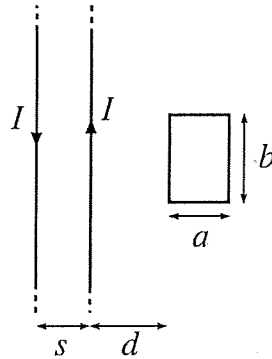


## S-96.101 Sovellettu kenttäteoria, exam, 7.6.2004

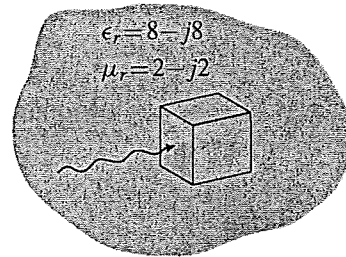
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1. Electric charge  $Q = 10 \text{ nC}$  is placed to a metal sphere which is located in vacuum and whose radius is  $a$ . What can be the minimum volume of the sphere, if the electric field strength is not allowed to exceed the break-down value  $E = 3 \text{ kV/mm}$ ?

2. A pair of long parallel wires with equal but opposite DC-currents  $I$  is located at the same plane with a rectangular wire loop. Determine the magnetic flux through the loop.  $\mu = \mu_0$ .



3. A linearly polarized homogeneous plane wave is propagating in a lossy medium with the frequency  $f = 150 \text{ MHz}$ . Determine the absorbed power in a cubic volume if the value of the electric field of the plane wave is  $E_0 = 50 \text{ V/m}$  at the plane through which the wave enters the cube. The length of the edge of the cube is  $d = 5 \text{ cm}$  and the relative permittivity and permeability of the medium are  $\epsilon_r = 8 - j8$  and  $\mu_r = 2 - j2$ , respectively.



4. The power of the TV transmitter of a broadcasting station is  $600 \text{ kW}$  and the gain of the transmitter antenna is  $2.15 \text{ dB}$ . The frequency of transmission is  $582 \text{ MHz}$  and successful reception requires a power of  $130 \text{ nW}$ . We suppose that the radio wave propagates in free space. What receiver antenna gain would be needed for successful reception  $200 \text{ km}$  away from the station?

Allowed in this exam:

- Calculator (no formula libraries)
- A self-made, one-sided, A4-sized formula sheet that must be returned with your answers

Please return all given answer paper sheets as one set and mark clearly your sketch papers.