28. Internationale Elektrotechnik-Olympiade der Schulen der Euroregion Neisse

NEISSE-ELEKTRO 2022

Name:

School:

1	2	3	4	5	Σ

Tasks for the finale; 90 min; with formulary (English edition)
Please **use a separate sheet of paper** for each task.
Write your name and school on each of these papers.

Task 1 (20 points)
Transform the voltage source in figure 1 on the left in the current source at the right.
Calculate
a) the current I_S,
b) the voltage U_1 and
c) the resistance R_i
with U_0 = 30 V and R = 20 Ω.

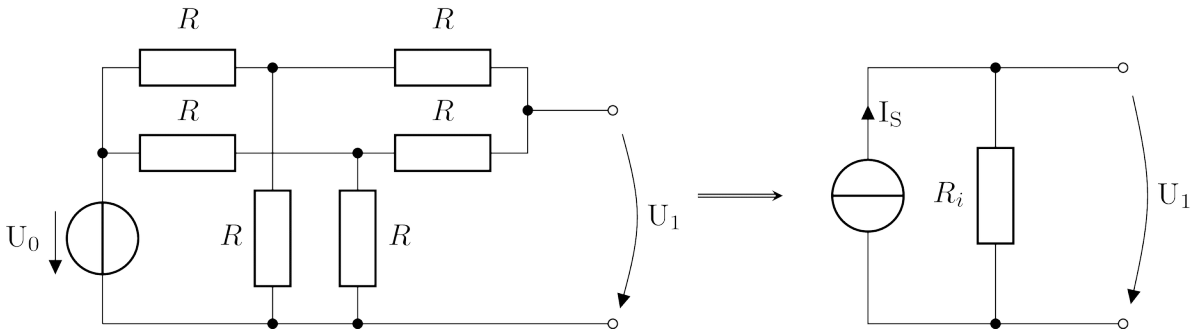

Figure 1

Task 2 (20 points)
The current I_1 and I_2 flow out of the drawing plane, I_3 flows into the plane according to figure 2. The magnetic fields of the currents superimposes each other.
I_1 = 65 A, I_2 = 45 A, $I_3 = I_1 + I_2$, r = 120 mm and
c = 160 mm

a) Calculate the magnitude of magnetic field H at point P.

b) Draw the vectors of the individual field strengths H, H_1, H_2 and H_3 at point P.

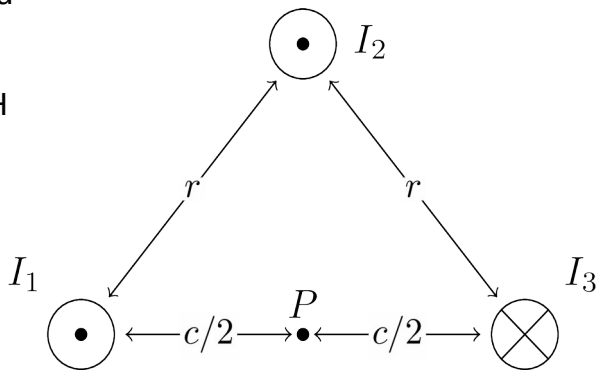

Figure 2

Task 3 (20 points)
A capacitor consists of two materials. One half of the area A is in the half of the height with relative permittivity ε_2. All the other material has permittivity ε_1 according to figure 3. (ε_0 = permittivity of vacuum, $\varepsilon_1 = 2$, $\varepsilon_2 = 3$)

a) Calculate the voltage U_1 with an applied voltage of $U_0 = 100V$.

b) Draw the equivalent schematic.

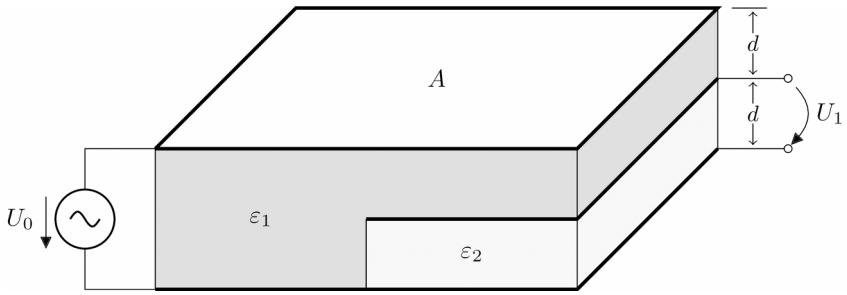

Figure 3

Task 4 (20 points)
Two measurements were made on a transformer: A voltage source U = 100 V with f = 400 Hz was connected to the primary side and current I and effective power P were measured on the terminals while the connections on the secondary side are unconnected (figure 4). Then the measurement is repeated on the secondary side, while the primary side was unconnected.

For primary side:
I = 1,6 A, P = 25 W
For secondary side:
I = 0,65 A, P = 7,5 W

Calculate R_1, R_2, L_1 and L_2

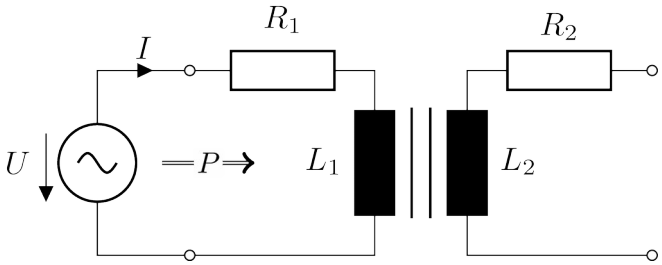

Figure 4

Task 5 (20 points)
Given is a low pass filter (figure 5) with L = 65 mH and R = 750 Ω.
a) Calculate the cut-off frequency f when the output voltage U_2 decreases to

$$\frac{U_2}{U_1} = \frac{1}{\sqrt{2}} \quad .$$

b) Calculate the the cut-off frequency f_2 if an additional load resistor of $R_2 = 2{,}5\ k\Omega$ is connected to the output.

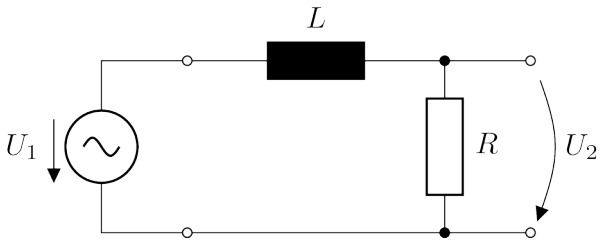

Figure 5

Before end, write your **name and school on each paper**.
- until 12 o'clock, 2nd April 2022: Send two photos with a **overview** of all papers with front an back side to neisse-elektro@hszg.de
- until 14 o'clock, 4th April 2022: Send a **detailed** scan or photo of **each** of your sheets to neisse-elektro@hszg.de (single or multiple emails)
See www.hszg.de/neisse-elektro → "Vorbereitung Przygotowanie Priprava" for more information
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