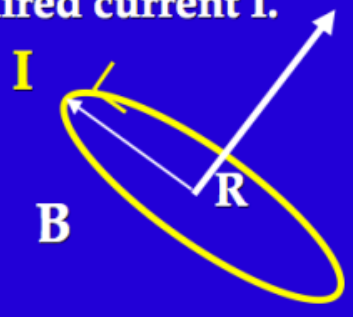
Magnetism

- A scientist uses a loop of wire with 100 turns to cancel the Earth's magnetic field (0.7 gauss) for an experiment. If the diameter of the loop is 0.50m, find the required current I.



Ans: 0.28A

$$B = \frac{\mu_0 I N}{2R} \Rightarrow 0.7 \times 10^{-4}$$

$$I = \frac{(.7 \times 10^{-4})2R}{(4\pi \times 10^{-7})100} = \boxed{.28\,A}$$

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Example:

Two long, parallel, current-carrying wires are separated by a distance d. Calculate the force (magnitude and direction) on wire exerted by the other. Where is the field due to the two wires equal to zero?

What if the direction of I_2 is reversed?

What if three long wires formed an equilateral triangle, how would you calculate the force on one wire?

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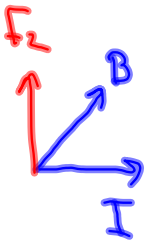


$F = I L B \sin\theta$ Force on I_2 up

$$F_2 = I_2 L B_1 \sin\theta$$

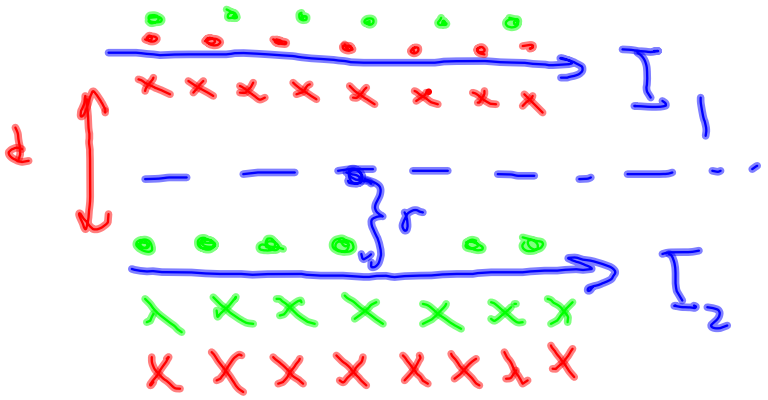
$$\theta = 90$$

$$= I_2 L B_1$$

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

$$F_2 = \frac{\mu_0 I_2 I_1 L}{2\pi d}$$

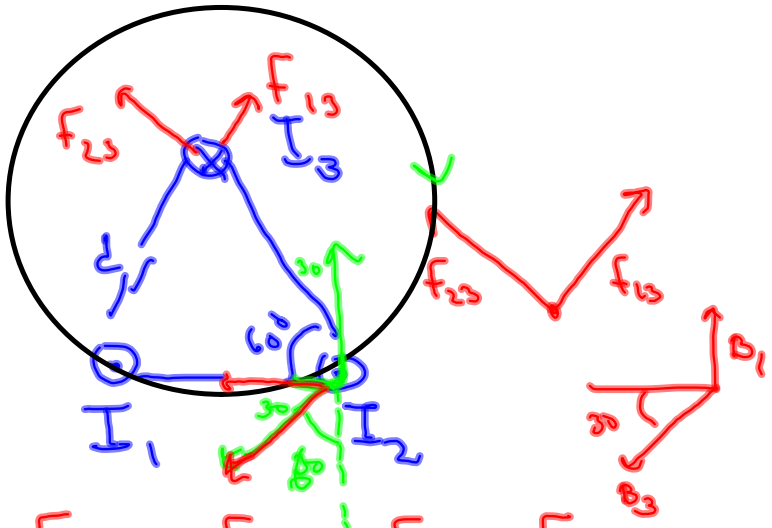
$$\frac{F_2}{L} = \frac{\mu_0 I_2 I_1}{2\pi d}$$



$$B_2 = B_1$$

$$\frac{\mu_0 I_2}{2\pi r} = \frac{\mu_0 I_1}{2\pi (d-r)}$$

Solve for r



Find F_{23x}, F_{13x}, F_{23y}, F_{13y}

$$F_{23} = \frac{\mu_0 I_2 I_3 L}{2\pi d}$$

Find magnetic field at I_2