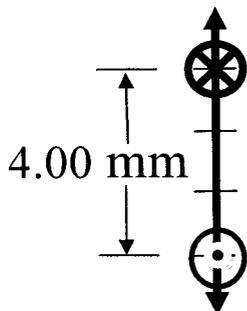


Two 25.0 cm long parallel wires are separated by 4.00 mm and balanced at this position. The wires are connected such that current can flow in opposite directions as shown.



The bottom wire is fixed. The top wire has 20.0 mg extra mass added to it causing it to fall toward the bottom wire. What is the magnitude of the downward force caused by this extra mass? (3)

$$F = mg = (20 \times 10^{-3} \text{ g}) \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) (9.8 \text{ m/s}^2) \\ = 1.96 \times 10^{-4} \text{ N}$$

What current in the wires will cause the top wire to levitate back to the original 4.00 mm separation? (7)

$$F = IL \left(\frac{\mu_0 I}{2\pi r} \right) = \frac{\mu_0 L}{2\pi r} I^2 \\ = \frac{(4\pi \times 10^{-7} \text{ N/A}^2)(.25 \text{ m})}{2\pi (.004 \text{ m})} I^2 = 1.96 \times 10^{-4} \text{ N}$$

$$I^2 = 15.7 \text{ A}^2$$

$$I = 3.96 \text{ A}$$

$$\vec{F} = I\vec{L} \times \vec{B} \quad B_{\text{wire}} = \frac{\mu_0 I}{2\pi r} \quad \mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2$$

Extra Credit: Who was Wally Pipp?