A5) (5 points) Prove that the force per unit volume in the x-direction acting on a small paramagnetic particle in an inhomogeneous magnetic field is given to a good approximation by

$$\frac{1}{2}\chi\mu_o\frac{d}{dx}(H^2),$$

where χ is the magnetic susceptibility of the particle, and the particle is in air.

(5 points) Apply this result to the following situation: A rod of sulphur, of 1.0 cm^2 cross-sectional area, is placed in air in a non-uniform magnetic field, the direction of the field at each end of the specimen being at right angles to its axis. The strength of the field at one end is 1.2 T and at the other end 0.3 T. The force on the rod due to the field acts parallel to its axis and has magnitude 6.5×10^{-4} N. Find the magnetic susceptibility of sulphur.