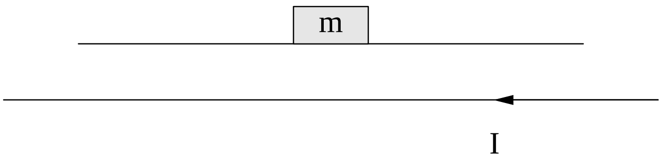
1. (20 pts.) A current balance apparatus (like the one you used in lab) has two parallel wires as shown in the following diagram. The upper wire has length 26.5 cm, while the lower wire has length 36.0 cm. A current I is flowing in the lower wire to the left, while a current of equal magnitude flows in the upper wire to the right. A series of small masses m can be placed on the top wire, and the current I required to return the top wire to its equilibrium balance condition is recorded for each mass. According to `Excel`,

$$m = (7.73 \times 10^{-7}\,\text{kg/A}^2)\, I^2$$

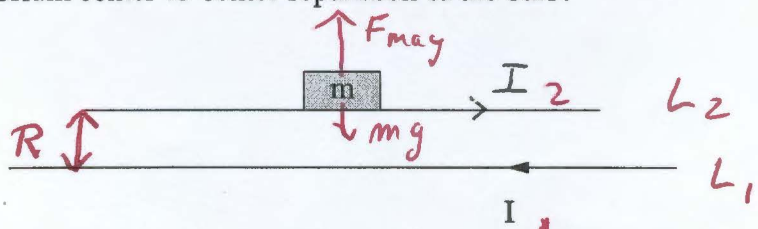
What is the equilibrium center-to-center separation of the bars?



1. (20 pts.) A current balance apparatus (like the one you used in lab) has two parallel wires as shown in the following diagram. The upper wire has length 26.5 cm, while the lower wire has length 36.0 cm. A current I is flowing in the lower wire to the left, while a current of equal magnitude flows in the upper wire to the right. A series of small masses m can be placed on the top wire, and the current I required to return the top wire to its equilibrium balance condition is recorded for each mass. According to Excel,

$$m = \left(7.73 \times 10^{-7}\,\text{kg/A}^2\right) I^2$$

What is the equilibrium center-to-center separation of the bars?



B_1 = B due to bottom wire at location of top wire

$$B_1 = \frac{\mu_0 I_1}{2\pi R}$$

Mag Force on top wire $= F = I_2 L_2 B_1$

$$F_{mag} = \frac{\mu_0 I_1 I_2 L_2}{2\pi R} \qquad \text{Here } I_1 = I_2 = I.$$

Equilibrium $\Rightarrow$ $F_{mag} = mg$.

$$m = \left(\frac{\mu_0 L_2}{2\pi R g}\right) I^2$$

. Compare to EXCEL above

$$\frac{\mu_0 L_2}{2\pi R g} = 7.73 \times 10^{-7}$$

$$\frac{\mu_0 L_2}{2\pi g\,[7.73 \times 10^{-7}]} = R$$

$$\frac{(4\pi \times 10^{-7})(0.265)}{2\pi (9.8)(7.73 \times 10^{-7})} = \boxed{R = 0.007\,m = 7\,mm}$$