

Homework 1:

Remember: In addition to this problem, you also have a “Mastering Physics” assignment Due February 8.

Due at the beginning of lecture, Friday, February 8. Write up of the solution to this problem in a coherent fashion.

A graduate student in electrical engineering has developed a new type of device for measuring magnetic fields (a magnetometer). He boasts that it is better than any of its competitors. A physics graduate student hears of this new device and she decides to try it out on the magnetic field inside a particle detector she is building. She carefully measures the magnetic field using the device in a certain region in space and then notices that these measurements can be reproduced with very high accuracy by a simple analytic expression:

$$\vec{B} = \hat{i}A \frac{x}{\sqrt{x^2 + y^2 + z^2}}$$

where A is a constant with dimensions of $T \cdot m$.

After obtaining this result, the physics student seeks out the developer of the magnetometer and says to him, “Either your device sucks or I will win a Nobel prize for the discovery of a density of magnetic monopoles. Unfortunately, I think it is the former.”

How did she reach this conclusion? (Hint: think about Gauss’s law)