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1-) $\vec{v} = u_0\, sen\left(\omega\left(t - \frac{y}{v_0}\right)\right)\hat{i} + v_0\,\hat{j}$

a-) Linha de corrente em $t = 0$ $(0,0)$ e $t = \frac{\pi}{2\omega}$ $(0,0)$

$\frac{dy}{dx} = \frac{v}{u}$ $\quad \frac{dy}{dx} = \frac{v_0}{u_0\, sen\left(\omega\left(t - \frac{y}{v_0}\right)\right)}$ $\quad v_0\,dx = u_0\, sen\left(\omega\left(t - \frac{y}{v_0}\right)\right)$

$\int_{x_0}^{x} v_0\,dx = \int_{y_0}^{y} u_0\, sen\left(\omega\left(t - \frac{y}{v_0}\right)\right)dy$ $\quad \int_{x_0}^{x} v_0\,dx = v_0\,x\Big|_{x_0}^{x}$ $\quad v_0(x - x_0)$

$\int_{y_0}^{y} u_0\, sen\left(\omega\left(t - \frac{y}{v_0}\right)\right)dy$ $\quad u_0\int_{y_0}^{y} sen\left(\omega t - \frac{\omega y}{v_0}\right)dy$ $\quad u = \omega t - \frac{\omega y}{v_0}$

$du = -\frac{\omega}{v_0}\,dy$

$u_0\int_{y_0}^{y} sen(u)\left(\frac{-v_0}{\omega}\right)du$ $\quad \frac{-u_0 v_0}{\omega}\int_{y_0}^{y} sen(u)\,du$ $\quad \frac{u_0 v_0}{\omega}\left(-\cos\left(\omega t - \frac{\omega y}{v_0}\right)\right)\Big|_{y_0}^{y}$

$\frac{u_0 v_0}{\omega}\left(\cos\left(\omega t - \frac{\omega y}{v_0}\right) - \cos\left(\omega t - \frac{\omega y_0}{v_0}\right)\right)$

$\cos(\omega t)\cos\left(\frac{\omega y}{v_0}\right) + sen(\omega t)\,sen\left(\frac{\omega y}{v_0}\right) - \cos(\omega t)\cos\left(\frac{\omega y_0}{v_0}\right) - sen(\omega t)\,sen\left(\frac{\omega y_0}{v_0}\right)$

$\cos(\omega t)\left(\cos\left(\frac{\omega y}{v_0}\right) - \cos\left(\frac{\omega y_0}{v_0}\right)\right) + sen(\omega t)\left(sen\left(\frac{\omega y}{v_0}\right) - sen\left(\frac{\omega y_0}{v_0}\right)\right)$

$v_0(x - x_0) = \frac{u_0 v_0}{\omega}\left(\cos(\omega t)\left(\cos\left(\frac{\omega y}{v_0}\right) - \cos\left(\frac{\omega y_0}{v_0}\right)\right) + sen(\omega t)\left(sen\left(\frac{\omega y}{v_0}\right) - sen\left(\frac{\omega y_0}{v_0}\right)\right)\right)$

sempre na origem $(0,0)$

$x = \frac{u_0}{\omega}\left(\cos(\omega t)\left(\cos\left(\frac{\omega y}{v_0}\right) - 1\right) + sen(\omega t)\left(sen\left(\frac{\omega y}{v_0}\right)\right)\right)$

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$t_0 = 0$

$$X = \frac{u_0}{\omega}\left(\cos(0)\left(\cos\left(\frac{\omega y}{v_0}\right)-1\right)+\operatorname{sen}(0)\left(\operatorname{sen}\left(\frac{\omega y}{v_0}\right)\right)\right) = \frac{u_0}{\omega}\left(\cos\left(\frac{\omega y}{v_0}\right)-1\right)$$

$t_0 = \frac{\pi}{2\omega}$

$$X = \frac{u_0}{\omega}\left(\cos\left(\frac{\pi}{2}\right)\left(\cos\left(\frac{\omega y}{v_0}\right)-1\right)+\operatorname{sen}\left(\frac{\pi}{2}\right)\left(\operatorname{sen}\left(\frac{\omega y}{v_0}\right)\right)\right) = \frac{u_0}{\omega}\operatorname{sen}\left(\frac{\omega y}{v_0}\right)$$

b-) Linha de trajetoria $t=0,\ t=\frac{\pi}{2\omega}$ $(0,0)$

$u = \frac{dx}{dt}$ $\quad \frac{dx}{dt} = u_0 \operatorname{sen}\left(\omega\left(t-\frac{y}{v_0}\right)\right)$ $\quad \int_{y_0}^{y} dy = \int_{t_0}^{t} v_0\, dt$

$v = \frac{dy}{dt}$ $\quad \frac{dy}{dt} = v_0$ $\quad y - y_0 = v_0(t-t_0)$

$$\int_{x_0}^{x} dx = \int_{t_0}^{t} u_0 \operatorname{sen}\left(\omega t - \frac{\omega y}{v_0}\right) dt \qquad \int_{x_0}^{x} dx = x - x_0 \qquad u = \omega t - \frac{\omega y}{v_0}$$

$du = \omega\, dt$

$$\int_{t_0}^{t} u_0 \operatorname{sen}(u)\frac{du}{\omega} \qquad \frac{u_0}{\omega}\int_{t_0}^{t}\operatorname{sen}(u)\,du \qquad -\frac{u_0}{\omega}\left(\cos\left(\omega t - \frac{\omega y}{v_0}\right)\right)\Bigg|_{t_0}^{t}$$

$$X - X_0 = -\frac{u_0}{\omega}\left[\cos\left(\omega t - \frac{\omega y}{v_0}\right) - \cos\left(\omega t_0 - \frac{\omega y}{v_0}\right)\right]$$

sempre na origem

$y = v_0(t-t_0)$

$$X = -\frac{u_0}{\omega}\left(\cos(\omega t) - \cos(\omega t_0)\right)$$

$t_0 = 0$

$y = v_0 t$

$X = \frac{-u_0}{\omega}(\cos(\omega t) - 1)$

$X = \frac{-u_0}{\omega}\left(\cos\left(\frac{\omega y}{v_0}\right) - 1\right)$

$t_0 = \frac{\pi}{2\omega}$

$y = v_0 t - \frac{\pi}{2\omega}$ $\quad t = \frac{y 2\omega - \pi}{2\omega v_0}$

$X = \frac{-u_0}{\omega}\left(\cos\left(\frac{2\omega y - \pi}{2 v_0}\right)\right)$

$X = \frac{-u_0}{\omega}\left(\cos(\omega t) - \cos\left(\frac{\pi}{2}\right)\right) = \frac{-u_0}{\omega}(\cos(\omega t))$