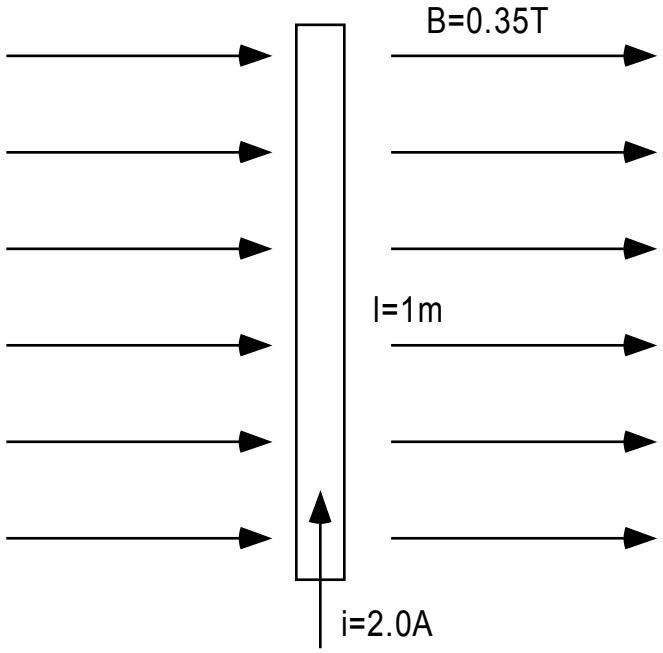
ECE 320: Homework #5

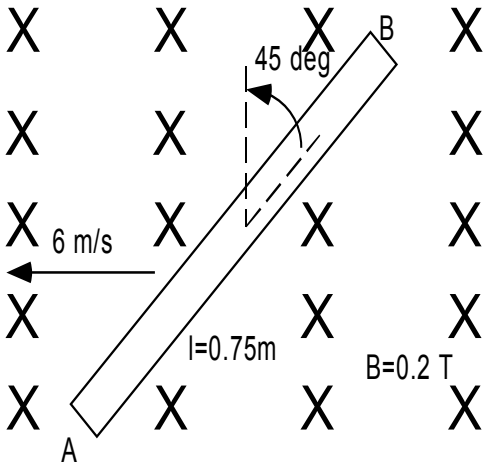
DUE DATE**:** By 5:00pm on Friday October 24.

Hand in to my mailbox, my office, or the homework collection box on the second floor of GJL (slot marked EE320).

1. A wire is shown in the figure below which is carrying 2.0A in the presence of a magnetic field. Calculate the magnitude and direction of the force induced on the wire.

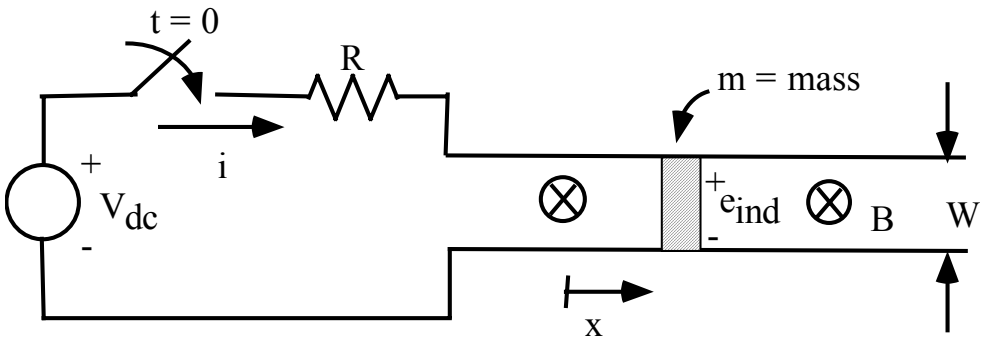


2. A wire is shown in Figure below which is moving in the presence of a magnetic field. With the information given in the figure, determine the magnitude and direction of the induced voltage on the wire.



3. A linear machine has a magnetic flux density of 0.6T into the page, a resistance of 0.3 ohm, a bar length of 1.0m, and a battery voltage of 120V.

   a. What is the initial force on the bar when the switch is closed at time t=0?
   b. What is initial current flow?
   c. What is the no-load steady-state speed of the bar?
   d. Suppose the bar is loaded with a 25N in the opposite direction to the bars motion. What is the new steady-state speed?
   e. Calculate steady-state values for i(t) and $e_{ind}(t)$ for the condition of part (d).
   f. What is the efficiency of the machine in the conditions of part (d)?
   g. Repeat parts (d) and (e) if the flux density falls to 0.5T. Comment on the impact of changing flux densities.
   h. Repeat parts (d) and (e) if the voltage falls to 100V and B= 0.6T. Again, comment on the results.



4. You are given a simple rotating dc machine with a single loop of wire similar to the one from lectures 23 and 24 with the following parameters:

B = 0.4 T, Vdc=48V, R=0.4ohm, r = 0.25 m, l = 0.5m and a rotational velocity
ω = 500 rad/sec

   a. Is this machine operating as a motor or a generator?
   b. What is the current Ia? Is it flowing into or out of the machine?
   c. What is the power flowing into/out of the machine?
   d. If the speed is increased to 550 rad/sec, recalculate current and power. Does the current direction change?
   e. Repeat part (d) if the speed decreases to 450 rad/sec.

5. Prove the relationship: Ea*Ia= $\tau*\omega$ based on the definitions of Ea and torque from Lect.23.