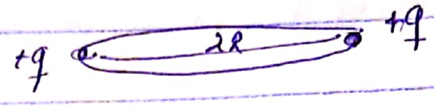
بسم الله الرحمن الرحيم

Name: Tamara Amro
ID #: 1172771

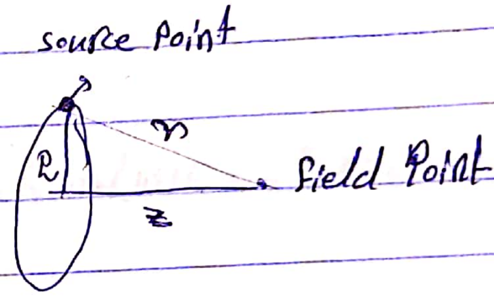
Q)



The potential of moving charge given by :-

$$V(r,t) = \frac{qc}{4\pi\varepsilon_0 (rc - r \cdot V)}$$

The particle on the circle loop :-
position of



$\acute{r}(t) = R\cos(\omega t)\,\hat{x} + R\sin(\omega t)\,\hat{y}$.
↓
source point

$v(t) = \dot{\acute{r}}(t) = -\omega R\sin(\omega t)\,\hat{x} + R\omega\cos(\omega t)\,\hat{y}$.

$r = \sqrt{R^2 + Z^2}$

$$V = \frac{q\,c}{4\pi\varepsilon_0 \left(\sqrt{R^2+Z^2}\,c - ((r - \acute{r}(t_r)) \cdot \vec{v})\right)}$$

$$(\vec{r} - \vec{r}(t_r)) \cdot \vec{V} = \left(z\hat{z} - R\cos(\omega t_r)\,\hat{x} - R\sin(\omega t_r)\,\hat{y}\right)$$

$$\cdot \left(-\omega R\sin(\omega t_r)\,\hat{x} + R\omega\cos(\omega t_r)\,\hat{y}\right)$$

$$= +R^2\omega\cos(\omega t_r)\sin(\omega t_r) - R^2\omega\cos(\omega t_r)\sin(\omega t_r)$$

$$= 0$$

so the scalar potential.

$$V = \frac{q\cancel{c}}{4\pi\varepsilon_0\sqrt{R^2+Z^2}\,\cancel{c}} = \frac{q}{4\pi\varepsilon_0\sqrt{R^2+Z^2}}$$ for one Point charge.

The Vector Potential

$$\vec{A} = \frac{\vec{V}}{c^2}V = \frac{\mu_0}{4\pi}\frac{q\vec{V}}{\sqrt{R^2+Z^2}} = \frac{\mu_0 q}{4\pi\sqrt{R^2+Z^2}}\left(-\omega R\sin(\omega t_r)\,\hat{x} + R\omega\cos(\omega t_r)\,\hat{y}\right)$$

$$\vec{E} = -\nabla V + \frac{\partial A}{\partial t}.$$

$$= -\left(\frac{\partial V}{\partial x}\hat{x} + \frac{\partial V}{\partial y}\hat{y} + \frac{\partial V}{\partial z}\hat{z}\right) - \frac{\partial A}{\partial t}$$

$$\nabla V = \frac{-q * 4\pi\varepsilon_0 \frac{1}{2}(R^2+Z^2)^{-\frac{1}{2}} 2Z\,\hat{z}}{(4\pi\varepsilon_0)^2\; R^2+Z^2} = \frac{-qZ}{4\pi\varepsilon_0\,(R^2+Z^2)^{\frac{3}{2}}}\hat{z}.$$

$$\cancel{\frac{\partial A}{\partial t} = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}}$$

$$A = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega R\sin\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{x} + R\omega\cos\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{y}\right)$$

where.

$r = \sqrt{R^2+z^2}$.

$$\frac{\partial A}{\partial t} = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega R\omega\cos\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{x} - R\omega\omega\sin\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{y}\right)$$

$$\frac{\partial A}{\partial t} = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega^2 R\cos\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{x} - R\omega^2\sin\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{y}\right)$$

$$\cancel{\frac{\partial A}{\partial t} = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega^2 R\cos\left(\omega\left(t-\frac{r}{c}\right)\right)\hat{x}\right.}$$

$$\frac{\partial A}{\partial t} = \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega^2 R\cos(\omega t_r)\hat{x} - R\omega^2\sin(\omega t_r)\hat{y}\right)$$

$$\vec{E} = -\nabla V - \frac{\partial A}{\partial t}$$

$$\vec{E} = \frac{-qz}{4\pi\varepsilon_0(R^2+z^2)^{3/2}}\hat{z} - \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega^2 R\cos(\omega t_r)\hat{x} - R\omega^2\sin(\omega t_r)\hat{y}\right)$$

for a one point charge.

$$\vec{B} = \nabla \times A$$

$$= -\frac{\partial A_y}{\partial z}\hat{x} + \frac{\partial A_x}{\partial z}\hat{y}$$

$$A_y = \frac{\mu_0 q R \omega}{4\pi\sqrt{R^2+z^2}} \cos\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right)$$

$$\frac{\partial A_y}{\partial z} = \frac{\mu_0 q R \omega^2 z (R^2+z^2)^{-\frac{1}{2}}}{4\pi\sqrt{R^2+z^2}\cdot c} \sin\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right)$$

$$+ R\omega \cos\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right) \cdot \frac{\mu_0 q}{4\pi} \cdot \frac{-1}{\cancel{2}} (R^2+z^2)^{-\frac{3}{2}} \cancel{2} z$$

$$= \frac{\mu_0 q R \omega^2 z (R^2+z^2)^{-\frac{1}{2}}}{4\pi\sqrt{z^2+R^2}\, c} \sin\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right)$$

$$- \frac{\mu_0 q R \omega z}{4\pi (R^2+z^2)^{\frac{3}{2}}} \cos\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right)$$

$$= \frac{\mu_0 q R \omega^2 z}{4\pi (R^2+z^2)\, c} \sin(\omega(t_r)) - \frac{\mu_0 q R \omega z}{4\pi (R^2+z^2)^{\frac{3}{2}}} \cos(\omega t_r)$$

$$A_x = \frac{-\mu_0 q \omega R}{4\pi\sqrt{R^2+z^2}} \sin\left(\omega\left(t - \frac{\sqrt{R^2+z^2}}{c}\right)\right) \cdot \hat{x}$$

$$\frac{\partial A_x}{\partial z} = \frac{-\mu_0 q \omega R}{4\pi\sqrt{R^2+z^2}} \cos(\omega t_r) \cdot -\omega \frac{1}{\cancel{2}}(R^2+z^2)^{-\frac{1}{2}} \cdot \cancel{2} \frac{z}{c} + \cdots$$

$$= \frac{\mu_0 q \omega^2 R z \cos(\omega t_r)}{4\pi (R^2+z^2) c} + -\sin(\omega t_r) \frac{\mu_0 q \omega R}{4\pi} \left(\frac{-1}{\cancel{2}}\right)(R^2+z^2)^{-\frac{3}{2}} \cdot \cancel{2} z$$

$$= \frac{\mu_0 q \omega^2 R z \cos(\omega t_r)}{4\pi (R^2+z^2) c} + \frac{\mu_0 q \omega R z}{4\pi (R^2+z^2)^{\frac{3}{2}}} \sin(\omega t_r)$$

$$\text{so } \vec{B} = \left(\frac{-\mu_0 q R \omega^2 z}{4\pi (R^2+z^2) c} \sin(\omega t_r) + \frac{\mu_0 q \omega R z}{4\pi (R^2+z^2)^{3/2}} \cos(\omega t_r)\right) \hat{x}$$

$$+ \frac{\mu_0 q \omega^2 R z}{4\pi (R^2+z^2) c} \cos(\omega t_r) \hat{y} + \frac{\mu_0 q \omega R z}{4\pi (R^2+z^2)^{3/2}} \cos(\omega t_r) \hat{y}$$

↓ for a one point charge.

The electric field for one point

$$\vec{E} = \frac{-qz\,\hat{z}}{4\pi\varepsilon_0 (R^2+z^2)^{3/2}} - \frac{\mu_0 q}{4\pi\sqrt{R^2+z^2}}\left(-\omega^2 R\cos(\omega t)\hat{x} - R\omega^2\sin(\omega t)\hat{y}\right)$$

for 2 repulsive point charge the x and y component cancel each other

$$\text{so } \vec{E} = \frac{-\cancel{2}qz\,\hat{z}}{\cancel{4}\pi\varepsilon_0 (R^2+z^2)^{3/2}} = \frac{-qz\,\hat{z}}{2\pi\varepsilon_0 (R^2+z^2)^{3/2}}$$

but the $r = \sqrt{R^2+z^2}$

$E \propto \frac{1}{r^3}$ this is not radiate at large ~~distance~~ distance.

c

~~so the Power~~ so there is no Power radiate in this system

$$S \propto E \times B \rightarrow P = \oint \langle S \rangle \cdot da = 0$$