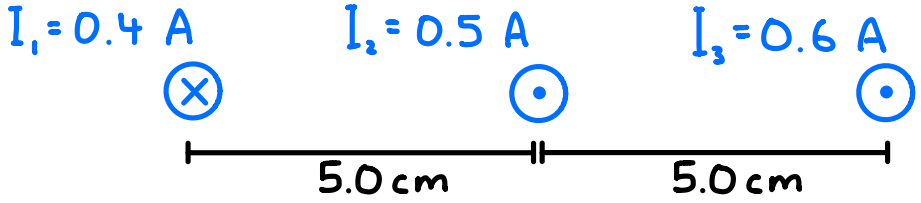
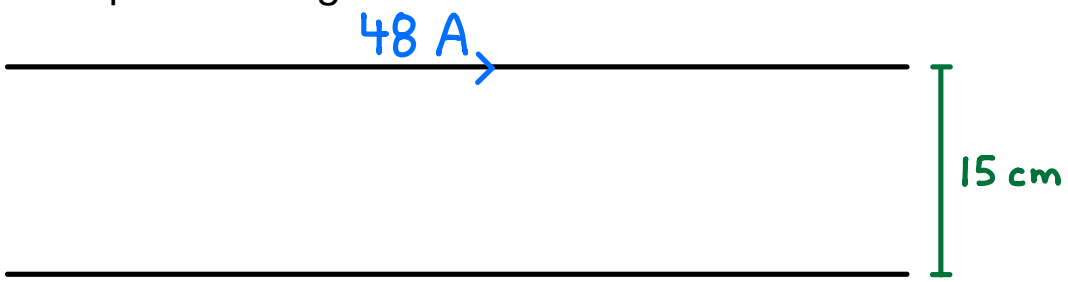
Three long wires have current passing through them as shown. What is the magnetic force per length on the middle wire?



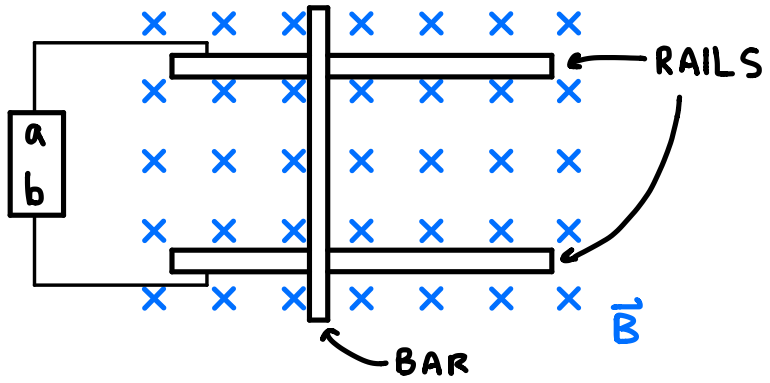
$2.0 \times 10^{-6} \frac{N}{m}$ RIGHT

A long horizontal wire carries a current of 48 A. A second wire, made of 2.5 mm-diameter copper and parallel to the first but 15 cm below it, is held in suspension magnetically. What is the magnitude and direction of the current in the lower wire? The density of cooper is 8.96 g/cm^3.



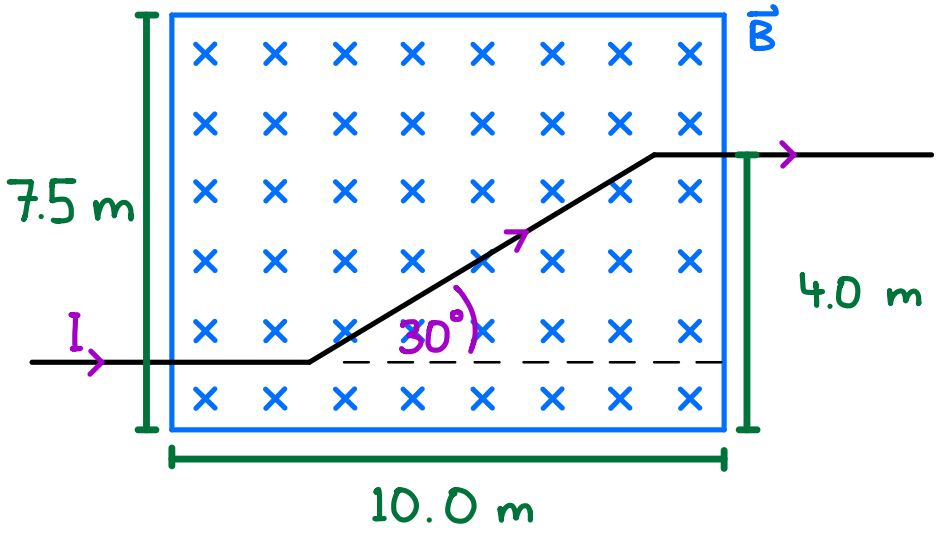
6730 A RIGHT

A bar lies across two parallel rails which are connected to a power source. Which side (a or b) must be of positive polarity if the net force on the bar is to the right.



a is positive.

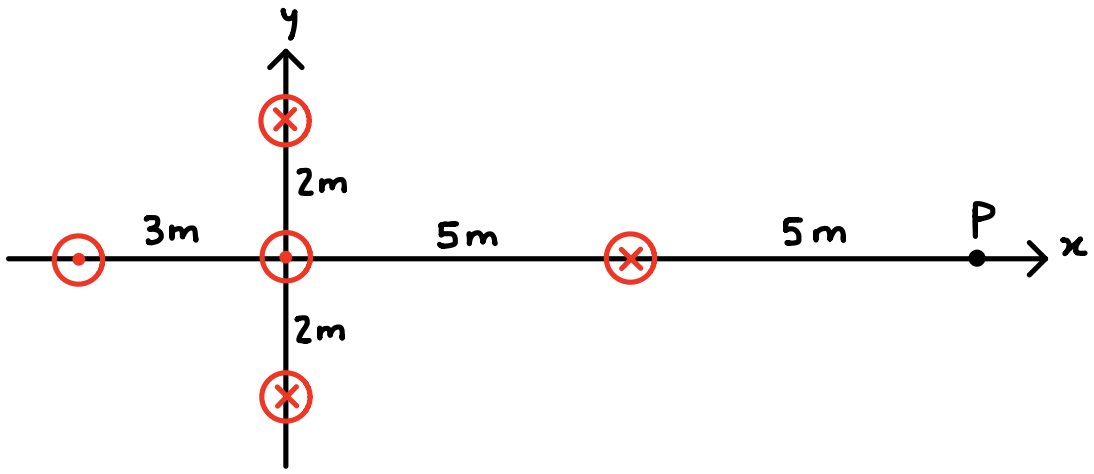
A wire carrying a current of 18 A is in a 1.4 T magnetic field. Determine the net force on the wire.



252.0 N NORTH + 100.8 N WEST

271 N 21.8° W OF N

Several long solenoids are placed perpendicular to the *xy*-plane. The magnetic field inside each solenoid is 25 T and in the directions shown. What is the net magnetic field at *P*?

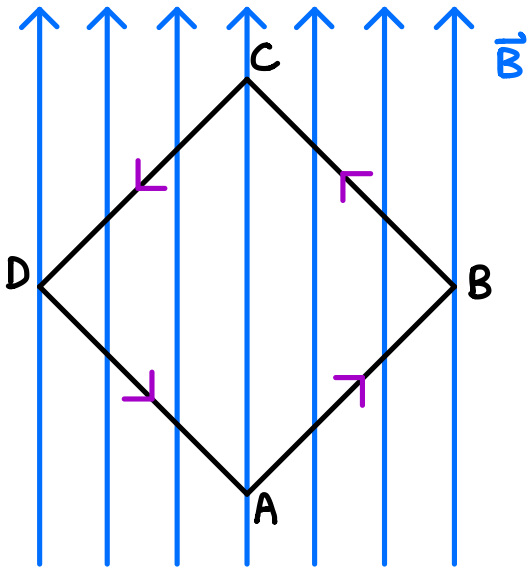


ZERO

A square loop of side length 1.7 m is placed in a 1.5 T magnetic field. Each of its sides makes a 45° with the magnetic field. The current through the loop is 2 A.

a) Find the magnetic force on side *AB*.

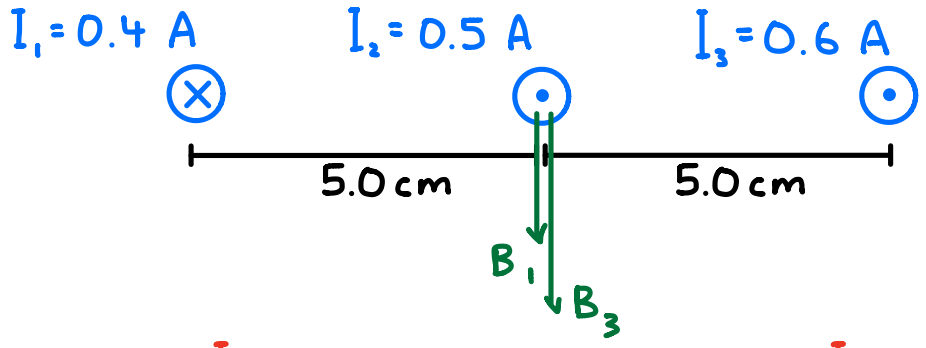
b) Find the net force on the loop.



a) 3.61 N OUT OF PAGE

b) ZERO

Three long wires have current passing through them as shown. What is the magnetic force per length on the middle wire?



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

$$= \frac{(4\pi \times 10^{-7})(0.4)}{2\pi (0.050)}$$

$$= 1.6 \times 10^{-6}\ \text{T} \quad \text{DOWN}$$

$$B_3 = \frac{\mu_0 I_3}{2\pi d}$$

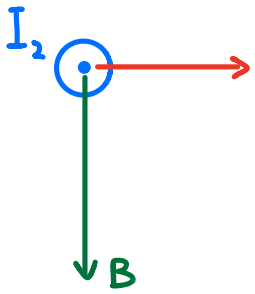
$$= \frac{(4\pi \times 10^{-7})(0.6)}{2\pi (0.050)}$$

$$= 2.4 \times 10^{-6}\ \text{T} \quad \text{DOWN}$$

$$\vec{B}_{NET} = \vec{B}_1 + \vec{B}_3$$

$$= (1.6 \times 10^{-6}) + (2.4 \times 10^{-6})$$

$$= 4.0 \times 10^{-6}\ \text{T} \quad \text{DOWN}$$



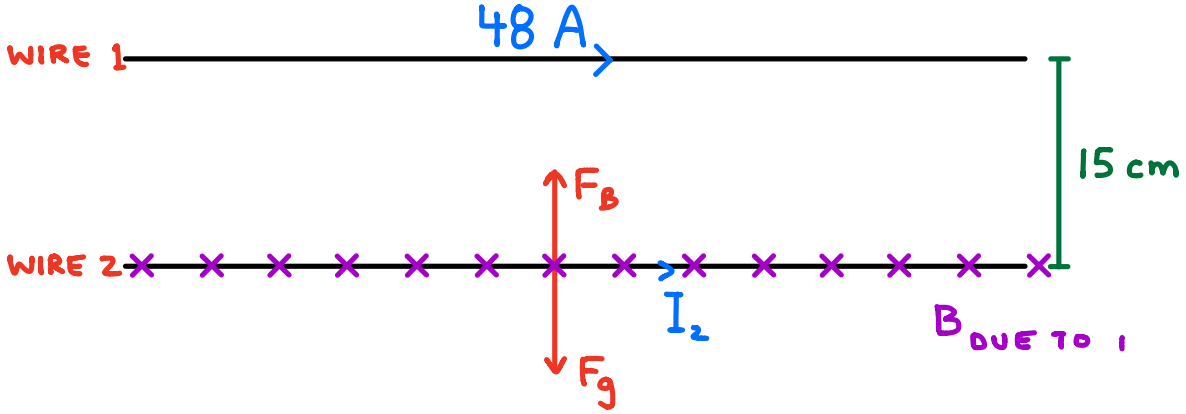
$$F_B = \ell I_2 B_{NET}$$

$$\frac{F_B}{\ell} = I_2 B_{NET}$$

$$= (0.5)(4.0 \times 10^{-6})$$

$$= \boxed{2.0 \times 10^{-6}\ \frac{\text{N}}{\text{m}} \quad \text{RIGHT}}$$

A long horizontal wire carries a current of 48 A. A second wire, made of 2.5 mm-diameter copper and parallel to the first but 15 cm below it, is held in suspension magnetically. What is the magnitude and direction of the current in the lower wire? The density of cooper is 8.96 g/cm^3.



$$\rho = 8.96 \frac{g}{cm^3} \times \frac{kg}{1000\,g} \times \left(\frac{100\,cm}{1\,m}\right)^3$$

$$= 8960 \frac{kg}{m^3}$$

$$F_{NET} = 0$$

$$F_g = F_B$$

$$mg = \ell I_2 B_{DUE\ TO\ 1}$$

$$\rho V g = \ell I_2 B_{DUE\ TO\ 1}$$

$$\rho A \ell g = \ell I_2 B_{DUE\ TO\ 1}$$

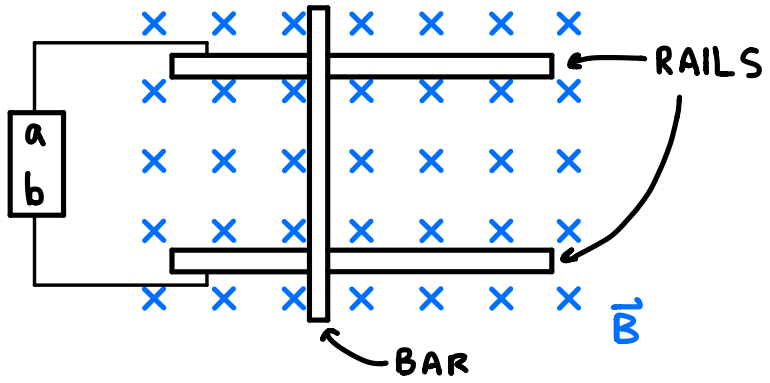
$$\rho(\pi r^2) g = I_2 \left(\frac{\mu_0 I_1}{2\pi d}\right)$$

$$I_2 = \frac{2\pi^2 \rho r^2 d g}{\mu_0 I_1}$$

$$= \frac{2\pi^2 (8960)(0.00125)^2 (0.15)(9.8)}{(4\pi \times 10^{-7})(48)}$$

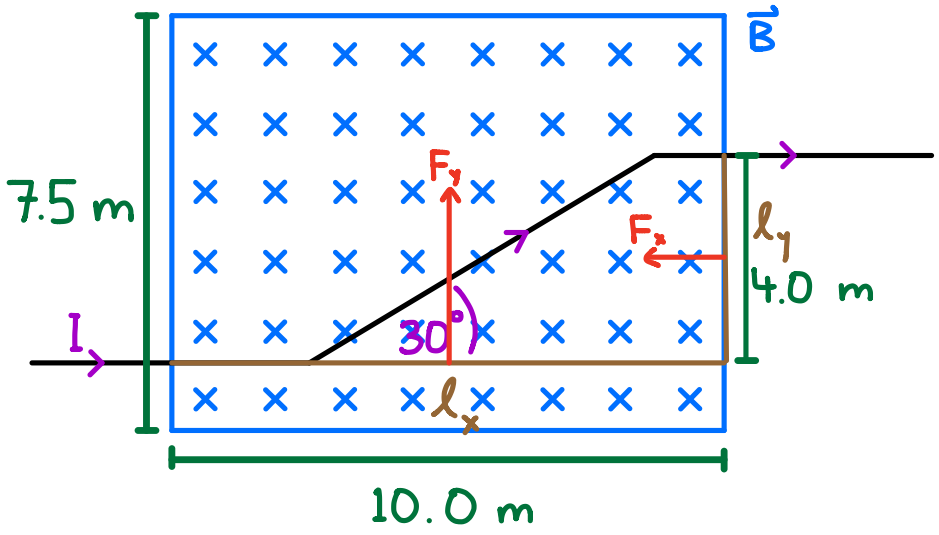
$$= \boxed{6730\ A \quad RIGHT}$$

A bar lies across two parallel rails which are connected to a power source. Which side (*a* or *b*) must be of positive polarity if the net force on the bar is to the right.



By the right hand rule, for the force on the bar to be to the right, current in the bar must be flowing down. This would mean *a* is positive.

A wire carrying a current of 18 A is in a 1.4 T magnetic field. Determine the net force on the wire.



$F_y = l_x I B$

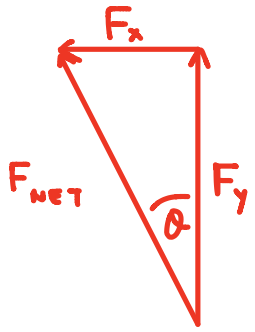
$= (10.0)(18)(1.4)$

$= 252$ N NORTH

$F_x = l_y I B$

$= (4.0)(18)(1.4)$

$= 100.8$ N WEST



$F_{NET} = \sqrt{F_x^2 + F_y^2}$

$= \sqrt{(252)^2 + (100.8)^2}$

$= 271$ N

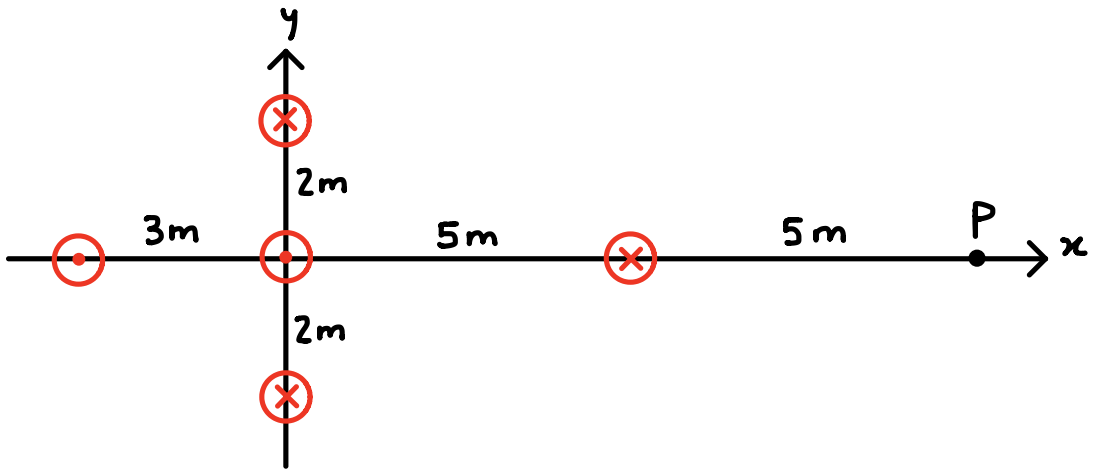
$\theta = \tan^{-1}\left(\frac{F_x}{F_y}\right)$

$= \tan^{-1}\left(\frac{100.8}{252}\right)$

$= 21.8°$

271 N 21.8° W OF N

Several long solenoids are placed perpendicular to the *xy*-plane. The magnetic field inside each solenoid is 25 T and in the directions shown. What is the net magnetic field at *P*?

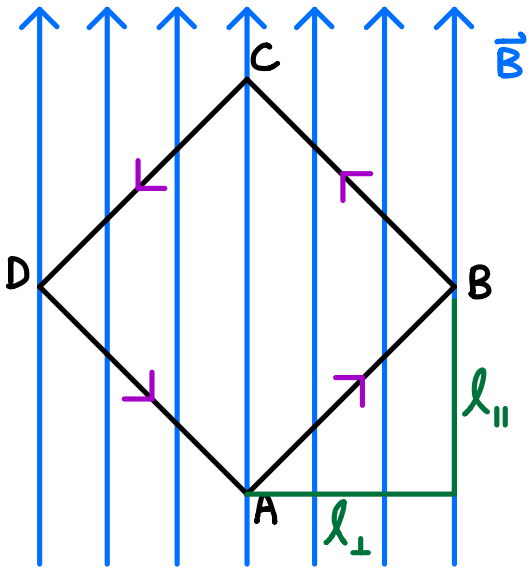


The magnetic field outside a solenoid is zero. As *P* is outside all five solenoids, the magnetic field at *P* is zero.

A square loop of side length 1.7 m is placed in a 1.5 T magnetic field. Each of its sides makes a 45° with the magnetic field. The current through the loop is 2 A.

a) Find the magnetic force on side *AB*.

b) Find the net force on the loop.



a) $\ell_{\perp} = \ell \cos 45°$

$= \frac{\sqrt{2}}{2}\ell$

$F_{AB} = \ell_{\perp} I B$

$= \frac{\sqrt{2}}{2} \ell I B$

$= \frac{\sqrt{2}}{2}(1.7)(2)(1.5)$

$=$ **3.61 N OUT OF THE PAGE**

b) $\vec{F}_{AB} = \vec{F}_{DA} = 3.61$ N OUT OF THE PAGE

$\vec{F}_{BC} = \vec{F}_{CD} = 3.61$ N INTO THE PAGE

$\vec{F}_{NET} = \vec{F}_{AB} + \vec{F}_{BC} + \vec{F}_{CD} + \vec{F}_{DA}$

$=$ **0 N**