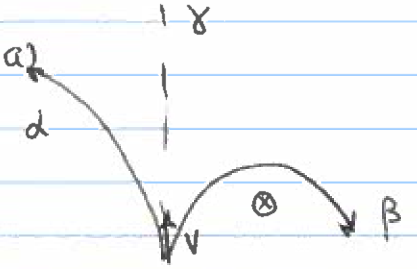
Written assignment #6 solutions

1. a)



Positively charged particle

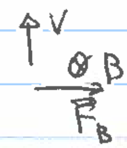
$\vec{F}_B = q\,\vec{v}\times\vec{B}$

α – positively charged α-particle, He^{2+}, $q_\alpha = +2e$

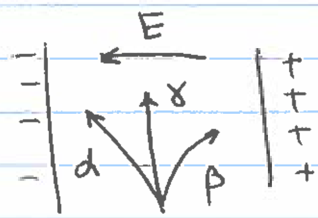
β – negatively charged electron $q_\beta = -e$

γ – no charge, photon $q_\gamma = 0$

negatively charge particle



b)



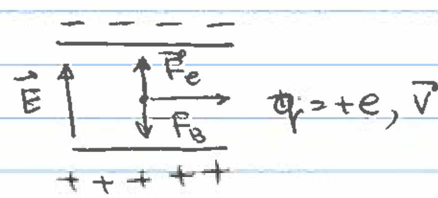
$\vec{F} = q\cdot\vec{E}$

Problem 2

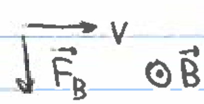
a) Energy conservation $e\cdot V = \frac{mv^2}{2}$ $\quad v = \sqrt{\frac{2e\cdot V}{m}}$

$$v = \sqrt{\frac{2\cdot 1.6\cdot 10^{-19}\,C\cdot 2\cdot 10^{3}\,V}{4\cdot 10^{-25}\,kg}} = 4\cdot 10^{4}\,m/s$$

b)



To compensate $\vec{F}_B = -\vec{F}_E$



out of the page

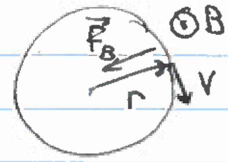
$F_e = \underline{q}\,\vec{E} = F_B = \underline{q}\,\vec{v}\times\vec{B}$

charge cancels out, so $q \to -q$ does not change compensation

c) $qE = qvB$

$$v = E/B = \frac{2500\,V/m}{0.035\,T} = 7.14\cdot 10^{4}\,m/s$$

d) Magnetic field only



$F_B = q\cdot \not{v}\cdot B = m a_{cp} = m\frac{v^{\not{2}}}{r}$

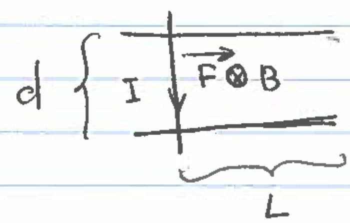
$r = \frac{mv}{qB}$

For two isotopes $r_{1,2} = m_{1,2}v/qB$

$\Delta r = r_1 - r_2 = \frac{\Delta m\cdot v}{qB} = \frac{5\cdot 10^{-27} kg \cdot 7.14\cdot 10^{4} m/s}{1.6\cdot 10^{-19} C\cdot 0.035 T} =$

$= 0.064 m$

Problem 3



$F = I\cdot d\cdot B$

a) once the current is on, there will be a ~~force~~ magnetic force pushing the rod to the right

$F = ma \Rightarrow a = \frac{I\cdot d\cdot B}{m}$

b) From 1d motion w/ constant acceleration

$v_f^2 - v_i^2 = 2L\cdot a$, $v_i^2 = 0$

$v_f = \sqrt{2La} = \sqrt{\frac{2IdLB}{m}}$