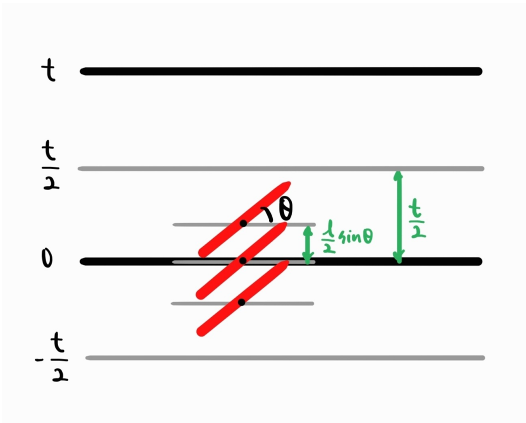
1. $l \leq t$



$$f_x(x) = \begin{cases} \frac{2}{t} & (0 \leq x \leq \frac{t}{2}) \\ 0 & elsewhere \end{cases}, \quad f_\theta(\theta) = \begin{cases} \frac{2}{\pi} & (0 \leq \theta \leq \frac{\pi}{2}) \\ 0 & elsewhere \end{cases}$$

$$\rightarrow f_{x,\,\theta}(x, \theta) = \begin{cases} \frac{2}{t} \cdot \frac{2}{\pi} & (0 \leq x \leq \frac{t}{2},\ 0 \leq \theta \leq \frac{2}{\pi}) \\ 0 & elsewhere \end{cases}$$

$$P = \iint f_{x,\,\theta}(x, \theta)$$

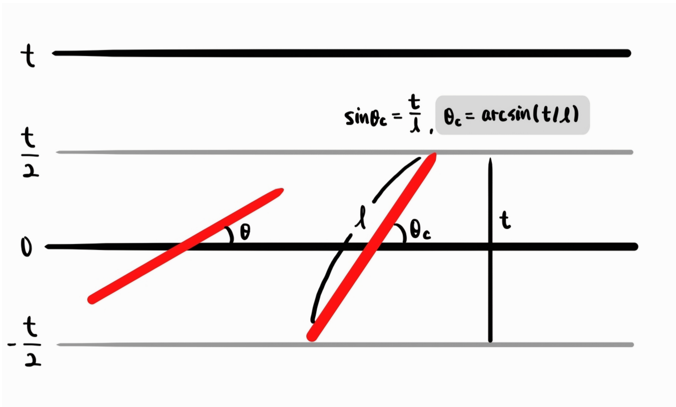
$$= \int_0^{\frac{\pi}{2}} \int_0^{\frac{l}{2}sin\theta} \frac{4}{t\pi}\, dx d\theta$$

$$= \int_0^{\frac{\pi}{2}} \frac{2l sin\theta}{t\pi}\, d\theta$$

$$= \frac{2l}{t\pi}[\, -cos\theta\,]_0^{\frac{\pi}{2}} \;= \frac{2l}{t\pi} = P$$

$$\underline{\therefore\ \pi = \frac{2l}{tP}}$$

2. $l > t$



$$f_x(x) = \begin{cases} \frac{2}{t} & (0 \le x \le \frac{t}{2}) \\ 0 & elsewhere \end{cases} \quad , \quad f_\theta(\theta) = \begin{cases} \frac{2}{\pi} & (0 \le \theta \le \frac{\pi}{2}) \\ 0 & elsewhere \end{cases}$$

$$\rightarrow f_{x,\,\theta}(x,\theta) = \begin{cases} \frac{2}{t}\cdot\frac{2}{\pi} & (0 \le \theta \le \theta_c) \\ 1\cdot\frac{2}{\pi} & (\theta_c \le \theta \le \frac{\pi}{2}) \end{cases}$$

$$P = \iint f_{x,\,\theta}(x,\theta)$$

$$= \int_0^{\theta_c}\int_0^{\frac{l}{2}sin\theta} \frac{4}{t\pi}\, dx d\theta + \int_{\theta_c}^{\frac{\pi}{2}} f(x)\, d\theta$$

$$= \frac{2l}{t\pi}\int_0^{\theta_c} sin\theta\, d\theta + \int_{\theta_c}^{\frac{\pi}{2}} \frac{2}{\pi}\, d\theta$$

$$= \frac{2l}{t\pi}[\,-cos\theta\,]_0^{arcsin(t/l)} + 1 - \frac{2}{\pi}\, arcsin(t/l)$$

$$* \; -cos\theta \; = -\sqrt{1-sin^2\theta} = -\sqrt{1-sin^2(sin^{-1}(t/l))} = -\sqrt{1-(t/l)^2}$$

$$= \frac{2l}{t\pi}(\,-\sqrt{1-(t/l)^2}+1\,) + 1 - \frac{2}{\pi}\, arcsin(t/l)$$

$$= -\frac{2}{t\pi}\sqrt{l^2-t^2} + \frac{2l}{t\pi} + \frac{2}{t\pi}\,(-t\cdot arcsin(t/l)) + 1$$

$$= \frac{2}{t\pi}(-\sqrt{l^2-t^2} + l - t\cdot arcsin(t/l)\,) + 1 = P$$

$$\therefore \; \pi = \frac{-\sqrt{l^2-t^2}+l-t\cdot arcsin(t/l)}{t(P/1)}$$