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Exercises and Complements for the Introduction to Physics II

for Students

of Biology, Pharmacy and Geoscience

Sheet 2 / 11.03.2021 Zoom - Q&A on the Exercises: **23.03.2021 / 24.03.2021**

Exercise 5.
The electrical field of planet Earth is ca. 130 V/m at its surface and points to the center of Earth. Calculate the total charge Q of Earth assuming Earth to be a conducting sphere.

Exercise 6.
A homogeneous line charge with linear charge density $\lambda = 3.5$ nC/m extends on the x-axis from $x = 0$ to $x = 5$ m.
(a) What is the total charge?
(b) Calculate the electric field on the x-axis at $x_1 = 6$ m and $x_2 = 9$ m.

Exercise 7.
(a) Calculate the electrostatic potential of the proton at a distance of $1 \cdot 10^{-10}$ m.
(b) What would be the electrostatic potential energy of the electron-proton system if the distance between electron and proton is $1 \cdot 10^{-10}$ m? Specify the energy in J and eV.
(c) Compare the result of (b) with the electrostatic potential and the electrostatic potential energy of the electron-proton system with a distance of $5.3 \cdot 10^{-11}$ m (this corresponds to the mean distance between electron and proton in a hydrogen atom.) Specify the energy in J and eV.

Exercise 8.
(a) What is the field strength of a homogeneous electrical field if an electron is accelerated with $2 \cdot 10^{15}$ m/s^2?
(b) After what time is the velocity of the electron (accelerated by this homogeneous field) $2 \cdot 10^6$ m/s if its velocity at the beginning was $v_0 = 0$ m/s?

Answers:

Exercise 5. (a) -5.87·10^5 C

Exercise 6. (a) 17.5 nC (b) 26 N/C, 4.4 N/C

Exercise 7. (a) 14.38 V (b) -14.38 eV (c) 27.13 V, -4.3·10^{-18} J

Exercise 8. (a) 11.3 kV/m (b) 1 ns