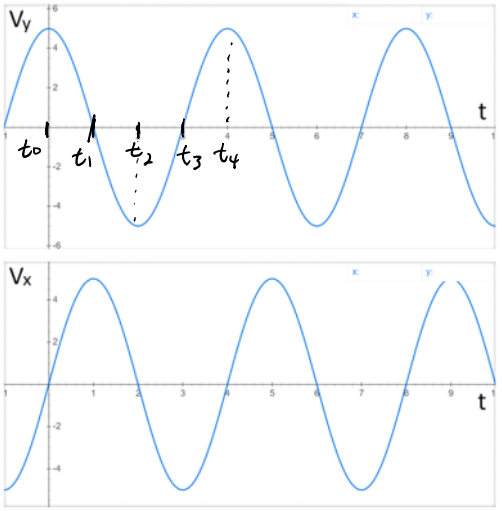
Week 10 quiz

Monday, May 31, 2021 8:37 PM

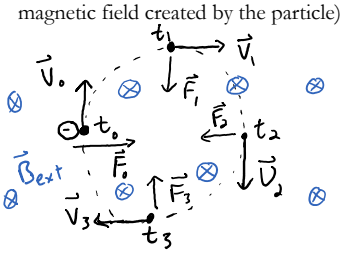
A negatively charged particle of mass 3 g has a net charge of -0.0023 C. Plots of the x and y velocities of the particle are shown in the graphs. Its velocity in the z direction is zero. On the graph, velocities are given in units of mm/s and time is given in seconds. The particle is travelling in uniform circular motion caused by an external magnetic force acting on it. There are no other forces acting on the particle.



(a) (2 pts) What is the period of the particle's uniform circular motion?

$T = 4\ sec$

(b) (4 pts) What direction does the external magnetic field point? Explain your reasoning. (hint: draw a diagram that shows the particle's motion and correlates locations with times on the graph) (hint #2: this is NOT the magnetic field created by the particle)



$\vec{F}^B = q\vec{V} \times \vec{B}_{ext}$

w/ $q(-)$, $\vec{V}_0 \uparrow$, & $\vec{F} \rightarrow$, $\vec{B}_{ext}$ must be into page

(c) (4 pts) What is the strength of the external magnetic field which exerts the force on the particle? (hint: what is the speed, not velocity, of the particle as it travels in a circle?)

$|\vec{F}^B| = |q||\vec{V}||\vec{B}|\sin\theta = m\frac{v^2}{r} \Rightarrow B = \frac{mv}{qr}$, m & q are known.

$|\vec{V}| = V_y(t_0) = 5\ mm/s$, for UCM, considering $speed = \frac{dist}{time}$, $v = \frac{2\pi r}{T}$

So, $B = \frac{m\,2\pi r}{q r T} = \frac{2\pi m}{qT} = 2.05\ T$

Rubric

~~ Part (a) ~~
2 pts - answer + units

~~ Part (b) ~~
1 pt - answer
3 pts - reasoning, including diagram

~~ Part (c) ~~
1 pt - UCM and B-force equation
1.5 pts - relating v and r
1 pt - algebra
0.5 pt - answer + units