

Pre-Semester 2010 - Physics Course - Extra Tutorial

STÉPHANE NGO DINH
STEPHANE.NGODINH@KIT.EDU

Sheet 9
14.09.2010

1. Things to learn by heart

- (a) How is the **capacitance** C of a parallel plate capacitor defined? How is it related to the plate area A and the plate distance d ?
- (b) What is the **relative permittivity** ϵ_r of a dielectric material?
- (c) State **Ohm's law**!
- (d) What is the total resistance of a **series connection** of resistors? What is the total resistance of a **parallel connection** of resistors?
- (e) A voltage U is applied at the ends of a conductor with resistance R such that a current I flows through it. What is the **electric power** (the rate with which electric energy is converted into some other form of energy, e. g. heat)?

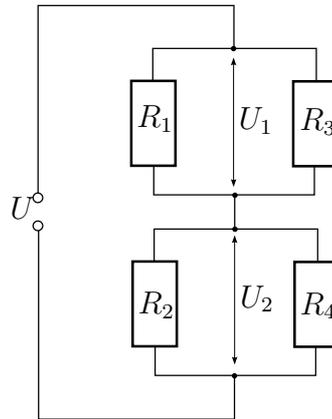
2. Motion in a Homogeneous Field

Consider a capacitor which consists of large plates which are perpendicular to the y -axis. Their distance is $d = 20$ cm: The upper plate lies in the $y = d/2$ -plane, the lower one in the $y = -d/2$ -plane. A voltage $U = 100$ is applied between the two plates (the upper one is on higher electric potential).

A point with charge $q = 10^{-3}$ C and mass $m = 1$ g starts in the middle of the capacitor (at $x = y = 0$) with velocity $v_{x0} = 24$ m/s, $v_{y0} = 10$ m/s.

- (a) Compute the electric field E . In which direction does it point?
- (b) Give the coordinates $x(t)$, $y(t)$ of the point as a function of time t . *Remark:* Sorry, I messed up the numbers such that the point *touches* the upper plate. For the following exercises, just assume that it continues to fly.
- (c) Does the charge point hit the upper plate?
- (d) When does it hit the lower plate (assume that the plates are infinitely extended in x -direction)?
- (e) With which velocity v and under which angle α (to the horizontal) does it hit the lower plate?

3. Resistors



In the figure above it is $R_1 = 10 \Omega$, $R_2 = 20 \Omega$, $R_3 = 50 \Omega$, $R_4 = 100 \Omega$ and $U = 24 \text{ V}$.

- Compute the total resistance of the circuit.
- What is the current I which flows through the voltage source? And what is the power P which is dissipated in the circuit?
- Compute the voltages U_1 and U_2 !
- What are, hence, the currents I_j which flow through the single resistors R_j ?