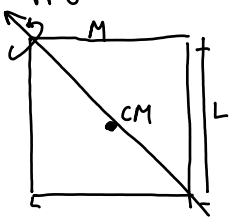
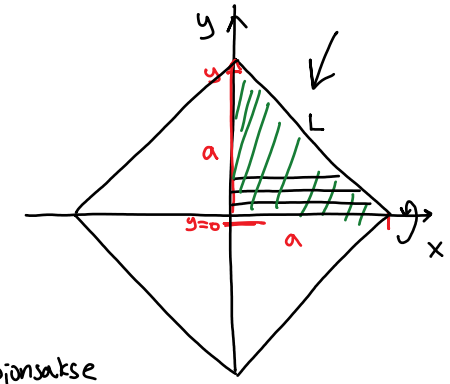
Uke 40 - Øving/Test 6

Sunday, 25 August 2024 17:39

Test

Oppgave 6





$dm = M\,dy\left(\frac{L}{\sqrt{2}} - y\right)\Big/ L^2$

Avstand til rotasjonsakse $= y$

Avstand til rotasjonsakse

$$I = \int r^2\,dm = \int_0^a y^2 \frac{M\left(\frac{L}{\sqrt{2}} - y\right)}{L^2}\,dy = \frac{M}{L^2}\int_0^{L/\sqrt{2}} y^2\left(\frac{L}{\sqrt{2}} - y\right)dy = \frac{M}{L^2}\left[\frac{Ly^3}{3\sqrt{2}} - \frac{y^4}{4}\right]_0^{L/\sqrt{2}} = \frac{M}{L^2}\left(\frac{L}{3\sqrt{2}}\left(\frac{L}{\sqrt{2}}\right)^3 - \frac{1}{4}\left(\frac{L}{\sqrt{2}}\right)^4\right)$$

$$= \frac{ML^2}{48}$$

$a^2 + a^2 = L^2$

$2a^2 = L^2$

$a = \frac{L}{\sqrt{2}}$

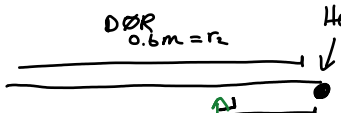
$$I_{hele} = 4 \cdot \frac{ML^2}{48} = \frac{ML^2}{12}$$ A

Dreiemoment, τ

Avstand til rotasjonsakse

$\tau = r \times \vec{F}$ Hvis r og $\vec{F}$ står $\perp$ på hverandre $\Rightarrow \tau = r \cdot F$

$\tau = I\frac{dW}{dt} = I\alpha$

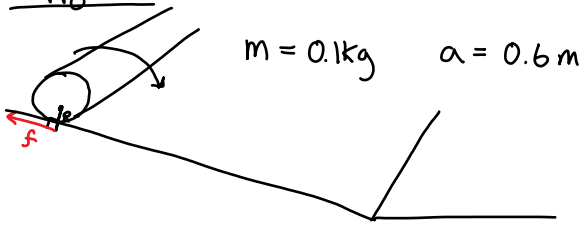


$\tau_1 = r_1 \cdot F_1 = 0.2\text{m} \cdot 30\text{N} = 6\text{Nm}$

$\Sigma\tau = 0 \Rightarrow$ Ingen rotasjon

$\tau_2 = r_2 F_1 = 0.6m \cdot 30N = 18Nm$

Oppgave 8



$\tau = r \times F \qquad \tau = I \cdot \alpha \qquad I = \Sigma r^2 \cdot m = R^2 m$

$\tau = R f \qquad \tau = R^2 m \alpha$

Ren rulling: $v = r\omega \quad a = r\alpha$

$Rf = R^2 m\alpha$

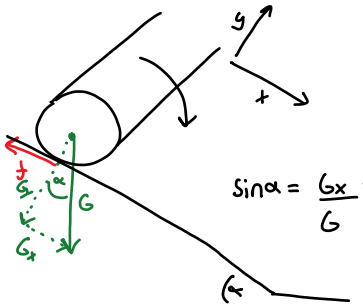
$f = Rm\alpha$

$\alpha = \frac{a}{R}$

$f = Rm \cdot \frac{a}{R} = m \cdot a = 0.1kg \cdot 0.6m/s^2 = \underline{0.06N\ A}$

Oppgave 9

$\Sigma F_x = ma$



$\Sigma F_x = G_x - f = ma$

$\sin\alpha \cdot G - f = ma$

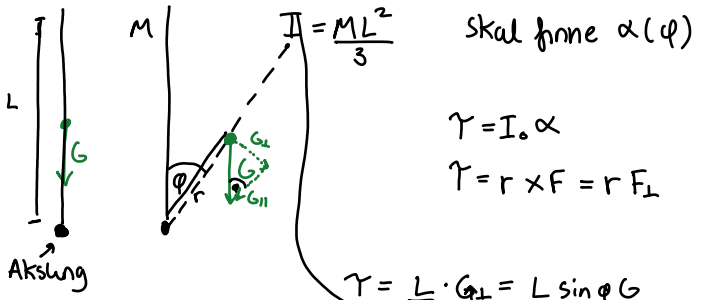
$\sin\alpha = \frac{G_x}{G} \Rightarrow G_x = \sin\alpha \cdot G$

$\sin\alpha = \frac{ma + f}{G}$

$\alpha = \sin^{-1}\left(\frac{ma}{mg} + \frac{0.06N}{mg}\right) = 7°\ A$

($a = 0.6m/s$, $m = 0.1kg$)

Oppgave 12



$I = \frac{ML^2}{3}$ Skal finne $\alpha(\varphi)$

$\tau = I_0 \alpha$

$\tau = r \times F = r F_\perp$

$\tau = \frac{L}{2} \cdot G_\perp = \frac{L}{2} \sin\varphi \, G$

$\sin\varphi = \frac{G_\perp}{G} \Rightarrow G_\perp = \sin\varphi \cdot G$

$\tau = I\alpha = \frac{ML^2}{3}\alpha$

$\frac{L}{2}\sin\varphi Mg = \frac{ML^2}{3}\alpha$

$\alpha = \frac{3}{2}\frac{g}{L}\sin\varphi$ E

Oppgave 17

Roterer spolen? $\Sigma\tau = 0 \Rightarrow$ Ingen rotasjon

$\tau = r \times F = R \cdot S > 0 \Rightarrow$ Har rotasjon

Bryter målinjen først? $\Sigma F_\square = S = m a_\square$

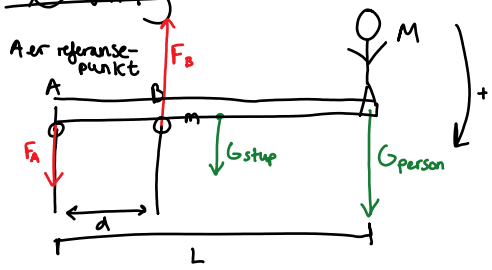
$\Sigma F_\circ = S = m a_\circ$

$m a_\square = m a_\circ$

$a_\square = a_\circ$ Bryter målinjen samtidig. C

Øving

Oppgave 1



+ $\Sigma \tau = 0$ (ingen rotasjon)

$\tau = r \times F$

$$\Sigma \tau = \tau_{person} + \tau_{stup} - \tau_B + \tau_A = 0$$

$$L \cdot G_{person} + \frac{L}{2} \cdot G_{stup} - d \cdot F_B + 0 \cdot F_A = 0$$

$$L M g + \frac{L}{2} \cdot m g = d F_B$$

$$F_B = \frac{Lg}{d}\left(M + \frac{m}{2}\right) \quad \underline{C}$$

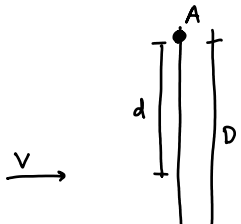
b) $\Sigma F_y = 0$

$$F_B - G_{person} - G_{stup} - F_A = 0$$

$$F_A = F_B - G_{person} - G_{stup}$$

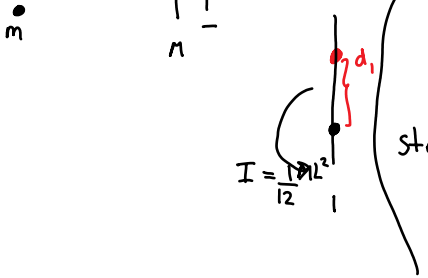
$$F_A = F_B - Mg - mg = F_B - g(M+m) \quad \underline{D}$$

Oppgave 5



a) $I = \sum_i m_i r_i^2$

$I_{stav+kule} = I_{stav} + I_{kula} = \frac{1}{3} M D^2 + m d^2$ A



$I_{stav} = \frac{1}{12}MD^2 + M\left(\frac{D}{2}\right)^2 = \frac{1}{3}MD^2$

Nytt gammelt — avstand som aksen er flyttet

Steiners Sats: $I = I_0 + M d_1^2$ ← Masse hele legemet

Krav: - samme system

$I_{kule} = \sum m_i r_i^2 = md^2$

b) $P = mv$ $\quad P_{sys} = \sum P_{komponenter} = P_{kule} + P_{stav} = mv + M \cdot 0 = mv\hat{x}$ B

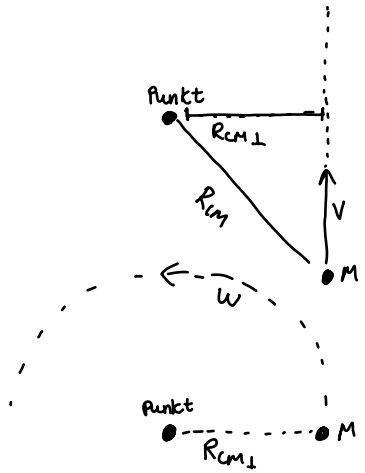
↑ retningsvektor

c) ~~Dreieimpuls, L~~

L_0: "evne" til rotasjon

$L = L_0 + L_S = R_{CM} \times MV + \cancel{I_0 w}$

Dreieimpulsen er bevart



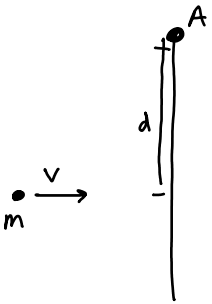
$L_0 = R_{CM} \times MV$

$= R_{CM\perp} \cdot MV$

$L_S = 0$

$L_0 = 0$

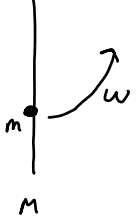
$L_S = I_0 w$



$L_{initial} = L_0 + \cancel{L_S}^{0} = R_{CM\perp} \cdot mv = dmv\,\hat{z}$ B

d) $L_{final} = \cancel{L_0}^{0} + L_S = L_S$

A



Dreie impuls er bevart : $L_{final} = L_{initial} = dmv\hat{z}$

e) $L_b \rightarrow L_s$

$L_{final} = L_{initial}$

$L_b + L_s = L_b + L_s$

$L_s = L_b$

$I_o \cdot w = mvd$ $\qquad I_o = md^2 + \frac{1}{3}MD^2$

$$w = \frac{mvd}{I_o} = \frac{mvd\hat{z}}{md^2 + \frac{1}{3}MD^2}$$ D

Test

Oppgave 24

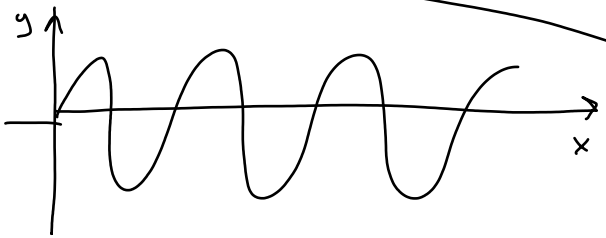
$a(t) = -40x(t)$

$\ddot{x} + w_0^2 x = 0$

$\ddot{x} = x(t)'' = a(t)$

$a(t) + w_0^2 x(t) = 0$

$-40x(t) + w_0^2 x(t) = 0$

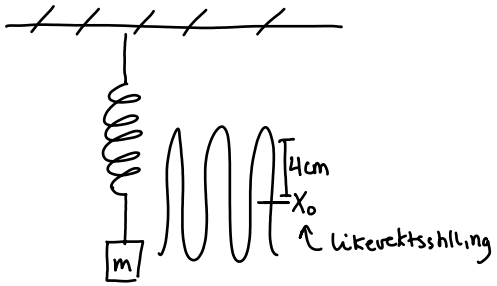


$w_0^2 = 40$

$w_0 = \sqrt{40}$

$$T = \frac{2\pi}{\omega_0} = 0.99345\,s \approx 1\,s$$ A

Oppgave 25



$$E_{total} = \frac{1}{2}kx^2 = \frac{1}{2}k \cdot 0.04^2 m^2 \quad (x = 4\,cm)$$

$$E_{p,2cm} = \frac{1}{2}k \cdot 0.02^2 m^2$$

$$\frac{E_{p,2cm}}{E_{total}} = \frac{\frac{1}{2}k \cdot 0.02^2 m^2}{\frac{1}{2}k \cdot 0.04^2 m^2} = \frac{1}{4}$$ C