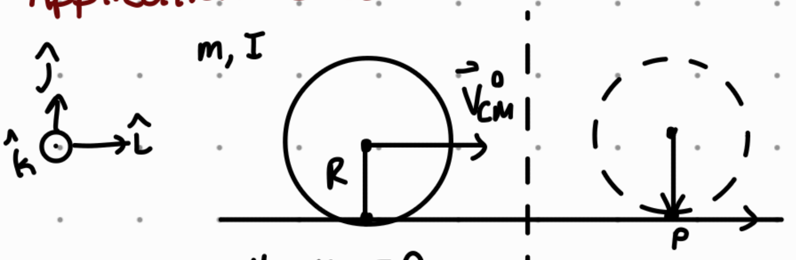
PHYS 301 Lecture 14 18.11.24

Application Session I



$\mu_s = \mu_k = 0$ $\mu_s \neq 0$ $\mu_k = 0$

$\vec{V}^0_P = \vec{V}^0_{cm} + (\vec{\omega} \times \vec{r})$

$\vec{\omega}^0 = \omega^0 \hat{k}$

$V^0_P = \vec{V}^0_{cm} + R\omega^0$

a)	$V^0_P < 0$
b)	$V^0_P = 0$
c)	$V^0_P > 0$

a) $m\vec{a}_{cm} = \mu_k g m \hat{\imath} \longrightarrow V_{cM} = V^0_{cm} + \mu_k g t$

$I\vec{\alpha}_{cm} = \mu_k mg R\hat{k} \Rightarrow R\omega^0_{cM} + \mu_k g t \dfrac{mR^2}{I}$

$V^0_P = V^0_{cM} + R\omega^0 < 0$

$V_P = V^0_P + \mu_k g t \left(1 + \dfrac{mR^2}{I}\right)$

$R\omega^0_{cm} \equiv -\alpha V^0_{cM} \longrightarrow \alpha > 1$

$R\omega_{cm} = -\alpha V^0_{cM} + \mu_k g t \dfrac{mR^2}{I}$

$V_P = -(\alpha - 1)V^0_{cM} + \mu_k g t \left(I + \dfrac{mR^2}{I}\right)$

$t_\omega : R\omega_{cM}(t_\omega) = 0 \rightarrow (\dots)$

COULDN'T FINISH!!!

$\dfrac{(\alpha-1)I}{I + mR^2} \overset{?}{\underset{?}{<}} \dfrac{\alpha I}{mR^2}$

$mR^2(\alpha - 1) < I\alpha + m^2\alpha$

$\rightarrow$ Goes the same way.

c) Let $R\omega^0 \equiv \alpha V^0_{cM}$: $V^0_P = (1+\alpha)V^0_{cM} > 0$ $\alpha > -1$

$m\vec{a}_{cm} = -\mu_k mg\hat{\imath} \Longrightarrow V_{cM} = V^0_{cM} - \mu_k g t$

$I\vec{\alpha}_{cM} = -\mu_k mg R\hat{k} \Rightarrow R\omega_{cm} = R\omega^0_{cm} - \mu_k g t \dfrac{mR^2}{I}$

$$V_p = (V^0_{cm} + R\omega^0_{cm}) - \left(1 + \frac{mR^2}{I}\right)\mu_k g t$$

- we must study α also (The object can return, or just stop)

$t_{cm} : V_{cm}(t_{cm}) = 0 \qquad t_{cm} = \frac{V^0_{cm}}{\mu_k g} \qquad : \; 1$

$t_\omega : R\omega(t_\omega) = 0 \qquad t_\omega = \frac{V^0_{cm}}{\mu_k g}\frac{\alpha I}{mR^2} \qquad : \; \alpha \frac{I}{mR^2}$

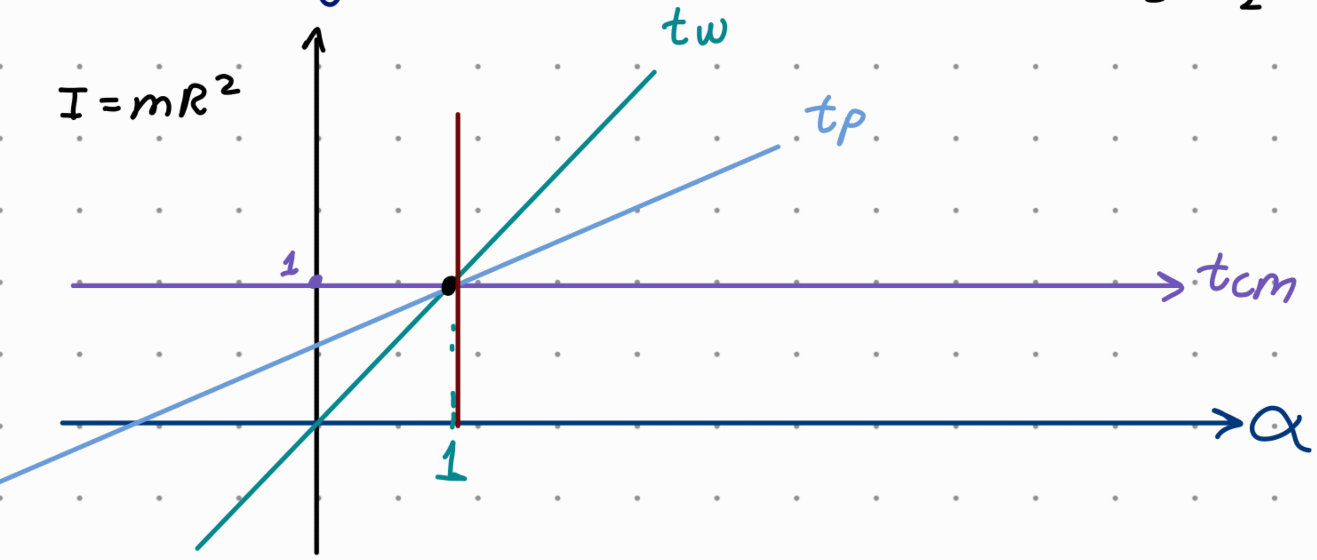
$t_p : V_p(t_p) = 0 \qquad t_p = \frac{V^0_{cm}}{\mu_k g}\frac{(1+\alpha)I}{I+mR^2} \qquad : \; (\alpha+1)\frac{I}{I+mR^2}$

- I want to compare this times.

Case Study:

$\frac{1}{2} + \frac{\alpha}{2}$

$I = mR^2$

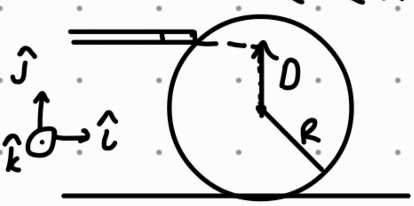


at $\alpha \to$ the object stops! and it should return.

→ What happens when $0 < \alpha < 1$?

t_ω stops first...

Question 2



$-R \leq D \leq R$ $\quad \vec{F} = f(t)\,\hat{\imath}$

$\mu_s \neq 0$

$\mu_k \neq 0$

$$\int_0^{\epsilon} \vec{F}\,dt = m v_{cm}^{o}\,\hat{\imath}$$

$$-\hat{k}\int_0^{\epsilon} f D\,dt = I\omega_{cm}^{o}\,\hat{k}$$

$$\boxed{\int_0^{\epsilon} f\,dt = \frac{-I}{D}\,\omega_{cm}^{o} \quad \& \quad \int_0^{\epsilon} f\,dt = m v_{cm}^{o}}$$

Additional constraints on the first problem.

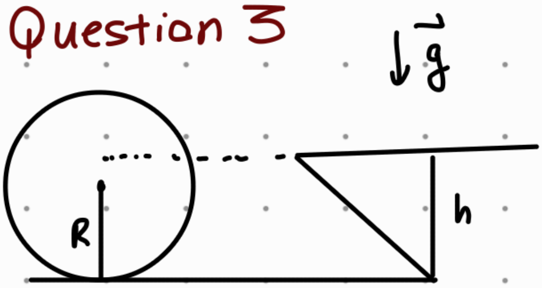
$$\boxed{\omega_{cm}^{o} = -m v_{cm}^{o}\,\frac{D}{I}}$$

$$V_p^{o} = V_{cm}^{o} + R\omega_{cm}^{o} = V_{cm}^{o} - \frac{R D m V_{cm}^{o}}{I}$$

$$I_{\text{solid sphere}} = \frac{2}{5} m R^2$$

$$V_p^{o} = V_{cm}^{o}\left(1 - \frac{5}{2}\frac{D}{R}\right)$$

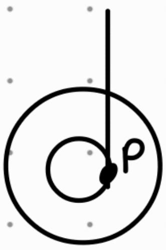
Question 3



Comes in rolling without slipping

what's needed to climb?

Q4



Yo-Yo. ip bitti! Ne olur?

P etrafında circular motion, yeterli enerjisi varsa geri sarmaya başlayacak.