1. A vortex of current is modeled by the following current density in space:

$$\vec{J}(x, y, z) = J_0 \left[ \frac{y}{\sqrt{x^2 + y^2}} \hat{x} - \frac{x}{\sqrt{x^2 + y^2}} \hat{y} + \hat{z} \right]$$

(a) How much current (C/s) is flowing through a disk-shaped area with radius $R$, centered on the origin in the $xy$-plane? (b) How much current (C/s) is flowing through a square of length $L$ with one side resting flush against the $z$ axis? (5 points)

2. A square loop of current with side lengths $L$ lies on the $xy$-plane, centered on the origin. Given a line current $I$, what is the $\vec{H}$-field along the $z$-axis ($\vec{H}(0, 0, z)$)? (10 points)

Here is an integral formula that might be useful:

$$\int \frac{du}{(a^2 + u^2)^{3/2}} = \frac{u}{a^2 \sqrt{a^2 + u^2}} + C$$