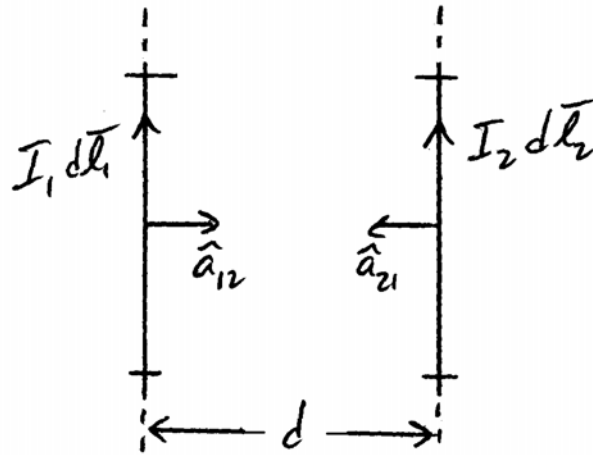


EX. Find the force between parallel wire segments. (Note: This is where research work on magnetic forces and currents started.)



$$d\vec{F}_{21} = \frac{\mu_0 I_1 d\vec{l}_1 \times (I_2 d\vec{l}_2 \times \hat{a}_{21})}{4\pi R_{21}^2}$$

$R_{21} = d$ ,  $d\vec{l}_2 \times \hat{a}_{21}$  yields a vector pointing up,  
(out of the page)

the cross product of  $d\vec{l}_1$  with a vector pointing up out of the page, yields a vector in the  $\hat{a}_{12}$  direction

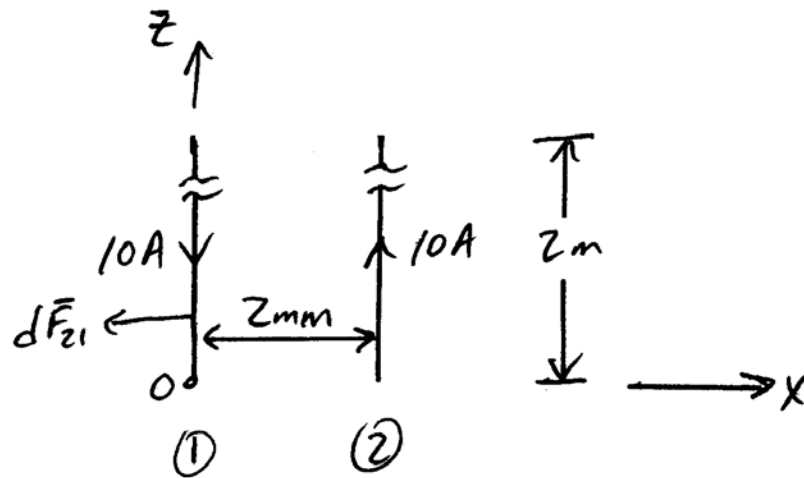
$$\underline{d\vec{F}_{21} = \hat{a}_{12} \frac{\mu_0 I_1 I_2 dl_1 dl_2}{4\pi d^2} = -d\vec{F}_{12}}$$

$\Rightarrow$  If  $I_1$  and  $I_2$  both flow in the same direction, the wire segments are attracted to one another (Keeps multi-filament stranded wires intact)

$\Rightarrow$  If  $I_1$  and  $I_2$  flow in opposite directions, the wire segments repel one another.

ex. cont.

Why don't household power cords blow apart then?



$$d\vec{F}_{21} = \hat{a}_{12} \frac{\mu_0 I_1 I_2 dl_1 dl_2}{4\pi d^2}$$

$$= \hat{a}_x \frac{(4\pi \times 10^{-7})(-10)(10)(2)(2)}{4\pi (2 \times 10^{-3})^2}$$

$$\underline{\underline{d\vec{F}_{21} = -\hat{a}_x 10 \text{ N} \approx -\hat{a}_x 2.25 \text{ lbs}}}$$

↳ The PVC or vinyl insulation enclosing the wires can easily handle this force distributed over the 2m (~6ft) length of the cord.