SET 3–DUE 4 FEBRUARY

"The purpose of computing is insight, not numbers."–W. Hamming

I'll be out of town all week starting Monday afternoon at a conference (2-6 February). Sorry, but I will be available for questions all day Thursday and Friday the week before.

A set of Jackson scattering problems.

1) [15 points] Jackson 10.4, parts a (5 points) and b (10 points) only. $\delta \gg R$ means that the size of the sphere is much less than the attenuation length, so the scatterer can just be treated as a dielectric sphere. In part b, to find absorption, calculate the power dissipated due to conductivity σ.

2) [15 points] Jackson 10.5. Part a (5 points), b (10 points). It is useful to show that

$$\vec{m} = \frac{ik\sigma}{2c} \int \vec{x}(\vec{x} \cdot \vec{B}) d^3x.$$

In part (b), the optical theorem says

$$\sigma = \frac{4\pi}{k} Im f(\hat{n} = \hat{n}_0)$$

with

$$f(\hat{n}) = E_{scatt}(\hat{n})/(E_0 \exp(ikr)/r)$$

as you'll see derived in a week or two, so to get his answer, just add the two $Im\ f(\hat{n} = \hat{n}_0)$'s. Welcome to real physics, we have to know everything all at once for this problem.

3) [20 points] Jackson 10.9a. Use the Born approximation. The integral peaks strongly in the forward direction, so you can replace $qa \simeq ka\theta$, $d\cos\theta = \theta d\theta$, and take the range of θ from 0 to infinity. You'll get an integral

$$\sigma \simeq 2\pi|\epsilon - 1|^2 k^2 a^4 \int_0^\infty x dx \frac{j_1(x)^2}{x^2}.$$

At that point Bessel function identities near Jackson 9.90 might be useful.