

A 16 cm long straight thin wire segment carries 12 A in the $\hat{a}_y$ direction in free space. If a magnetic field of $\vec{H} = 7957.75\hat{a}_x + 1989.44\hat{a}_y + 3987.87\hat{a}_z$ (A/m) is applied, find the force on the wire.

$$\text{Use (8.8), } d\vec{F} = I d\vec{\ell} \times \vec{B}$$

$$I = 12 \text{ A} \quad d\vec{\ell} = \hat{a}_y 0.16 \text{ m}$$

$$\begin{aligned} \vec{B} &= \mu_0 \vec{H} = 4\pi \times 10^{-7} (7957.75\hat{a}_x + 1989.44\hat{a}_y + 3987.87\hat{a}_z) \\ &= 0.01\hat{a}_x + 0.0025\hat{a}_y + 0.005\hat{a}_z \text{ (T)} \end{aligned}$$

$$\begin{aligned} d\vec{F} &= 12 \hat{a}_y 0.16 \times (0.01\hat{a}_x + 0.0025\hat{a}_y + 0.005\hat{a}_z) \\ &= 12(0.16)0.01(-\hat{a}_z) + 0 + 12(0.16)0.005\hat{a}_x \end{aligned}$$

$$d\vec{F} = 0.009622\hat{a}_x - 0.01920\hat{a}_z \text{ (N)}$$

$$\underline{\underline{d\vec{F} = 9.622\hat{a}_x - 19.2\hat{a}_z \text{ (mN)}}$$