University of Washington **Autumn Quarter 2018**
Physics 513 **November 1, 2018**
Graduate Electrodynamics I

Mid-Term Exam

Printed Name _____
last *first*

- If you need more space than is available to answer any part of a problem, use the **back side of the same page** to complete your answer. Scratch paper will not be graded.

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

- This is an open-book exam; you may refer to Jackson in paper or electronic form.

POINTS ARE TOTALED ON THE BACK OF THE EXAM

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I. (30 points) Electrostatic potential.

A sphere of radius R is centered at the origin and a charge q is at the origin. It is known that the electrostatic potential on the surface of the sphere is $\Phi|_s = \Phi_0 \cos\theta$ with Φ_0 a constant. Find the electrostatic potential inside and outside the sphere.

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II. (35 points) Electric field. A certain charge distribution results in a radial electric field $\mathbf{E} = \eta \frac{e^{-kr}}{r^2} \hat{\boldsymbol{r}}$ with η and *k* constants.

(a) Find the charge distribution.

(b) Sketch the charge distribution.

(c) Find the total charge in the system.

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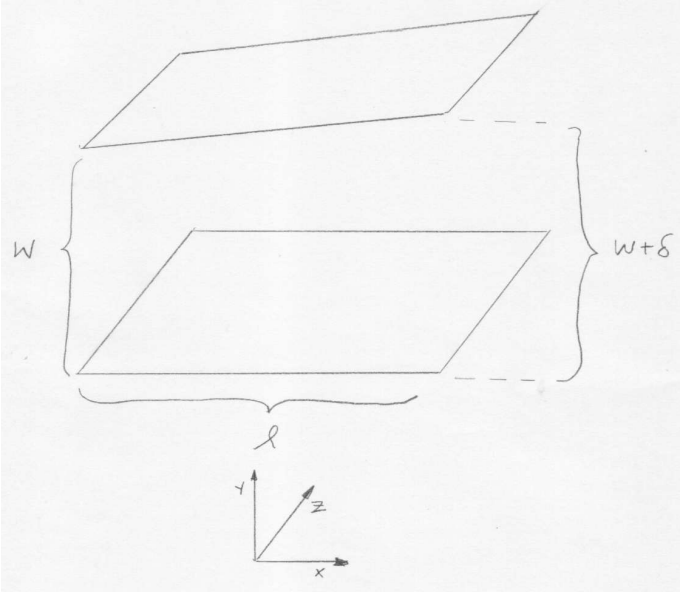
III. (35 points) 2D Capacitor.

Consider the slightly non-parallel parallel-plate capacitor, as shown. The capacitor extends a considerable distance in the positive and negative z-directions, so this is a 2D problem. The lower plate is grounded, the upper plate has potential Φ_0. You can ignore edge effects.



a. Justify the assumption that the potential only depends on the azimuth angle (in cylindrical coordinates) of the line connecting where the plates intersect (which is a single point in a 2D figure) to a field point within the capacitor.

b. Find the potential between the plates.

c. Calculate the capacitance per unit length of this two-plate system

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POINTS TOTALS

1. ______________________/30

2. ______________________/35

3. ______________________/35

Total ______________________/100