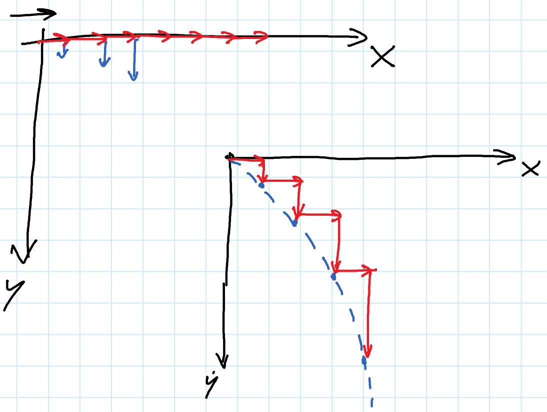


$x(t) = v_x \cdot t$

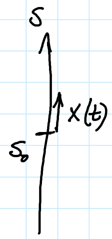
$y(t) = \frac{1}{2} g t^2$

$$\vec{x} = \begin{pmatrix} x(t) \\ y(t) \\ z(t) \end{pmatrix} = \begin{pmatrix} v_x \cdot t + 0 \\ 0 - \frac{1}{2} g t^2 \\ 0 \end{pmatrix}$$

~~F_G~~

T

$|\vec{F}_{ges}| = |\vec{F}_G| + |\vec{F}_{Feder}| = mg - Ds(t)$



$m \cdot a = m \cdot \frac{d^2 x(t)}{dt^2} = -D \cdot x(t)$

$$\boxed{\frac{d^2 x(t)}{dt^2} = -\frac{D}{m} \cdot x(t)}$$

$-A\omega^2 \cancel{\sin(\omega t+\varphi)} = -\frac{D}{m} \cdot \cancel{A \sin(\omega t+\varphi)}$

$\hookrightarrow -\omega^2 = -\frac{D}{m}$

$\hookrightarrow \omega = \sqrt{\frac{D}{m}}$

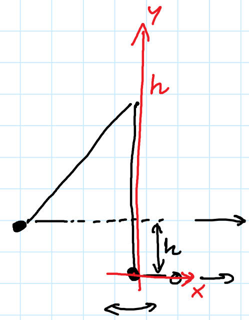
Frequenz: ω

$x(t) = A \cdot \sin(\omega \cdot t + \varphi)$

$\frac{d}{dt}(\omega t + \varphi)$

$\frac{dx}{dt} = A\omega \cdot \cos(\omega t + \varphi)$

$\frac{d^2x}{dt^2} = A\omega^2 \cdot (-\sin(\omega t + \varphi))$



$\rightarrow E_{pot} = m \cdot g \cdot h \quad E_{kin} = 0$

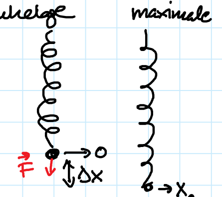
$\rightarrow E_{pot} = 0 \quad E_{kin} = \frac{1}{2} m v^2$

Wagen mit Feder auf Luftkissenbahn

$E_{kin} = \frac{1}{2} m v^2$

$E_{pot} = \frac{1}{2} D x^2$

Ruhelage | maximale Auslenkung



Ruhelage	maximale Auslenkung
$E_{kin} = \frac{1}{2} m v^2$	$E_{kin} = 0$
$E_{pot} = 0$	$E_{pot} = \frac{1}{2} D x_0^2$

$W = F \cdot x = D \cdot x \cdot x$

$\Delta W = F(x) \Delta x$

$W = \int_0^{x_0} F(x) \cdot dx = \int_0^{x_0} D \cdot x \cdot dx = D \cdot \frac{1}{2} x^2 \Big|_0^{x_0} = \frac{1}{2} D x_0^2$

Auslenkung x_0	Durchgangszeit Δt	Geschwindigkeit v
0,2 m	24 ms	$0.4 \frac{m}{s}$
0,4 m	12 ms	$0.8 \frac{m}{s}$
0,5 m	9 ms	$1.1 \frac{m}{s}$
$E_{pot} = \frac{1}{2} D x^2$		$E_{kin} = \frac{1}{2} m v^2$

Breite ~~Blättchen~~: $1 cm = 0{,}01 m = \Delta x$

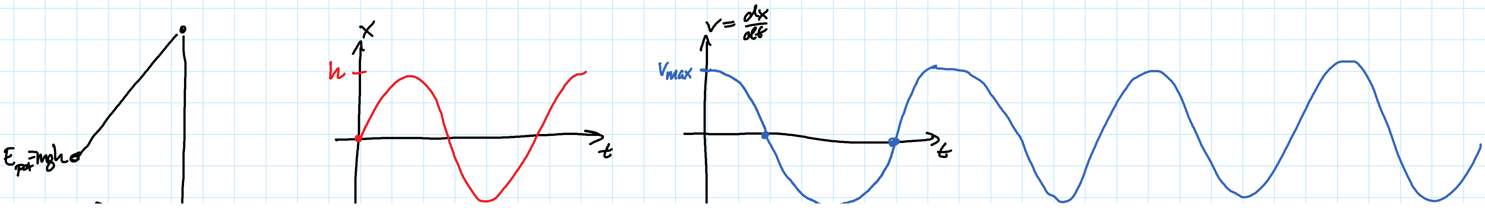
$\Delta t = 24 ms = 0{,}024 s$

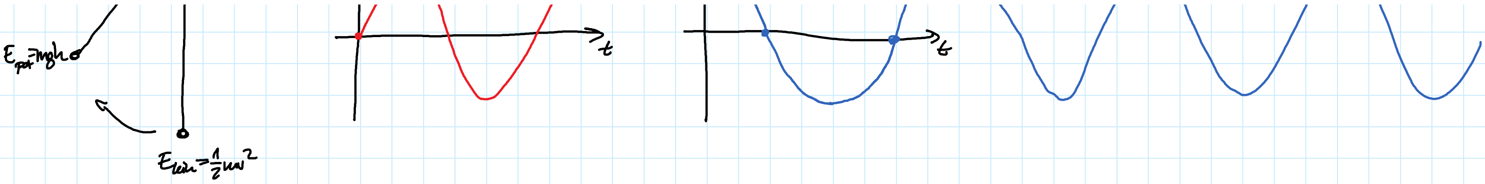
$v = \frac{\Delta x}{\Delta t} = \frac{0{,}01 m}{0{,}024 s} = \frac{1}{2.4} \frac{m}{s} \approx 0.4 \frac{m}{s}$

$v = \frac{\Delta x}{\Delta t} = \frac{0{,}01 m}{0{,}012 s} = 0.8 \frac{m}{s}$

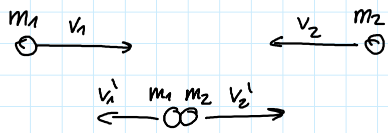
$\frac{\Delta x}{\Delta t} = \frac{0{,}01 m}{0{,}009 s} = 1.1 \frac{m}{s}$

Konservative Kräfte



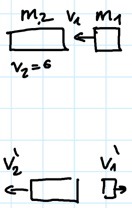


Impulserhaltung



$$m_1 \cdot v_1 + m_2 \cdot v_2 = m_1 \cdot v_1' + m_2 \cdot v_2'$$
$$p_1 + p_2 = p_1' + p_2'$$

$$F_1 = m_1 \cdot a_1 \equiv - F_2 = m_2 \cdot a_2$$
$$m_1 \cdot \frac{dv_1}{dt} = - m_2 \cdot \frac{dv_2}{dt}$$
$$m_1 \cdot \frac{dv_1}{dt} + m_2 \cdot \frac{dv_2}{dt} = 0$$
$$\frac{d}{dt}(m_1 \cdot v_1) + \frac{d}{dt}(m_2 \cdot v_2) = 0$$
$$\frac{d}{dt}(m_1 \cdot v_1 + m_2 \cdot v_2) = 0$$
$$\frac{d}{dt}(p_1 + p_2) = 0 \implies p_1 + p_2 = \text{const.}$$



$v_1 = \frac{10\,cm}{t_1}$ $\quad t_1 = 254\,ms \quad t_2 = \infty$

$= 0{,}4 \frac{m}{s}$ $\quad t_1' = 897\,ms$

$v_2 = 0$ $\quad t_2' = 391\,ms$

$v_1' = -0{,}1 \frac{m}{s}$

$v_2' = 0{,}25 \frac{m}{s}$

$$p = m_1 \cdot v_1 + m_2 \cdot v_2 = 250g \cdot 0.4 \frac{m}{s} + 0 = 0{,}1 \frac{kg\,m}{s}$$
$$p' = m_1 \cdot v_1' + m_2 \cdot v_2' = 0{,}25kg \cdot \left(-0{,}1 \frac{m}{s}\right) + 0{,}5kg \cdot 0{,}25 \frac{m}{s} = -0{,}025 \frac{kg\,m}{s} + 0{,}125 \frac{kg\,m}{s} = 0{,}1 \frac{kg\,m}{s}$$
$$E_{kin} = \frac{1}{2} m_1 v_1^2 + 0$$
$$E_{kin}' = \frac{1}{2} m_1 v_1'^2 + \frac{1}{2} m_2 v_2'^2$$