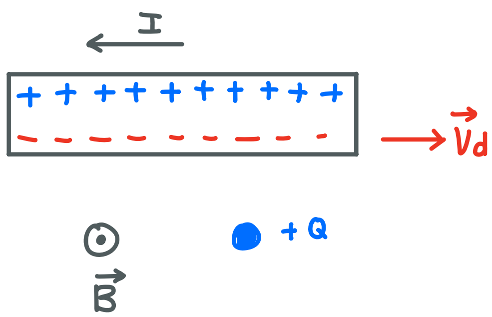
1) Consider a wire carrying an Electric current to the left and a +ve charge +Q located next to the wire.

2) Inside the wire, -ve e^- are moving to the right with vel. V_d while +ve ions remain stationary.

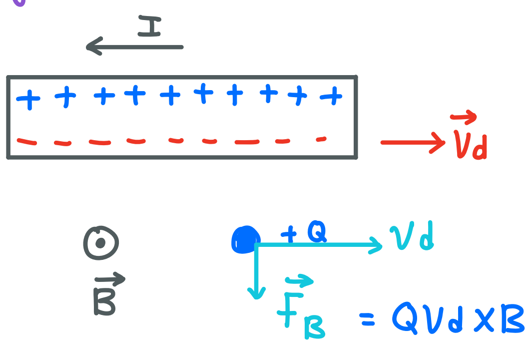
* Maxwell right hand Screw rule

$\Rightarrow$ B in paper.



(kept fixed outside)

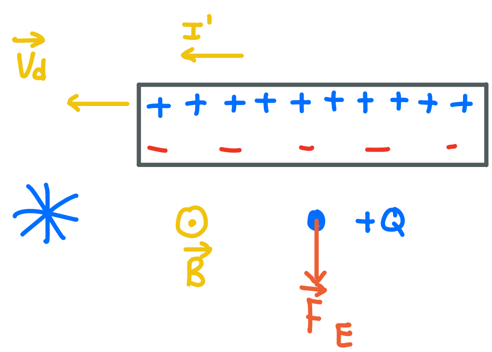
Since the charge +Q has a velocity of 0, it experiences no magnetic force. Futhermore, the wire appears to be neutral, with no net electric charge.



If the charge +Q has a velocity $\vec{V_b}$ towards the right, it will experience a downward magnetic force.

Now consider from the perspective of the charge +Q.

The charge Q is moving towards the right at the same speed as the e^- in the wire. In the F.O.R of charge Q, it has a velocity of 0, and thus, it will experience no magnetic force. The wire still appears to have a (different) current I', as the +ve ions move to the left, creating a magnetic field B out of the page.



In the Lab FOR, where the electrons and the charge +Q move towards the right at the same speed, V_d, the electrons appear closer together (Length Contracted) than they are in the FOR of the electrons (or the charge +Q since it is moving with the e^-).

Why??

In the FOR of the charge +Q, the electrons thus appear to be spaced further apart (less dense). On the other hand, in the FOR of +Q, the +ve ions, which are moving towards the left, appear closer together as the distance between them is now contracted.

* In the F.O.R of the charge +Q, the charge has a velocity of zero and cannot experience a magnetic force. The ions appear to move to the left, and thus appear denser, since the distance between ions is contracted. The distance between electrons, on the other hand, is larger in this F.O.R. It thus appear that the wire is +vely charged, and would exert a downward electric force on the charge, +Q.

In both FOR, the +ve charge, +Q experiences a downward force. Whether Electric or Magnetic depends on the choice of the FOR.

LORENTZ TRANSFORMATION

$$x = \frac{x' + vt'}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad t = \frac{t' + \frac{vx'}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$L = \frac{L_0}{\gamma} \qquad t = \gamma t_0$$

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Effects of Special relativity.

① **Length Contraction** - The length of an object in a moving F·O·R will appear to be contracted in the direction of motion. <u>Maximum length is in a frame in which the object is at rest.</u>

↘ Object in its own FOR even in a moving FOR will see itself at normal length. Only an outsider seeing the frame moving with the object will notice the contractions!