

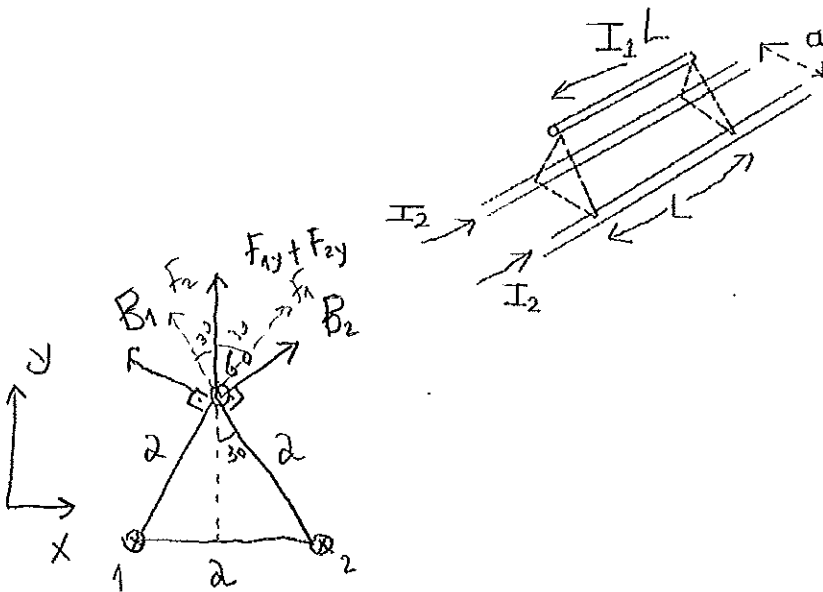
Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name:

Student ID:

Signature:

Two infinitely long, parallel wires are lying on the ground a distance a apart as shown in the figure. A third wire, of length L and mass m , carries a current of I_1 and is levitated above the first two wires, at a horizontal position midway between them. The infinitely long wires carry equal currents I_2 in the same direction, but in the direction opposite that in the levitated wire. What current must the infinitely long wires carry so that the three wires form an equilateral triangle?



The total force on y-direction must be zero

$$F_y = 0 = F_{y\text{grav.}} + F_{1y} + F_{2y}$$

$$F_{y\text{grav.}} = -mg$$

$$F_{1y} = F_{2y} = B \cdot I_1 \cdot L \cdot \cos 30^\circ = \frac{\mu_0 I_2}{2\pi a} I_1 L \cdot \frac{\sqrt{3}}{2} = \frac{\mu_0 I_1 I_2 L \sqrt{3}}{4\pi a}$$

$$F_y = 0 = -mg + \gamma \cdot \frac{4\sigma l_2 L \sqrt{3}}{2 \cdot \frac{1}{2} \pi a} \Rightarrow$$

$$\Rightarrow \sqrt{3} \sigma l_2 L = mg \cdot 2\pi a \Rightarrow$$

$$\Rightarrow \boxed{l_2 = \frac{mg \cdot 2\pi a}{\sqrt{3} \sigma l_1 L}}$$