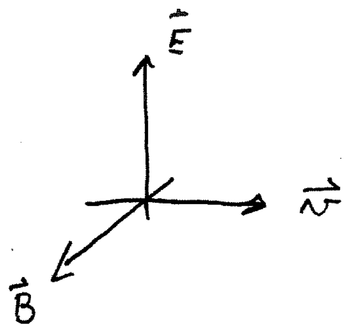
PROBLEM Set 10
SOLUTIONS

P385 – F07
PROF. BARTYNSKI

ELECTROMAGNETISM (I)
Due WED 11/21/07

1 | G:5.3 Assume $\vec{B} = B_0\hat{x}$, $\vec{v} = v_0\hat{y}$, $\vec{E} = E_0\hat{z}$



(a)

$$\vec{F} = q\left(\vec{E} + [\vec{v}\times\vec{B}]\right)$$

$$\vec{v}\times\vec{B} = v_0B_0[\hat{y}\times\hat{x}] = v_0B_0(-\hat{z})$$

So $\vec{F} = q(E_0\hat{z} - v_0B_0\hat{z}) \Rightarrow F = 0$ if $E_0 = v_0B_0 \Rightarrow \boxed{v_0 = \frac{E_0}{B_0}}$

(b) Magnetic force supplies centripital acceleration

$$\Rightarrow q\cancel{v}B = \frac{mv^{\cancel{2}}}{R} \Rightarrow R = \frac{mv}{qB} = \frac{m(E_0/B_0)}{eB_0} = \boxed{\frac{mE_0}{eB_0^2} = R}$$

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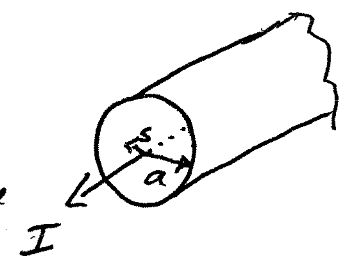
2 | G.5.5

(a) If the current flows on surface, then perpendicular length is circumference of circle $\Rightarrow$ $K\cdot 2\pi a = I \Rightarrow \boxed{K = \frac{I}{2\pi a}}$



(b) Let $J = \frac{\alpha}{s}$ then $I = \int_{\phi=0}^{2\pi}\int_{s=0}^{a} \frac{\alpha}{s}\cdot s\,ds\,d\phi = 2\pi\alpha a = I$

So $\boxed{J = \frac{I}{2\pi a s}}$