Physics 8.07, Fall 1999
Homework #7

Reading for Tuesday, October 26: Griffiths pp. 321–343.

Reading for Thursday, October 28: Griffiths pp. 345–363.

Problem Set #7

Due **Thursday, October 28** by 9:30 AM in the 8.07 homework box in 4-339B.

1. Griffiths, problem 6.16.

2. Griffiths, problem 6.23.

3. An infinitesimal current loop with magnetic dipole moment $\mathbf{m} = m\hat{z}$ is located at the point $(0, 0, d)$. The lower half-space $z < 0$ is filled with a homogeneous substance with magnetic susceptibility χ_m. Find $\mathbf{B}, \mathbf{M}$, and $\mathbf{H}$ everywhere in space.

4. Griffiths, problem 7.11.

5. Griffiths, problem 7.19.

6. Griffiths, problem 7.20.

7. A pair of square current loops parallel to the x-y plane are positioned with their sides parallel and their centers along the z-axis at the points $(0, 0, 0)$ and $(0, 0, d)$. The side length of each of the squares is $2a$. (This geometry is just like in problem 7.20, but the loops are square and of the same size.)

(a) Compute the mutual inductance between the two current loops as a function of z and a.

(b) Compute the asymptotic form (leading term in $1/d$) of the mutual inductance as $z \to \infty$. Check your result by comparing to the result you would find using the long-range magnetic field from an appropriate dipole.

(c) Compute the asymptotic form of the mutual inductance as $d \to 0$. This corresponds to the self-inductance of a single square current loop. Is your answer physically sensible?