

## Examination in Applied Electromagnetism 081023

All examination aids except those which provide contact with the outer world are allowed.

If numeric values are needed but not given, you may assume reasonable numbers!

1

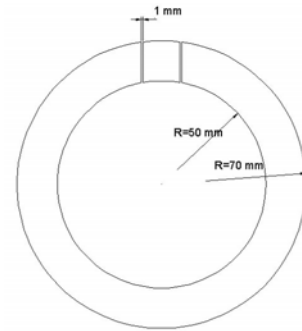
One wire is positively charged so that it gives an electric field  $12 \text{ V/m}$  at  $1,0 \text{ m}$  distance. Another wire with a negative charge of the same magnitude is placed  $10 \text{ mm}$  directly above the first. What is the magnitude and direction of the field at the same distance ( $1,0 \text{ m}$ ) to the side of the wires?

2

Reading thought is not possible (yet), but measuring the magnetic field caused by thoughts might be possible. A thought is a nerve impulse in the cm range. It travels with a velocity of around  $10 \text{ m/s}$  and carries a charge of around  $1 \text{ pC}$ . What is the order of magnitude of the B-field outside the skull if the thought takes place in the middle of the skull ?

3-4

Inductive charging of batteries is very common (tooth brushes, DEC phones etc) Assume it is done with a toroidal coil, as in the figure to the right. Along the major part of the torus a coil is wound with 2000 turns and along the shorter part (in the top) another coil with 500 turns. The shorter part is the part that can be taken away, and between that and the rest of the coil there are air gaps of  $1 \text{ mm}$  each.



Specify the current needed in the first coil to generate  $5 \text{ V}$  in the second?

$\mu_r = 400$  in both iron parts of the coil.

5

Metal detectors often work with electrical fields formed by dipoles (dipole antennas). Assume a dipole with  $p = 0,025 \text{ Cm}$  just above the ground. This detects a nail,  $2 \text{ mm}$  in cross section and  $10 \text{ mm}$  in length and  $1 \text{ m}$  down into the soil. What E-field does this nail cause on the ground due the charge distribution the dipole causes in it?

Neglect effects caused by the soil.

6

What is the capacitance per meter (Farad / meter ) of two parallel wires  $1 \text{ mm}$  in radius and  $4 \text{ mm}$  separated. They are isolated with a dielectricum with  $\epsilon_r = 4,4$

Write your mail address on the envelope!!!