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Exercises and Complements for the Introduction to Physics II

for Students

of Biology, Pharmacy and Geoscience

Sheet 5 / 30.03.2022 Discussion: **05.04.2022 / 06.04.2022**

Exercise 17.

A wire made of aluminum (density $\rho = 2.7 \cdot 10^3$ kg/m^3) is suspended horizontally between the two poles of a horseshoe magnet, which is positioned vertically with one pole on top of the other. The wire can oscillate freely in the vertical magnetic field (flux density $B = 0.08$ T). Through the wire flows a current, with current density $j = 10^5$ A/m^2. At which angle with respect to the vertical axis of the pendulum (the so-called Lorentz swing) will the wire be in static equilibrium?

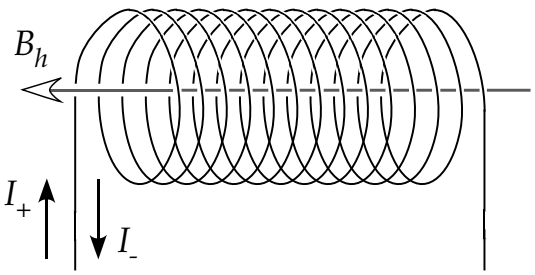
Exercise 18.

A ^{63}Cu-Ion (charge $+e$, mass $m_1 = 1.045 \cdot 10^{-25}$ kg) initially at rest is accelerated by a potential $U = 2.5$ kV and then deflected into a homogeneous magnetic field, which is perpendicular to the trajectory of the ion (mass spectrometer). The trajectory radius of the Cu ion is 317.3 mm.

(a) Calculate the magnetic field strength B
(b) What is the radius of the trajectory of a similar ^{65}Cu-Ion of mass $m_2 = 1.078 \cdot 10^{-25}$ kg in the same magnetic field?

Exercise 19.

The B-field of the Earth (B_H) should be compensated locally with a coil of length 2 m and 100 turns.



(a) How large must the current in the coil be, if the B-field of the Earth is $B_H = 2.1 \cdot 10^{-5}$ T?
(b) Which direction of the current must be chosen: I_+ or I_-?

Exercise 20.

A DC voltage of $U_0 = 133$ V at a current of $I_0 = 3.5$ A is applied through a single-layered coil, with $N = 300$ windings. The coil is wound around a closed ring-shaped iron core (diameter of the core $d_E = 2$ cm, diameter of the ring $d_S = 10$ cm, permeability $\mu_r = 600$). The voltage is switched off and simultaneously the coil is short-circuited. What is the magnitude of the current in the coil $t = 1 \cdot 10^{-3}$ s after switching it off?

Answers.

Exercise 17. 16.8°

Exercise 18. (a) 0.18 T (b) 322.2 mm

Exercise 19. (a) 0.33 A

Exercise 20. 2 A