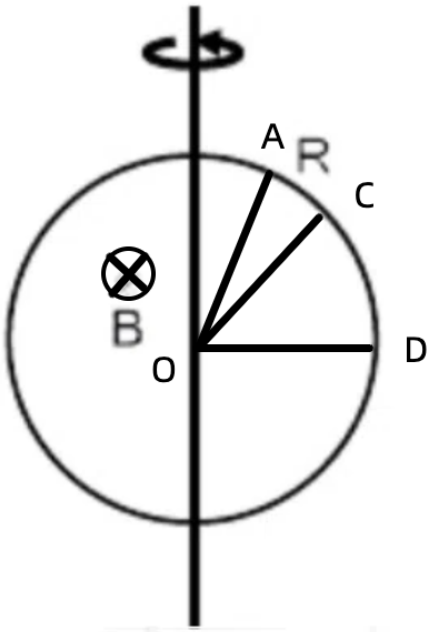
Additional Homework #2

JOINT INSTITUTE 交大密西根学院

Due: 11:59 pm on Nov 15, 2024

Problem 1 (30 pts)

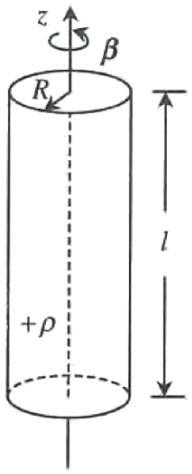
A uniform circular coil with radius R and resistance r rotates at an angular velocity ω around an axis perpendicular to the uniform magnetic field B. $\angle AOD = \varphi, \angle COD = \frac{\pi}{4}$. Find $V_{CA} = V_C - V_A$ and $V_{DA} = V_D - V_A$.



Problem 2 (40 pts)

A uniform long cylinder with radius R and length l has a mass of m and is uniformly charged with a volume charge density of $+\rho$ ($R \ll l$). An external torque causes the cylinder to rotate counterclockwise (observed in the opposite direction of the z-axis) around the vertical axis (z-axis) at a constant angular acceleration $\vec{\beta}$. Boundary effects and electromagnetic radiation are ignored.

1. Find the magnetic induction intensity $\vec{\mathbf{B}}$ at any point in the cylinder;
2. Find the electric field intensity $\vec{\mathbf{E}}$ at any point in the cylinder;
3. How large is the external torque to keep the cylinder rotating at a constant angular acceleration $\vec{\beta}$?



Problem 3 (30 pts)

The capacitances of the three capacitors are C_1, C_2, and C_3, the coil inductance is L, the resistance is R, the electromotive force of the power supply is ε, and the internal resistance of the power supply is negligible. At the beginning, the switch K is placed at point A and a balance is reached. The capacitors C_1 and C_2 are charged by the power supply.

1. Find the voltages on capacitors C_1 and C_2;

2. Connect switch K to point B. Assume that the moment when point B is just connected is $t_L = 0$. What is the value of time t when the current in coil L first reaches the maximum? What are the voltages on capacitors C_1 and C_2 at this time? What is the maximum current I_m flowing through the coil?

3. What is the value of time t_C when the absolute value of voltage on capacitor C_3 first reaches the maximum? What is the current I flowing through the coil at this time? What is the value of charge on capacitor C_3?