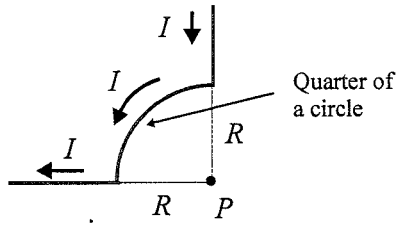
S-104.1020 Physics II (AUT, BIO, EST,TLT) **1st midterm exam** **March 5, 2007**

1. An electric dipole consists of two charges, q_1 = -3,0 nC and q_2 = +3,0 nC. The dipole moment is 12,0x10^{-12} Cm.
   a) Calculate the distance *d* between the charges.
   b) The electric dipole is located in a homogeneous electrical field with a field strength of E=10 V/m. The electric field forms an angle of 30° with the direction of the dipole moment. Calculate the torque acting on the dipole.
   c) Calculate the potential energy of the dipole.

2. Two distantly separated conducting spheres have a radius of 12,0 cm and 8,0 cm and a charge of -5,0 nC and +4,0 nC, respectively. Calculate the charges after the spheres have been connected with a thin conducting wire.

3. A capacitor of capacitance *C* is charged to a potential difference V_0. The terminals of the charged capacitor are then connected to those of an uncharged capacitor with capacitance *C/2*. Find a) the original charge of the system, b) the final potential difference across each capacitor, c) the final energy of the system, and d) the decrease in the energy of the system.

4. Current *I* flows in a wire as shown in the figure (you can assume that the straight part are infinite in length). What is the magnetic field *B* caused by the wire at point *P* (magnitude and direction)?



5. Current *I* flows in a cylinder along its axis. The base radius of the cylinder is *R*, the current density is constant, and the permeability is μ_0. Use Ampère's Law to calculate the magnetid field *B*
   a) inside the cylinder and
   b) outside the cylinder at a distance *r* from the axis.

Constants: mass $m = 9.11 \cdot 10^{-31}$ kg and charge $e = 1.60 \cdot 10^{-19}$ C of an electron,
$c = 3.00 \cdot 10^{8}$ m/s, $\mu_0 = 4\pi \cdot 10^{-7}$ Tm/A, $\varepsilon_0 = 8.85 \cdot 10^{-12}$ F/m

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