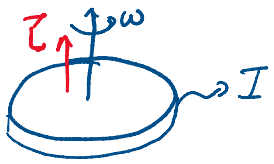
Lecture 21

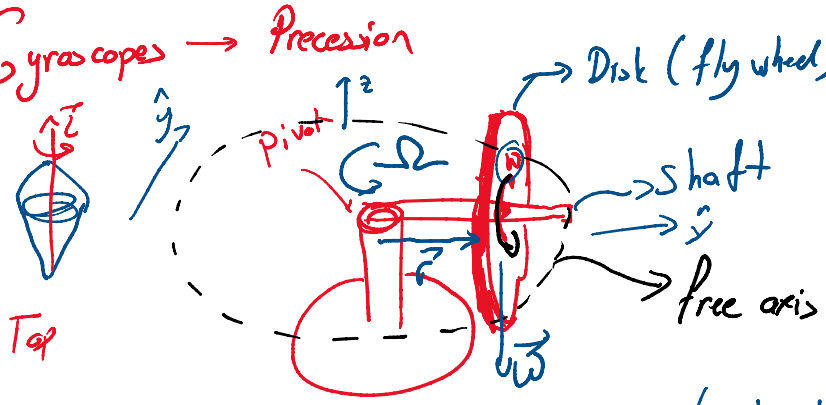
5 Aralık 2019 Perşembe 09:23



$\vec{L} = I\vec{\omega}$

$\vec{L}$ → What happens when $\vec{L}$ changes direction?

⇒ Gyroscopes → Precession

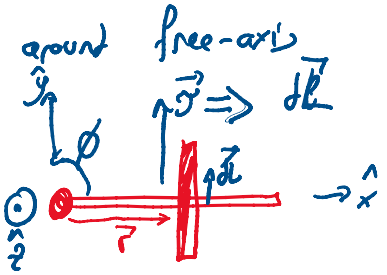


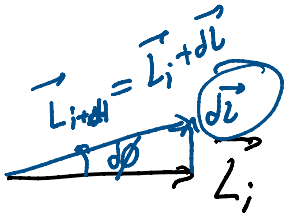
→ If the flywheel is stationary (not rotating), gravity applies torque on the shaft.

$\vec{L}_i = 0$

$\frac{d\vec{L}}{dt} = \vec{\mathcal{T}} \quad \vec{\mathcal{T}} = \vec{r} \times \vec{W} \quad \boxed{d\vec{L} = \vec{\mathcal{T}}\, dt}$ *

→ If it spins, I will observe that it will rotate around free-axis



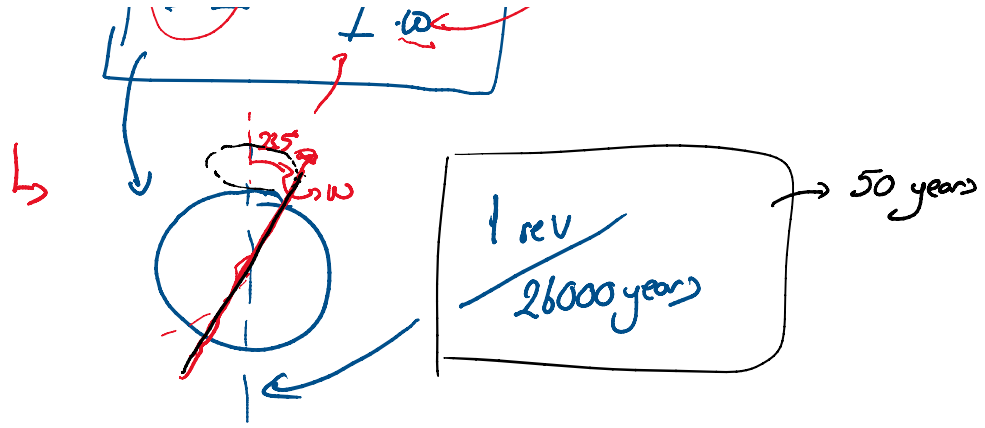


↳ Let's add rotation $\vec{\omega} \neq 0$

$$\Omega = \frac{d\phi}{dt} = \frac{|d\vec{L}|/|\vec{L}|}{dt} = \frac{|d\vec{L}|}{dt}\cdot\frac{1}{|\vec{L}|}$$

$|d\vec{L}|/dt = rW$, $|\vec{L}| = I\omega$

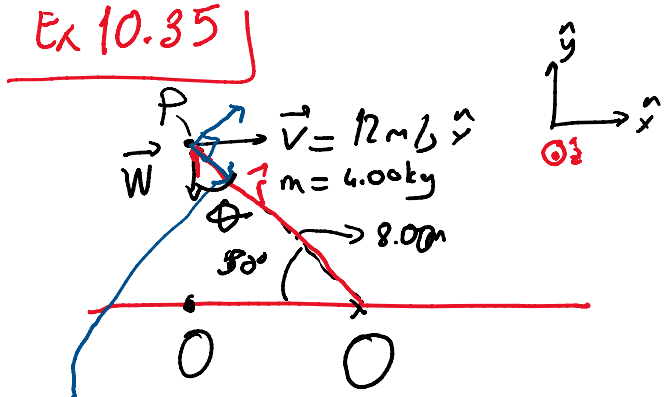
$$\boxed{\Omega = \frac{rW}{I\omega}}$$



Midterm II → 14th of Dec.

↳ Chapter 10 included

Ex 10.35



a) What are the magnitude and direction of the angular momentum relative to point O?

$-\hat{z}$ ← $\vec{L} = \vec{r} \times \vec{p}$

$|\vec{L}| = r \cdot p \sin 50° = 294\ kg\,m^2/s$

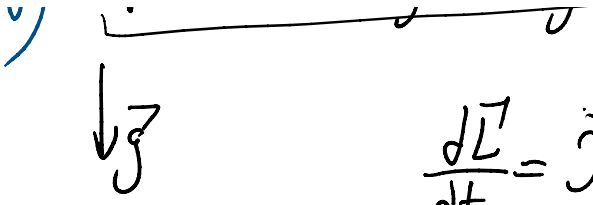
↳ lin K.E: $\frac{1}{2} M v^2 = 288\,J$

↳ rot. K.E: $\frac{1}{2} I \omega^2 + \frac{1}{2} M v_r^2$

$\omega = \frac{v \sin 50}{r}$; $v_r = v \cos 50$

mr^2 → 169 J + 119 J = 288 J

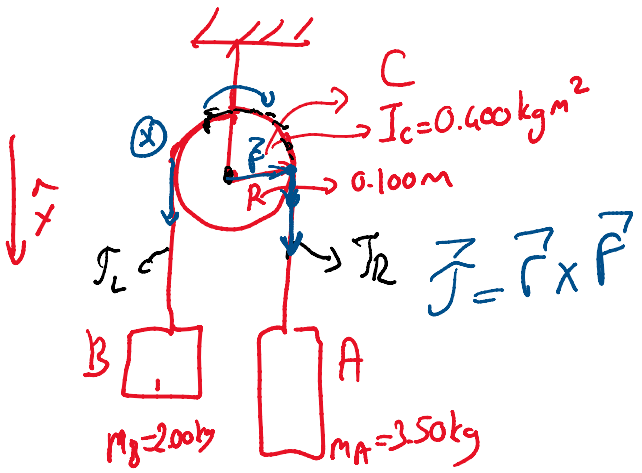
b) Rate of change of angular momentum at point P?



$$\frac{d\vec{L}}{dt} = \vec{\tau} \Rightarrow \tau = r W \sin(\theta + 90^\circ) = 202\,N.m$$

$\hat{z}$

Ex 10.59

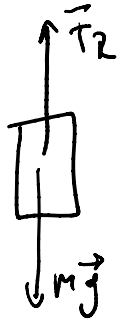


$\vec{\tau} = \vec{r} \times \vec{F}$

→ Find the acceleration of A, B and angular acceleration of C

no slipping between the rope & C

→ Tension on each side of the cord?



A > $m_A g - T_R = m_A \cdot a$

B > $T_L - m_B g = m_B a$

$(T_R - T_L) \cdot R = I_C \cdot \alpha$

Net torque

$\alpha \cdot R = a$

$(T_R - T_L) = \frac{I_C a}{R^2}$

$a = 0.323\,m/s^2$

$\alpha = 3.23\,rad/s^2$

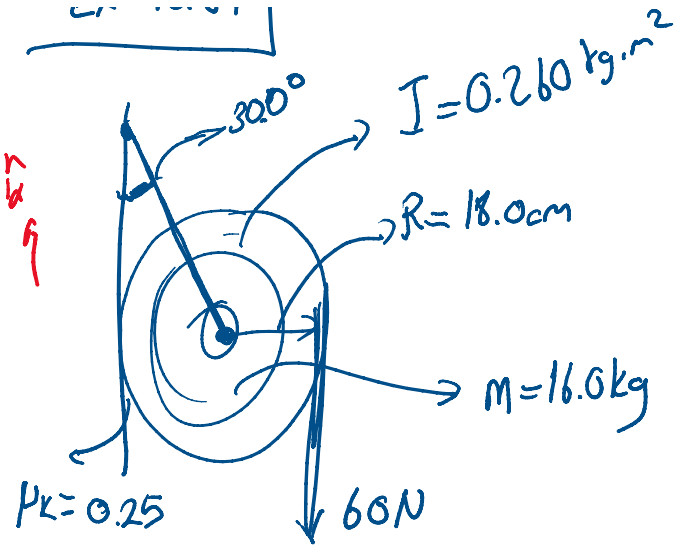
$T_R = 39.2N$

$T_L = 20.7N$

Ex 10.61

$I = 0.260\,kg.m^2$

$\alpha = ?$



$\alpha = ?$