Physics 2401 Summer 2, 2008
Exam III

$e = 1.60\times10^{-19}$ C, m(electron) = 9.11×10^{-31} kg, $\varepsilon_0 = 8.845\times10^{-12}$ C^2/Nm^2,
$k_e = 9.0\times10^{9}$ Nm^2/C^2, m(proton) = 1.67×10^{-27} kg. n = nano = 10^{-9}, μ = micro = 10^{-6}, m = milli = 10^{-3}

e

1. A charged particle is in a region of non-zero magnetic field. If it feels no force
a) it is moving perpendicular to the field b) it is not moving at all
c) it is moving parallel to the field d) a or b (e) b or c

$|\vec{F}| = |q\vec{v}\times\vec{B}| = qvB\sin\theta$
$|\vec{F}| = 0$ if $\vec{v} = 0$ or $\theta = 0$

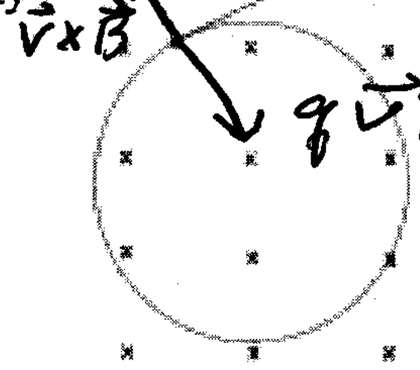
C

2. An electron has a velocity of 6.0×10^6 m/s in the positive x direction at a point where the magnetic field has the components $B_x = 3.0$ T, $B_y = 1.5$ T, and $B_z = 2.0$ T. What is the magnitude of the acceleration of the electron at this point?
a. 2.1×10^{18} m/s^2
b. 1.6×10^{18} m/s^2
(c) 2.6×10^{18} m/s^2
d. 3.2×10^{18} m/s^2
e. 3.7×10^{18} m/s^2

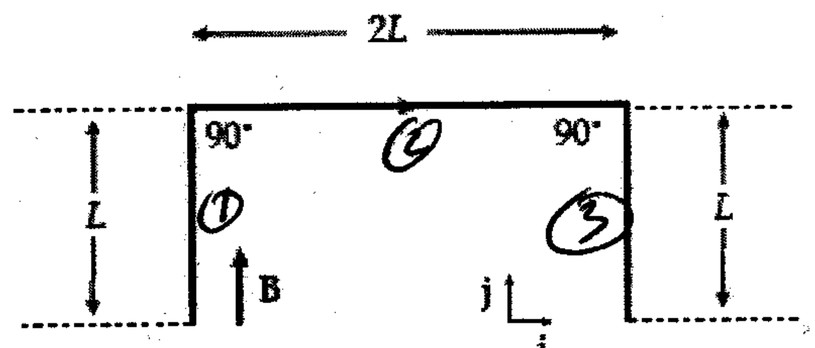
$\vec{F} = q\vec{v}\times\vec{B} = -e\,(6.0\times10^6\,\text{m/s}\,\hat{i})\times(3.0\,\text{T}\,\hat{i} + 1.5\,\text{T}\,\hat{j} + 2.0\,\text{T}\,\hat{k})$
$= -e\,(6.0\times10^6\,\text{m/s})(0 + 1.5\,\text{T}\,\hat{k} - 2.0\,\text{T}\,\hat{j})$
$= -1.44\times10^{-12}\,\text{N}\,\hat{k} + 1.92\times10^{-12}\,\text{N}\,\hat{j}$
$|\vec{F}| = \sqrt{F_x^2 + F_y^2} = 2.4\times10^{-12}$ N
$a = \frac{|\vec{F}|}{m_e} = 2.6\times10^{18}\,\text{m/s}^2$

a

3. The particle in the diagram on the right has an instantaneous velocity shown by the arrow. It is
(a) negatively charged b) positively charged



4. A straight wire is bent into the shape shown. Determine the net magnetic force on the wire when the current I travels in the direction shown in the magnetic field **B**.



b

a. $2IBL$ in the $-z$ direction
(b.) $2IBL$ in the $+z$ direction
c. $4IBL$ in the $+z$ direction
d. $4IBL$ in the $-z$ direction
e. zero

$F_① = F_③ = 0$ since I parallel to $\vec{B}$
$F_② = I\ell B\sin\theta$ ($\theta = 90°$)
$= I\,2L\,B$
Points in by RHR $-\hat{k}$