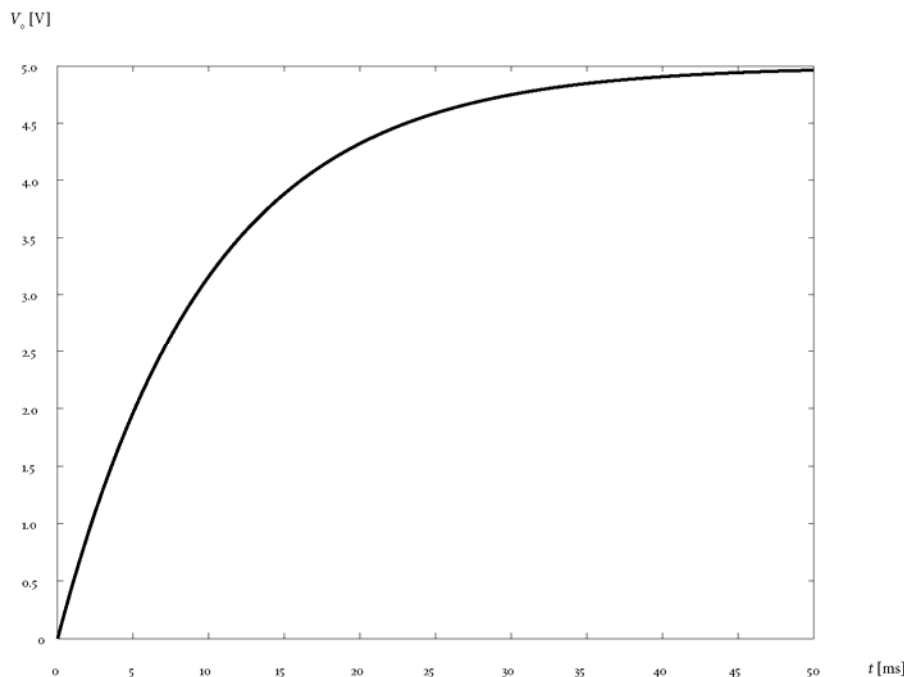
# RC-CIRCUITS

## Basic Problems

1. A capacitor with capacitance  $100\ \mu\text{F}$  is discharged through a resistor with resistance  $330\ \text{k}\Omega$ . 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  $15\ \text{k}\Omega$  are connected in series to a power supply with  $50\ \text{V}$ . The half life period of the charging process is  $0.4\ \text{s}$ . Calculate the current flowing  $0.2\ \text{s}$  after the charging process has started.
3. A capacitor is charged on a voltage of  $100\ \text{V}$  through a resistor. After  $4\ \text{s}$  the voltage across the capacitor is  $75\ \text{V}$ . How long does it take to charge the capacitor to the same voltage if it is connected to  $150\ \text{V}$ ?
4. The half lifes for discharging two different capacitors through the same resistor are  $2\ \text{s}$  and  $4\ \text{s}$ , respectively. Calculate the half life when the two capacitors are connected in series or in parallel.
5. 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“.

## Additional Problems

6. A capacitor is charged to  $5\ \text{V}$  through a resistor with resistance  $100\ \Omega$ . 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).



7. A simple flash light consists of a capacitor with capacitance  $2\ \mu\text{F}$  which is charged on  $100\ \text{V}$  through a resistor with resistance  $1\ \text{M}\Omega$ . A neon bulb is connected in parallel to the capacitor. When the voltage across the capacitor reaches the neon bulb's ignition voltage  $V_I = 80\ \text{V}$ , the bulb lights up and the capacitor is quickly discharged until the bulb goes out at the extinguish voltage  $V_E = 70\ \text{V}$ .
  - a) Draw the schematic circuit diagram for this flash light.
  - b) Sketch the voltage across the capacitor vs. time for several periods.
  - c) How long does it take until the neon bulb lights up for the first time? Calculate the flashing frequency.

SOLUTIONS TO THE BASIC PROBLEMS: 1.  $46\ \text{s}$ ; 2.  $2.4\ \text{mA}$ ; 3.  $2\ \text{s}$ ; 4.  $1.3\ \text{s}$  bzw.  $6\ \text{s}$ ; 5.  $T_{10} = R \cdot C \cdot \ln 10$