Physics 841 - Homework 10 **due Fri., Mar. 27, 2020**

Problems

1. **A strip with current:**
   A straight and infinitely long strip of width $2a$ carries a current I which is uniformly distributed across the width of the strip. The strip is positioned in the $x = 0$ plane between $y = -a$ and $y = a$, the current is in the z direction.

   (a) (25 pts) Find the magnetic field $\vec{B}$ at an arbitrary point $\vec{r} = (x, y, z)$.

   (b) (10 pts) To check your result consider the limiting case of large distances from the strip.

2. **A rotating sphere:**
   A sphere of radius a carries a uniform surface-charge distribution σ. The sphere is rotated about a diameter with constant angular velocity ω.

   (a) (35 pts) Find the vector potential $\vec{A}$ and the magnetic field $\vec{B}$ inside and outside the sphere.

3. **Current flow over a sphere:**
   A current I starts at $z = -\infty$ and flows up the z-axis as a linear filament until it hits an origin-centered sphere of radius R. The current spreads uniformly over the surface of the sphere and flows up lines of longitude from the south pole to the north pole. The recombined current flows thereafter as a linear filament up the z-axis to $z = +\infty$.

   (a) (5 pts) Find the current density on the sphere.

   (b) (20 pts) Use explicitly stated symmetry arguments and Ampere's law in integral form to find the magnetic field at every point in space.

   (c) (5 pts) Check that your solution satisfies the magnetic field matching conditions at the surface of the sphere.