DUE: THURSDAY, FEBRUARY 21, 2013

MIDTERM ALERT: The midterm exam will be posted on the class website at the end of the day on Friday February 22 and will be due at 10 am on Monday February 25. While working on the exam, you may refer to Jackson’s text and any second electromagnetic textbook of your choosing. (If you do consult a second text, please indicate which one you used.) Any reference for integrals or other mathematical facts, and any personal handwritten notes are also OK. You are also free to consult any of the class handouts, including the solution sets. However, you may not collaborate with anyone else. The exam will cover material from Chapters 8, 9 and 11 of Jackson (and the first three problem sets of this course).

1. Jackson, problem 9.1

2. Jackson, problem 9.2

3. Jackson, problem 9.7

HINT: One way of solving part (a) of this problem is to use the results of problem 9.6. If you choose this technique, you should provide some details on how you would establish the relevant results that you need from problem 9.6.


HINT: The charge density can be expressed as \( \rho(\vec{x}, t) = \rho_0 \Theta(R(\theta) - r) \), where the step function \( \Theta(x) = 1 \) for \( x > 0 \) and \( \Theta(x) = 0 \) for \( x < 0 \). The constant \( \rho_0 \) can be determined in terms of the total charge \( Q \) which is conserved and hence time-independent. Find the relation between \( \rho_0 \) and \( Q \) assuming that \( \beta \ll 1 \). Then writing \( \beta = \beta_0 e^{-i\omega t} \), expand the expression for \( \rho(\vec{x}, t) \) to linear order in \( \beta_0 \). You can now use this expression to evaluate the electric multipole moments. You can also evaluate the current density \( \vec{J}(\vec{x}, t) \) by making use of the continuity equation. This will be needed to evaluate the magnetic multipole moments.

5. Jackson, problem 9.16