1. Wire (7 pts)

A conducting wire is formed of a cylindrical copper core with a diameter of $a = 2{,}5\,\mathrm{mm}$. The core is wrapped in a concentric, cylindrical aluminium coating, the total diameter of the wire being $b = 4\,\mathrm{mm}$. A current of $I = 2{,}4\,\mathrm{A}$ flows through the wire. The specific resistivity of copper is $\rho_c = 0{,}0168 \cdot 10^{-6}\,\Omega\cdot\mathrm{m}$ and of aluminium, $\rho_a = 0{,}028 \cdot 10^{-6}\,\Omega\cdot\mathrm{m}$.

1) What are the current densities j in different parts of the wire (current density is defined as the current per cross-section area)?

2) What is the magnetic inductance B_1 at the distance $c = 1\,\mathrm{cm}$ from the axis of the wire?

3) What is the magnetic inductance B_2 at the surface between the copper and aluminium?

Remark It may be useful to know the circulation theorem: $\int \vec{B} \cdot \vec{dl} = \mu_0 I$, where the integral is taken along a closed trajectory (loop) and I is the net current flowing though that loop; $\mu_0 = 4\pi \cdot 10^{-7}\,\mathrm{H}\cdot\mathrm{m}^{-1}$. This formula is completely analogous to the formula for the work done by a force along a trajectory: $\vec{F}$, $A = \int \vec{F} \cdot \vec{dl}$.