Solution for Problem A5

(5 points) Force on a dipole m oriented in the direction of the field is

$$F = m\mu_o \frac{dH}{dx}$$

in x-direction.
The dipole moment is

$$m = \chi H \times volume$$

so that

$$\frac{F}{volume} = \frac{1}{2}\chi\mu_o \frac{dH^2}{dx}$$

(5 points) The force on the rod is

$$F = \int dx A \frac{1}{2\mu_o}\chi \frac{dB^2}{dx} = \frac{\chi}{2\mu_0} A[B^2]_{upperend}^{lowerend}$$

From this equation we get $\chi = 1.2 \times 10^{-5}$.