University of Washington **Autumn Quarter 2020**
Physics 513 **November 6-9, 2020**
Graduate Electrodynamics I

Mid-Term Exam I

- The exam is due via email by Monday, November 9, at 4 pm PST. Points will be deducted for a late submission.

- Use a separate sheet of paper for each problem solution; you will therefore have a minimum of 3 pages in your submitted PDF file. Assemble the PDF pages in problem-order (1, 2, 3).

- This is an open-book exam; you may refer to the Jackson textbook, your lecture notes and anything on the course web site.

- Show your work in enough detail so the grader can follow your reasoning and your method of solution.

- Please take up to an hour and 20 minutes to complete the exam, please don't continue beyond that.

- Feel free to contact me with questions.

- Email-submission instructions:
  1. Scan your solutions as a single PDF file
  2. Name your file `midtermI-`*lastname*`.pdf`
  3. Attach your file to an email
  4. ... with subject line `midtermI-`*lastname*
  5. Send that email to `ljrosenberg@phys.washington.edu`

I. (35 points) Potential at the Edge of Charged disk.
A thin disk of radius *R* carries a uniform surface charge σ. Find the electrostatic potential at the edge of the disk.

II. (35 points) Potential Between a Ground Plane and a Cone.
Consider a cone of half-angle θ_0. (θ_0 is the angle between the cone inside axis and the cone surface.) The potential of the cone is fixed at Φ_0. The tip of the cone is placed so the tip is almost touching a grounded conducting plane with the cone axis normal to the plane. Find the potential between the ground plane and cone. (This is a "discone" antenna, which has certain attractive features.)

III. (30 points) Electric Multipoles.
Consider a number of equally-spaced point charges arranged in a straight line where the charges may have different values.
(a) Find the fewest number of charges and their values for which the lowest multipole moment is a quadrupole.
(b) Find the fewest number of charges and their values for which the lowest multipole moment is an octupole.