17. Internationale Elektrotechnik-Olympiade der Schulen der Euroregion Neisse

NEISSE - ELEKTRO 2000

Name:.....

1	2	3	4	5	Σ

Tasks fort he finale test
90 min; with formula sheet (English edition)

1
Given is the electrical circuit according to figure **1**

R_1 - R_7 = 10 Ω
U_{q1} - U_{q4} = 2 V
R_{i1} - R_{i4} = 1 Ω

a) Simplify the circuit in figure 1 to a basic circuit with only one voltage source and one load resistance
b) Calculate for the basic circuit the parameter U_q, R_i, R_a, I and U_{AB}
c) Calculate the amounts of all currents from I_1 to I_7 and all voltages from U_1 to U_7!

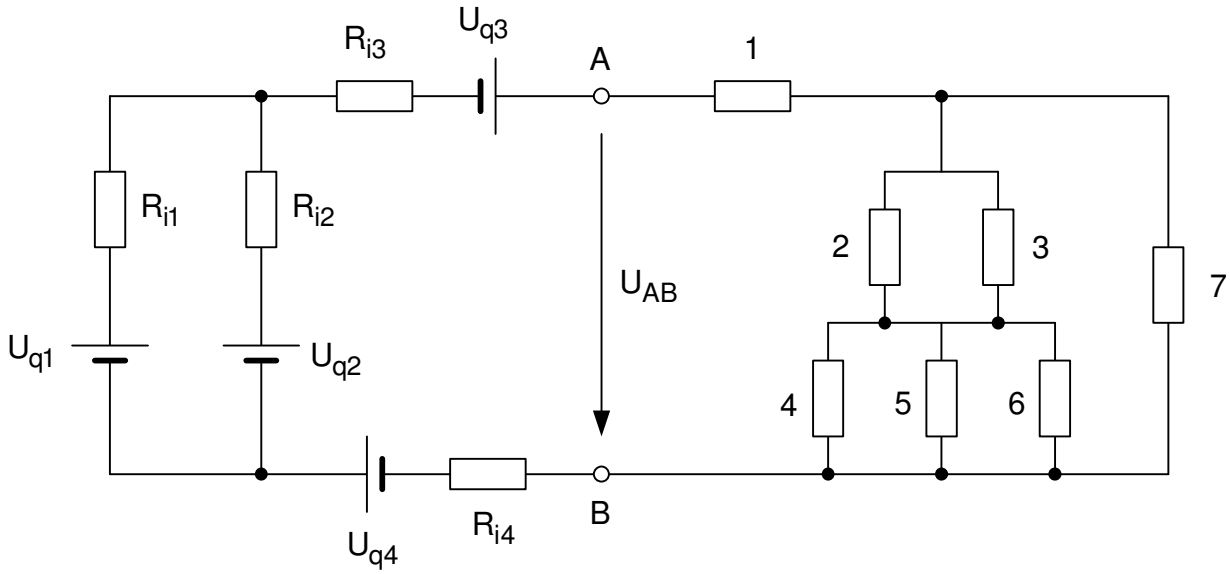

Figure 1

2
An electrical current of I = 100 A is flowing through a conductor consisting of three different materials in series connection like shown in figure 2 a)
The conductivity of the materials is: $\kappa_1 = 1$ S/cm $\kappa_2 = 2$ S/cm $\kappa_3 = 4$ S/cm

a) Calculate the voltage U_1 - U_3 over each material part!
b) Calculate the electrical field intensity E_1 - E_3 over each material part!

The same current of I = 100 A is flowing through a conductor consisting of three different materials in parallel connection like shown in figure 2 b).
The conductivity of the materials is the same as in figure 2 a).

c) Calculate the different currents $I_1 - I_3$ and the voltage!
d) Calculate the current density $S_1 - S_3$ in each material part!

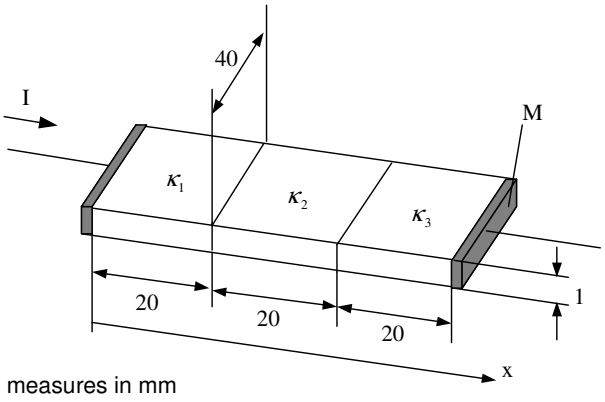

Figure 2a

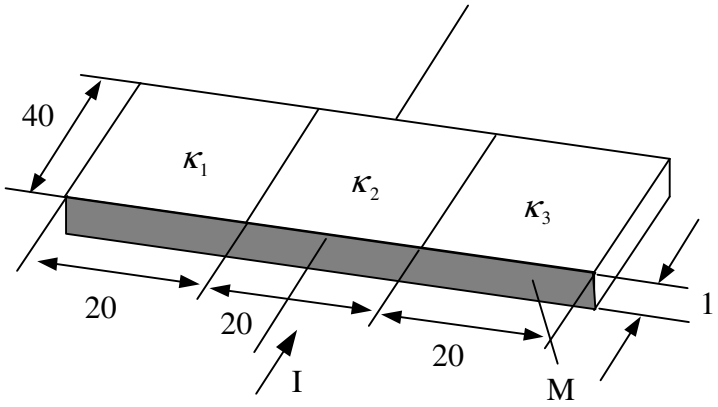

Figure 2b

3

The determination of the resistance R is done by two different measurements. The first one (figure 3a), exact for the voltage, with the results U = 9,0 V and I = 76 mA under consideration of a resistance of the voltage meter R_{MU} = 9,0 kΩ. The second one (figure 3b), exact for the current, with the results U = 10,0 V and I = 80 mA.

Calculate the resistance R and the resistance of the current meter R_{MI}.

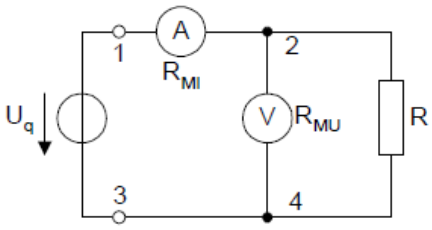

Figure 3a

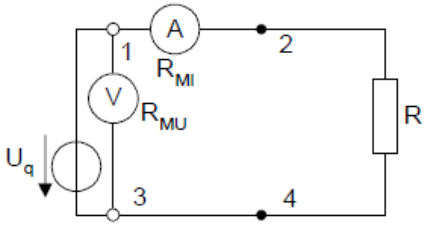

Figure 3b

4

A high voltage cable with a two layer insulation according to figure 4 can be considered as two cylindrical capacitors with the following parameters:

U_{total} = 10 kV, f = 50 Hz
length of the cable l = 100 m

r_a = 4 cm
r_i = 1 cm
r_1 = 2 cm
ε_{r1} = 3
ε_{r2} = 1

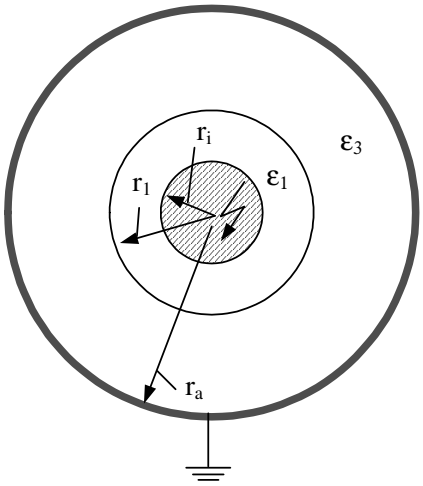

Figure 4

a) Calculate the capacitances C_{total}, C_1 and C_2 of this cable!
b) Calculate the electrical charge $Q = Q_1 = Q_2$ of this cable!
c) Calculate the voltage over each layer of the insulation U_1 and U_2 !

5

The current in an unlimited long conductor is I = 1000 A

a) Calculate the magnetic field strength H for a straight conductor like indicated in figure 5 a) in three different points P_1 , P_2 and P_3 (r = 0,5 m).
b) Calculate the magnetic field strength H for a right angle conductor like indicated in figure 5 b) in three different points P_1 , P_2 and P_3 .
c) Calculate for b) the magnetic flux density B in P_1 if the conductor is surrounded by air.

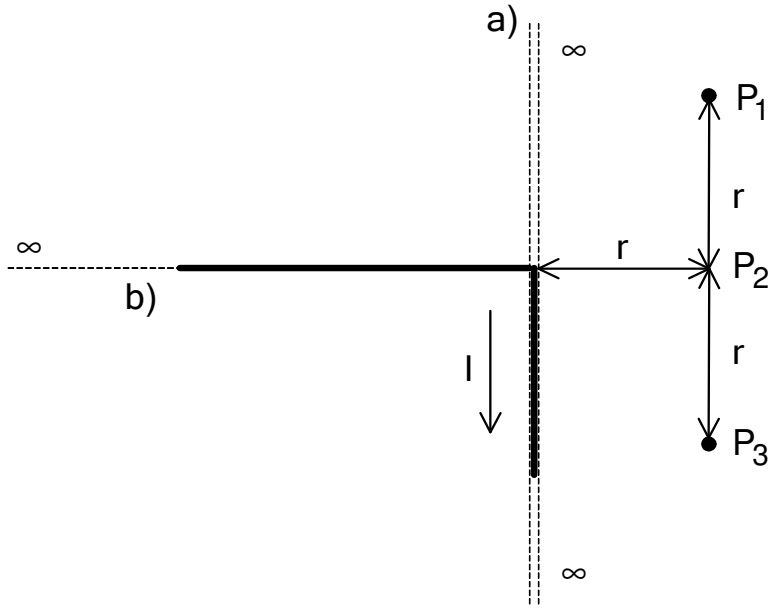

Figure 5