Physics 606 Homework #3 Spring '20
Dr. Drake

1. Jackson 2.14

2. Jackson 2.25(a)

3. Consider a 2-D wedge-shaped conducting object with inner radius a and outer radius b and azimuthal extent β. The potential is maintained at zero at the inner and outer radii and $\phi = 0$. The potential is maintained at V at $\phi = \beta$.

   (a) Construct a set of basis functions that can be used to solve for Φ inside the object. Use functions that are periodic in radius ρ and exponential in azimuthal angle ϕ. Derive the orthogonality relation for your basis functions. Sketch the ρ dependence of the three lowest order eigenfunctions.
   Hint: Change the radial variable to $\ln(\rho/a)$.

   (b) Use your basis functions to solve for Φ inside the object. Sketch the electric field.

4. Consider a rectangular, grounded conducting box of dimensions a in the x and y directions and c in the z direction.

   (a) A charge q is placed in the center of the box. What is the electric field acting on the charge? Why?

   (b) The particle is displaced a small distance $\Delta z \ll c$ along the z direction from the center of the box. Calculate the electric field acting on the charge first for arbitrary a/c and then for $a/c \gg 1$ and $a/c \ll 1$.
   Hint: you need to eliminate the self-field of the charge. How do you do this?

   (c) Calculate the motion of the charge (mass m) while $\Delta z \ll c$. Qualitatively describe what happens when Δz is not small.