Physics 1C Practice final answers

(1) $\theta(V_R) = \tan^{-1}\left(\frac{R}{\omega^2 N}\right)$

$\theta(V_N) = \tan^{-1}\left(-\frac{\omega^2 N}{R}\right)$

(2) (a) $d\vec{F} = \frac{E_0 B_0}{\mu_0 c}\sin^2(\omega t)\, a\, dr\, \hat{x}$

(b) $\langle d\vec{\tau}_{abs}\rangle = \frac{E_0 B_0}{2\mu_0 c} a r\, dr\, \hat{z}$

$\langle d\vec{\tau}_{ref}\rangle = 2\langle d\vec{\tau}_{abs}\rangle$

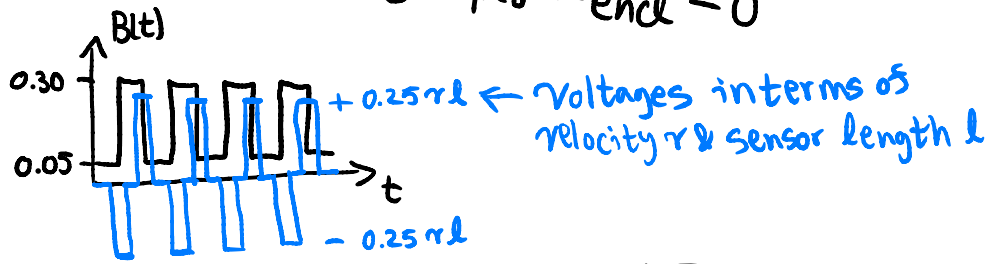
(c) $\langle \vec{\tau}\rangle = \frac{3 E_0 B_0}{4\mu_0 c} a\left((l+a)^2 - l^2\right)\hat{z}$

(d) $\ddot{\theta} = \frac{3 E_0 B_0}{4\mu_0 c I} a\left((l+a)^2 - l^2\right)$ counterclockwise

(3) $\mu_0 I_{encl} = \int d\vec{l}\cdot\vec{B} = \int_0^{2\pi} d\theta \sqrt{a^2\cos^2\theta + b^2\sin^2\theta}\ \hat{T}(\theta)\cdot\vec{B}$

$\vec{B} = \text{const} \Rightarrow \mu_0 I_{encl} = 0$

(4)



(5) The matchstick appears $\frac{105}{29} \approx 3.6$cm to the left and is uninverted with height $\frac{60}{29} \approx 2.1$cm and magnification 0.52

(6) The difference in path lengths adjusted to free-space is

$l = 2\cdot(1\cdot 4/3 + 3\cdot 3/2) = \frac{35}{3}$ [mm] → Constructive if $m\lambda_0 = l$, $m \in \mathbb{Z}$

↳ destructive if $(m+1/2)\lambda_0 = l$

(7) $\theta_{observed} = \tan^{-1}(\tan(\theta)/\gamma)$ where $\gamma = u/c$

(8) approaching at $c/3$