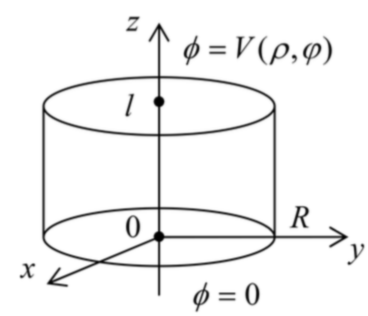
PHYS 203B - Spring 2020
Midterm Exam

All problems are open book and open notes. However **you are not to search the web for answers. You cannot discuss/consult with anyone** *except the TA or the instructor, who can help you with clarification on the wording of questions. Make sure to justify your work, and be judicious in what steps to include in your work (even if you are very smart and could mentally derive the result in your mind in one step, you should take the time to write down sufficiently many intermediate steps that you would convince a reasonable TA that you understand and the work is yours.) Cite the textbook or notes wherever you are using one of their equations or results.*

1. The figure below shows a cylinder of circular cross section of radius R with its axis along $\hat{z}$ and its base at $z = 0$.



The sides and bottom lid of the cylinder are maintained at zero potential; the potential on the top lid, at $z = l$ is given by $V J_1(\xi_{11}\rho/R)\sin\varphi$ where ξ_{11} is the first zero of the Bessel function $J_1(x)$, and ρ and φ are polar coordinates. Determine the electric potential everywhere inside the cylinder.

2. Charges $\pm q$ are placed at corners of a square of side a, alternating signs (so that the edges from the corner with charge $+q$ go to corners with charges $-q$. The square rotates with constant angular velocity ω about an axis normal to the plane of the square and through its center. Calculate the leading multipole that contributes to radiation in the long wavelength approximation, as well as the radiation fields, the angular distribution of the (time average) power radiated, and the total (time-averaged) power radiated.

3. A perfectly conducting spherical shell of radius a, is split into two hemispheres by a very thin gap at the equator. An alternating potential is applied to the two halves of the sphere, $V\cos(\omega t)$ and $-V\cos(\omega t)$ to top and bottom halves, respectively. Determine, in the long-wavelength approximation, the radiation fields, the time averaged angular distribution of power radiated, and total time averaged power of radiation.