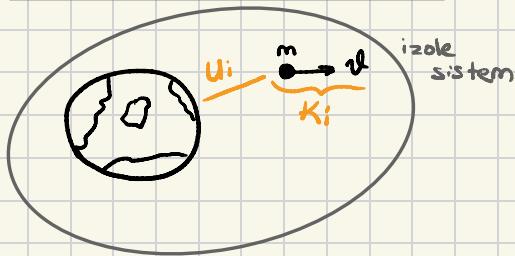


Enerji Korunumu

izole Oluşan Sistem

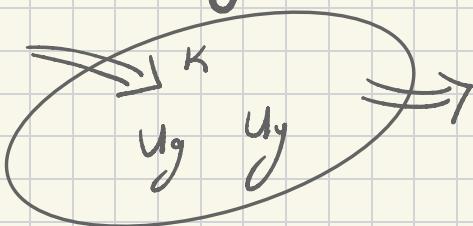


$$\sum E_i = \sum E_s$$

$$K_i + U_i = K_s + U_s$$

$$\Delta K + \Delta U_g + \Delta U_y = 0$$

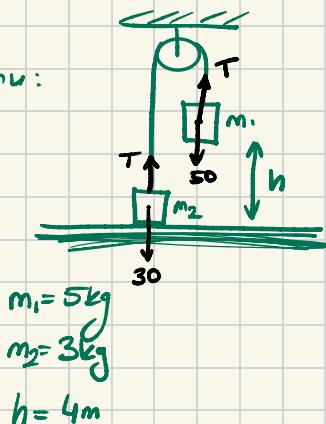
izole Olmayan Sistem



$$W = \int \sum \vec{F} \cdot d\vec{r}$$

$$W_s = - \int f ds$$

Jonu:



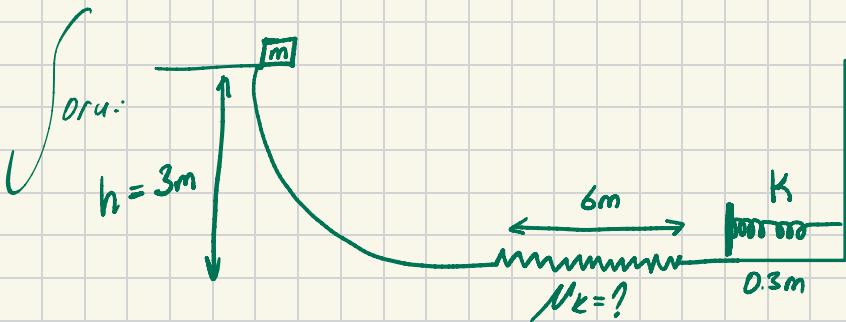
m_1, m_2 aynı yükseklikte hızları ne olur?

$$E_i = E_s = 50 \cdot 4 = 200 \quad V_1 = V_2 = V$$

$$200 = 80 \cdot 2 + \frac{m_1 V_1^2}{2} + \frac{m_2 V_2^2}{2}$$

$$40 = 4V^2$$

$$\sqrt{10} = V$$



$$m = 10\text{kg}$$

$$K = 2250 \text{ N/m}$$

$$E = 300\text{J}$$

$$E_{\text{kinetic}} = 600 \cdot MK$$

$$(U_{gs} - U_{gi}) + (U_{ys} - U_{yi}) + (K_s - K_i) = 0$$

$$300 - 600MK = \underbrace{\frac{1}{2} k \cdot x^2}_{101.25}$$

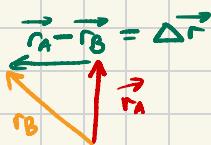
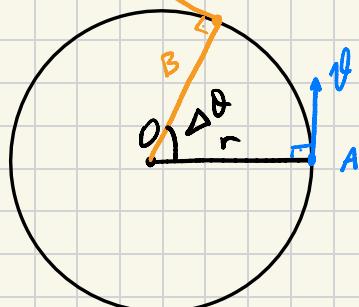
$$MK = 0.33$$

$$300 - 600MK = \frac{1}{2} 225 \cdot \frac{9}{10}$$

$$MK = 0.33$$

Düzgün Dairesel Hareket

- Hızın büyüklüğü sabittir.



$$|\vec{v}_A| = |\vec{v}_B| = v$$

$$|\vec{r}_A| = |\vec{r}_B| = r$$

$$\frac{|\Delta \vec{r}|}{r} = \frac{|\Delta \vec{v}|}{v}$$

$$|\Delta \vec{v}| = \frac{v \cdot |\Delta \vec{r}|}{r}$$

$$|\vec{a}_{\text{ort}}| = \frac{\Delta v}{\Delta t}$$

$$|\vec{a}_{\text{ort}}| = \frac{v}{r} \cdot \frac{|\Delta \vec{r}|}{\Delta t}$$

$$a = \frac{v^2}{r}$$

merkezil iume büyüğlüğü



1) Hızın büyüklüğünün
değişiminden dolayı sahip olduğu iume

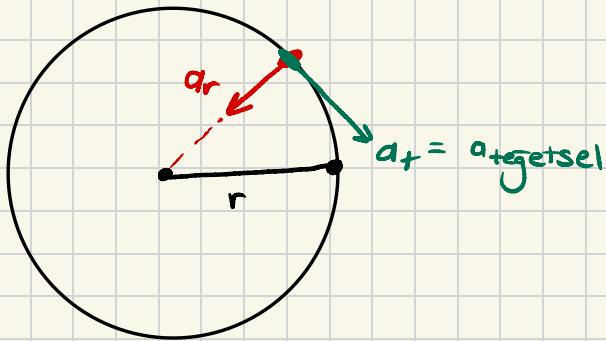
$$a_1 = \frac{d\mathcal{V}}{dt}$$

2) Hızın yönünün değişmesinden dolayı sahip olduğu iume

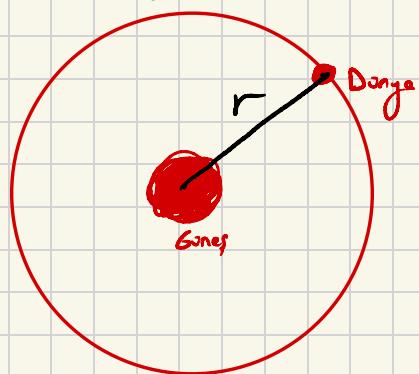
$$a_{toplam} = \vec{a}_1 + \vec{a}_2$$

$$a_2 = \frac{\mathcal{V}^2}{r}$$

Dairesel Hareket



Dünyanın Göres etrafında dönmesi sonucu sahip olduğu merkezil ıvme nedir?

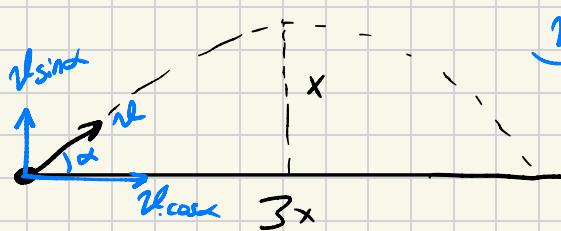


$$a = \frac{v^2}{r}$$

$$2\pi r = vt$$

$$\frac{\left(\frac{2\pi r}{t}\right)^2}{r} = \frac{4\pi^2 r}{t^2} = a$$

Bir top yerden belli bir hızla fırlatılmış



$$\underbrace{v \sin \alpha \cdot t}_{10t} - \frac{gt^2}{2} = x$$

$$v \sin \alpha = 10 +$$

$$\frac{10t^2 - 5t^2}{5t^2} = x$$

$$\tan \alpha = \frac{10}{2} = \frac{5}{3}$$

$$v \cos \alpha \cdot 2 = 15t$$

$$v \cos \alpha = \frac{15}{2} +$$

$$\alpha = 53^\circ$$

Başlangıçta bir paracagın $\vec{a} = 3\hat{j} \text{ m/s}^2$

x konum vektörü = ?

$$x = 0 + 5i + \frac{3\hat{j} \cdot t^2}{2}$$

h_{12} vektörü = ?

$$x = 5t\hat{i} + \frac{3t^2}{2}\hat{j}$$

$t=2$ iin konum = ?

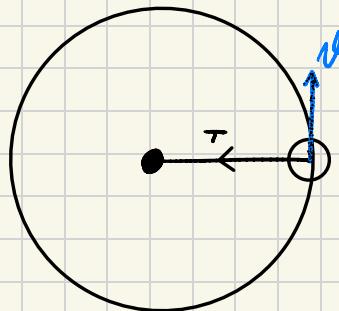
$$\vec{r} = 5\hat{i} + 3\hat{j}$$

$$(10, 6)$$

$$(5\hat{i} + 6\hat{j}) = h_{12}$$

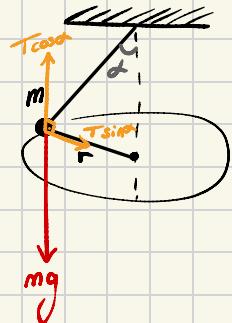
$$\sqrt{25+36} = \sqrt{71} = \text{sürt}$$

$\vec{h}_0 = 5\hat{i} \text{ m/s}$ olarak veriliyor.

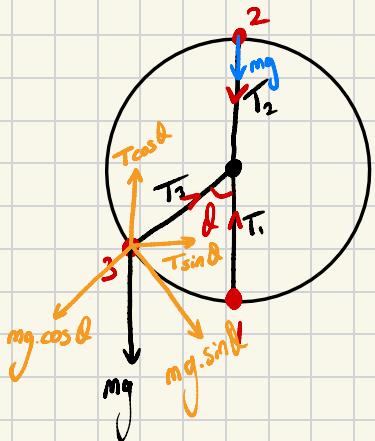


$$T = \frac{m \cdot v^2}{r}$$

$$F_r = m \cdot a_r = \frac{m \cdot v^2}{r}$$



$$\begin{aligned} T \sin \alpha &= \frac{m \cdot v^2}{r} \\ T \cos \alpha &= mg \end{aligned} \Rightarrow v = \sqrt{r \cdot g \cdot \tan \theta}$$

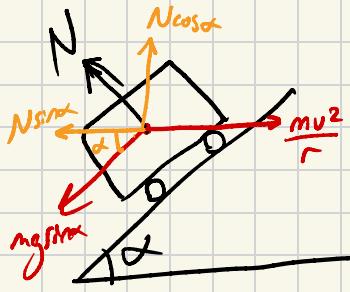


$$3) T - mg \cos \theta = \frac{m v^2}{r}$$

$$T_3 = mg \left(\cos \theta + \frac{v^2}{r} \right)$$

$$T_1 = mg \left(1 + \frac{v^2}{r} \right) = mg + \frac{m v^2}{r}$$

$$T_2 = \left(\frac{m v^2}{r} - mg \right)$$



$$v = 13.4 \text{ m/s}$$

$$r = 35 \text{ m}$$

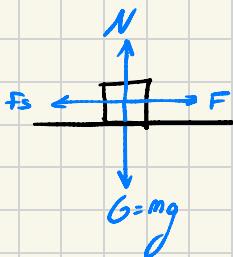
$$N \sin \alpha = \frac{mv^2}{r}$$

$$N \cos \alpha = mg$$

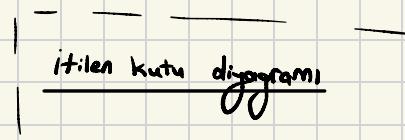
$$\tan \alpha = \frac{v^2}{rg}$$

Serbest Cism Diyagramı

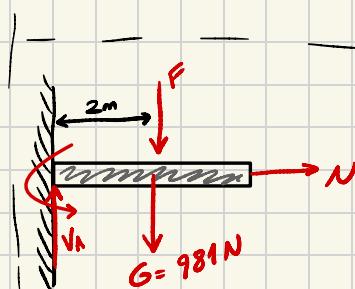
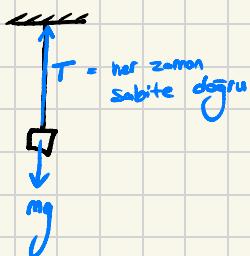
Üstünde cisme etki eden bütün kuvvetler ölçeksiz gösterilir.

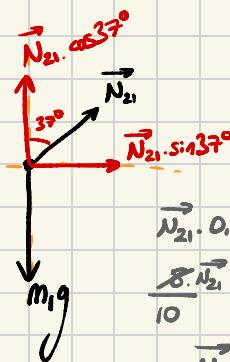
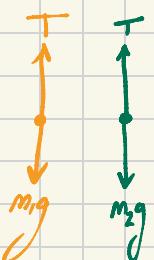
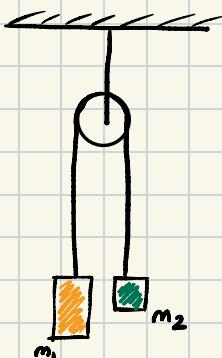
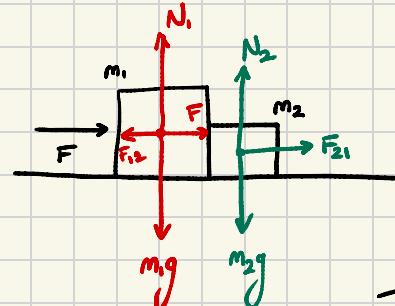
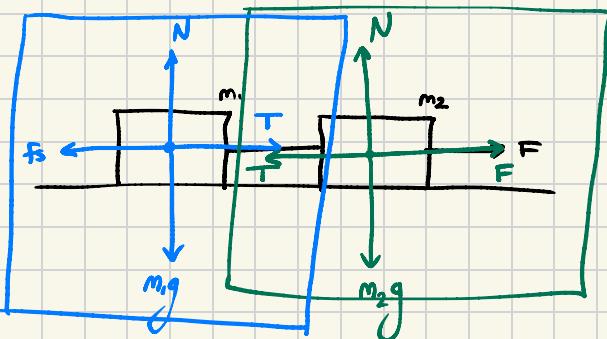
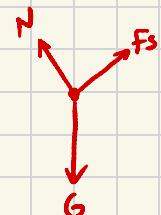
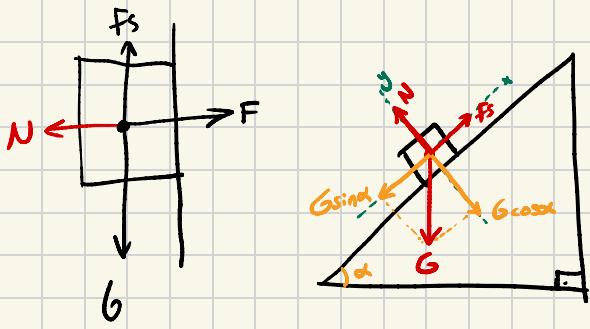


Tas binanın topesinden birakılıyor. Taşa etkiyen kuvvet diyagramı=?



Tavandaki avize serbest cisim diyagramı





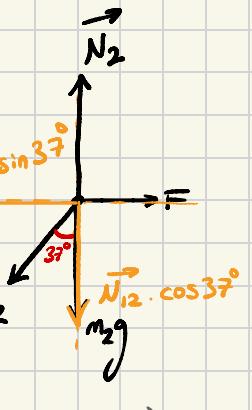
$$N_{21} \cdot 0,8 = m_1 \cdot g$$

$$\frac{8 \cdot N_{21}}{10} = 24$$

$$N_{21} = 30 \text{ N}$$

$$\frac{N_{21} \cdot 6}{10} = 2,4 \cdot g$$

$$\frac{30}{4} = \frac{3}{0,4} = \frac{18}{24} = g$$

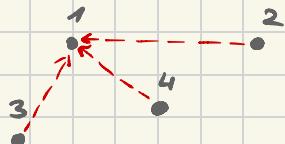


$$F - N_{12} \cdot \frac{6}{10} = 4 \cdot g$$

$$\frac{-30 \cdot 6}{10} = 30$$

$$F = 48$$

Lineer Momentum ve Korunumu



$$\sum \vec{F}_1 = \vec{F}_{21} + \vec{F}_{31} + \vec{F}_{41}$$

$$\sum \vec{F}_2 = \vec{F}_{32} + \vec{F}_{12} + \vec{F}_{42}$$

Bir kuvetsiz düzlemede kütlelerin birbirine uyguladığı toplam kuvet "0" dir.

+

$$\sum \vec{F}_1 + \sum \vec{F}_2 + \sum \vec{F}_3 = 0$$

$$m_1 \vec{a}_1 + m_2 \vec{a}_2 + m_3 \vec{a}_3 = 0$$

$$m_1 \frac{d\vec{v}_1}{dt} + m_2 \frac{d\vec{v}_2}{dt} + m_3 \frac{d\vec{v}_3}{dt} = 0$$

$$\frac{d}{dt} (m_1 \vec{v}_1 + m_2 \vec{v}_2 + m_3 \vec{v}_3) = 0$$

$$M \cdot \vec{V} = \vec{P}$$

$$* a = \frac{dV}{dt}, \alpha = \frac{d\omega}{dt}$$

Kuvetsiz sisteme $P_i = P_s$

$$\vec{P}_{top} = Sbt$$

* Dışardan kuvvet uygulanmıyorsa lineer momentum muhakkak eşittir.

Soru: Sürünmesiz düzlemede 50 kg okun 0,5 kg kütle bir ok fırlatıyor. Okun hızı 50 m/s ise okunun hızı?

$$50 \cdot x \xleftarrow{\text{kg.m/s}} 0.5 \cdot 50 = 25 \text{ kg.m/s}$$

$$x = -0.5 \text{ m/s}$$

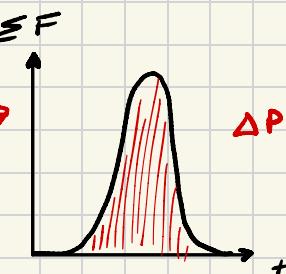
$$\sum \vec{F} = m \cdot \frac{d\vec{U}}{dt}$$



$$\sum \vec{F} = \frac{d\vec{P}}{dt}$$



$$\int_{p_i}^{p_s} d\vec{P} = \int_0^+ \sum F \cdot dt$$



$$\Delta P = itme$$

$$F_{\text{ort}} = \frac{1}{\Delta t} \int_{t_1}^{t_2} \sum F \cdot dt$$

itme (impuls) =
anlık
momentum değişimi

1500kg otomobil duvara çarptırıyor. Otomobilin çarpışmadan önceki ve sonraki hızları,

$$\vec{v}_i = -15 \hat{i} \text{ m/s}$$

$$\vec{v}_s = 2.6 \hat{i} \text{ m/s}$$

Eğer çarpışma 0.15 sn süreyinde çarpışma itmeyi ve otomobile etki eden ortalama kuvveti bulunuz.

$$2) 26500 = \frac{15}{100} \cdot F_{\text{ort}}$$

$$1) \quad -22500 \hat{i} \text{ kg}\cdot\text{m/s} \xrightarrow[1500, -15]{ } 3900 \hat{i} \text{ kg}\cdot\text{m/s}$$

$$176000 N = F_{\text{ort}}$$

$$\Delta P = 26400 \hat{i}$$

Garpisimalar

$$m_1 \rightarrow \vec{v}_1 \quad \vec{v}_2 \leftarrow m_2$$

$$\sum \vec{P}_i = \sum \vec{P}_s$$

* Dışardan kütçe bulunmayan
tüm lineer durumlarda

$$m_1 v_{1i} + m_2 v_{2i} \dots = m_1 v_{1s} + m_2 v_{2s} \dots$$

eğer esnekse kinetik enerji korunacağından:

$$\frac{m_1 v_{1i}^2}{2} + \frac{m_2 v_{2i}^2}{2} + \dots = \frac{m_1 v_{1s}^2}{2} + \frac{m_2 v_{2s}^2}{2} + \dots$$

$$\vec{v}_{1i} + \vec{v}_{1s} = \vec{v}_{2i} + \vec{v}_{2s} = \dots$$



$$v_{1s} = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) v_{1i} + \left(\frac{2m_2}{m_1 + m_2} \right) v_{2i}$$

$$v_{2s} = \left(\frac{m_2 - m_1}{m_2 + m_1} \right) v_{2i} + \left(\frac{2m_1}{m_1 + m_2} \right) v_{1i}$$

1. Durum

$$m_1 \rightarrow v_1 \quad \text{m}_2 \quad v_2 = 0$$

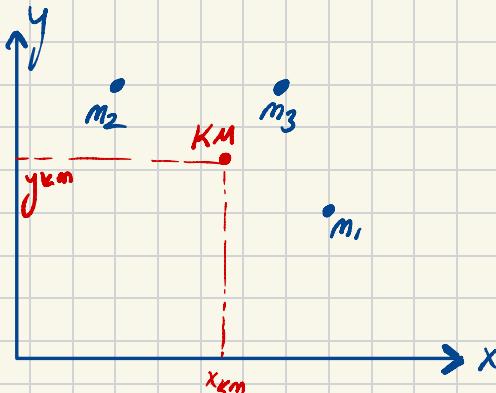
*) m₂ etkileşim edebilecek kadar küçük

$$v_{1s} = -v_{1i}$$

$$v_{2s} = -v_{1i}$$

$$v_{2s} \approx 0$$

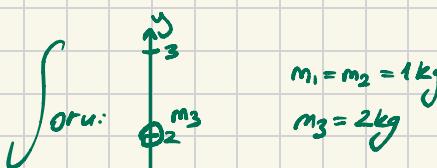
Kütle Merkezi



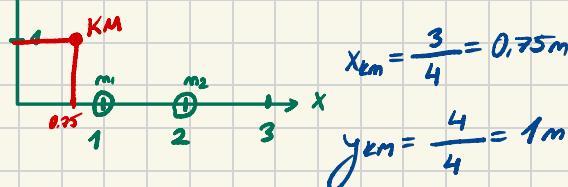
$$x_{km} = \frac{m_1 x_1 + m_2 x_2 + \dots}{m_1 + m_2 + m_3 \dots}$$

$$x_{km} = \frac{1}{M} \sum_{i=1}^n m_i x_i$$

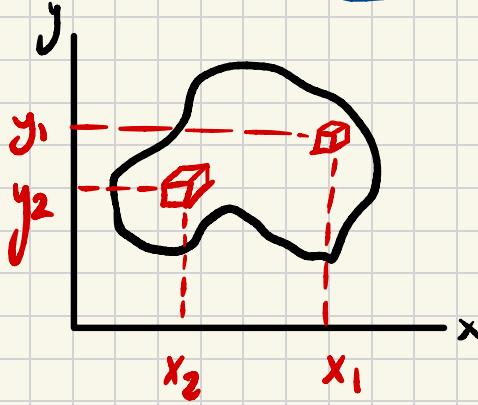
$$y_{km} = \frac{1}{M} \cdot \sum_{i=1}^n m_i y_i$$



$$\vec{r}_{km} = x_{km} \hat{i} + y_{km} \hat{j} + z_{km} \hat{k}$$



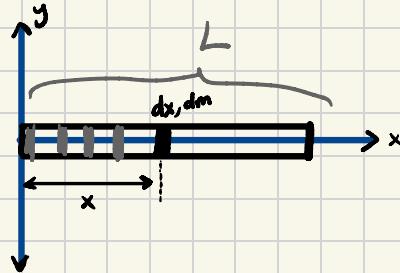
Sürekli Kütle Dağılımına Sahip Cisimlerin Kütle Merkezleri



$$x_{km} \approx \frac{1}{M} \sum_{i=1}^n \Delta m_i x_i$$

$$x_{km} \approx \frac{1}{M} \cdot \lim_{\Delta m_i \rightarrow 0} \sum_{i=1}^{\infty} \Delta m_i x_i$$

$$x_{km} = \frac{1}{M} \int y dm$$



$$\frac{L}{dx} \times \frac{M}{dm}$$



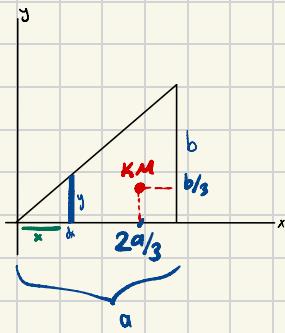
$$dm = \frac{M}{L} dx \quad | \quad dm = \lambda dx$$

gizisel kütte yoğunluğu

$$X_{KM} = \frac{1}{M} \int x dm$$

$$X_{KM} = \frac{1}{M} \int_0^L x \lambda dx$$

$$X_{KM} = \frac{\lambda}{M} \cdot \frac{L^2}{2} = \frac{1}{2} L$$



$$dm = \nabla dA$$

$$\nabla = \frac{M}{A}; \quad dA = y dx$$

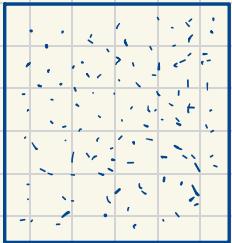
$$dm = \nabla y dx$$

$$X_{KM} = \frac{1}{M} \int x dm$$

$$X_{KM} = \frac{\nabla}{M} \int_0^a x y dx$$

$$X_{KM} = \frac{2a}{3}$$

$$y_{KM} = \frac{b}{3}$$



\vec{v}
 $\vec{\alpha}$

$$\vec{r}_{km} = \frac{1}{M} \sum_{i=1}^n m_i \vec{r}_i$$

$$\overline{\vec{v}}_{km} = \frac{d\vec{r}_{km}}{dt} = \frac{d}{dt} \left[\frac{1}{M} \sum_i m_i \vec{r}_i \right]$$

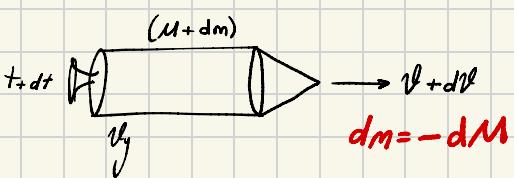
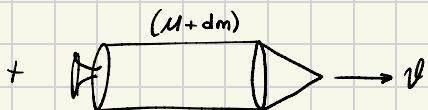
$$M \overline{\vec{v}}_{km} = \sum_i m_i \cdot \vec{v}_i$$

$$\vec{a}_{km} = \frac{d\overline{\vec{v}}_{km}}{dt} = \frac{d}{dt} \left[\frac{1}{M} \sum_i m_i \vec{v}_i \right]$$

$$M \cdot \vec{a} = \sum_i m_i \vec{a}_i$$

$$\vec{F} = \sum_i \vec{F}_i$$

Roket Hareketi:



+ anında

$$(M+dm) \vec{v} = M(\vec{v} + d\vec{v}) + dm(\vec{v} - \vec{v}_y)$$

$$\vec{v}_s = \vec{v}_i + \vec{v}_y \ln \left(\frac{M_i}{M_s} \right)$$

$$T = M \cdot \frac{d\vec{v}}{dt} \rightarrow T = \left| \vec{v}_y \frac{dM}{dt} \right|$$

Roket hızı $3 \cdot 10^3 \text{ m/s}$

Bu anda roket atesleniyor.

Roketin yakıtı $5 \cdot 10^3 \text{ m/s}$ 'lik hızla teneh ediyor

Roketin hızlesi yanıyor düşerse yere göre hızı = ?

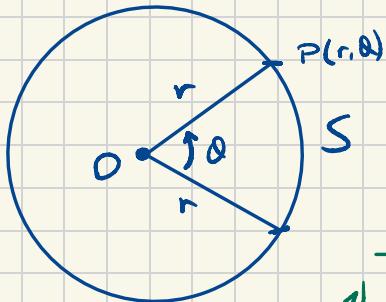
$$V_s = V_i + g_y \ln \left(\frac{M_i}{0.5 M_f} \right)$$

$$(3 \cdot 10^3) + (5 \cdot 10^3) \cdot \ln 2 = 6.5 \cdot 10^3 \text{ m/s}$$

Roket yakıtı 50 kg/s oranında yanıpoproje itme kuvveti = ?

$$\left| g_y \frac{dm}{dt} \right| = T = 50 \cdot 5 \cdot 10^3 = 25 \cdot 10^4 \text{ N}$$

Katı Bir Cismenin Sabit Eksenle Dönmesi



Tam bir tur için

$$2\pi r = r \cdot Q$$

$$2\pi = Q \text{ (radyan)}$$

$$S = r \cdot Q$$

$$Q = \frac{\text{birimi}}{\text{radyan}}$$

1) Açısal Yer Değiştirme

$$\Delta Q = Q_s - Q_i$$

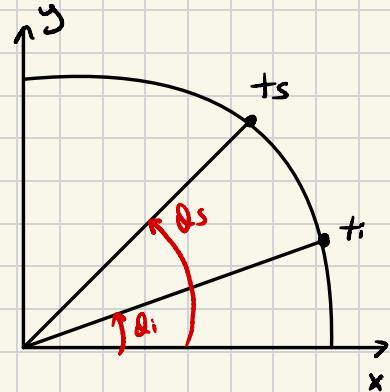
2) Ortalama Açısal Hız

$$w_{\text{ort}} = \frac{\Delta Q}{\Delta t} \text{ (rad/s)}$$

3) Anı Açısal Hız

$$w = \lim_{\Delta t \rightarrow 0} \frac{\Delta Q}{\Delta t} = \frac{dQ(t)}{dt}$$

+rew operatörü



4) Ortalama Açısal İme

$$\alpha_{\text{ort}} = \frac{\Delta w}{\Delta t} \text{ (rad/s}^2\text{)}$$

5) Anı Açısal İme

$$\alpha = \lim_{\Delta t \rightarrow 0} \frac{\Delta w}{\Delta t} = \frac{dw(t)}{dt}$$

Sabit Aksal i̇mel: Dönme Hareketi

Dönme Hareketi

$$\omega_s = \omega_0 + \alpha t$$

$$\theta_s = \theta_0 + \omega_0 t + \frac{\alpha t^2}{2}$$

$$\omega_s^2 = \omega_0^2 + 2\alpha(\theta_s - \theta_0)$$

$$(\alpha = sbt)$$

değilse;

$$\omega = \frac{d\theta}{dt}$$

$$\alpha = \frac{d\omega}{dt}$$

Öteleme Hareketi

$$\vartheta_s = \vartheta_0 + \omega_0 t + \frac{\alpha t^2}{2}$$

$$x_s = x_0 + \vartheta_0 t + \frac{\alpha t^2}{2}$$

$$\vartheta_s^2 = \vartheta_0^2 + 2\alpha(x - x_0)$$

$$(\alpha = sbt)$$

değilse;

$$\vartheta = \frac{dx}{dt}$$

$$\alpha = \frac{d\vartheta}{dt}$$

Soru: $\alpha = 3,5 \text{ rad/s}^2$

$$t_0 = 0 \Rightarrow \omega_0 = 2 \text{ rad/s}$$

a) $t = 2 \text{ sn}'deki \Delta \theta = ?$

$$\theta_s = \theta_0 + \omega_0 t + \frac{\alpha t^2}{2}$$

$$\Delta \theta = 4 + \frac{3,5 \cdot 4}{2} = 11 \text{ rad}$$

b) $t = 2 \text{ sn}$, kaç tur atar?

$$\frac{11}{2\pi} \text{ derece yani } \frac{180 \cdot (11)}{\pi} = 630^\circ$$

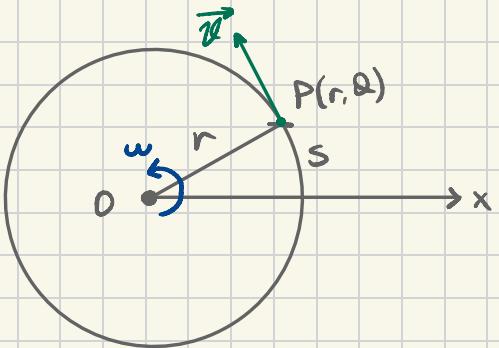
1.75 tur

c) $t = 2 \text{ sn}$
açısal hız = ?

$$\omega_s = \omega_0 + \alpha t$$

$$\omega_s = 2 + 7$$

$$\omega_s = 9 \text{ rad/s}$$



$$S = r \cdot Q$$

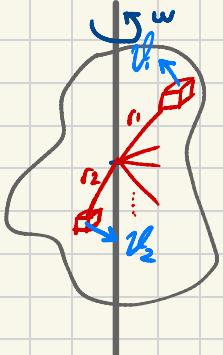
$$\frac{ds}{dt} = r \cdot \frac{dQ}{dt}$$

$$v = r \cdot \omega$$

$$\frac{d\theta}{dt} = r \cdot \frac{d\omega}{dt}$$

$$a = \alpha \cdot r$$

Dönme Kinetik Enerjisi



$$K \approx \frac{1}{2} \Delta m_1 v_1^2 + \frac{1}{2} \Delta m_2 v_2^2 + \dots$$

$$K \approx \sum_{i=1}^N \frac{1}{2} \Delta m_i v_i^2$$

$$K \approx \frac{1}{2} \left(\sum_{i=1}^N \Delta m_i r_i^2 \right) \omega^2$$

$$K = \frac{1}{2} \left(\lim_{\Delta m_i \rightarrow 0} \sum_{i=1}^{\infty} \Delta m_i r_i^2 \right) \cdot \omega^2$$

- Sadece "ω" hepinde
görs.

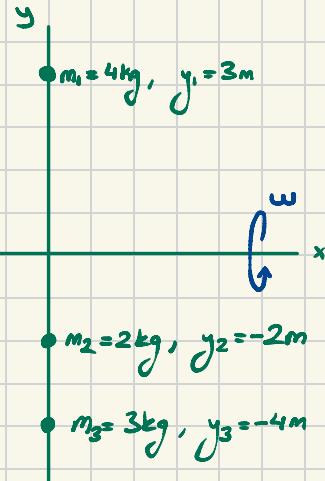
$$\int r^2 dm = I$$

- eylemsizlik momenti

$$K = \frac{1}{2} I \omega^2$$

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

İoru:



$$w = 2 \text{ rad/s}$$

Sistemin kinetik enerjisi kaç $J = ?$

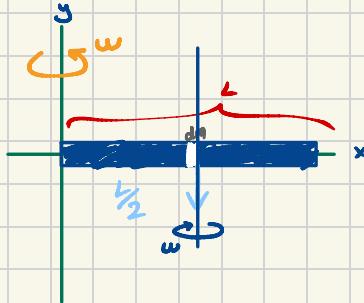
$$K = \frac{1}{2} I w^2$$

$$I = \sum_i m_i r_i^2 \text{ ise,}$$

$$\frac{4.9}{36} + \frac{2 \cdot 4}{8} + \frac{3 \cdot 16}{48} = 92 \text{ kg.m}^2$$

$$\frac{1}{2} 92 \cdot 2^2 = 184 \text{ J}$$

İoru:



$$I = \int x^2 dm$$

$$dm = \frac{M}{L} \cdot dx$$

$$I = \int_0^L x^2 \frac{M}{L} dx$$

$$\left. \frac{x^3}{3} \right|_0^L = \frac{L^3}{3} \cdot \frac{M}{L} = \frac{ML^2}{3}$$

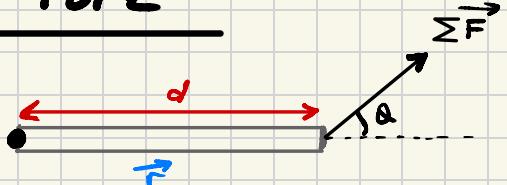
Eylemsizlik momenti nedir?

$$I = \int x^2 dm$$

$$I = \frac{1}{3} ML^2$$

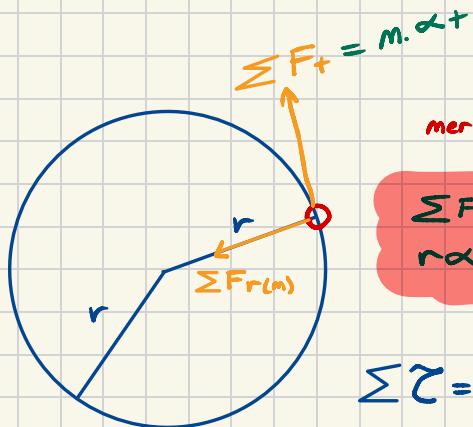
$$I = \lambda \cdot \frac{L^3}{3}$$

Tork



$$\vec{\tau} = (\sum F \cdot \sin \alpha) \cdot d$$

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



$$\sum F_r = m \cdot \alpha t$$

$$r \alpha = a t$$

$$\sum \tau = (m \cdot r^2) \alpha$$

$$\sum \tau = I \alpha$$

Juru: m küteli cubuk yatayda paralelken serbest bırakılır. Anteç aksiyal inmeyi ve cubugun en ucunun çizgisi bulunu.



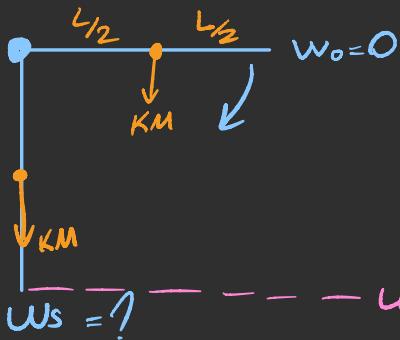
$$I = \frac{1}{3} m L^2$$

$$\tau = I \cdot \alpha = mg \cdot \frac{L}{2}$$

$$\frac{3g}{2k} \cdot k = \frac{3g}{2}$$

$$\frac{1}{3} m L^2 \cdot \alpha = mg \cdot \frac{L}{2}$$

$$\alpha = \frac{3g}{2L}$$



$$r. \omega = \sqrt{L}$$

$$\frac{L}{2} \cdot \sqrt{\frac{3g}{L}} = \sqrt{\omega_{KM}}$$

$$\sqrt{\frac{3g}{L}} = \sqrt{\omega_p}$$

$$\Delta E = 0$$

$$mgL = K + mg \frac{L}{2}$$

$$\frac{mgL}{Q} = K$$

$$\frac{mgL}{Z} = \frac{I}{Z} \omega_s^2$$

$$\frac{3mgK}{2IL^2} = \omega_s^2$$

$$\sqrt{\frac{3g}{L}} = \omega_s$$

Danen katı cismin özesindeki herhangi bir noktası bir sabit eksekle yelpaze, açının zamanla değişimi:

$$\theta = (5 + 10t + 2t^2) \text{ rad}$$

$$(t=3) \text{ sn igin}$$

acısal konum, hiz, ivme

$$\omega = 10 + 4t \rightarrow 22$$

$$\alpha = 4 \rightarrow \alpha = 4$$

$$\theta = 53 \text{ rad}$$

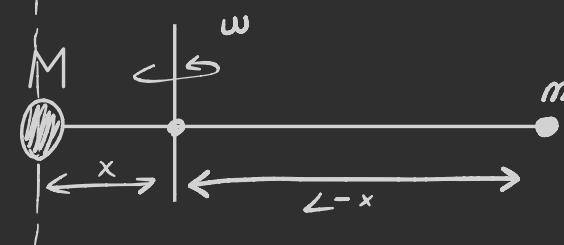
$$\alpha = (10 + 6t) \text{ rad/s}^2$$

$$10 + 6t = \frac{d\omega}{dt}$$

$$\omega(t) = (10t + 3t^2) \text{ rad/s}$$

$$\theta(t) = (5t^2 + t^3) \text{ rad}$$

$$\theta(4) = 144 \text{ rad}$$



$$I = M L^2 \quad M = \frac{M_m}{m+M}$$

$$M = \frac{Mm}{m+M}$$

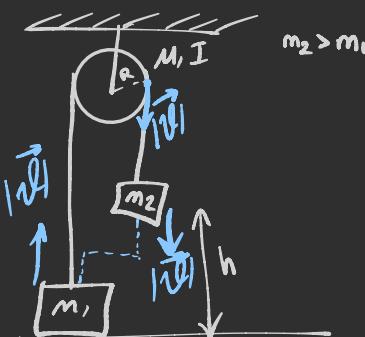
$$I = \sum_i m_i r_i^2$$

$$I = Mx^2 + m(L-x)^2$$

$$\frac{dI}{dx} = 2Mx + 2m(L-x)(-1)$$

$$Mx = ml - mx$$

$$x = \left(\frac{m}{m+n} \right) L$$



$$m_2 > m_1$$

$$m_2gh = \frac{m_2gh}{2} + \frac{m_1gh}{2} + \frac{m_1v^2}{2} + \frac{m_2v^2}{2} + \frac{Iw^2}{2}$$

✓ w = v

$$\sqrt{\frac{(m_2 - m_1)gh}{m_1 + m_2 + \frac{I}{R^2}}} = \mathcal{V}$$

$$8.40 = \underline{\underline{320}} J \quad \frac{2040.9}{2}$$

$$320 + 180 = \frac{500J}{25} = \frac{40J^2}{Z}$$

24 = 5

$$45.3 = \frac{62}{48.4}$$

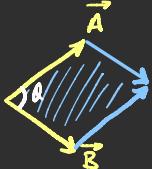
$$\vec{F}_1 \times \vec{r}_1 =$$

$$\begin{array}{r}
 \boxed{6} \\
 \times \begin{array}{r} 1 \\ 2 \\ 3 \\ 4 \\ \hline 1 \\ 2 \\ 3 \\ 4 \\ \hline \end{array} \\
 \hline
 \end{array}$$

Açısal Momentum

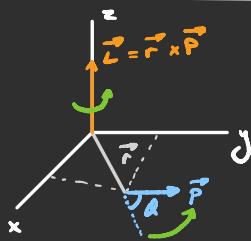
$$\vec{C} = \vec{A} \times \vec{B}$$

$$C = A \cdot B \cdot \sin \theta$$



$$*\vec{A} \times (\vec{B} \times \vec{C}) = \vec{A} \times \vec{B} + \vec{A} \times \vec{C}$$

$$*(\vec{A} \times \vec{B}) \frac{d}{dt} = \frac{d\vec{A}}{dt} \times \vec{B} + \vec{A} \times \frac{d\vec{B}}{dt}$$



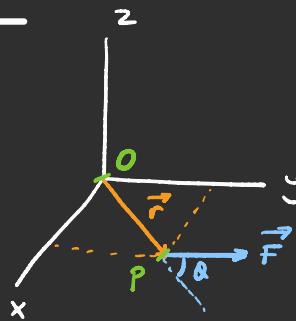
$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{p} = p_x\hat{i} + p_y\hat{j} + p_z\hat{k}$$

$$L_x = (y p_z - z p_y)$$

$$L_y = (z p_x - x p_z)$$

$$L_z = (x p_y - y p_x)$$



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

$$\sum \vec{\tau} = \frac{d}{dt} (\vec{r} \times \vec{P})$$

$$\Downarrow$$

$$\sum \vec{\tau} = \vec{r} \times \vec{P}$$

↓

$$\sum \vec{\tau} = \frac{d\vec{L}}{dt}$$

Sonuç

$$\vec{F} = (2\hat{i} + 3\hat{j}) N$$

$$\vec{r} = (4\hat{i} + 5\hat{j}) m$$

a) Net tork

$$\begin{vmatrix} 2 & j & k \\ 4 & 3 & 0 \\ 2 & 3 & 0 \\ i & j & k \\ 4 & 5 & 0 \end{vmatrix} = 12k$$

2k

Nektasal Parçacıklar ise

$$\vec{L}_{top} = \sum_i \vec{L}_i$$

Rijit Çism Açısal Momentumu

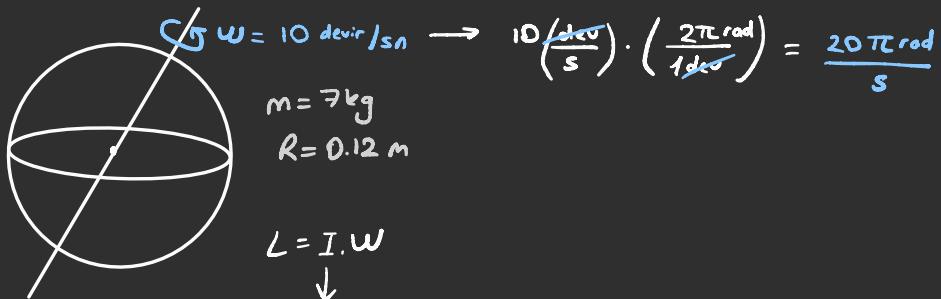
$$\vec{L}_i = \vec{r}_i \times \vec{p}_i$$

$$L_i = r_i \cdot \Delta m_i \cdot \dot{\theta}_i = r_i \cdot \Delta m_i \cdot r_i \cdot \omega$$

$$L_{top} \approx \left(\sum_i r_i \cdot \Delta m_i \right) \omega$$

$$L_{top} = \left(\lim_{\Delta m_i \rightarrow 0} \sum_i r_i^2 \Delta m_i \right) \omega$$

$$L_{top} = \left(\int r^2 dm \right) \cdot \omega \Rightarrow L = I \cdot \omega$$



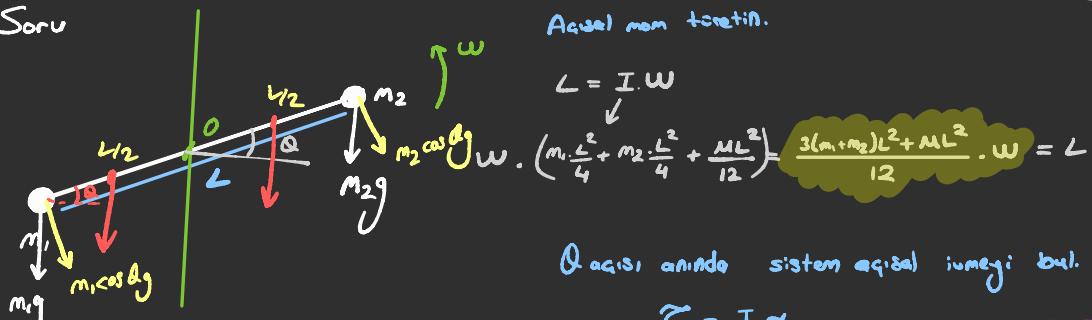
$$L = I \cdot \omega$$

↓

$$\frac{2}{5} \cdot 7 \cdot (0.12)^2 \cdot 20\pi =$$

$$\frac{2.53 \text{ kg} \cdot \text{m}^2}{\text{s}} =$$

Soru



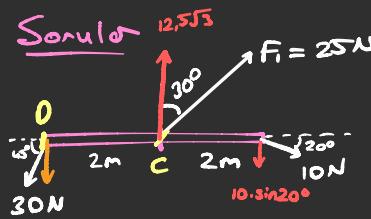
Q. aq. işi, anında sistem aq.şal iumeğ: bul.

$$Z = I \cdot \alpha$$

$$|m_1 \cos \alpha g - m_2 \cos \alpha g| = \frac{3(m_1+m_2)L^2 + ML^2}{12} \cdot \alpha$$

$$\sum \vec{Z} = \frac{d \vec{L}}{dt}$$

$$\sum \vec{Z} = 0 \text{ ise aq.şal momentum sabit}$$



xy düzleminde hareket eder
 $1,5 \text{ kg}$ küteli cisimin hiz vektörü
 $(4,2\hat{i} - 3,6\hat{j}) = \vec{v}$

Orjinden çizilen konum vekti $= (1,5\hat{i} + 2,2\hat{j})$

-Açıklar Momen?
 $L = I \cdot \omega$
 $L = \vec{r} \times \vec{P}$
 $\vec{P} = (6,3\hat{i} - 5,4\hat{j})$
 $\vec{r} = (1,5\hat{i} + 2,2\hat{j})$
 $\vec{L} = -20,43\hat{k}$

 $L = I \cdot \omega = \vec{r} \times \vec{P}$

$mV = (m+M) \dot{\theta}_{kop}$

$$\frac{mV}{m+M} = \dot{\theta}_{kop}$$

$$\boxed{(m+M) \dot{\theta}_{kop} \cdot l}$$
 $r \omega = \dot{\theta}$
 $\omega = \frac{\dot{\theta}}{r}$

Statik Denge ve Esneklik

- * Tüm kuvvetlerin bileskesi sıfır ise cisim dengedir.

$$\sum F = 0$$

durum
sabit hızlı

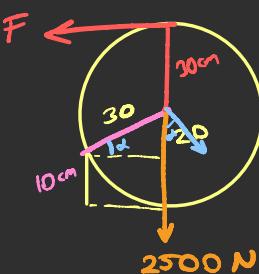
- * Statik = Durgun

Cisim → noktasal $\rightarrow \sum F = 0$ geterlidir.
 Cisim → rıgit (gerçek) $\rightarrow \sum F = 0$ ve cismin herhangi bir noktaya göre torku sıfır olmalıdır.

öteleme dengesi

$$\begin{aligned}\vec{\Sigma} &= \vec{F} \cdot d \quad (\vec{F} \perp d) = \vec{F} \times \vec{d} \\ \vec{\Sigma} &= \vec{F} \cdot d \cdot \sin\alpha\end{aligned}$$

dönme dengesi



$$SOF =$$

Esneklik

- * Gerçekte bütün cisimler bozunmaya uğrar.



- * Her bir rıgit cisim, işin kuvvetlere karşı belirttiğim dirence ve rıgitliğini koruma gücü vardır.
- Dirence noktasının dayanımız ise kırılma bölgесine uğrar.

Esneklik Modülü

- * Young modülü : koton uzaklığında bir değişimde karşı getirilen direnç orası.

- * Kesme sabiti : Karbon, atomik düzeylerde birbirini üzerinde kaynat -eine kesme- ortaya çıkan direnç

- * Hasım modülü : Hasım değişikliklerinde gelebilecek direnç ölçüsü

$$F_S = -k \cdot x$$

$$x = A \cdot \cos(\omega t + \phi)$$

$$T = \frac{2\pi}{\omega}$$

mots. gerilik

$$a_{max} = Aw^2$$

$$v_{max} = Aw$$

$$v(t) = -A \cdot \omega \cdot \sin(\omega t + \phi)$$

$$a(t) = -A \cdot \omega^2 \cdot \cos(\omega t + \phi)$$

yay-kötür

$$2\pi \sqrt{\frac{m}{k}} = T = \frac{2\pi}{\omega}$$

anlık kuvvet uygulanrsa
aciseli momentum korur.

ilerleyen cisim
hayatda da giderken
 $f=0$

Gizisel

$$m\ddot{\theta}_0 = m\ddot{\theta} + mWr$$

$$= mwd + MWr$$

$$\ddot{\theta} = \frac{mwd + MWr}{M+m}$$

$$\frac{(1/3ML^2 + md^2)\omega^2}{d} = \omega^2(Md + Mr)$$

$$\frac{1/3ML^2 + md^2}{d} = mr\ddot{\theta} + \frac{ML}{2}\ddot{\theta}$$

$$\frac{1/3M}{d} = \frac{ML}{2}$$

$$d = \frac{2L}{3}$$

$$\frac{Ac. sa)}{Li = Ls} \quad L = r \times P$$

$$m\ddot{\theta}_0 = I_a \cdot \ddot{\theta}$$

$$m\ddot{\theta}_0 = \frac{(1/3ML^2 + md^2)}{d} \cdot \omega$$