

Midterm, PHY 505, March 26, 2021, 8.00-8.55

1. The questions in this problem should be answered in no more than a couple of lines.
 - a. What is the magnetic field corresponding to the vector potential $\vec{A} = B_0(y, x, 0)$? Explain your result.
 - b. What is the surface charge density of a capacitor filled with a medium with dielectric constant ϵ and potential difference of V ? The distance of the plates is a .
 - c. Using that $\vec{B} = \frac{q}{c} \vec{v} \times \vec{r}/r^3$ show that \vec{B} is a pseudovector.

2. Consider a spherical shell with radius b and surface charge distribution $\sigma = \sigma_0(\cos \theta + \frac{1}{2} \sin \theta \cos \phi)$. Find the electric potential for $r > b$ and $r < b$.

3. Consider a nonconducting charged hollow cylinder with radius b that rotates with angular frequency ω about its axis. The surface charge density is σ .
 - a. What is the electric field for $r < b$ and $r > b$?
 - b. What is the magnetic field for $r < b$ and $r > b$.
 - c. What is the energy per unit length of the electric field and of the magnetic field (the energy density of the magnetic field is obtained by replacing $\vec{E} \rightarrow \vec{B}$ in the energy density of the electric field)?