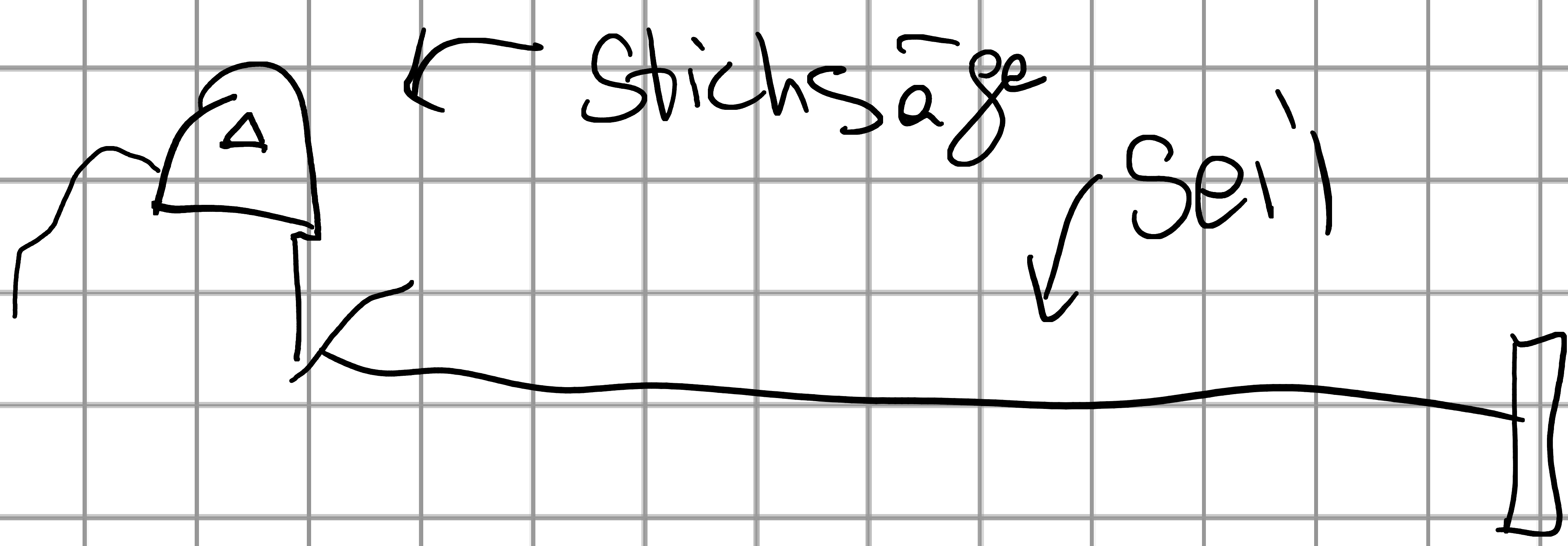
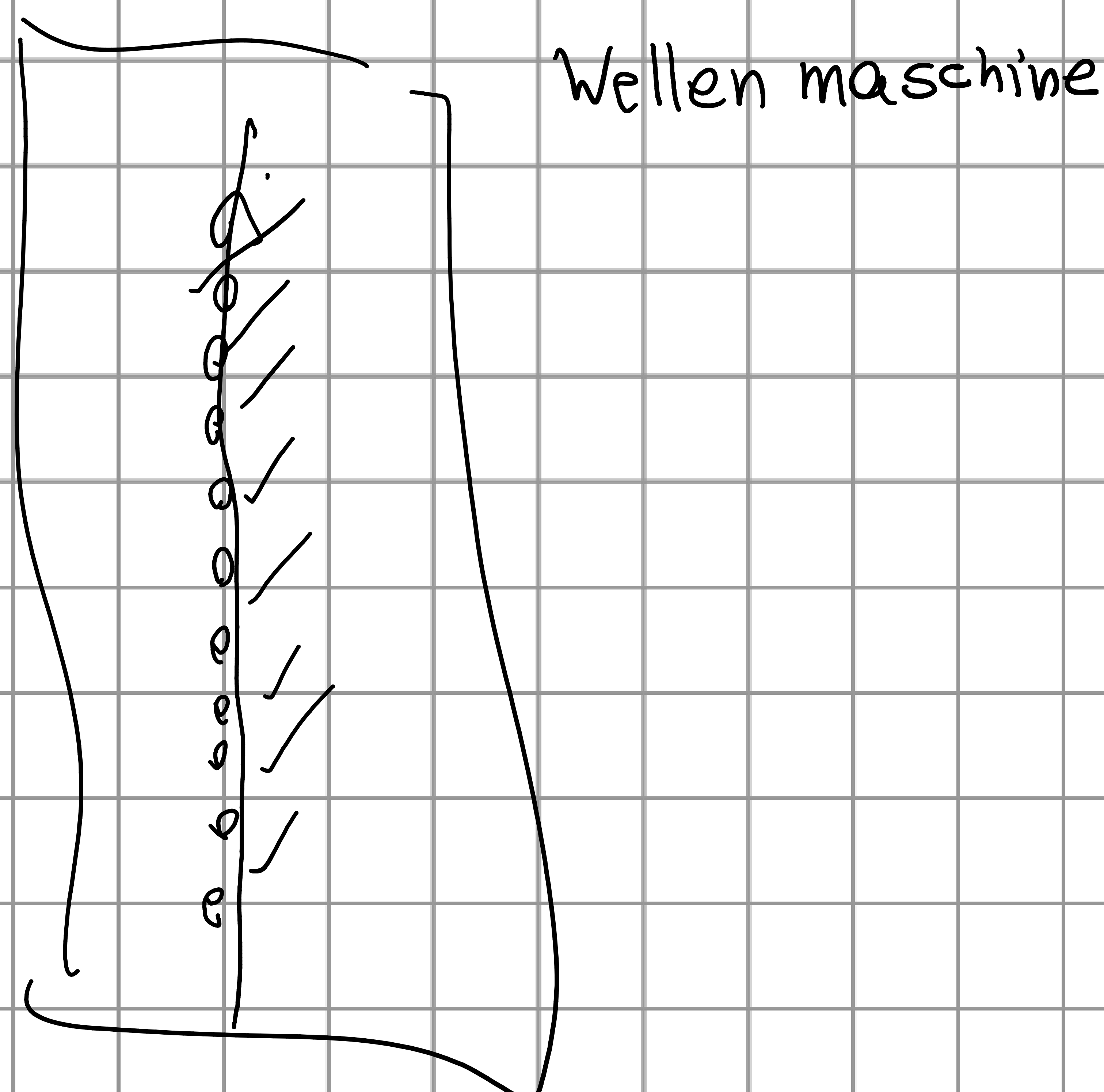
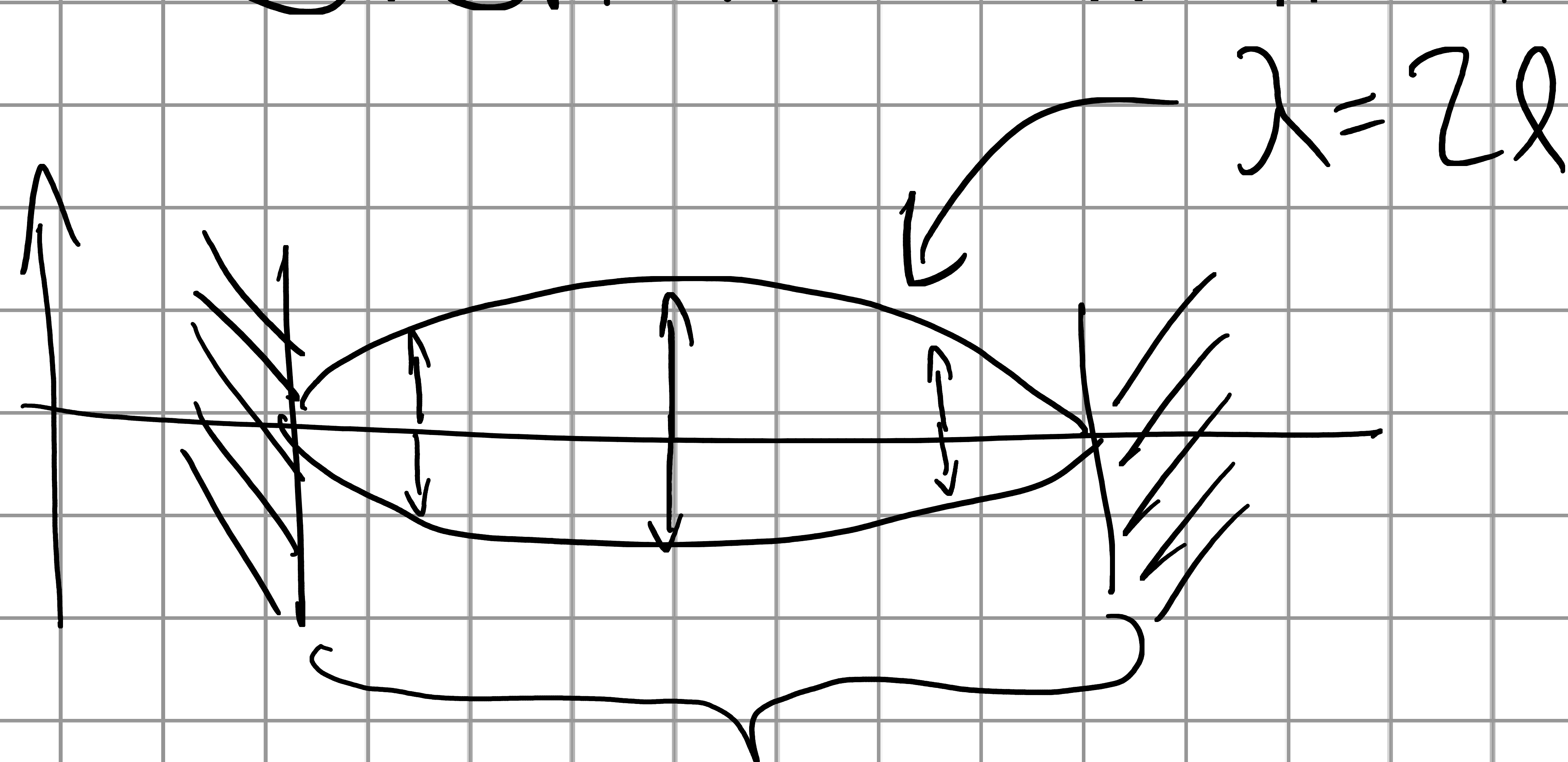
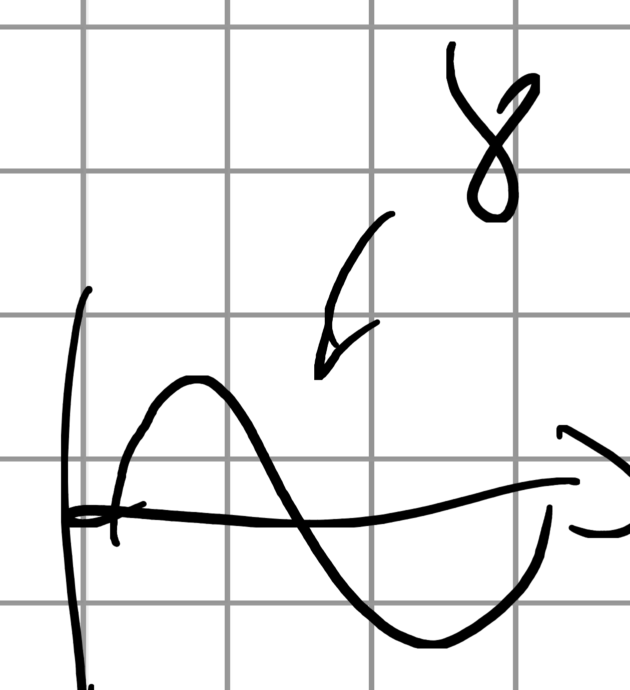




13.3 Stehende Wellen





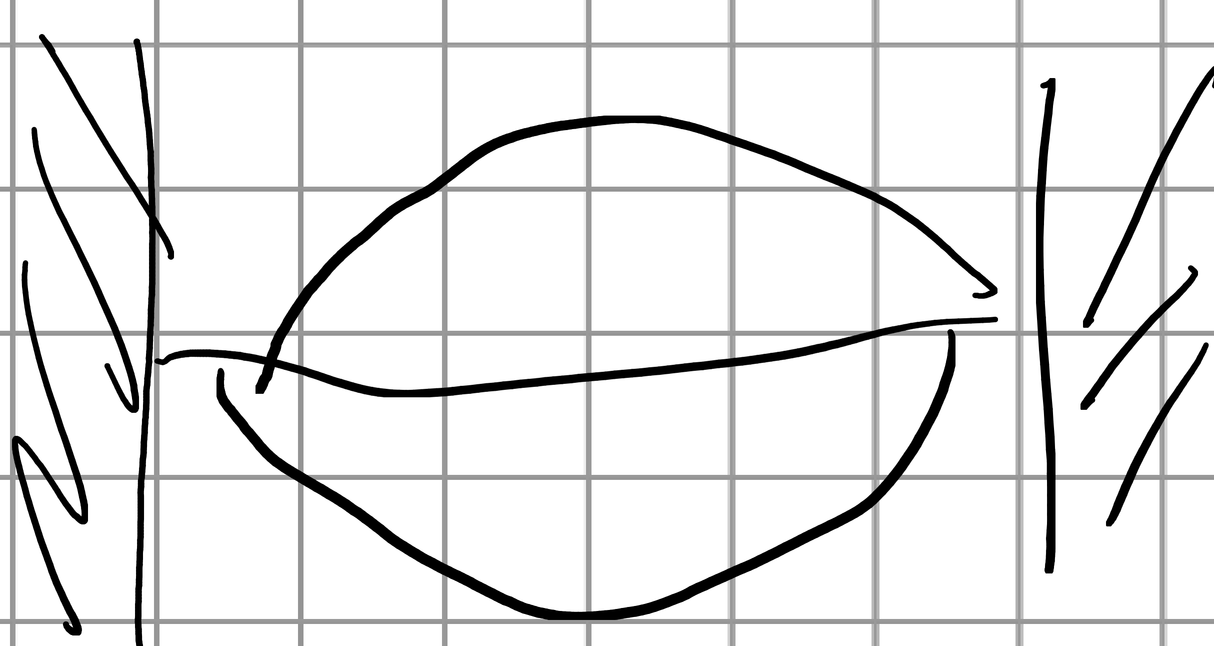
$$z(x,t) = f(x) \cdot g(t)$$

Bsp.: Harmonische Oszillation

$$f(x) = z_0 \cdot \sin(kx + \delta)$$

$$g(x) = \cos(\omega t + \varphi)$$

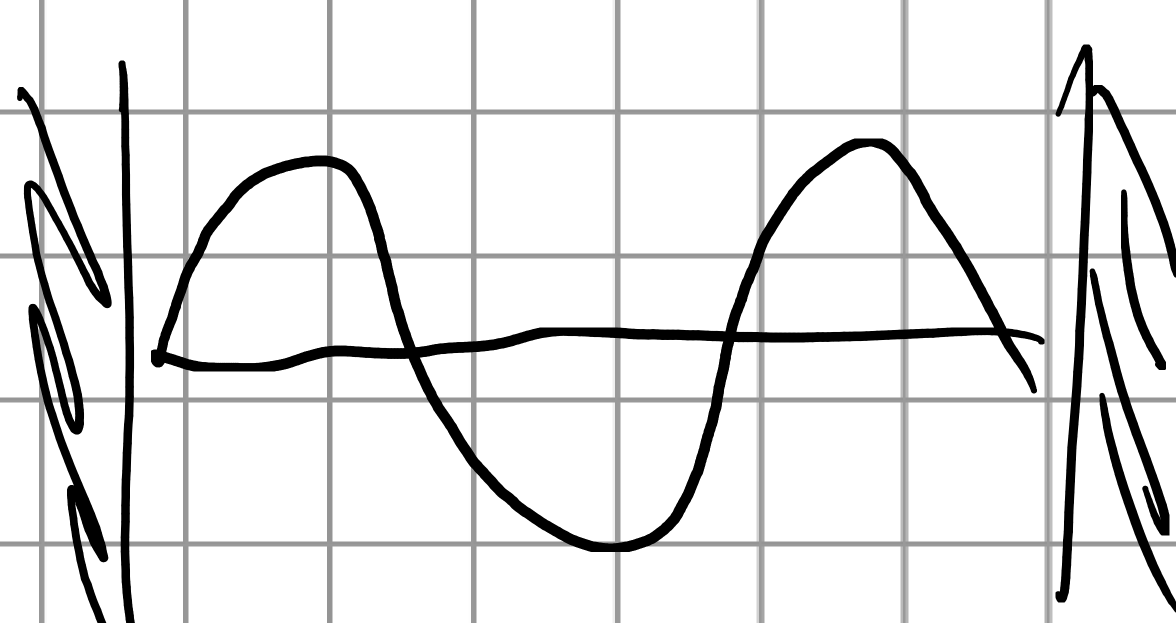
Schwingungsmoden der
Stehenden Wellen



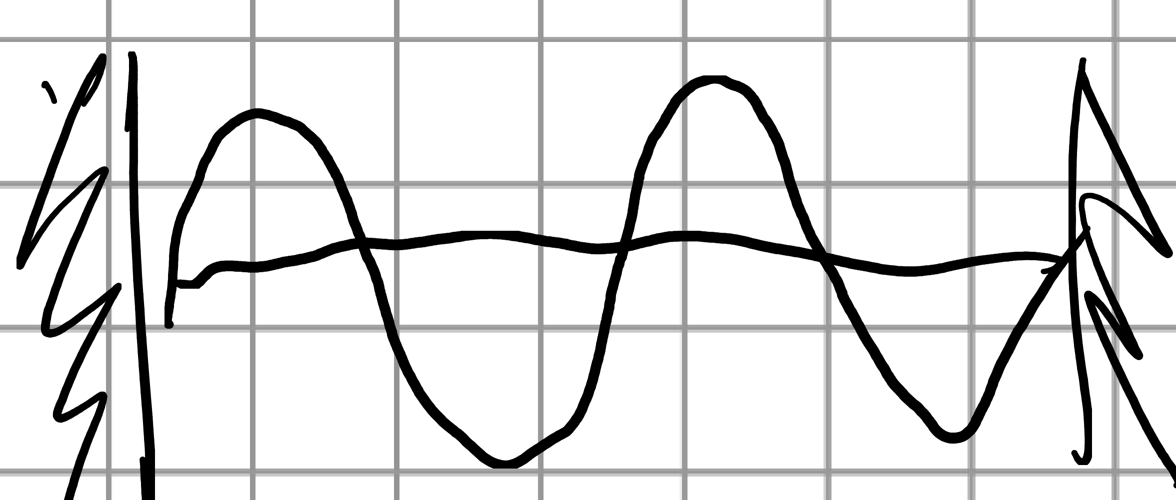
$\lambda_1 = 2\,l$

$n \hat{=}$ Nummer Schwingungs-moden

$\lambda_2 = l$



$\lambda_3 = \frac{2}{3}\,l$



$\lambda_4 = \frac{1}{2}\,l = \frac{2}{4}\,l$

$\vdots$

$\lambda_n = \frac{2}{n}\,l$

Welle kein Massetransport

Energie breitet sich aus

$$\text{Intensität} \approx \frac{\text{Leistung}}{\text{Fläche}}$$

12.4 Anwendung : Akustik

Schall ist eine longitudinale Druckwelle in eine Medium

Generell: $v = \sqrt{\frac{\text{Rückstellkraft}}{\text{Massenfaktor}}}$

Saite $v = \sqrt{\frac{F}{\mu}}$

Schall $v = \sqrt{\varkappa \frac{p_0}{\delta_0}}$

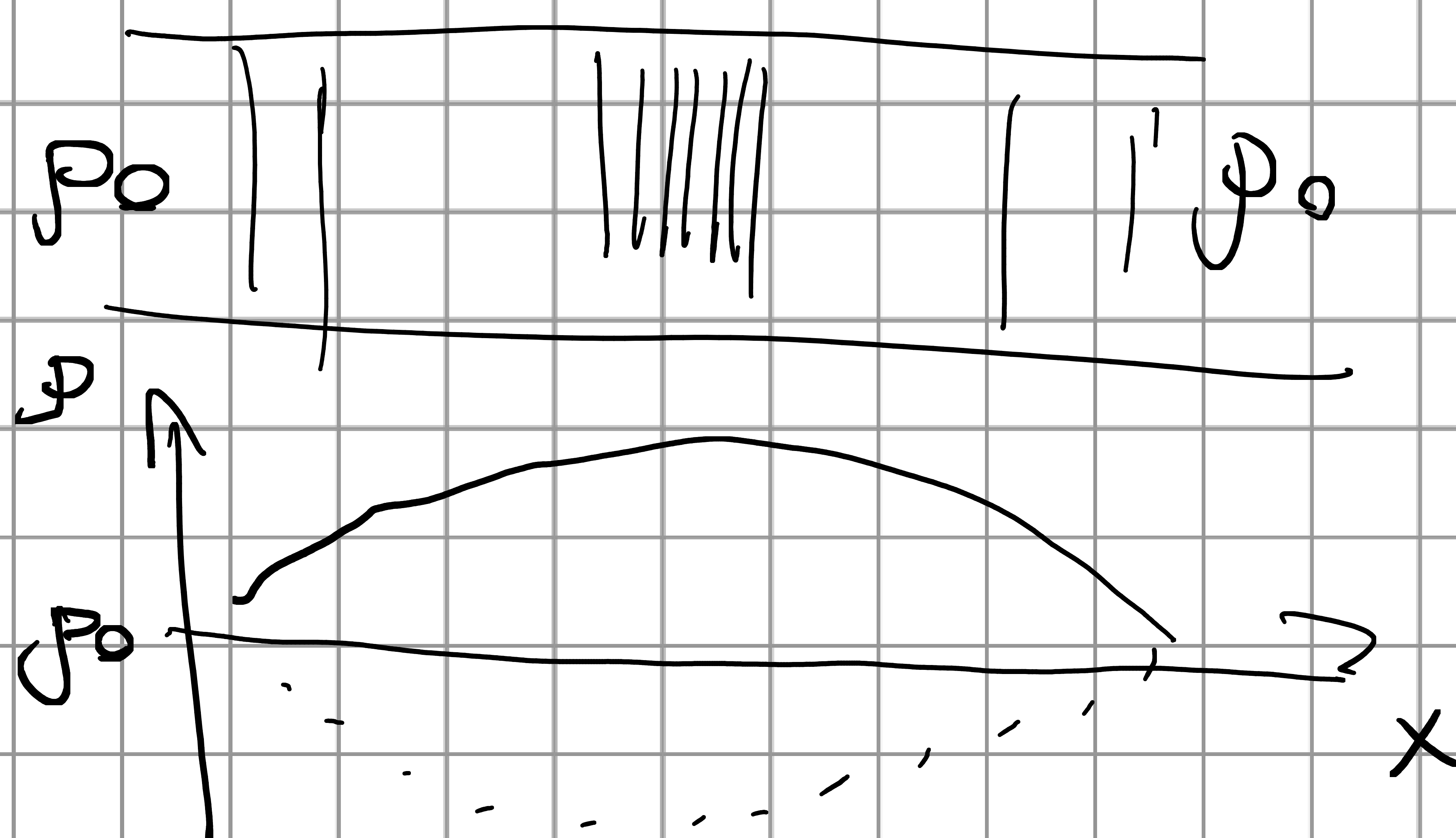
Faktor mediumsspezifisch

Luft $\varkappa = 1{,}4$ $p_0 = 10^5 \frac{N}{m^2}$ $\rho = 1{,}3 \frac{kg}{m^3}$ $\boxed{v = 330 \frac{m}{s}}$

Sonderfälle

1 Stehende Schallwellen

a) Pfeife an beiden Enden offen



$\lambda_n = 2 \cdot l$ $n=1$

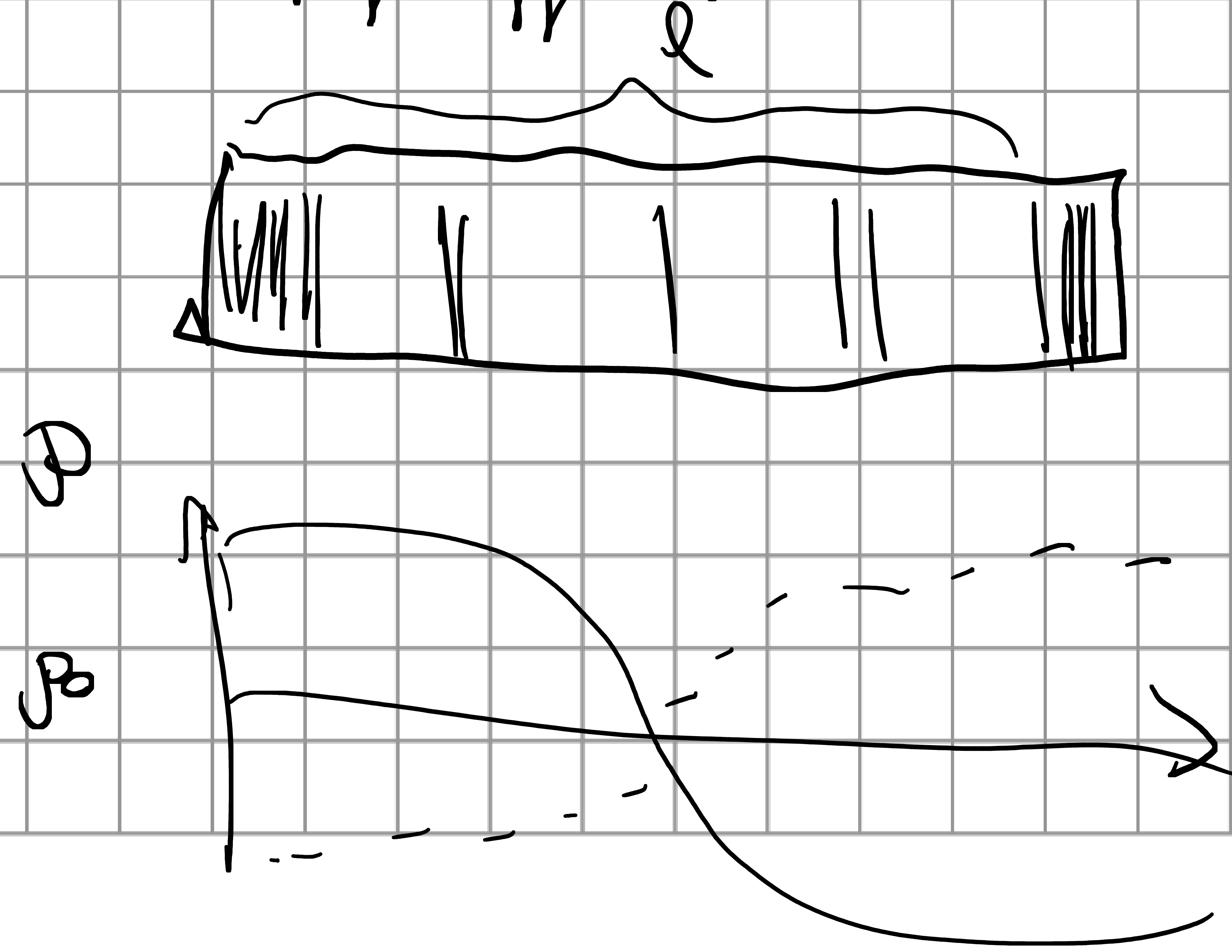
$\vdots$

$= \frac{2l}{n}$

Frequenz $\nu_n = \frac{\omega_n}{2\pi} = \frac{n}{2l} \cdot v$

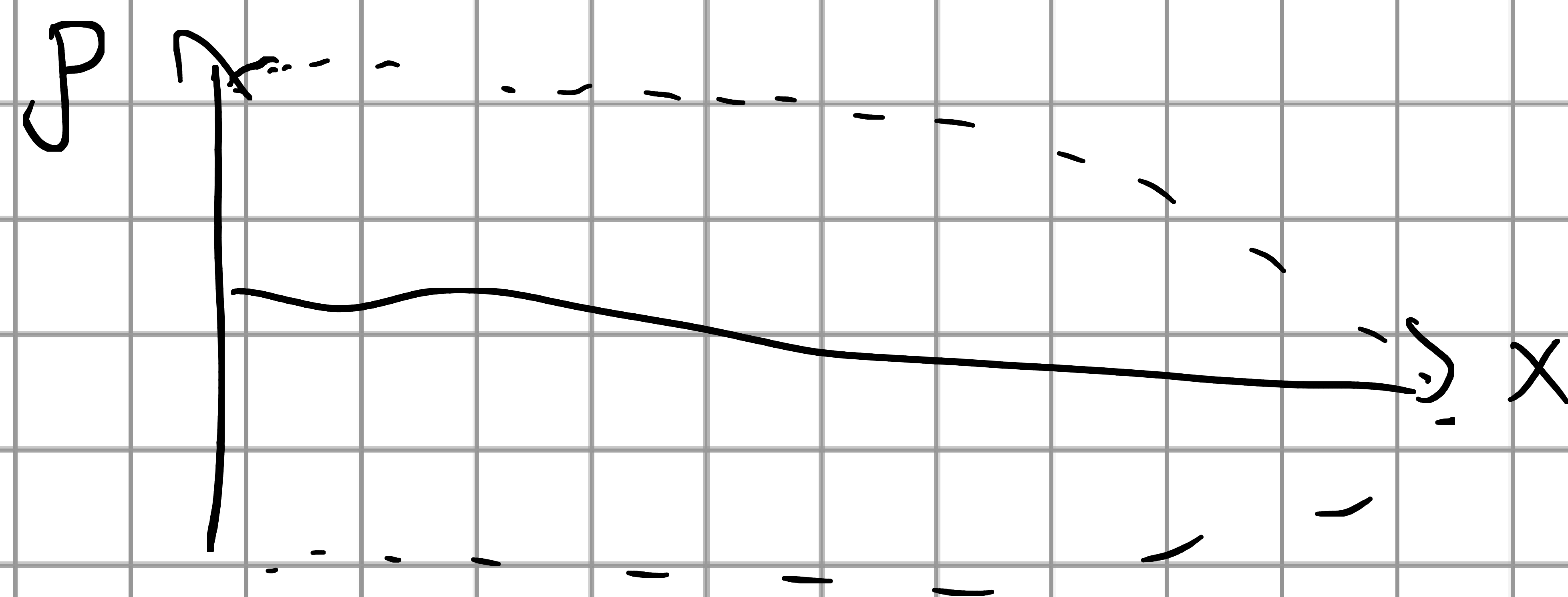
Ausbreitungsgeschwindigkeit

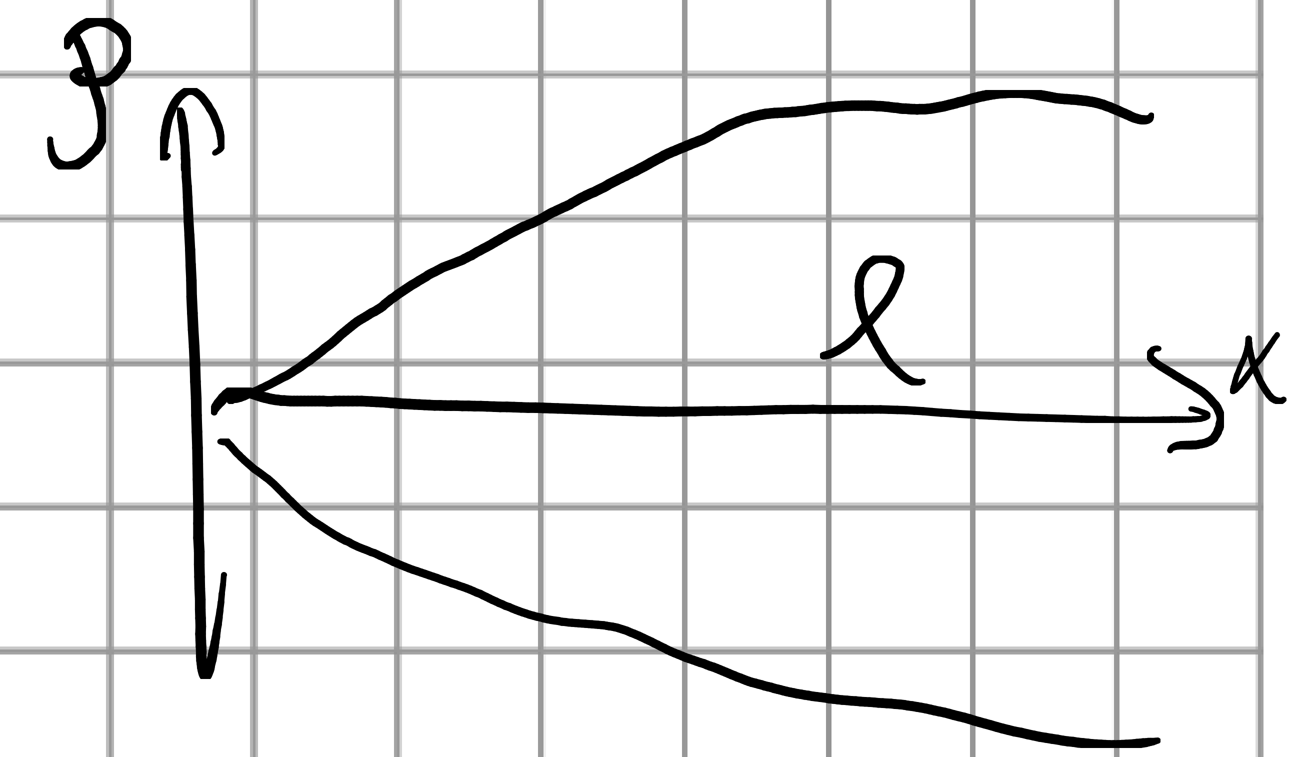
b) Pfeiffe an beiden Enden geschlossen

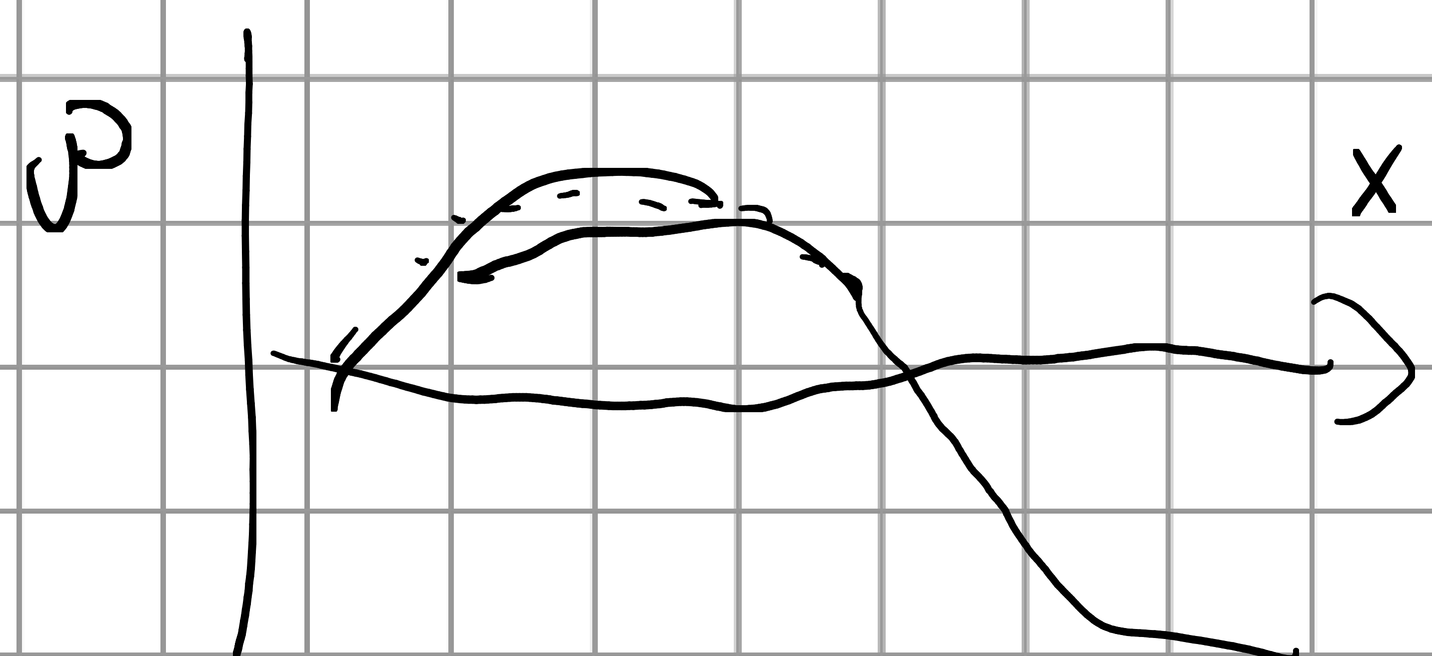


c) Ein Ende offen, ein Ende geschlossen

$\lambda_1 = 4l$







$$\lambda_n = \frac{4}{2n-1} \cdot l$$