Institutt for fysikk, NTNU
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Løsningsforslag til øving 10

Veiledning uke 11

Oppgave 1

The conductor may be divided into sylindracal tubes with inner radius r, outer radius $r + dr$, and hence a cross section with area

$$dA = 2\pi r\ dr$$

The current running in such a tube is

$$dI = j \cdot dA = j_0\, e^{-r/R} \cdot 2\pi r\ dr$$

Total current I is then found by integrating dI over the cross section of the conductor, i.e., by letting r vary from 0 to R:

$$\begin{aligned} I &= \int dI \\ &= \int_0^R j_0\, e^{-r/R} \cdot 2\pi r\ dr \\ &= 2\pi j_0\, R^2 \int_0^1 x\, e^{-x}\, dx \\ &= 2\pi j_0\, R^2 \left(1 - \frac{2}{e}\right) \end{aligned}$$

Here, we have substituted $x = r/R$ so that $dr = R\, dx$ and $r = R\, x$. The integral is easily solved with integration by parts.