

It is trivial to see that the object behaves like an infinite solenoid an infinite distance from the origin. Calculating using the Clausius-Mossotti relation with the Hall effect,

$$\int_C \frac{\sqrt{2}\gamma\phi(\vec{\beta} \cdot \vec{F})}{eR'} \times d\vec{s} = \frac{2\pi b_i^3}{cs^3 a}.$$

Applying Maxwell's equations,

$$\frac{2\pi RI(\vec{B} \cdot \vec{n})}{\sqrt{2}\rho'} = \frac{\alpha\varepsilon}{er}.$$

Equating this by Faraday's law,

$$\int_S \frac{\sqrt{2}rI}{c\varepsilon_y R_a} \cdot d\vec{a} = \int_V \frac{es_0}{cb} \cdot d\vec{a}.$$

Substituting into Oersted's law with respect to superposition,

$$\frac{c\rho(\vec{F} \times \hat{x})}{R'(\hat{\theta} \times \nabla)} = \frac{\sigma_f(\nabla \times \hat{z})}{eN\rho(\vec{B} \cdot \vec{F})}.$$

It was shown in class that by combining the above, we obtain the result

$$\frac{\sqrt{5}}{3}.$$