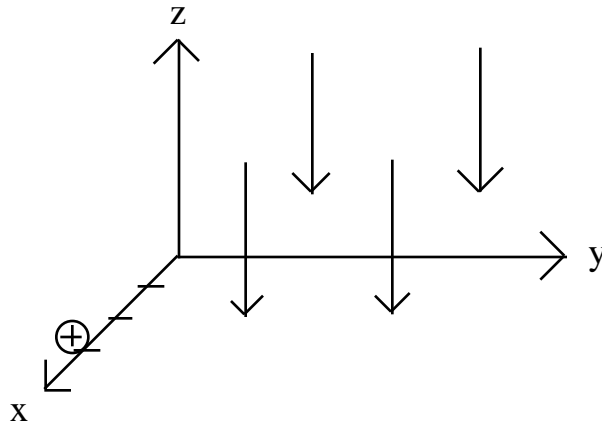


THE MOTION OF A CHARGED PARTICLE IN A MAGNETIC FIELD – Q20.0H

Parametric equations

$$\begin{cases} x = 3 \cos \omega t \\ y = 3 \sin \omega t \\ z = 5\sqrt{3}t \end{cases}$$



Initial Conditions

(a) $\vec{B} = -6\hat{k}, T(\text{teslas})$

(b) A charge of $q = 2\text{C}$ enters the 1st octant at $(3,0,0)\text{m}$ with a speed of 10m/s at a 60° angle with the xy -plane, parallel to the yz -plane. (ie, $\vec{r}_0 = (3,0,0)\text{m}$ and $\vec{v}_0 = (0,5,5\sqrt{3})\text{m/s}$)

1. $\vec{F}_m = ?$

2. What is the speed of the particle when $t = 0\text{sec}$?

What is the speed of the particle after 2 seconds?

3. The particle spirals upward. What is the z -coordinate of the particle after $t = 3\text{s}$?

What is v_z after $t = \sqrt{3}\text{sec}$?

4. We notice that while the particle spirals upward, looking down on the xy -plane, the particle appears to be going in a circle.

The magnetic force is centripetal so: $F_m = F_c = ma_c = m \frac{v^2}{R}$.

Using $v = 5\text{m/s}$ and a radius of 3m , find the mass of this charged particle.

5. If $R = 3\text{m}$, find the position, $\vec{r} = (x, y, z)$, of the particle after $t = \frac{\pi}{10}\text{sec}$.

6. Using $v = R\omega$ and $\omega = \frac{2\pi}{T}$, determine the frequency, $f = ? \text{ Hz (cps)}$.

7. Copy the coordinate axes shown above, and draw the helical path of the particle.