Problems please turn in not later than Fri, Feb 19, 10am

1. **Cartesian Multipole Moments of a Charged Ring:** A thin circular ring of radius R and located in the xy-plane and centered at the z-axis has line charge density $+\lambda_0$ for $0 \leq \varphi < \pi$ and line charge density $-\lambda_0$ for $\pi \leq \varphi < 2\pi$, where φ is the azimuthal angle around the z-axis.

   (a) (20 pts) Calculate the components of the dipole moment of the ring.

   (b) (20 pts) Calculate the components of the quadrupole tensor of the ring. (Hint: exploit the symmetries of the tensor and the ring.)

   (c) (10 pts) Do your results depend on the choice of the origin of the coordinate frame?

   (d) (10 pts) Another point-like dipole $\vec{p}_2$ is located on the z-axis at a large distance $z \gg R$. Calculate the torque acting on this dipole with respect to its center.

2. **Summary of Course Topics:** (40 pts) Please compile your *personal summary* of the course topics so far (special relativity and electrostatics up to and including cartesian multipole expansion). This should not just be a list of all possibly useful equations you can find. Your summary should reflect key concepts and the relations between them. Make sure you understand the content of the equations you assemble and how to apply them. (This assignment is intended to support your preparations for the exam. Please try to present a clear view of the topics, but you may want to avoid spending too much time just on perfecting the write-up.)