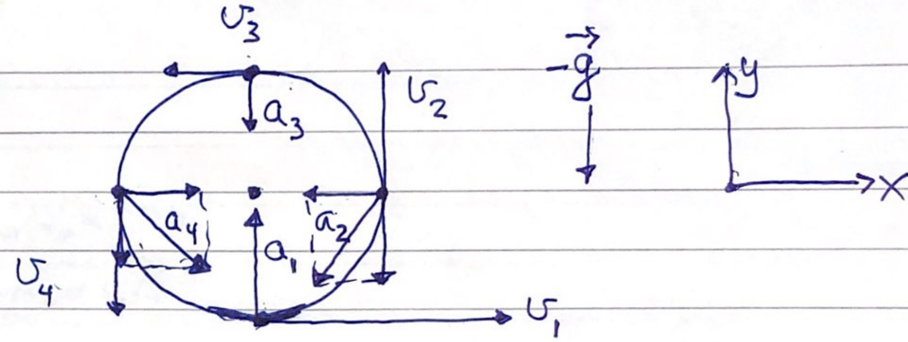
FY6013, Eksamen 1/12-21, Tematikker:

- Kinematikk, sirkelbevegelse
- Skråplan, gli, rulle, friksjon
- Kollisjon, elastisk, fullstendig uelastisk
- Treghetsmoment, punktmasser $\left(I = \sum_j m_j \cdot r_j^2 \right)$
- Steiners sats
- Statisk likevekt, $\sum \vec{F} = 0$, $\sum \vec{\tau} = 0$
- N2, rotasjon, $\tau = I\alpha$ $\quad (\alpha = \dot{\omega} = \ddot{\theta})$
- Rulling, rent eller med "sluring"

- Trykkendring i fluider, $p = p_0 \pm \rho g h$
- Pascals prinsipp; $p_1 = p_2 \Rightarrow F_1/A_1 = F_2/A_2$
- Oppdrift og Arkimedes' lov
- Bernoullis lov (energibevarelse)
- ~~Viskositet~~, strømning med motstand, $R \cdot Q = \Delta p$, (Poiseuilles lov)

(Ca) 25 (del-)oppg med lik vekt; 5 (små) fluidmek.

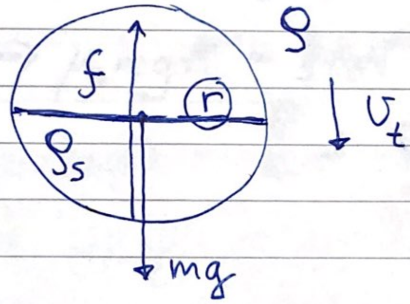
16/12-2015, nr 6:



$a_\perp = v^2/R$

$a_1 > a_3, \quad a_2 = a_4 > a_3$

18/12-2019, nr 4:



$$\underline{f = \frac{1}{2}\rho A C_d v^2}$$

$$\text{N1}: \underline{\frac{1}{2}\rho A C_d v_t^2 = mg}$$

$$P_t = f \cdot v_t$$

$$A = \pi r^2; \quad m = \rho_s \cdot V = \rho_s \cdot \frac{4\pi}{3} r^3$$

$$\overset{\text{N1}}{\Rightarrow} \underbrace{\frac{1}{2}\rho \cdot \pi r^2 C_d \cdot v_t^2} = \underbrace{\rho_s \frac{4\pi}{3} r^3 g}$$

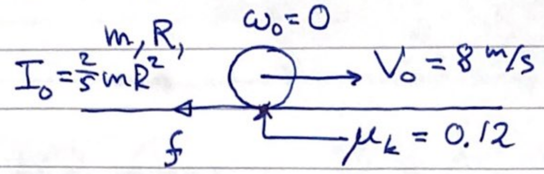
$$\Rightarrow v_t^2 \sim r \Rightarrow v_t \sim \sqrt{r}$$

$$\Rightarrow P_t \sim r^3 \cdot r^{1/2}$$

$\Rightarrow P_t$ øker med faktor $4^3 \cdot 4^{1/2} = \underline{\underline{128}}$

når r økes til $4r$

18/12-2019, nr 19:



N2, rot.om CM: $\tau = f \cdot R = I_0 \dot{\omega} = \frac{2}{5} mR^2 \cdot \frac{d\omega}{dt}$

$$f = \mu_k N = \mu_k mg$$

$$\Rightarrow \mu_k \cancel{m} g \cancel{R} = \frac{2}{5} \cancel{m} R^{\cancel{2}} \cdot d\omega/dt \Rightarrow \frac{d\omega}{dt} = \frac{5}{2} \frac{\mu_k g}{R}$$

$$\Rightarrow \omega(t) = \overset{0}{\overset{\shortparallel}{\omega_0}} + \frac{5\mu_k g}{2R} \cdot t$$

$$\Rightarrow 30\, s^{-1} = t \cdot 5 \cdot 0.12 \cdot 9.81\, m/s^2 / 2 \cdot 0.11\, m = t \cdot 26.75\, s^{-2}$$

$$\Rightarrow t = \frac{30\, s^{-1}}{26.75\, s^{-2}} = 1.12\, s \approx \underline{1.1 s}$$

N2, trans: $f = m \cdot a \Rightarrow -\mu_k mg = m \cdot a$

$$\Rightarrow a = -\mu_k g$$

$$\Rightarrow V(t) = V_0 - \mu_k g \cdot t$$

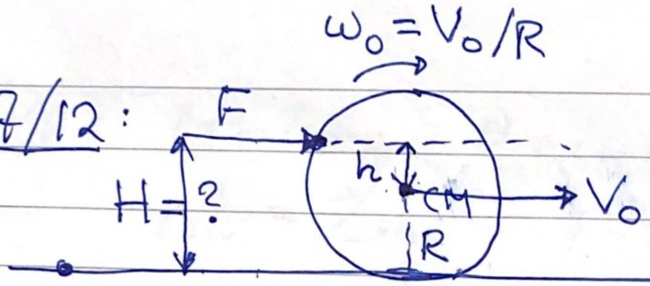
Ren rulling: $V(t) = \omega(t) \cdot R$

$$\Rightarrow V_0 - \mu_k g t = \frac{5}{2} \mu_k g \cdot t$$

$$\Rightarrow V_0 = \frac{7}{2} \mu_k g t \Rightarrow \underline{t_{rr} = \frac{2V_0}{7\mu_k g}}$$

$$= \frac{2 \cdot 8}{7 \cdot 0.12 \cdot 9.81} = \underline{1.94 s}$$

Test 7/12:



$M, R, I_0 = \frac{2}{3}MR^2$ (kuleskall)

$H = h + R$

N2, trans: $\underline{F} = M \cdot A = M \cdot \frac{\Delta V}{\Delta t} = \underline{\frac{M \cdot V_0}{\Delta t}}$

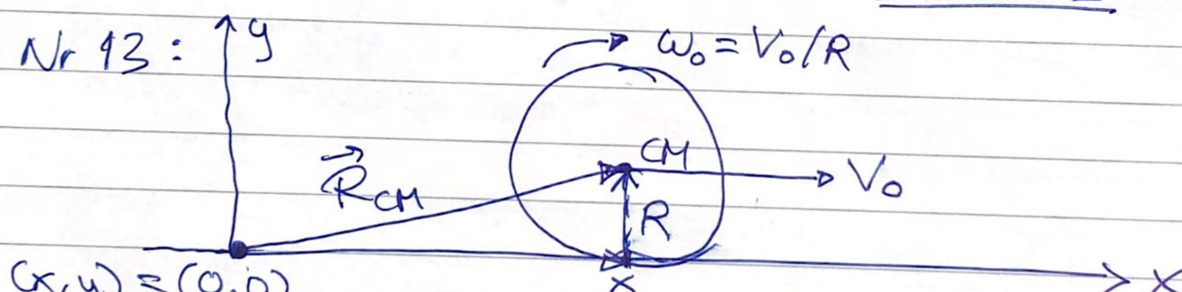
N2, rot: $\tau = \underline{F \cdot h} \overset{N2}{=} I_0 \cdot \alpha = \frac{2}{3}MR^2 \cdot \frac{\Delta \omega}{\Delta t}$

$= \frac{2}{3}MR^2 \cdot \frac{\omega_0}{\Delta t} = \underline{\frac{2}{3} MR V_0 / \Delta t}$

$\Rightarrow \underbrace{\frac{\cancel{MV_0}}{\cancel{\Delta t}}}_{F} \cdot h = \frac{2}{3} \frac{\cancel{MRV_0}}{\cancel{\Delta t}} \Rightarrow h = \frac{2}{3}R$

$\Rightarrow \underline{\underline{H = \frac{5}{3}R}}$

Nr 13:



$$\underline{\vec{L} = \vec{L}_s + \vec{L}_b}$$

$\vec{L}_s = I_0 \vec{\omega} = \frac{2}{3}MR^2 \cdot \frac{V_0}{R} \cdot (-\hat{z}) = \underline{-\frac{2}{3}MRV_0 \hat{z}}$

$\vec{L}_b = \vec{R}_{CM} \times \vec{P}_{CM} = (\underline{x\hat{x}} + \underline{R \cdot \hat{y}}) \times \underline{M \cdot V_0 \hat{x}}$

$= RMV_0 \cdot (-\hat{z})$

$$\Rightarrow \underline{\underline{\vec{L} = -\frac{5}{3}MRV_0 \hat{z}}}$$

Tall: $M = 2{,}7g \quad R = 20\,mm$

$\Delta t = 2ms \quad F = 2.7\,N$

$$\Rightarrow V_0 = \frac{F \cdot \Delta t}{M} = \frac{\cancel{2{,}7}\,\cancel{kg}\,m/s^{\cancel{2}} \cdot 2 \cdot \cancel{10^{-3}}\,\cancel{s}}{\cancel{2.7} \cdot \cancel{10^{-3}}\,\cancel{kg}} = \underline{\underline{2\,m/s}}$$

$$\omega_0 = \frac{V_0}{R} = \frac{2\,m/s}{0.020\,m} = \underline{\underline{100\,rad/s}}$$

$$\tau = F \cdot h = 2.7N \cdot \frac{2}{3} \cdot 0.020m = \underline{\underline{0.036\,Nm}}$$

$$L = \frac{5}{3} \cdot 0.0027\,kg \cdot 0.020m \cdot 2\,m/s$$

$$= \underline{\underline{1.8 \cdot 10^{-4}\,kg\,m^2/s}}$$