

Workbook



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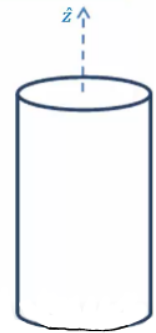
Time Dependent Fields

Questions

- 1) An infinite solid cylinder of radius R is spinning at an angular velocity $\omega = \alpha t$. The cylinder has charge density ρ .

- Calculate the magnetic field.
- Calculate the electric field.
- What force acts on charge q ?

$$\oint \vec{E} \cdot d\vec{l} = - \int \int \frac{d\vec{B}}{dt} \cdot d\vec{s}$$



- 2) A parallel plate capacitor is given. Each plate is circular and has radius R , and the plates are a distance d from one another. A constant current, I , flows through the capacitor.

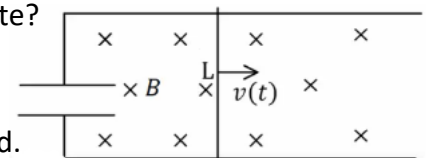
- Calculate the charge on the capacitor, as a function of time, given that $q(t = 0) = 0$.
- Calculate the electric field, as a function of time.
- Calculate the magnet field.
- Calculate the energy stored between the capacitor plates.
- Calculate the Poynting vector on the edge of the capacitor.

Find its flux through the Gaussian surface encasing the capacitor.

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \int \vec{j} \cdot d\vec{s} + \mu_0 \int \int \epsilon_0 \frac{d\vec{E}}{dt} \cdot d\vec{s}$$

- 3) A parallel plate capacitor is given. Each plate is circular and has radius a , and the plates are a distance d from one another. The capacitor is connected to a conducting track (there is no resistance). A non-resistant rod of length L is placed on the track. The rod is pulled away from the capacitor at a velocity of $v(t) = At$. A uniform magnetic field B acts into the page.

- Calculate the charge on the capacitor. Which is the positive plate?
- Calculate the electric field inside the capacitor.
- Calculate the magnet field both inside and outside the capacitor. Ignore the fields produced by the rod.
- The rod is of mass M . Calculate the force required in order to move the rod at the same velocity.



*For the solutions go see the videos