

SET 4–DUE 11 FEBRUARY

“If you can’t be a giant, you want to be the giant killer”–M. Perl

Two fairly straightforward (though intricate) Jackson diffraction problems.

1) [20 points] Jackson 10.11. (a,b only). iHint: expand

$$R = [(x - x')^2 + y'^2 + z^2]^{1/2} \sim z[1 + \frac{(x - x')^2 + y'^2}{2z^2} + \dots]$$

For Fresnel integrals, see Abramowitz and Stegun, p. 300 or Morse and Feshbach, p. 816.

There does not seem to be a standardized notation for these functions!

2) [20 points] Jackson 10.12. In (a), work in the Fraunhofer limit. It is quite similar to the calculation done on pp. 491-492, except that the initial polarization is $\vec{\epsilon}_0 = \hat{y}$. For part (b), use the Dirichlet formula, 10.85. (drop the $+i/(kR)$)

THIS PROBLEM FROM LAST WEEK IS PUT OFF TO THIS WEEK

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.