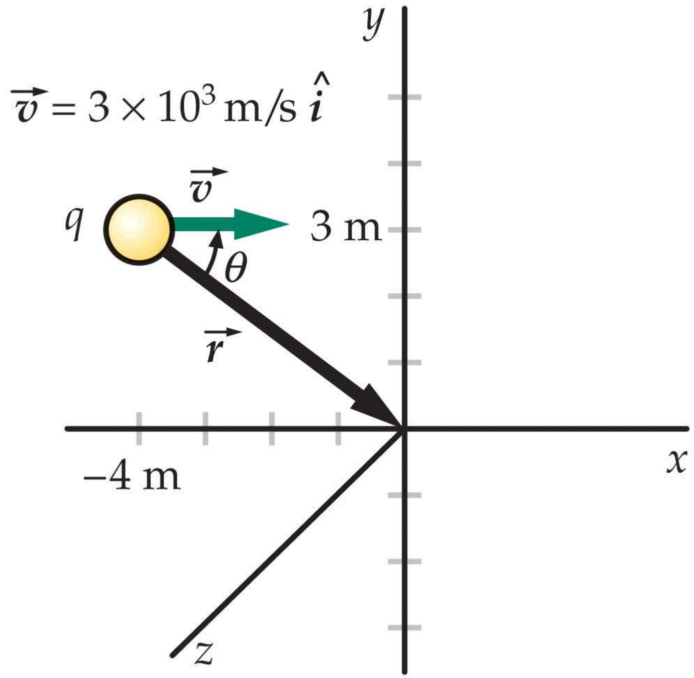
Magnetic Field Application (1)

A particle with charge $q = 4.5\text{nC}$ is moving with velocity $\vec{v} = 3 \times 10^3 \text{m/s}\hat{i}$. Find the magnetic field generated at the origin of the coordinate system.

- Position of field point relative to particle: $\vec{r} = 4\text{m}\hat{i} - 3\text{m}\hat{j}$
- Distance between Particle and field point: $r = \sqrt{(4\text{m})^2 + (3\text{m})^2} = 5\text{m}$
- Magnetic field:

$$
\begin{aligned}
\vec{B} &= \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\vec{r}}{r^3} \\
&= \frac{\mu_0}{4\pi}\frac{q(3\times 10^3\text{m/s}\hat{i})\times(4\text{m}\hat{i} - 3\text{m}\hat{j})}{(5\text{m})^3} \\
&= -\frac{\mu_0}{4\pi}\frac{q(3\times 10^3\text{m/s}\hat{i})\times(3\text{m}\hat{j})}{(5\text{m})^3} \\
&= -3.24\times 10^{-14}\text{T}\hat{k}.
\end{aligned}
$$



Magnetic Field Application (11)

The electric field E_x along the axis of a charged ring and the magnetic field B_x along the axis of a circular current loop are

$$E_x = \frac{Q}{4\pi\epsilon_0}\frac{x}{(x^2+R^2)^{3/2}}, \qquad B_x = \frac{\mu_0 I}{2}\frac{R^2}{(x^2+R^2)^{3/2}}$$

(a) Simplify both expressions for $x = 0$.

(b) Simplify both expressions for $x \gg R$.

(c) Sketch graphs of $E_x(x)$ and $B_x(x)$.