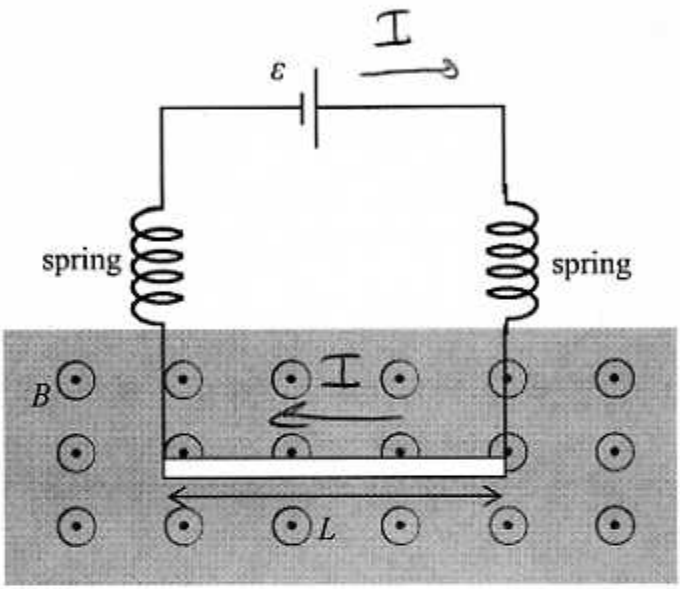
Name: _____ Section: ____

Tuesday, October 27

Quiz 9A

A bar of length L and resistance R is suspended from two springs of spring constant k attached to a battery with emf ε. When a magnetic field B pointing out of the page is turned on in the region of the bar (see figure), the bar moves to a new equilibrium position. Which way does the bar move, and by how much? (Assume all the wires in the circuit, including the springs, have negligible resistance).



Current $I = \frac{\varepsilon}{R}$ flows left through the bar

$F = ILB$ pointing up acts on the bar (forces on side wires cancel out)

$\Rightarrow$ bar moves **up**

by: $2kx = ILB$ (2 springs)

$$x = \frac{ILB}{2k} = \boxed{\frac{\varepsilon LB}{2kR}}$$

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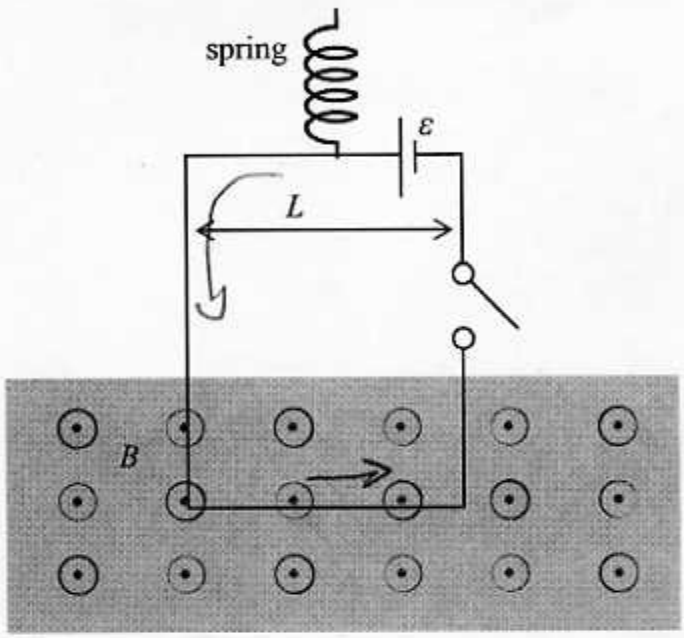
Quiz 9B

A loop of sides L and $2L$ and total resistance R is partially placed into a region of magnetic field B out of the page (see figure). The switch is initially open. The loop is suspended (through an insulating hook) from a spring of spring constant k. When the switch is closed, the circuit moves and reaches a new equilibrium position. Does the spring stretch or is it compressed? By how much?



Current $I = \frac{\varepsilon}{R}$ flows CCW in the circuit.

$F = ILB$ pointing down acts on the ~~bottom~~ wire (forces on the side wires cancel each other out)

Spring is [stretched] by

$kx = IBL$

$= \frac{\varepsilon}{R} BL$

$$\boxed{x = \frac{\varepsilon BL}{kR}}$$

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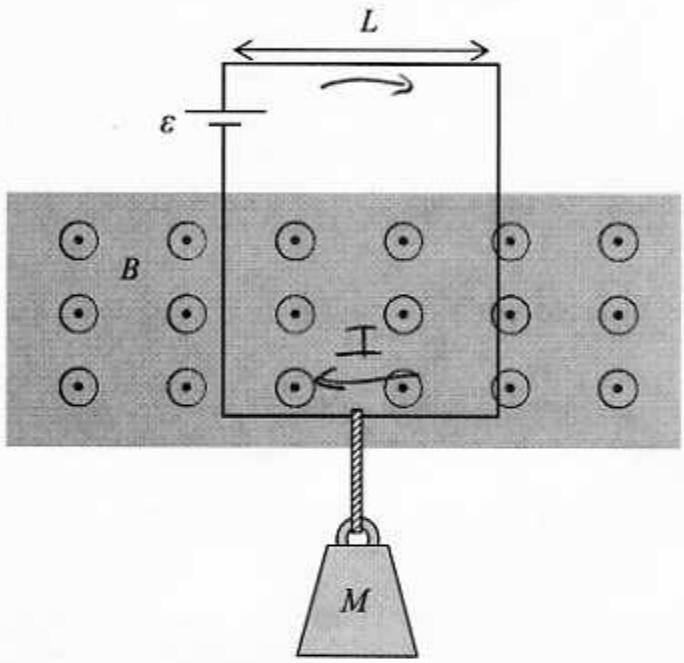
Quiz 9C

A loop of sides L and $2L$ and total resistance R is partially placed into a region of magnetic field B out of the page (see figure). When a block of mass M hangs from the lower part of the loop, the system is in equilibrium. Determine the relation between M and B. (You may assume that the weight of the circuit is negligible compared to the other forces acting on the system).



Current $I = \frac{\mathcal{E}}{R}$ flows CW in the circuit

Force $F = ILB$ pointing up acts on the bottom wire (forces on side wires cancel each other out)

Equilibrium: $Mg = ILB = \frac{\mathcal{E}}{R}LB$

$$M = \frac{\mathcal{E}LB}{gR}$$

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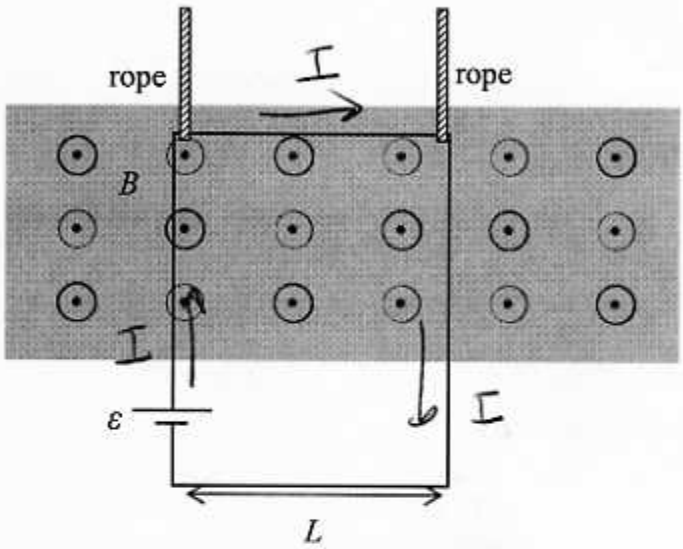
Quiz 9D

A loop of sides L and $2L$ and total resistance R hangs from two insulating ropes as shown. The loop is then partially placed into a region of magnetic field B out of the page (see figure). The system is allowed to reach equilibrium. Find the tension in the ropes.
(You may assume that the weight of the circuit is negligible compared to the other forces acting on the system).



Current $I = \frac{\varepsilon}{R}$ flows CW in the circuit.

Force $F = ILB$ pointing down acts on top wire
(forces on side wires cancel out)

$$2T - ILB = 0$$

$$T = \frac{ILB}{2} = \boxed{\frac{\varepsilon LB}{2R}}$$