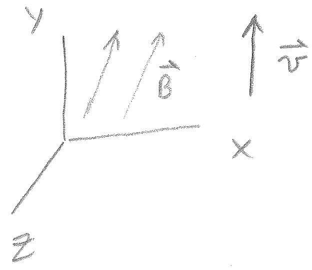
27.4

particle $m = 1.81 \times 10^{-3}\ kg$ $\vec{v} = 3 \times 10^{4}\ m/s\ \hat{j} \equiv v\hat{j}$

$q = 1.22 \times 10^{-8}\ C$

$\vec{B} = 1.63\ T\ \hat{i} + 0.98\ T\ \hat{j}$



$\vec{F} = q\vec{v} \times \vec{B} = m\vec{a}$

$\Rightarrow \vec{a} = \frac{q}{m}\vec{v} \times \vec{B} = \frac{q}{m}(3 \times 10^{4}\ m/s)\ \hat{j} \times (B_x\hat{i} + B_y\hat{j})$

$\Rightarrow \vec{a} = \frac{q}{m} v B_x(-\hat{k}) = \frac{1.22 \times 10^{-8}\ C}{1.81 \times 10^{-3}\ kg}(3 \times 10^{4}\ m/s)(1.63\ T)(-\hat{k})$

$= \boxed{-0.329602\ m/s^2\ \hat{k}}$

27.10

a) $\Phi_B = \oint \vec{B} \cdot d\vec{A} = 0 \Rightarrow \Phi_1 + \Phi_{others} = 0$

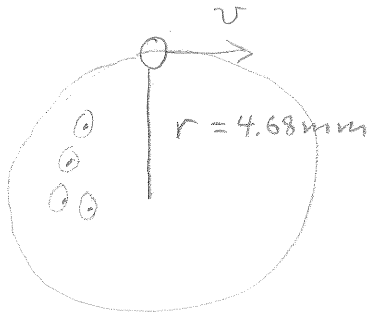
$\Rightarrow \Phi_{others} = -\Phi_1 = \boxed{-0.12\ Wb}$

b) The net $\vec{B}$-flux through any closed surface must be zero.

c) The result would be the same, unless you find a magnetic mono pole (the first ever).

27.14 particle $q = 6.4 \times 10^{-19} C$

a)



$B = 1.65\ T$

$\vec{B}$ is at you

$|F| = ma = q|\vec{v} \times \vec{B}| = qvB \qquad a = \frac{v^2}{r}$ to go in a circle

$\Rightarrow m\frac{v^{\cancel{2}}}{r} = q\cancel{v}B \Rightarrow mv = qBr$

$\Rightarrow |\vec{p}| = mv = qBr = (6.4 \times 10^{-19} C)(1.65\ T)(4.68\ \cancel{mm})\left(\frac{10^{-3} m}{\cancel{mm}}\right)$

$= \boxed{4.94208 \times 10^{-21}\ kg\ \frac{m}{s}}$

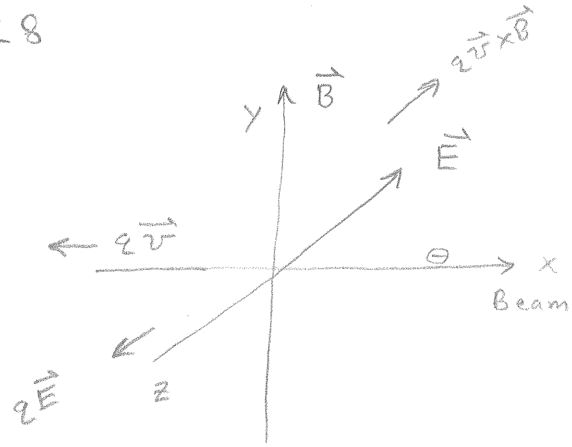
b)

$\vec{L} = \vec{r} \times \vec{p} \Rightarrow |\vec{L}| = rmv = (4.68\ \cancel{mm})|\vec{p}|\ \frac{10^{-3} m}{\cancel{mm}}$

$= \boxed{2.31289 \times 10^{-23}\ kg\ \frac{m^2}{s}}$

27. 28

b)



a)

$$\sum \vec{F} = ma = 0 \Rightarrow q\vec{v}\times\vec{B} = q\vec{E}$$

$$\Rightarrow vB = E \Rightarrow v = \frac{E}{B} = \frac{1.56\times10^{4}\ \frac{V}{m}}{4.62\times10^{-3}\ T} = \boxed{3.37\times10^{6}\ m/s}$$

c)

$$ma = \frac{m_e v^{\cancel{2}}}{r} = q\cancel{v}B \Rightarrow r = \frac{m_e v}{qB} = \frac{m_e v}{eB}$$

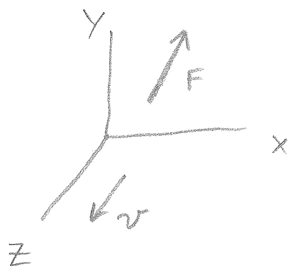
$$\Rightarrow r = \frac{(9.109\times10^{-31}\ kg)\ 3.3766\times10^{6}\ m/s}{(1.602\times10^{-19}\ C)(4.62\times10^{-3}\ T)} = \boxed{4.156\times10^{-3}\ m}$$

$$\omega = \frac{v}{r} \Rightarrow \frac{2\pi}{T} = \frac{v}{r} \Rightarrow T = \frac{2\pi r}{v}$$

$$= \frac{2\pi\ (4.156\times10^{-3}\ m)}{3.3766\times10^{6}\ m/s} = \boxed{7.73\times10^{-9}\ sec}$$

27.58

a)



B_z cannot be found Because it does not effect the net Force on the particle

$$\vec{F} = q\vec{v} \times \vec{B} = qv\left[\hat{k} \times \hat{j}\, B_y + \hat{k} \times \hat{i}\, B_x\right]$$

$$= \underbrace{-qvB_y}_{F_0 3}\,\hat{i} + \underbrace{qvB_x}_{F_0 4}\,\hat{j} \Rightarrow \boxed{B_y = -\frac{3F_0}{qv} \quad B_x = \frac{4F}{qv}}$$

b)

$$|\vec{B}|^2 = (6F_0/qv)^2$$

$$= B_x^2 + B_y^2 + B_z^2$$

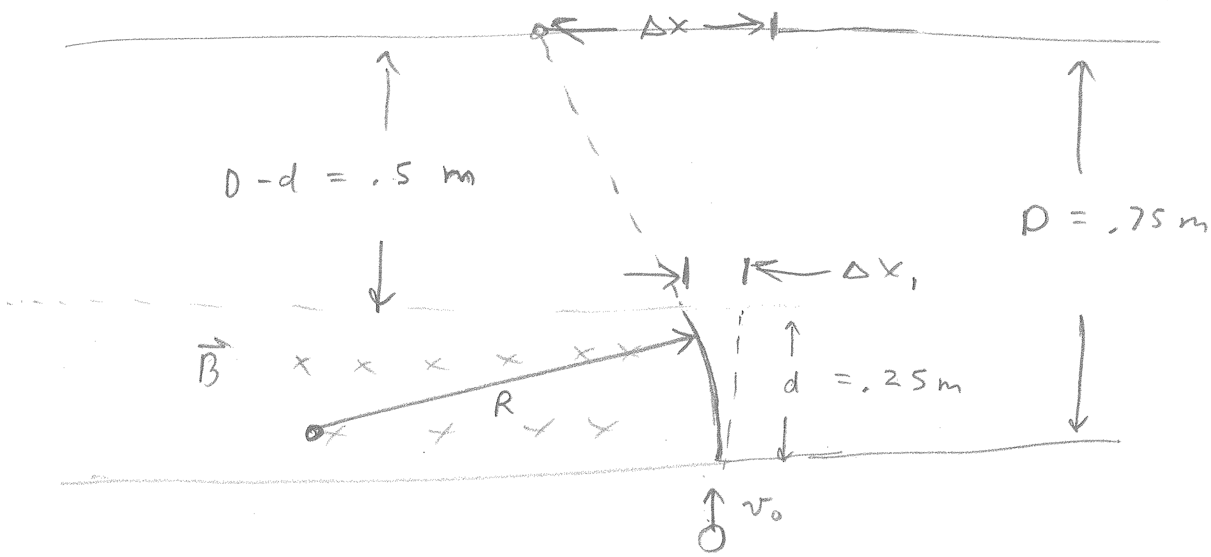
$$\Rightarrow B_z^2 = 36\left(\frac{F_0}{qv}\right)^2 - \overbrace{9\left(\frac{F_0}{qv}\right)^2}^{B_y^2} - \overbrace{16\left(\frac{F_0}{qv}\right)^2}^{B_x^2} = (36-25)\left(\frac{F_0}{qv}\right)^2$$

$$\Rightarrow \boxed{B_z = \pm\sqrt{11}\,\frac{F_0}{qv}}$$

27.89

$q = 2.15\ \mu C$ $m = 3.2 \times 10^{-11}\ kg$

$v_0 = 1.45 \times 10^5\ m/s$ $B = 0.42\ T$



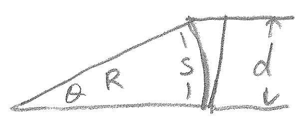
a)

$$m\vec{a} = \vec{F} = q\vec{v}_0 \times \vec{B} \Rightarrow m\left(\frac{v^{\cancel{2}}}{R}\right) = q\cancel{v}B$$

$$\Rightarrow R = \frac{mv}{qB} = \frac{(3.2\times10^{-11}\ kg)(1.45\times10^5\ m/s)}{2.15\times10^{-6}\ C\ (0.42\ T)} = \boxed{5.138\ m}$$

b)

arc traveled



$$\theta R = s \qquad \sin\theta = \frac{d}{R} \Rightarrow \theta = \sin^{-1}\left(\frac{d}{R}\right)$$

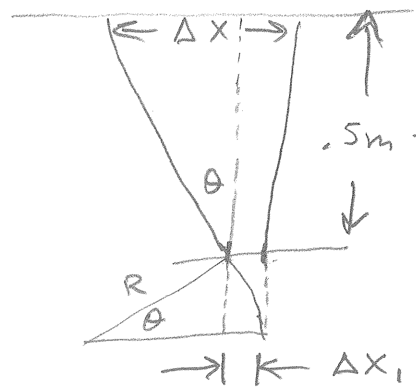
$$\Rightarrow s = R\left[\sin^{-1}\left(\frac{d}{R}\right)\right] \qquad s = v_0 t_1$$

$v = v_0 =$ const.
just changes direction not magnetude

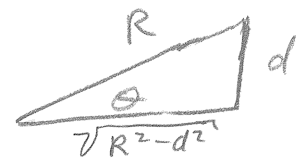
$$\Rightarrow t_1 = \frac{s}{v_0} = \frac{R\sin^{-1}\left(\frac{d}{R}\right)}{v_0}$$

$$= \frac{5.13846\ m}{1.45\times10^5\ m/s}\sin^{-1}\left(\frac{.25}{5.138\ m}\right) = \boxed{1.725\times10^{-6}\ s}$$

27.89 c)



$\Delta x = \Delta x_1 + D' \sin\theta$



$\Delta x_1 = R - R\cos\theta$

$\Rightarrow \quad \Delta x = (R - R\cos\theta) + D'\sin\theta$

from (b)

$\sin\theta = \dfrac{d}{R} \quad \Rightarrow \quad \cos\theta = \dfrac{\sqrt{R^2-d^2}}{R}$

$$\Rightarrow \quad \Delta x = R - R\left(\frac{\sqrt{R^2-d^2}}{R}\right) + D'\frac{d}{R}$$

$$= R - \sqrt{R^2-d^2} + \frac{D'd}{R}$$

$$= (5.13846\,m) - \sqrt{(5.13846\,m)^2 - (.25\,m)^2} + \frac{(.5\,m)(.25\,m)}{5.13846\,m}$$

$$= \boxed{0.0304\ m}$$