21. Internationale Elektrotechnik-Olympiade der Schulen der Euroregion Neisse

NEISSE - ELEKTRO 2015

Name:...

1	2	3	4	5	Σ

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

1

Two conductors of Aluminium and Copper with the same cross section of $A = 2,5\ mm^2$ are connected in series and a current of $I = 12\ A$ is flowing through both.

a) Calculate the amounts of the current density S and the electric field strength E in both conductors for the following specific electrical resistances:
   Copper $\rho = 0,017\ 10^{-6}\ \Omega m$
   Aluminium $\rho = 0,027\ 10^{-6}\ \Omega m$

b) Which cross section would be necessary for the aluminium conductor to have the same electric field strength E in both conductors?

c) How long must be the aluminium conductor, to have the same resistance R than a copper conductor of a length of 10 m for both with the same cross section ($A = 2,5\ mm^2$)?

d) Calculate the amount of this resistance R!

2

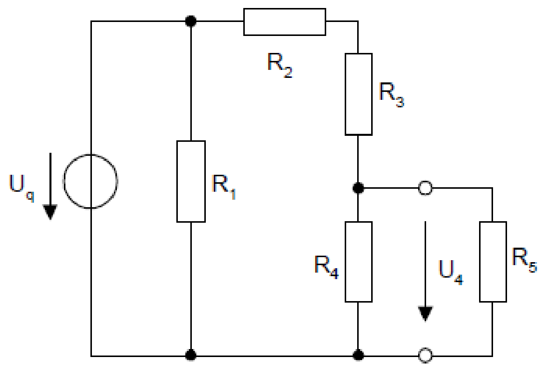
An Edison electric lamp with the following parameters $P_N = 60\ W$ and $U_N = 230\ V$ has an Wolfram heating wire ($\rho_{20} = 0,055\ \Omega\ mm^2 / m$) with a length of $l = 60\ cm$ and a diameter of $d = 0,03\ mm$.

a) Calculate the temperature of the heating wire in service ($\alpha = 0,0041 / K$)
b) Calculate the current I and the electrical power P during switch-on at a temperature of $\vartheta = 20\ °C$

(Help: Calculation of the resistance at service temperature: $P_N = U_N\ I_N$ and $R_B = U_N / I_N$)

3

Given is the electrical circuit according to figure 1



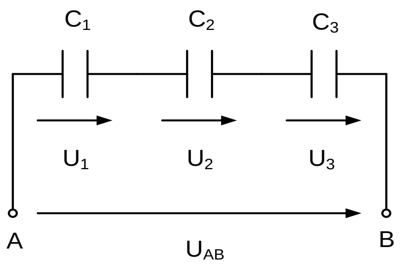
U_q = 12 V
R_1 = 10 kΩ
R_2 = 40 Ω
R_3 = 60 Ω
R_4 = 100 Ω

Figure 1

a) Calculate the voltage U_4 without the resistance R_5 in this circuit!
b) Which amount must have the resistance R_5 that the voltage U_4 is just 10 % of the voltage U_q ?
c) Calculate for this case of b) the currents I_1 up to I_5 and the total current I_G of the voltage source!

4

Given is the series connection of 3 capacitors according to figure 2



C_1 = 150 pF
C_2 = 250 pF
C_3 = 480 pF

U_{AB} = 100V

Figure 2

a) Calculate the total Capacitance C_{AB} the total Charge Q_{AB} and the voltages U_1 , U_2 and U_3 !
b) To which amounts the total Capacitance C_{AB} , the total Charge Q_{AB} and the voltages U_1 , U_2 and U_3 will change in case of a breakdown of the capacitor C_3

5

In an infinite long conductor is the current flow of a direct current   I = 100 A

a) Calculate the amount of the magnetic field strength H and of the magnetic flux density (magnetic induction) B in a distance of r = 10 cm!
b) Calculate the length l of the conductor to have in point P (see figure 3) 90% of the magnetic field strength H compared to the infinite long conductor!

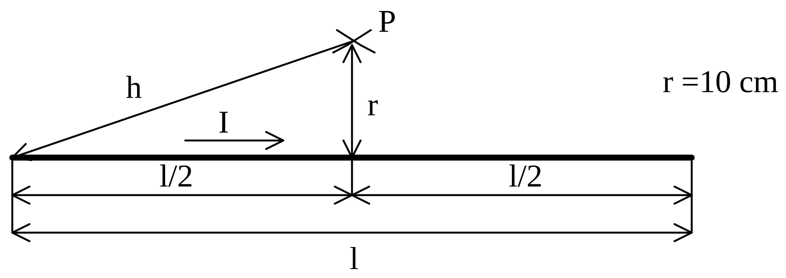


Figure 3