

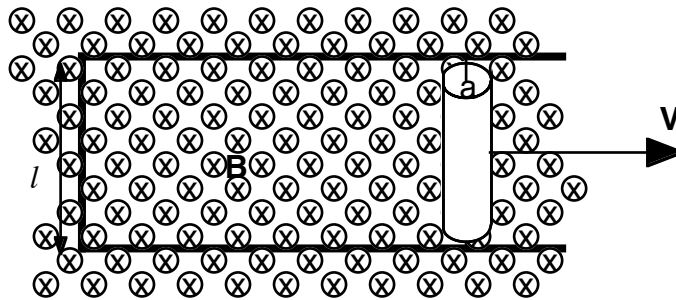
Physics 406

Problem Set #2: DUE Fri. Sept. 7, 2012

Read: Griffiths Chap. 7

(1) Energy Conservation in Motional EMF (15 points)

A cylindrical resistive material with mass density ρ_m (mass/volume) and conductivity σ slides frictionlessly on two parallel conducting rails. The length of the cylinder is l and the cross sectional area is A . A uniform magnetic field \mathbf{B} , pointing into the page fills the entire region. The bar moves to the right, starting with a velocity v_0 .



- (a) What current flows through the circuit, and in what direction?
- (b) What is the magnetic force on the rod? In what direction?
- (c) Use Newton's equation to show that velocity of the rod as function of time is

$$v(t) = v_0 e^{-\Gamma t}, \text{ where } \Gamma = \frac{B^2 \sigma}{\rho}$$

- (d) The initial kinetic energy was $\frac{1}{2}mv_0^2$. At $t = \infty$ the rod loses all this energy.

Where does it go? Prove that energy is conserved by showing that the total energy that goes into this sink is $\frac{1}{2}mv_0^2$.

(2) Griffiths, Problem 7.48. The Bevatron (10 pts).

(3) Griffiths, Problems 7.53 and 7.54. Transformers (15 pts).