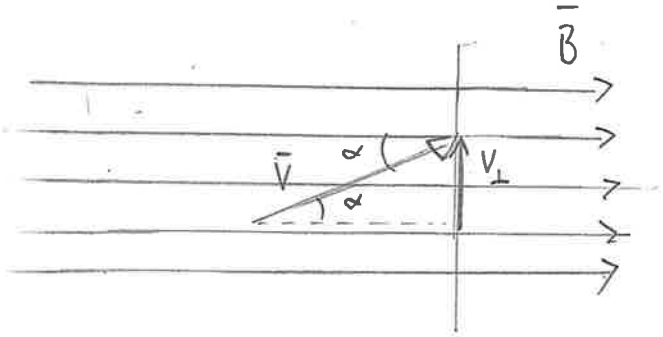
3-14) $V = 2.5\ Mm/s$ $\sphericalangle \bar{v}, \bar{B} = 25° = \alpha$ $B = 170\ mT$

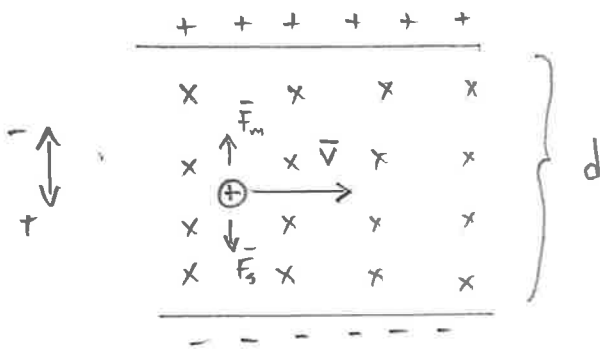


$$\frac{V_\perp}{V} = \sin\alpha$$

$$V_\perp = V \sin\alpha$$

$$F_m = Q V_\perp B$$
$$= Q V \sin\alpha \cdot B$$
$$= 1{,}60218 \cdot 10^{-19} C \cdot 2{,}5 \cdot 10^{6}\ m/s \cdot \sin 25° \cdot 170 \cdot 10^{-3}\ T$$
$$= 2{,}877\ldots \cdot 10^{-14} N \approx \underline{2{,}9 \cdot 10^{-14} N}$$

3-12) $V = 1{,}1\ Mm/s$ $B = 23\ mT$ $d = 16\ mm$



Protoni etenee suoraan tasaisella nopeudella
eli $a = 0$ $\Rightarrow$ Newtonin toisen lain mukaan silloin
$\sum \bar{F} = \bar{0}$ (paino ~ 0N , ilmanvastus ~ 0N)

$$\bar{F}_s + \bar{F}_m = 0$$

$$F_s - F_m = 0$$

$$F_s = F_m$$

$$E\cancel{Q} = \cancel{Q} v B \quad \text{missä} \quad E = \frac{U}{d} \quad (U = Ed$$

$$\frac{U}{d} = vB \quad \| \cdot d$$

$$U = vBd$$
$$= 1{,}1 \cdot 10^{6}\ m/s \cdot 23 \cdot 10^{-3}\ T \cdot 16 \cdot 10^{-3}\ M = 404{,}8\ V$$
$$\approx \underline{400\ V}$$

3-16) $v = 9{,}0\ \mathrm{Mm/s}$ $B = 0{,}25\ \mathrm{mT}$ $\bar{v} \perp \bar{B}$

a) $F_m = QvB$

$= 1{,}60218 \cdot 10^{-19}\,\mathrm{C} \cdot 9{,}0 \cdot 10^{6}\,\mathrm{m/s} \cdot 0{,}25 \cdot 10^{-3}\,\mathrm{T} = 3{,}6 \cdot 10^{-16}\,\mathrm{N}$

$= \underline{0{,}36\ \mathrm{fN}}$

Voiman suunta etenemissuuntaan nähden oikealle. Perusteluna oikean käden sääntö

b) Rataehto NII-lain mukaan...

$\Sigma \bar{F} = m\bar{a}$, positiivinen suunta kohti radan keskipistettä

F_{kitka} ja $F_{ilma} \approx 0\,\mathrm{N}$

$F_M = m\frac{v^2}{r}$

$QvB = m\frac{v^2}{r}$

$r = \frac{mv}{QB} = \frac{9{,}10938 \cdot 10^{-31}\,\mathrm{kg} \cdot 9{,}0 \cdot 10^{6}\,\mathrm{m/s}}{1{,}60218 \cdot 10^{-19}\,\mathrm{C} \cdot 0{,}25 \cdot 10^{-3}\,\mathrm{T}} = 0{,}2046\ldots\,\mathrm{m}$

$\approx \underline{0{,}20\,\mathrm{m}}$

c) $t = \frac{s}{v}$

$t = \frac{2\pi r}{v}$

$t = \frac{2\pi \cdot 0{,}2046\ldots\,\mathrm{m}}{9{,}0 \cdot 10^{6}\,\mathrm{m/s}} = 1{,}428\ldots \cdot 10^{-7}\,\mathrm{s}$

$\approx \underline{0{,}14\ \mu\mathrm{s}}$