Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

Prof. Dr. J. Käs, Dr. M. Zink

Exercise Sheet 1 (WS 2010/11)

Date of Issue to Students: Oct. 14th 2010

Date of Submission: Oct. 21st 2010

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

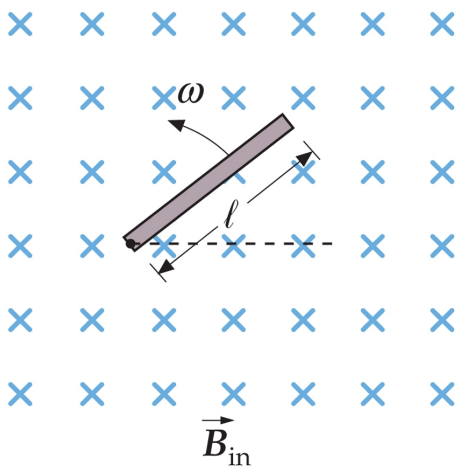
Exercises:

1. Find the magnetic force acting on a proton moving in the $+x$ direction at a speed of $0.446 \cdot 10^6$ m/s in a uniform magnetic field of 1.75 T in the $+z$ direction. (5 Points)

2. A magnetic field of 1.2 T is perpendicular to the plane of a 14 turn square coil with sides 5.0-cm long. (a) Find the magnetic flux through the coil. (b) Find the magnetic flux through the coil if the magnetic field makes an angle of 60° with the normal to the plane of the coil. (4 Points)

3. A uniform magnetic field is established perpendicular to the plane of a loop that has a radius equal to 5.00 cm and a resistance equal to 0.400 Ω. The magnitude of the field is increasing at a rate of 40.0 mT/s. Find (a) the magnitude of the induced voltage in the loop and (b) the induced current in the loop. (6 Points)

4. A conducting rod of length l rotates at constant angular speed ω about one end, in a plane perpendicular to a uniform magnetic field B (see figure on reverse side). (a) Show that the potential difference between the ends of the rod is $\frac{1}{2} B l^2 \omega$. (b) Let the angle θ between the rotating rod and the dashed line be given $\theta = \omega t$. Show that the area of the pie-shaped region swept out by the rod during time t is $\frac{1}{2} l^2 \theta$. (c) Compute the flux ϕ_m through this area, and apply $U_{ind} = -d\phi_m/dt$ (Faraday's law) to show that the motional voltage is given by $\frac{1}{2} B \omega l^2$.


ω
ℓ
$\vec{B}_{\text{in}}$