DUE: TUESDAY, FEBRUARY 17, 2026

MIDTERM ALERT: The take-home midterm exam will be posted on the class website after class on Tuesday February 17 and will be due in class on Thursday February 19.

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 material posted on the class website. However, you may *not* collaborate with anyone else (this includes AI help such as ChatGPT).

The exam will cover material from Chapter 7 (sections 1, 2, 5, 8, 10), Chapter 9 (sections 1–4, 6), and Chapter 11 (sections 1–7, 9, 10) of Jackson (and the material covered by 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 9.3

3. Jackson, problem 9.6

4. Jackson, problem 9.7, part (a)

5. 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.

6. Jackson, problem 9.16

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