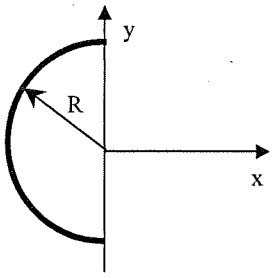
S-104.1020 Physics II (AUT, BIO, EST, TLT) **Exam, Sep 5, 2007**



1. Charge $+q$ is distributed evenly on an arc with radius R. Calculate the magnitude and direction of the electric field in the origin.

2. A dielectric sphere has a constant charge density. The total charge of the sphere with radius R is $+Q$.
   a) Calculate using Gauss's law the electric field inside and outside the sphere. (4 p.)
   b) Calculate the electric energy density in the center and on the surface of the sphere. (2 p.)

3. A toroid having a radius of 0,500 m and 500 windings carries a current of I = 1,5 A. The inside of the toroid is filled with magnetic material where the magnetic flux density is B = 1,5 T. Calculate a) the magnetic permeability and b) the magnetic susceptibility of the material.

4. Homogenous electric field $\overline{E}$ and homogenous magnetic field $\overline{B}$ are detected in the same spot in vacuum. The energy densities of the fields are equal. Calculate E if $B = 1,2 \cdot 10^{-5}$ T.

5. Unpolarised light hits the planar surface of a glass plate at an angle of 57°. The reflected light is totally linearly polarised. What is the refractive index of the glass? Calculate also the refraction angle.

6. A monochromatic beam of a semiconductor laser with a wavelength of 640 nm is directed into a narrow slit having a width of 0,10 mm. The Fraunhofer diffraction pattern is formed onto a screen at a distance of 35 m from the slit. Calculate the width of the central intensity maximum (the separation of the minimums next to the maximum).

Constants: mass $m_e = 9.11 \cdot 10^{-31}$ kg and charge $e = 1.60 \cdot 10^{-19}$ C of an electron, mass of proton $m_p = 1.67 \cdot 10^{-27}\,kg$, $c = 3.00 \cdot 10^{8}$ m/s, $\mu_0 = 4\pi \cdot 10^{-7}$ Tm/A, $\varepsilon_0 = 8,85 \cdot 10^{-12}$ F/m, $h = 6.635 \cdot 10^{-34}$ Js

Name, student number, degree programme (EST, TLT, AUT, BIO, ...), course code and the date on each examination paper.