

**Homework #10 (10 points) - Show all work on the following problems:**

**Problem 1 (3 points):** Calculate the magnetic field at the center of a uniformly charged spherical shell of radius  $R$ , carrying total charge  $Q$ , and spinning around the  $z$ -axis with a uniform angular velocity  $\omega$ . *Hint: Start with the solution derived for the magnetic field above/below the center of a circular loop of current.*

**Problem 2 (2 points):** Consider a large parallel-plate capacitor with uniform charge density  $\sigma$  on the top plate, and  $-\sigma$  on the bottom plate, moving with a constant speed  $v$  tangential to the surface of the plates.

**2a (1 point):** Find the magnetic field between the plates and above and below them.

**2b (1 point):** Find the magnitude and direction of the magnetic force per unit area on the upper plate (caused by the bottom plate).

**Problem 3 (3 points):** Consider a finite segment of wire aligned with the  $z$ -axis, extending from point  $z_1$  to  $z_2$ , and carrying a current  $I$ .

**3a (1.5 points):** Find the magnetic vector potential at a radial distance  $s$  from the origin.

**3b (1.5 points):** Show that the curl of this magnetic vector potential gives the same magnetic field as derived in Ex. 5.5.

**Problem 4 (2 points):** Find the magnetic vector potential above and below an infinite plane (in the  $x$ - $y$  plane) with a surface current density  $K$  flowing in the  $x$ -direction.