Aufgabe 3

Lösung einer Schwingung, z.B.

$x(t) = x_0 \sin(\omega t)$

$\dot{x}(t) = v(t) = x_0 \omega \cos(\omega t)$

$\ddot{x}(t) = a(t) = -x_0 \omega^2 \sin(\omega t) = -\omega^2 x(t)$

$\omega^2 = \frac{|a_1|}{|x_1|} = 4\frac{1}{s^2} \quad \Rightarrow \quad T = \frac{2\pi}{\omega} = \pi s$

$v_{max} = x_0 \omega = v_2 \quad \Leftrightarrow \quad x_0 = \frac{v_2}{\omega} = 0,2m$

Aufgabe 4

$E_{kin} = \frac{1}{2} m_S v^2; \qquad E_{pot} = \gamma \frac{m_E m_S}{r}$

$F_z = F_G \quad \Rightarrow \quad \frac{m_S v^2}{r} = \gamma \frac{m_E m_S}{r^2} \quad \Rightarrow \quad v^2 = \frac{\gamma m_E}{r}$

$\Longrightarrow E_{kin} = \frac{1}{2} \gamma \frac{m_E m_S}{r} = \frac{1}{2} E_{pot}$

Aufgabe 5

a) $\dot{V}_1 = A_1 v_1 \qquad \Rightarrow \qquad v_1 = \frac{\dot{V}_1}{A_1} = 1\frac{m}{s}$

$A_1 v_1 = A_2 v_2$ (konst. Volumenstrom) $\quad \Rightarrow \quad v_2 = \frac{A_1}{A_2} v_1 = 2 v_1 = 2\frac{m}{s}$

$p_1 + 1/2 \rho v_1^2 = p_2 + 1/2 \rho v_2^2 = p_2 + 2 \rho v_1^2$

$p_2 = p_1 - 3/2 \rho v_1^2 = (2 \cdot 10^5 - 0,015 \cdot 10^5)\frac{N}{m^2} = 1,985 \cdot 10^5 \frac{N}{m^2}$

b) $\dot{V}_1 = \dot{V}_2 \qquad \Rightarrow \qquad v_2 = 2\frac{m}{s}$

$p_1 + 1/2 \rho v_1^2 + \rho g h_1 = p_2 + 1/2 \rho v_2^2 + \rho g h_2$

$p_1 + 1/2 \rho v_1^2 = p_2 + 1/2 \rho v_2^2 + \rho g \underbrace{(h_2 - h_1)}_{h}$

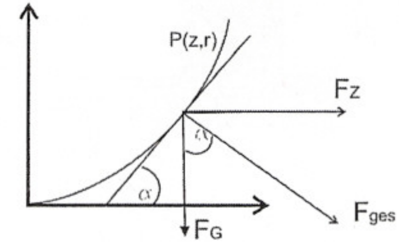
$p_2 = p_1 - 3/2 \rho v_1^2 - \rho g h = 0,985 \cdot 10^5 \frac{N}{m^2}$

$1 m^3 \hat{=} 1000 \, l$ $\qquad$ $1 m^2 = 10\,000 \, cm^2$

$0,01 \hat{=} 10 \, l$ $\qquad$ $0,01 = 100 \, cm^2$

$0,005 = 50 \, cm^2$

Aufgabe 1



Im Gleichgewicht ($P(z,r)$ in „Ruhe") verschwindet die Tangentialkomponente $\Rightarrow \vec{F}_{ges} \perp$ Tangente

$$\tan\alpha = \frac{F_z}{F_G} \hat{=} \frac{dz}{dr} \qquad \text{Steigung/Tangente in} P(z,r)$$

$$\frac{F_z}{F_G} = \frac{m\omega^2 r}{mg} = \frac{\omega^2 r}{g} = \frac{dz}{dr} \Rightarrow dz = \frac{\omega^2 r}{g} dr \Longrightarrow z(r) = \frac{\omega^2}{g} \int_0^r r' dr' \Rightarrow \underline{z(r,\omega) = \frac{1}{2}\frac{\omega^2}{g} r^2}$$

Aufgabe 2

a) Kreisscheibe:

$\Theta = \int r^2 dm = \int r^2 \rho d 2\pi r dr = \frac{1}{2} \rho d \pi r^4 \; (= \frac{1}{2} m r^2)$

Garnrolle:

$\Theta_S = \frac{1}{2} \rho \pi \left(r_1^4 d_m + 2 r_2^4 d\right)$

$\Theta_D = \Theta_S + M r_2^2$ bzgl. Auflagepunkt $\quad \Rightarrow \Theta_D = \Theta_S + \rho\pi \left(r_1^2 d_m + 2 r_2^2 d\right) r_2^2$

b) $\vec{M} = \vec{r} \times \vec{F} = \Theta_\omega \dot{\vec{\omega}} = \dot{\vec{L}}$

$\Theta_D \dot{\vec{\omega}} = F(r_2 - r_1) \qquad \Rightarrow \quad \dot{\omega} = \frac{F(r_2 - r_1)}{Theta_D} = 5\frac{1}{s^2}$

$a = r_2 \dot{\omega} = 0,2\frac{m}{s^2}$

F

c) $\Theta_D \dot{\omega} = F \cdot r_1 \quad \Rightarrow \quad \dot{\omega} = \frac{F r_1}{\Theta_D} = 15\frac{1}{s^2}$

$a = r_2 \dot{\omega} = 0,6\frac{m}{s^2}$

d) $\vec{M}' \overset{!}{=} 0 \rightarrow \vec{r} \| \vec{F}$

$\cos\alpha = \frac{r_1}{r_2} \qquad \Rightarrow \qquad \alpha = \arccos\frac{r_1}{r_2}$