Ques1.

In a cyclotron, protons are accelerated to a kinetic energy of $K = 0.5$MeV. What should be the radius R of the trajectory of the charged particles when the field is $B = 10$ T? Neglect relativistic corrections. Given: mass of proton is 1.6×10^{-21}Kg; charge of proton 1.6×10^{-19}C; 1eV$= 1.6 \times 10^{-19}$J. 10

Ques2.

The space and time dependence of charge density in a region is given by $\rho = -2\alpha t \left(x\, e^{-\alpha x^2} + y\, e^{-\alpha y^2} + z\, e^{-\alpha z^2} \right)$. Find the current density at a point $P(\frac{1}{\sqrt{\alpha}}, \frac{1}{\sqrt{\alpha}}, \frac{1}{\sqrt{\alpha}})$.

- $\vec{J} = \frac{1}{e}(\hat{x} + \hat{y} + \hat{z})$
- $\vec{J} = -\alpha e\,(\hat{x} + \hat{y} + \hat{z})$
- $\vec{J} = e\frac{(\hat{x}+\hat{y}+\hat{z})}{\sqrt{3}}$
- $\vec{J} = -\frac{1}{e}\frac{(\hat{x}+\hat{y}+\hat{z})}{\sqrt{3}}$
- $\vec{J} = -e\,(\hat{x} + \hat{y} + \hat{z})$
- $\vec{J} = \frac{\alpha}{e}\frac{(\hat{x}+\hat{y}+\hat{z})}{\sqrt{3}}$

Ques3.

Find the surface current density for the following cases: 1) A thin spherical shell of radius R with surface charge density σ, centred at the origin and rotating with angular velocity $\omega\hat{k}$ about its diameter; 2) A thin cylindrical shell of radius R with surface charge density σ rotating with angular velocity $\omega\hat{k}$ about its axis.

- $\sigma\omega R\sin\theta\hat{\phi}$, $\sigma\omega R\hat{\phi}$
- $\sigma\omega R\hat{\phi}$, $\sigma\omega R\sin\theta\cos\phi\hat{\phi}$
- $\sigma\omega R\sin\theta\cos\phi\hat{\phi}$, $\sigma\omega R\hat{\phi}$
- $\sigma\omega R\sin\theta\phi$, $\sigma\omega R\sin\theta\cos\phi\hat{\phi}$
- $\sigma\omega R\sin\theta\sin\phi\hat{\phi}$, $\sigma\omega R\sin\phi\hat{\phi}$
- $\sigma\omega R\hat{\phi}$, $\sigma\omega R\sin\theta\hat{\phi}$

Ques4.

The square loop of sides 2 m carries a current 1 A and is placed in a field pointing into the page, as shown in the figure. The field changes in strength at a rate -0.5 T/m along the positive x-direction. The force acting on it is $n\,\hat{m}$ Newton. The values of n and m are -2 , x , respectively.