DUE: THURSDAY, FEBRUARY 16, 2023

MIDTERM ALERT: The midterm exam will be posted on the class website after class on Thursday February 16 and will be due at the end of the day on Friday February 17. Completed exams should be placed in my physics department mailbox or sent to me via email.

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 and/or the posted lecture notes are also OK. You are also free to consult any of the material posted on the class website. 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 9.2

HINT: Show that the time-dependent quadrupole tensor can be written as the real part of a complex tensor of the form $Q_{ij}(t) = Q_{ij}e^{-2i\omega t}$, where Q_{ij} is a a complex matrix that depends on a and q. Note the factor of 2 in the exponent. How does this affect the application of the formulas for $dP/d\Omega$ and P given in section 9.3 of Jackson?

2. 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.

3. Jackson, problem 9.8

HINT: To answer part (b), consider the case where only one of the three components of the electric dipole moment in a spherical basis, q_{1m}, is nonzero. See eqs. (4.5) and (4.7) of Jackson for the relations between $\vec{\boldsymbol{p}}$ and the q_{1m}. Consider separately the cases of $m = -1, 0$ and $+1$. Determine how the ratio of angular momentum radiated to energy radiated depends on m.

4. Jackson, problem 9.16

NOTE: Do *not* employ any approximations associated with the multipole expansion in this problem.