

# Homework 1:

**Remember: In addition to this problem, you also have a “Mastering Physics” assignment Due February 6.**

**Due at the 10:00 a.m., Friday, February 6. The homework should be placed in the appropriate envelope outside Tom Cohen’s office (2104 Physics). Use the envelope labeled by your section.**

**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:

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

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)