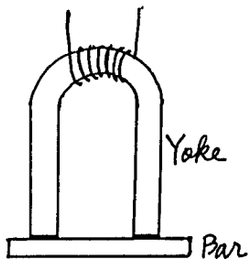
1. (10%) Solar energy impinges on the top of the atmosphere at the rate of 1.3 Kw/m^2. What is the electric field amplitude?

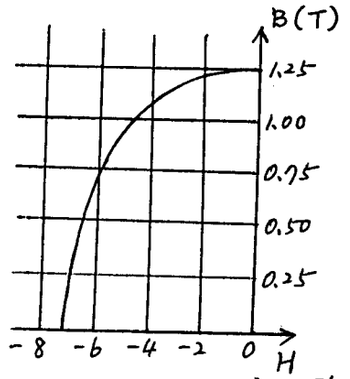
2. (10%) An electromagnet consists of a U-shaped iron yoke and iron bar. There exists a thin air gap between the bar and the yoke. If the magnetic flux through the circuit is 1.5×10^{-2} Wb and the yoke-bar contact area is 1.5×10^{-2} m^2 per yoke, what is the weight of (including the weight of the bar) which the yoke will support?



3. (10%) Two large conducting planes intersect at an angle of α to form a wedge. An infinitesimal insulating gap exists at the intersection edge. The two conducting planes are at potentials $V=0$ and $V=V_0$ respectively. Find V and $\vec{E}$ between these two planes.

4. (16%) A tiny electric dipole of moment $\vec{p}$ is placed at a distance r from a long straight wire which has a uniform charge density λ per unit length. What is the force and torque on the dipole, (a) if $\vec{p}$ is parallel to the wire? (b) if $\vec{p}$ is along the radial direction?

5. (18%) (a) An iron ring has a uniform cross-sectional area of 150 mm^2 and a mean radius of 200 mm. An air gap 1 mm wide is cut in it. Find the number of ampere-turns required to produce a flux density $B=0.5$ T in the air gap. Neglect fringing. ($\mu=250\mu_0$ when $B=0.5$ T in the iron).



(b) If the iron ring is first magnetized to saturation with a uniform toroidal coil wound on it and then cut off the current. What is the flux density B in the air gap? Use the demagnetization curve shown.

6. (18%) A sphere made of material of constant permeability μ is placed in a uniform external magnetic field $\vec{B}$. Find the magnetization of the sphere.

7. (18%) Design an air-filled rectangular waveguide which, at 10 GHz, will operate in the TE_{10} mode with 25% safety factor, i.e., $1.25 f_c \le f \le 0.75 f_c'$, where f_c is the cutoff frequency for the TE_{10} mode and f_c' is that for the mode with the next higher cutoff. (Choose the upper bound to reduce the attenuation.)