

Magnetic Moments

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1 Midterm Example Problems

1.1 Spinning Rods

A uniformly charged rod of length L and charge Q spins at angular velocity ω about an axis through the center of the rod perpendicular to the length.

- (a) Calculate the magnetic moment.
- (b) If a uniform magnetic field $\vec{B} = B_0 \hat{z}$ is present, what is the torque on and potential energy of this rod.

Source: modified from Packard Final Exam, Spring 2000, question 4

1.2 Non-uniform Field

A rigged square current loop with sides s , current I , and mass m is on a table with coefficient of static friction μ_s . The magnetic field is pointed along the vertical direction, and has magnitude that increases linearly with position: $\vec{B} = B_0 \frac{x}{a} \hat{y}$, for a constant a . What is the minimum that μ_s can be if the loop does not move?

Source: Speliotopoulos Final Exam, Fall 2012, question 4

1.3 Levitating Rings?

A ring of radius R , charge Q and mass M is spinning around its symmetry axis. The ring sits on a horizontal frictionless surface. A uniform external magnetic field of strength B is parallel to the plane of the ring. Find the angular velocity ω at which there is zero normal force between one edge of the ring and the surface.

Source: Packard Final Exam, Fall 2004, question 1

