PHYSICS

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  21. şube

Object — Motion of object — Interaction of Object with environment

Particles → dm
⋮ } $\int dm = M$
planets

Motion of object: translational, rotational

Interaction of Object with environment ↓ Force

$m = 50\,kg$

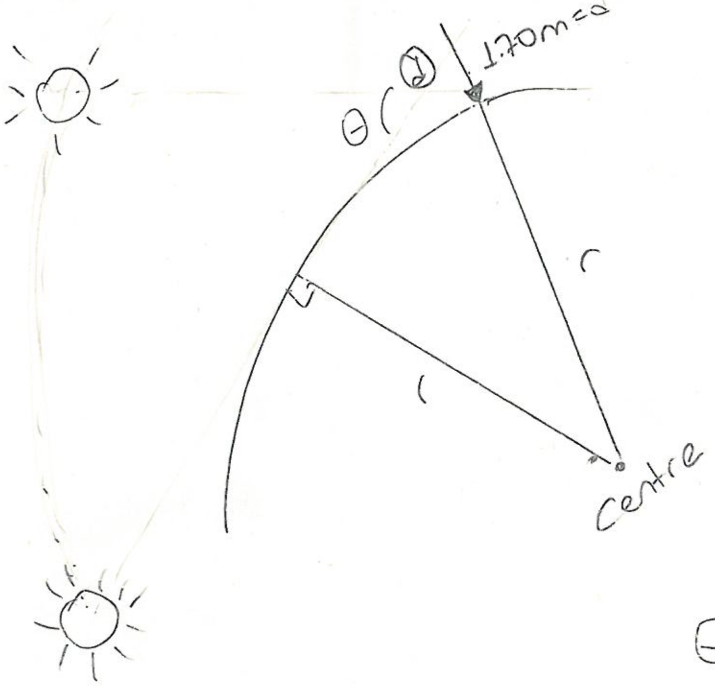
$W \cong 500N$ ya da $kg\,m/s^2$

$W = F.x$

$\tau = F \times x$

Solid angle?
↳ steradian

Let's measure the radius of our Earth



$d^2 + r^2 = (r+h)^2$

$d^2 + \cancel{r^2} = \cancel{r^2} + 2hr + h^2$ → Buniye gitti?

$d^2 = 2hr$

$\frac{\theta}{360^\circ} = \frac{t}{24h}$

$\frac{\theta}{360^\circ} = \frac{t}{24h}$

$\theta = \frac{(360^\circ)(11,5)}{(24h)(60 min/h)}$ → 60s/min

$\theta = 0,04625^\circ$

$\tan\theta = \frac{d}{r}$ $d^2 = 2hr$

$r = \frac{2h}{\tan^2\theta}$

$= \frac{2(1,70)}{\tan^2\theta}$

$6,37 \times 10^6 m$

$= 5,22 \times 10^6 m$

IMPORTANT

$\hat{i} \times \hat{j} = \hat{k}$ — i'den başla sonuç k

j'den " " i

k " " " j

6 EKİM SALI 2016

VECTORS

Adding

Multiplying vectors → scaler product

$\vec{a}.\vec{b} = |\vec{a}|.|\vec{b}|.\cos\theta$ → a comp along b.

$\neq 0$

→ vector product

What is θ between $\vec{a}$ and $\vec{b}$

$\vec{a} = 3\hat{i} - 4\hat{i}$ $\quad \vec{b} = -2\hat{i} + 3\hat{k}$

$\hat{i}.\hat{i} = 1$

$\hat{j}.\hat{j} = 1$

$\hat{k}.\hat{k} = 1$

$\cos\theta = \dfrac{\vec{a}.\vec{b}}{|\vec{a}|.|\vec{b}|} = \dfrac{-6}{18}$

$\theta = 108°$

$\vec{a}.\vec{b} = \underbrace{\sqrt{3^2+4^2}}_{|\vec{a}|} . \underbrace{\sqrt{2^2+3^2}}_{|\vec{b}|} . \cos\theta$ $\quad -6$

-6 $\qquad 18$

$\vec{a} = 4\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{b} = -\hat{i} + \hat{j} + 4\hat{k}$

Find a vector $\vec{c}$ such that $\vec{a} - \vec{b} + \vec{c} = 0$

$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$

$\quad 4 \qquad -3 \qquad 1$

$4\hat{i} - 3\hat{j} + k + \hat{i} - \hat{j} - 4\hat{k} + C_x\hat{i} + C_y\hat{j} + C_z\hat{k} = 0$

$\underbrace{(4 + 1 + C_x)}_{0} + \underbrace{(-3 - 1 - C_y)}_{0}\hat{j} + \underbrace{(+1 - 4 + z)\hat{k}}_{0} = 0$

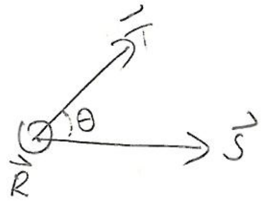
$C_z = 3$

$C_y = 4$

$C_x = -5$

$\vec{c} = -5\hat{i} + 4\hat{j} + 3\hat{k}$

④



$\theta \neq 90^\circ$

a) $|\vec{R}| = |\vec{S}|\,|\vec{T}|\,\sin\theta$

b) $-\vec{R} = \vec{T} \times \vec{S}$

c) $\vec{e} \cdot \vec{S} = 0$

d) $\vec{R} \cdot \vec{T} = 0$

e) $\vec{S} \cdot T = 0$

kesinlikle yalnış?

$\hat{i}, \hat{j}, \hat{k}$

$\underline{\underline{e}}$ / açı 90 değil.

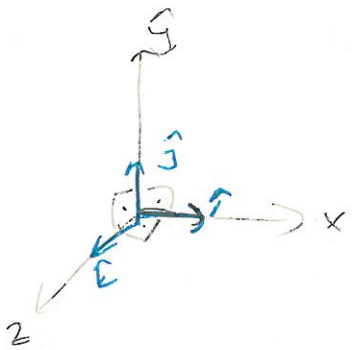
a, b, c, d

a: yönler ters uyuyor

b: ters çevirdir

c: 90°

d: 90



$|\vec{a} \times \vec{b}| = |\vec{a}| \cdot |\vec{b}| \cdot \sin\theta$

$|\hat{i} \times \hat{j}| = 1 \cdot 1 \cdot \sin 90^\circ$

$= 1.$

$\hat{i} \times \hat{j} = \hat{k}$

$\hat{j} \times \hat{k} = \hat{i}$

$\hat{k} \times \hat{i} = \hat{j}$

$\vec{a} \times \vec{b} = (a_x \hat{i} + a_y \hat{j} + a_z \hat{k}) \times (b_x \hat{i} + b_y \hat{j} + b_z \hat{k})$

$= a_x b_y \hat{k} + a_x b_z (-\hat{j}) + a_y b_x (-\hat{k}) + a_y b_z \hat{i} + a_z b_x \hat{j} + a_z b_y (-\hat{i})$

$= \underbrace{(a_y b_z - a_z b_y)}_{C_x} \hat{i} + \underbrace{(a_z b_x - a_x b_z)}_{C_y} \hat{j} + \underbrace{(a_x b_y - a_y b_x)}_{\underbrace{C_z}} \hat{k}$

$\vec{C_z} = C_z \hat{k}$

$$\vec{C} = \vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

$\hat{i} \quad \hat{j} \quad \hat{k}$ ← yok.

$a_x \quad a_y \quad a_z$

$a_y b_z \hat{i} + a_x b_y \hat{k} + b_x a_z \hat{j}$

$- a_y b_x \hat{k} - a_z b_y \hat{i} - a_x b_z \hat{j}$

$=$

1f $\vec{c} = \vec{a} \times \vec{b}$

$\vec{a} = 3\hat{i} - 4\hat{j}$

$\vec{b} = -2\hat{i} + 3\hat{k}$

$c \rightarrow -12i - 9\hat{j} - 8\hat{k}$

$\vec{a} = 3\hat{i} + 3\hat{j} - 2\hat{k}$

$\vec{b} = -\hat{i} - 4\hat{j} + 2\hat{k}$

$\vec{c} = 2\hat{i} + 2\hat{j} + \hat{k}$

a) $\vec{a} \cdot (\vec{b} \times \vec{c}) \Rightarrow \vec{b} \times \vec{c}$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -1 & -4 & 2 \\ 2 & 2 & 1 \\ i & j & k \\ -1 & -4 & 2 \end{vmatrix}$$

b) $\vec{a} \, (\vec{b} + \vec{c})$

c) $\vec{a} \times (\vec{b} + \vec{c})$

$= -4\hat{i} - 2\hat{k} + 4\hat{j} + 8\hat{k} - 4\hat{i} + \hat{j}$

$= -8i + 5\hat{j} + 6\hat{k}$

a) $\vec{a} \cdot (-8i + 5\hat{j} + 6\hat{k})$

$= -24 + 15 - 12$

$= -21$

HOMEWORK!

b) $\vec{a} \cdot (\vec{b} + \vec{c}) = -9$

c) $a \times (\vec{b} + \vec{c}) = 5\hat{i}, -11\hat{j} - 9\hat{k}$

MOTION ALONG A STRAIGHT LINE

Kinematic's

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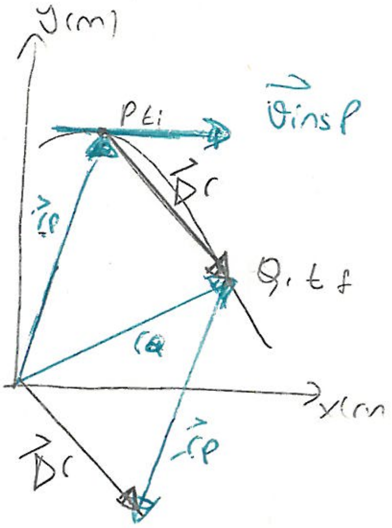


→ 1) Herhangi bir parçacığın yörüngesi.

Çünkü konum, konum ile ilişkili!

$$\Delta \vec{r} = \vec{r}_{final} - \vec{r}_{initial}$$
$$= \vec{r}_Q - \vec{r}_P$$

AVERAGE VELOCITY ⇒ $\vec{\vartheta}_{ort} = \dfrac{\Delta \vec{r}}{\Delta t}$ $\qquad \vec{\vartheta}_{ins} = \lim\limits_{\Delta t \to 0} \dfrac{\Delta \vec{r}}{\Delta t}$

$$\vec{\vartheta}_{ins} = \frac{d\vec{r}}{dt} \qquad \vec{\vartheta}_{av} = \frac{\vec{r}_Q - \vec{r}_P}{t_f - t_i}$$

$$a = \frac{\vartheta_f - \vartheta_i}{t_f - t_i} = \frac{\vartheta - \vartheta_0}{t - 0}$$

↓ Average Acceleration.

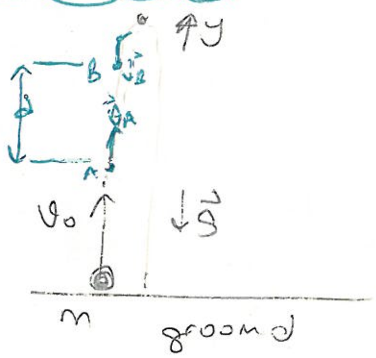
↳ $\boxed{\vartheta = \vartheta_0 + at}$

$$\frac{dx}{dt} = \vartheta_0 + \frac{d^2x}{dt^2}\, t$$

$$x - x_0 = \vartheta_0 t + \frac{1}{2} a t^2$$

$$x = x_0 + \vartheta_0 t + \frac{1}{2} a t^2$$

$$\frac{dx}{dt} = \vartheta = 0 + \vartheta_0 + \frac{1}{\cancel{2}} a \cancel{2} t$$
$$= at + \vartheta_0$$



$$y = y_0 + \cancel{\vartheta_0 y} - \frac{1}{2} g t^2$$
0

$$\vec{r} = \vec{r}_0 \pm \vartheta_0 t \pm \frac{1}{2} a t^2$$
↳ $\vec{a} = a_x \hat{i} + a_y \hat{j} + a_z \hat{k}$

$$\vartheta_{yf}^2 - \vartheta_{yi}^2 = 2a_y (y_f - y_i)$$

$$\vartheta_B^2 - \vartheta_A^2 = 2g\,d$$

HOMEWORK

$\vec{a} = 3\hat{i} + 3\hat{j} - 2\hat{k}$

$\vec{b} = -\hat{i} - 4\hat{j} + 2\hat{k}$

$\vec{c} = 2\hat{i} + 2\hat{j} + \hat{k}$

$\boxed{\cos\theta = \dfrac{\vec{a}\cdot\vec{b}}{|\vec{a}|\,|\vec{b}|}}$

$\vec{a}(\vec{b}+\vec{c})$

$(\vec{a}\vec{b} + \vec{a}\cdot\vec{c})$

$-3 \; -1\cancel{2} - \cancel{4} + \cancel{6} + \cancel{6} - 2 = -9$
$\quad -6$

$\vec{a}\times(\vec{b}+\vec{c})$

$\vec{a}\times\vec{b} + \vec{a}\times\vec{c}$

$$\left|\begin{matrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 3 & -2 \\ -1 & -4 & +2 \\ i & j & k \\ 3 & 3 & -2 \end{matrix}\right| \qquad \left|\begin{matrix} i & j & k \\ 3 & 3 & -2 \\ 2 & 2 & 1 \\ i & j & k \\ 3 & 3 & -2 \end{matrix}\right|$$

$6\hat{i} - 12k + 2j$

$-(-3\hat{k} + 8i + 6j)$

$6i - 8i - 12k + 6k + 2j - 6j$

$(-2\hat{i} - 6k - 4j) + (-7i + 7j)$

$6k - 4\hat{i} + 3j - (3i + 6k - 4j)$

$-4\hat{i} - 3i + 3j + 4j + 6k - 6k$

?

VECTORS

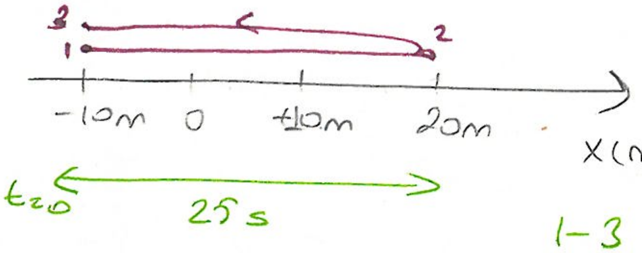
Motion along a straight line → 1D

2D, 3D

At rest $\vartheta_i = 0$

$x = -10\,m$ $t = 0$

$x = 20\,m$ $\Delta t = 25\,s$

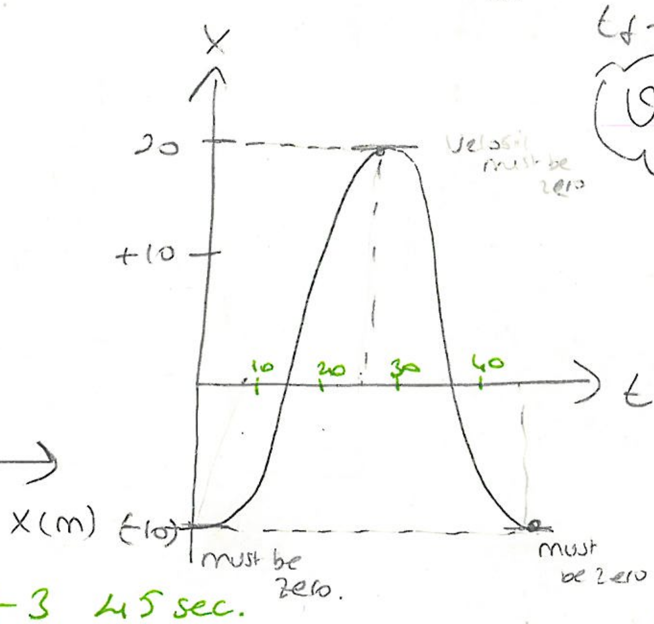


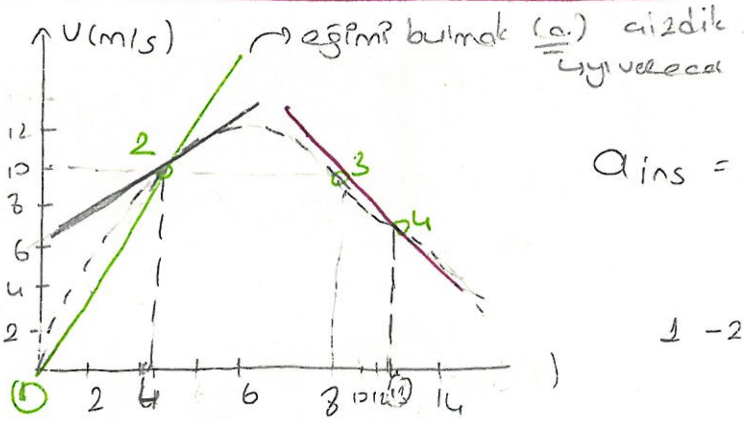
1–3 45 sec.

$x = -10\,m \quad (t = 0)$

$$\vec{\vartheta}_{av} = \frac{\vec{x}_f - \vec{x}_i}{t_f - t_i}$$

$$\vartheta_{ins} = \frac{dx}{dt} = 0$$





$$\vec{a}_{av} = \frac{\vec{\vartheta}_{final} - \vec{\vartheta}_{ins}}{t_f - t_i}$$

$$a_{ins} = \frac{d\vartheta}{dt} \qquad \Delta t \Rightarrow 0$$

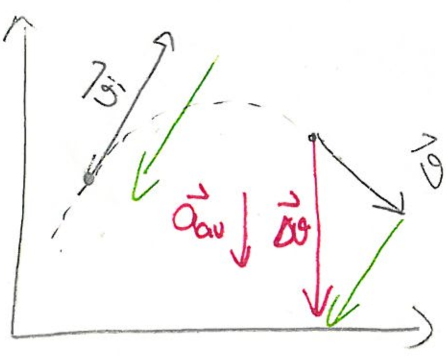
$$1-2 \quad a_{av} = \frac{\vartheta_2 - \vartheta_2}{t_2 - t_1} = \frac{10 - 0}{40} = 2{,}5\,m/s^2$$

$$2-3 \quad a_{av} = \frac{\quad}{\quad} = 0$$

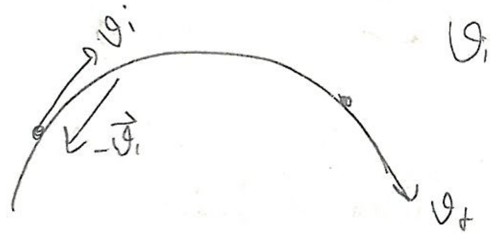
$$3-4 \quad a_{av} = \frac{\quad}{\quad} = \frac{v_4 - v_3}{t_4 - t_3} = \frac{8 - 10}{13 - 8} = 0{,}4\,m/s^2$$

HIZIN DEĞİŞİMİNİN YÖNÜ

İVMENİN YÖNÜDÜR.



$$a_{av} = \frac{\vec{\vartheta}_f - \vec{\vartheta}_i}{t_f - t_i}$$



$\vartheta_i = \vartheta_f$ $\quad \vec{a} \quad a$

$\vec{\vartheta}_i = \vec{\vartheta}_F$

IMPORTANT

$$\vec{\vartheta}_{av} = \frac{\overset{x_f}{x} - \overset{x_i}{x_0}}{\underset{t_i}{t} - 0}$$

$$a_{av} = \frac{\vartheta - \vartheta_0}{t - 0}$$

$$x = x_0 + v_{av} t$$

$$v_{av} = \frac{1}{2}(\vartheta + v_0)$$

$$\vartheta = v_0 + a_{av} t$$

$$t = \frac{\vartheta - v_0}{a}$$

$$v_{av} = \frac{1}{2}(v + v_0)$$

$$\boxed{x = x_0 + v_0 t + \frac{1}{2} a t^2}$$

$$\frac{dx}{dt} = 0 + v_0 + at = \boxed{\vartheta = \vartheta_0 + at}$$

$$= \boxed{\vartheta^2 - v_0^2 = 2a(x - x_0)}$$

time missing equation!

$$x = x_0 + v_{av} t$$

$$x = x_0 + \left[\frac{1}{2}(v_0 + \vartheta)\right] t$$

$$x = x_0 + \left[1 (v_0 + v)\right]\left(\frac{v - v_0}{a}\right)$$

$$x - x_0 = \frac{1}{2a}(v + v_0)(v - v_0)$$

$$x = x_0 \mp \vartheta_{ax} t \mp \frac{1}{2} a_x t^2$$

$$y = y_0 \mp v_{0y} t \mp \frac{1}{2} a_y t^2$$

$$\vartheta_x = \vartheta_{0x} \pm a_x t$$

$$\vartheta_y = \vartheta_{0y} \pm a_y t$$

$$\vartheta_z = \vartheta_{0z} \pm a_z t$$

$$\boxed{\vartheta_{fx}^2 - \vartheta_{ix}^2 = 2a_x \overbrace{(x_F - x_i)}^{\Delta x}}$$

$$\vartheta_x^2 - \vartheta_0^2 =$$

SABİT İVMELİ

$$a = \frac{dv}{dt}$$

$$dv = a\,dt$$

$$\int dv = \int a\,dt$$

$$v = at + c \quad \swarrow \text{const.}$$

$$t=0 \Rightarrow v_0 = c = v$$

↑ initial velocity

$$v = v_0 + at \qquad v = \frac{dx}{dt}$$

$$\int dx = \int (v_0 + at)\,dt$$

$$x = \underbrace{v_0 t + \frac{1}{2} a t^2}\ + c$$

$$t=0 \Rightarrow x = x_0 = c$$

$$t=0 \Rightarrow x = x_0 = c$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2 \quad //$$

After spotting a police car, you brake a Porsche from 75 km/h to 45 km/h over a displacement of 88m.

a) what is acc? (assume $\vec{a}$ = const) (m/s² unit?)

b) What is the elapsed time?

c) If you continue to slow down with the acc. Calculated in a, how much time will elapse in bringing the car to rest from 75 km/h?

d) In (c) what distance will be covered?

$$\Delta x = x - x_0 = 88\ m$$

$$1{,}6\ m/s^2$$

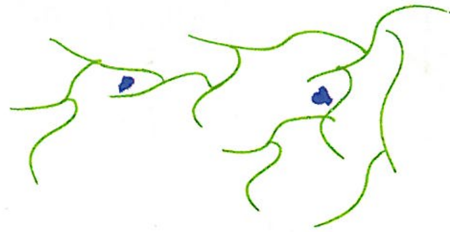
$$v_{x_f}^2 - v_{x_i}^2 = 2a_x \underbrace{(x_f - x_i)}$$

çevir

$$a_x = \frac{(45\ km/h)^2 - (75\ km/h)^2}{2(88 \times 10^{-3}\ km)} \cong -2 \times 10^4\ km/h^2$$

$$=$$

$t = \frac{v - v_0}{a}$ or $t = \frac{2(x-x_0)}{v_0+v}$



$$t = \frac{45-75}{-(2\times10^{4})} = 15\times10^{-4}$$

$\simeq$ 5 sec

c) Hareket devam ediyor. Duruncaya kadar.

$t = \frac{v^0 - v_0}{a}$ $\vec{a} = \frac{\vec{v}_F - \vec{v}_i}{\vec{a}}$ $\vec{a} = \frac{\vec{v}_F - \vec{v}_i}{\Delta t}$ negatif old. kaç veriyorsun..

$$= \frac{-75}{-2} \simeq 4\times10^{-3}\ h$$

≈ 13 s.

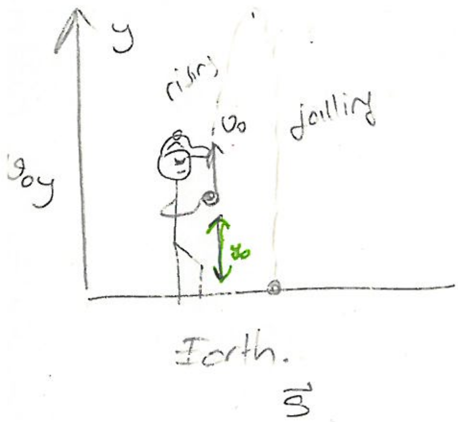
FREE FALLING

d) 0.133 m
↳ HOMEW

$\vec{F} = \frac{G m_E m}{r_E^2} \rightarrow |\vec{g}|$ $= m\vec{g}$

$|\vec{g}| = 10 m/s^2$

$= 9.8 m/s^2$



rising

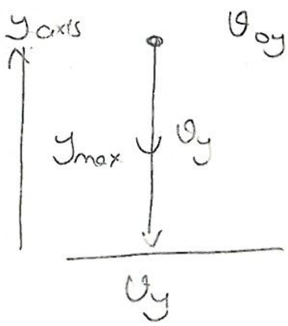
$y = y_0 \pm v_{0y} t \mp \frac{1}{2} g t^2$

$= y_0 + v_{0y} t - \frac{1}{2} g t^2$

$v_y = v_{0y} - gt = 0$ at $y = y_{max}$

$t_{rising} = \frac{v_{0y}}{g}$

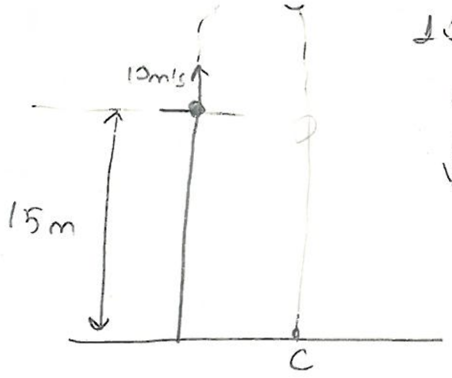
falling



$y = y_{max} - \frac{1}{2} g t^2 = 0$ herhangi bir zamanda kolay bulması yolu.

↳ t falling

Thoughts and words



10 m/s initial velocity.

$\updownarrow t_{rising}$

a) h_{max}?

b) $\vec{v}_c = ?$

c) total flight time?

$$v_0 = v_{0y}$$

$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

y_{max} ← y; 15m ← y_0; t_{rising} ← t

a) $y_{max} = 15 + 10\left(\frac{10}{10}\right) - \frac{1}{2}10\,10^2$ for y_{max}

$= 20m.$

$$v_y = v_{0y} - gt_{rising} = 0$$

$$t_{rising} = \frac{v_{0y}}{g}.$$

b) $v_f^2 - v_i^2 = 2g\Delta y$

$v_c^2 = 2g\Delta y$

$= 2(10)(20)$

$v_c = 20 \text{ m/s}$

$\vec{v}_c = -20\hat{j} \text{ m/s}$

c) $v_y = v_{0y} - gt$

$-20 = 10 - 10t$

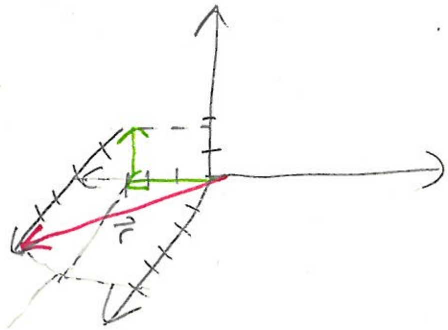
$\hookrightarrow t_{total} = \frac{30}{10} = 3 \text{ sec.}$

MOTION IN 2 & 3 DIMENSIONS

x
y
z

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

$\vec{r} = r_x\hat{i} + r_y\hat{i} + r_z\hat{k}$



$\vec{r} = -3\hat{i} + 2\hat{j} + 5\hat{k}$

$\vec{r_f} = 2\hat{i} + \hat{j} - 3\hat{k}$

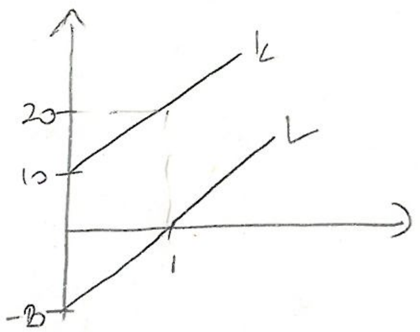
$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$

$v = v_x\hat{i} + v_y\hat{j} + v_z\hat{k}$

$$v = \frac{\Delta r}{\Delta t}$$

$$\vec{v} = \frac{\vec{r_f} - \vec{r_i}}{\Delta t}$$

In a straight road, two cars K and L move with constant velocities. You may see the position. In which second, they will be in the parallel position



$X = X_0 + Vt$

$X_K = 10 + \frac{\Delta x}{\Delta t} t$

$= 10 + \frac{(20-10)}{1} t$

$X_K = 10 + 10t$

$X_L = -20 + Vt$

$= -20 + \frac{\Delta x}{\Delta t} t$

$= -20 + \frac{(0+20)}{1} t$

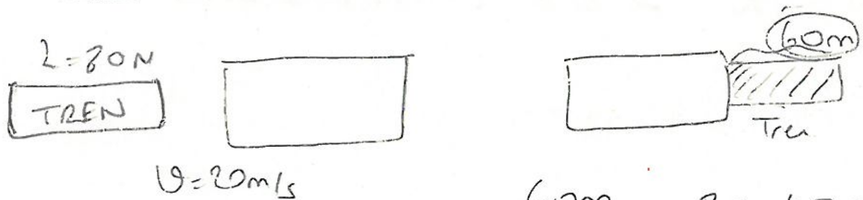
$= -20 + 20t$

$X_L = 20t - 20.$

$X_K = X_L \Rightarrow -20 + \cancel{20}t = 1\cancel{0}t + 10$ 10

$10t = 30 \quad t = 3s$

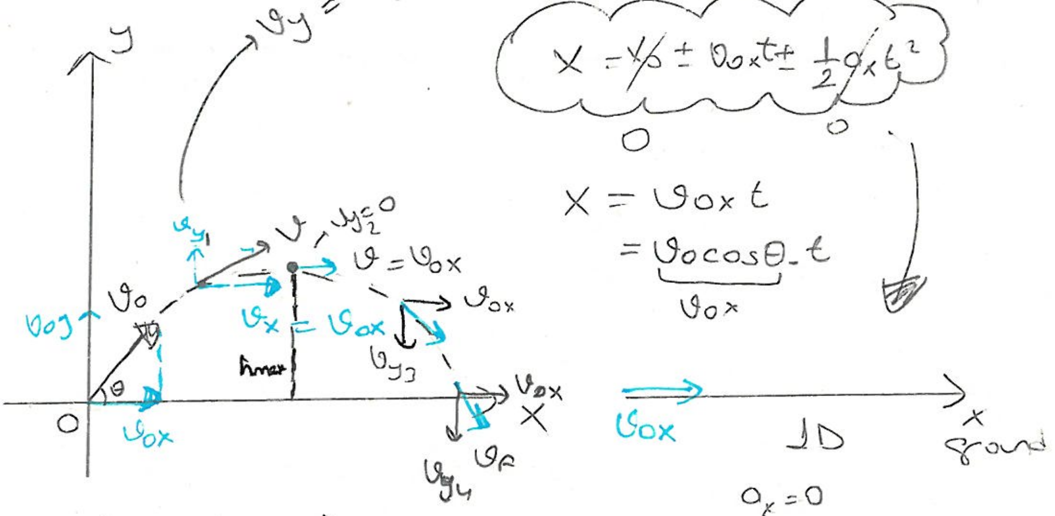
A train passing a tunnel with a constant velocity of 20 m/s During this motion, The end part of the train is going in the tunnel while the front part removes from the tunnel during 3 seconds. Find the length of the tunel.



60m $\quad 80 - 60 = 20$

A ba

2D Motion



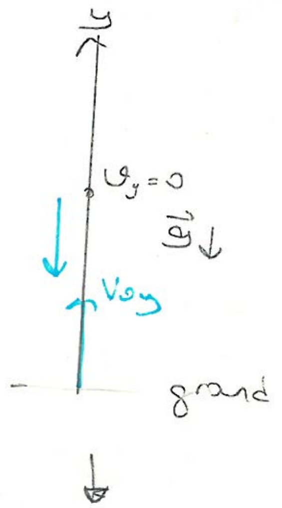
$$x = \cancel{x_0} \pm v_{0x}t \pm \frac{1}{2}\cancel{a_x}t^2$$

0 0

$$x = v_{0x}t = \underbrace{v_0\cos\theta}_{v_{0x}} \cdot t$$

1D

$a_x = 0$



$$y = \cancel{y_0} \pm v_{0y}t \pm \frac{1}{2}g_y t^2$$

0

$$\frac{dy}{dt} = v_y = v_{0y} - gt = 0 \Longleftarrow \boxed{y = v_{0y}t - \frac{1}{2}g_y t^2}$$

t_{rising}

$$y = v_0 \sin\theta\, t - \frac{1}{2}g_y t^2$$

$$v_y^2 - v_{0y}^2 = 2g(y - y_0) \leftrightarrows \underbrace{(y - y_0)}_{h_{max}} = \frac{(v_0\sin\theta)^2}{2g}$$

v_y: 0 at hmax

v_{0y}: $v_0 \sin\theta$

TRAJECTORY INFORMATION ABOUT PROJECTILE MOTION

$y = f(x)$

$$t = \frac{x}{v_0\cos\theta}$$

$$y = v_0\sin\theta\, t - \frac{1}{2}gt^2$$

$$y = v_0\sin\theta \frac{x}{v_0\cos\theta} - \frac{1}{2}g\frac{x^2}{v_0^2\cos^2\theta}$$

$$y = \tan\theta\, x - \frac{g}{2v_0^2\cos^2\theta}x^2 \rightarrow \text{parabolic}$$

$$y = ax - bx^2$$

MENZIL

$$x - x_0 = (v_0\cos\theta)\,t = R$$

$$y - y_0 = (v_0\sin\theta)\,t - \frac{1}{2}gt^2$$

$$\underbrace{\left(v_0\sin\theta - \frac{1}{2}gt\right)}_{=0} \cdot \underbrace{t}_{=0} = 0$$

$$t_{flight} = \frac{2v_0\sin\theta}{g}$$

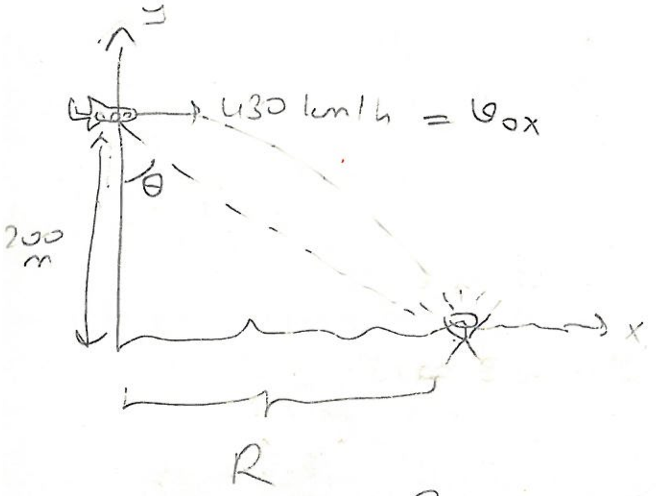
$$R = v_0\left(\cos\theta \frac{2v_0\sin\theta}{g}\right) \rightarrow \sin 2\theta$$

$$R = \frac{v_0^2\sin 2\theta}{g} \rightarrow 2\theta = 90^\circ \quad \theta = 45^\circ$$

EXAMPLE

A resque plane is flying at a constant elevation of 1200 m. with a speed of 430 km/h toward a point directly over a person strugsling in the water
Çırpınan

At the what angle of sight θ should the pilot release a resque capsule if it is to strike (very close to) the person in the water?



$\tan\theta = \dfrac{R}{1200\,m} \leftarrow ?$

$x = v_{0x} t$

$y = y_0 - \frac{1}{2} g t^2 \quad \swarrow V_{0y} = 0$

0

$t_{flish} = \sqrt{\dfrac{2y_0}{g}}$

$R = v_{0x} \sqrt{\dfrac{2y_0}{g}}$

$= (430\,km/h) \sqrt{\dfrac{2(1200)}{9{,}8\,m/s^2}}$

$R = 1865\,m$

$\tan\theta = \dfrac{1865}{1200} \rightarrow \arctan\theta \cong \theta = 57°$.

$\boxed{t_{flish} = \dfrac{2 v_0 \sin\theta}{g}}$

Stuntman → dublör.

Can he make the jumb

$h = \frac{1}{2} g t^2$

$4{,}8 = \frac{1}{2} g t^2$

$\dfrac{9{,}6}{g} = t^2$

$9{,}8$

$0{,}99\,s.$

$R = v_0 \cdot \cos\theta\, t$

1

$v_0 t$

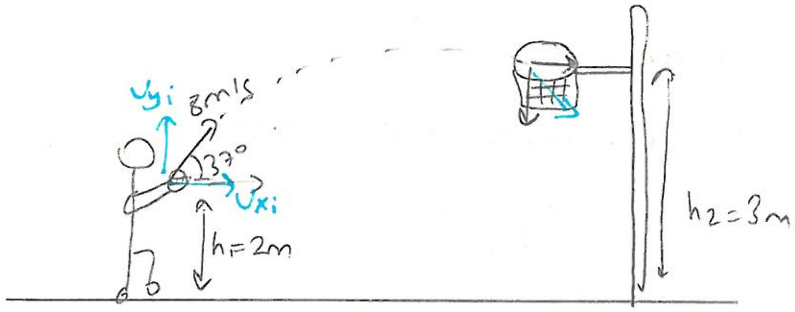
$= (4{,}5\,m/s)\ (0{,}99)$

$R \cong 4{,}5\,m$

$R < 6{,}2$

WASTED !

#



Find the velocity at basket

$v_f^2 - v_i = \pm 2a$ (displacement)
(final-intial)

$v_{yf}^2 - v_{yi}^2 = -2g\,(\underbrace{y_{final}}_{h_2} - \underbrace{y_{initial}}_{h_1})$

$v_{yf}^2 - [8\sin(37°)]^2 =$

$-2(9,8(3-2))$

$v_{yf} = \sqrt{3}$ m/s

$v_{xi} = 8 \cdot \cos 37$
$= 6,4$ m/s.

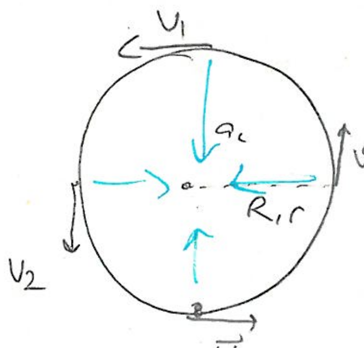
UNUTMA!!

vektörel yazım.

$\vec{v}_f = 6.4\hat{i} - \sqrt{3}\hat{j}$ m/s

$\tan\alpha = \frac{v_{xi}}{v_{yf}} = \frac{6.4}{\sqrt{3}} \Rightarrow \alpha = 74.8°$

UNIFORM CIRCULAR MOTION



$v = |\vec{v}_1| = |\vec{v}_2|$ ---- linear velocity

R - radius of paticular

t → time

T → period - time interval for a revolution second

f = frequency - the number of the

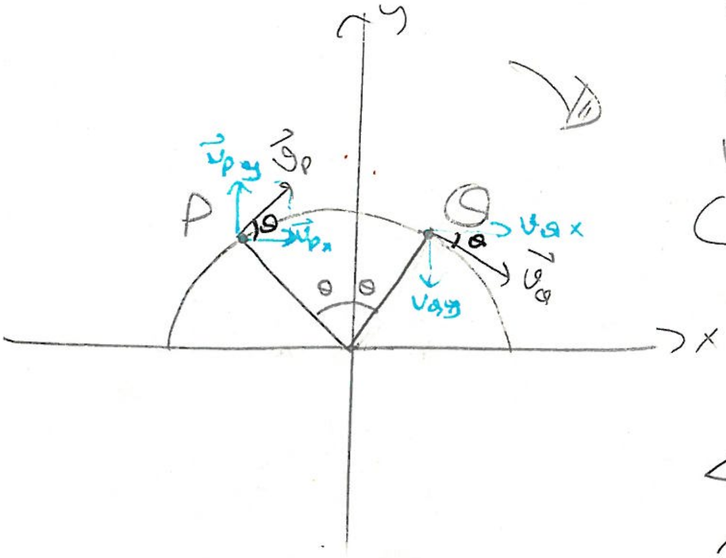
$f = \frac{1}{T}$

$a = \frac{v^2}{R}$ → centripetal acceleration.
→ sadece büyüklüğü
yönü hep merkeze doğru.

$w = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T}$

$v = \frac{\Delta(\text{arclength})}{\Delta t} = \frac{2\pi R}{T}$ m/s

$\vec{v} = w \cdot R$
→ linear velocity.



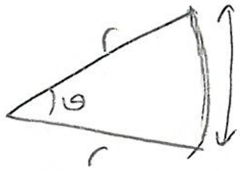
$v_{Px} = v_P \cos\theta = v \cos\theta$

$v_{Py} = v_P \sin\theta = v \sin\theta$

$v_{Qx} = v_Q \cos\theta = v \cos\theta$

$v_{Qy} = v_Q \sin\theta = v \sin\theta$

↳ has negatif direction.

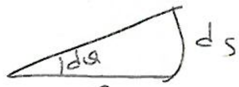


length of thory = S

$r\theta = S$

$$v = \frac{\Delta(\text{length})}{\Delta t}$$

$$\Delta t = \frac{\Delta(r\theta)}{v}$$



$r\,d\theta = ds$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t_f - t_i} \qquad \vec{v}_Q - \vec{v}_P$$

↳ average.

$v_{Qx} - v_{Px}$

$v_{Qy} - v_{Py}$

$$\vec{a} = \frac{\Delta v_x \hat{i} + \Delta v_y \hat{j}}{\Delta t}$$

$$a_{xav} = \frac{v_{Qx} - v_{Px}}{\Delta t} = \frac{v\cos\theta - v\cos\theta}{\Delta t} = 0$$

$$a_{yav} = \frac{v_{Qy} - v_{Py}}{\Delta t} = \frac{-v\sin\theta - v\sin\theta}{\Delta t} = \frac{-2v\sin\theta}{\Delta t}$$

$$= \frac{-2v\sin\theta}{2r\theta / v} \qquad \frac{2\theta r}{v}$$

$$a_{yav} = -\left(\frac{v}{r}\right)\left(\frac{\sin\theta}{\theta}\right)$$

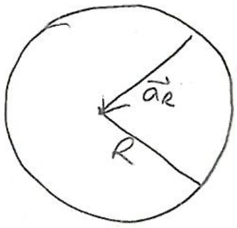
↳ $a_{ins} = \frac{v^2}{r}$

merkez kaç diye bir şey yok
sonra etki tepkide görücek
(her önemisi farklı nesnelere etki edecek.

$f = \frac{1}{T}$ 4/6

16 EKİM CUMA
2015

$v = \frac{\text{displacement}}{\Delta t} = \frac{2\pi r}{T} = wr.$



diameter 20m
constant speed

a) $\vec{v} = ?$, $w = ?$
$\vec{a} = ?$ $\rightarrow$ $w = 2\pi f$
centripete

$\frac{1}{T} \leftarrow f$ { $\Delta t = 4$ seconds
8 rotations are occurred.

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

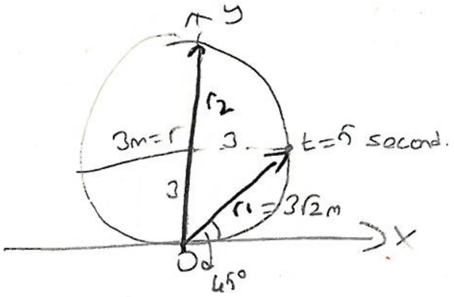
$w = \frac{2\pi}{T}$

$f = \frac{8}{4} = 2\, s^{-1}$

$v = 2\pi f R = wR = 120 m/s$

$w = 2\pi f = 2\pi 2 \cong 12 rad/s$

$a = \frac{v^2}{R} = \frac{(120)^2}{10} = 1440 m/s^2$



1 revolution 20 s
$\Downarrow$
T

a) what are particle's position vectors at

$t = 5$ second 1 pos
$t = 10$ second 2 pos

$\vec{r}_1 =$ $\vec{r}_1 = [3\sqrt{2} \cos 45°]\hat{i} + [3\sqrt{2} \sin 45]\hat{j}$ m
$\hookrightarrow$ scaler compenent of r_x

$\vec{r}_2 = 6\hat{j}\, m.$

b) $\Delta t = 5$ sec
Find displacement?
$0 \rightarrow 10$ sec
Av. velocity?

$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$
$\vec{r}_2 - \vec{r}_1 = -3\hat{i} + 3\hat{j}\, m$

$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = -0{,}6\hat{i} + 0{,}6\hat{j}\, m/s$

$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t} = a_x\hat{i} + a_y\hat{j} \longrightarrow |\vec{a}| = \sqrt{a_x^2 + a_y^2}$

RELATIVE MOTION

Frame
↳ gözlem noktası!

$\vec{v}_{LK} = ?$ $\vec{v}_{KL} = ?$

a) find the velocity of L respect to K.

b) " " " " K respect to L

↑ 5 m/s
K

L → 5 m/s

$\vec{v}_{LK} = \vec{v}_{LG} + \vec{v}_{GK}$ $\quad \vec{v}_{LG} = 5\hat{i}$ m/s

$= \vec{v}_{LG} + (-\vec{v}_{KG})$ $\quad \vec{v}_{KG} = 5\hat{j}$ m/s.

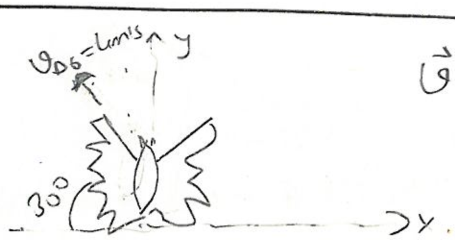
$\vec{v}_{GK} = -\vec{v}_{KG} = -5\hat{j}$ m/s.

$\vec{v}_{LK} = 5\hat{i} - 5\hat{j}$ m/s

$\vec{v}_{KL} = \vec{v}_{KG} + \vec{v}_{GL}$ $\quad \vec{v}_{KG} = 5\hat{j}$ m/s

$= \vec{v}_{KG} + (-\vec{v}_{LG})$ $\quad -\vec{v}_{LG} = -5\hat{i}$ m/s

$\Rightarrow (-5\hat{i} + 5\hat{j})$ //



$\vec{v}_{IB} = ?$

$\vec{v}_{IB} = \vec{v}_{IG} + \vec{v}_{GB} \rightarrow -\vec{v}_{BG}$

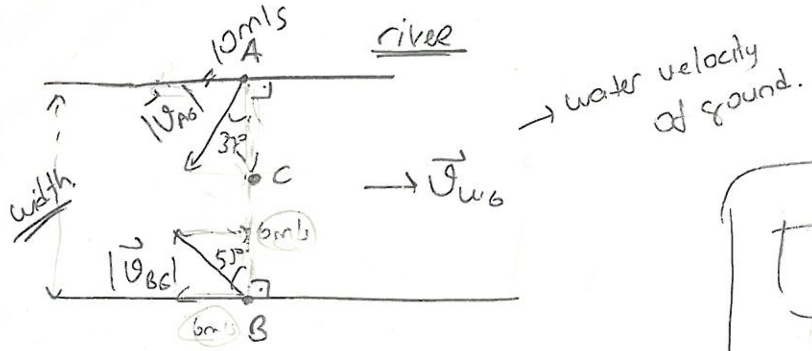
$\vec{v}_{IG} = 5\cos 50°\hat{i} + 5\sin 50°\hat{j}$ (m/s)

$\vec{v}_{BG} = -4\cos 30°\hat{i} + 4\sin 30°\hat{j}$ (m/s)

$-\vec{v}_{BG} = \vec{v}_{GB} = 4\cos 30°\hat{i} - 4\sin 30°\hat{j}$ m/s.

$v_{IB} = (3{,}2 + 3{,}5)\hat{i} + (3{,}8 - 2)\hat{j}$

$= 6{,}7\hat{i} + 1{,}8\hat{j}$ m/s //



A and B swimmers (10 s after)

a) $\vec{v}_{WG} = ?$

b) width of the river?

MY SOLUTION:

$$\boxed{\vec{v}_{WG} = 6m/s}$$

$$v_{B_0} \underbrace{\cos 37}_{\frac{4}{5}} = 6. \quad \frac{6.5}{4} = 7{,}5\ m/s$$

$$\left(\frac{\cancel{6.5}^{3}}{\cancel{4}_{2}} \cdot \frac{3}{\cancel{5}} + 8\right).10$$

$$\left(\frac{3}{2} + 8\right).10$$

$$\frac{3+16}{2}.10\,5 \quad 25.5 \quad \frac{175m}{}$$

SOLUTION

$$|\vec{v}_{WG}| = |\vec{v}_{AG_x}|$$

$$|\vec{v}_{WG}| = |\vec{v}_{BG_x}|$$

$$\vec{y}_{BA} = \vec{y}_{BC} + \vec{y}_{CA}$$

Displacement along x axis?

X comp of velocities = 0

$$v_{WG} = v_{AG_x} \Rightarrow v_{WG} = 10 \sin 37$$

$$v_{WG} = v_{BG_x} \Rightarrow v_{WG} = v \sin 53 \qquad = 1$$

$$v = 7{,}5\ m/s$$

$$|\vec{y}_{BC}| = v_{BG_y}\, t$$

$$= v_{BG} \cos 53°\, t$$

$$|\vec{y}_{CA}| = v_{AG_y} \cos 37°\, t \quad \Big) t$$

$$7{,}5m$$

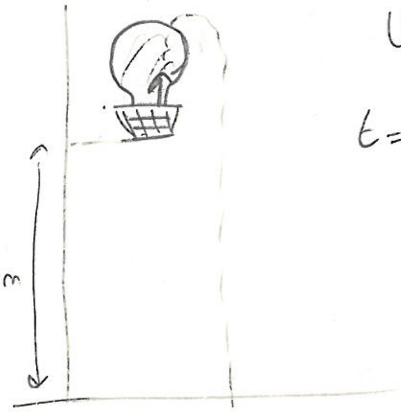
$$= (v \cos 53).10 + (10 \cos 37)\, 10$$

$$= |\vec{y}_{BA}| = 125m$$

A balloon is ascending (artan yükselme) at the rate of 12 m/s and is 80 m above the ground when package is dropped.

ⓐ How long does the package take to reach the ground?

ⓑ With what speed does it hit the ground?



$v_0 = 12\,m/s$

$t = ?$ For total motion of the package

$y = y_0 + v_0 t - \frac{1}{2} g t^2$ → maybe accupted

$0 = 80 + 12t - \frac{1}{2} 10 t^2$

$0 = 80 + 12t - 5t^2$

$-5t^2 + 12t + 80 = 0$

$t_1 = \frac{-12 \pm \sqrt{(12)^2 - 4(-5).80}}{2(-5)} = \frac{-12 \pm \sqrt{144+1600}}{-10}$

$= \frac{-12 \pm \sqrt{1744}}{-10}$

$= \frac{-12 \pm 42}{10} = \frac{-12}{10} = 1,2$

$-1,2$

$\frac{54}{10} = 5,4$

$v_y = v_0 - gt$

↳ $t = 5,4s$

$v_y = 12 - 10 . 5,4$

$= 12 - 54 = -42\,m/s$

$t_1 = 1,2s$ ✗

$t_2 = 5,4s$ ✓

If a position vector is

$\vec{r} = (\hat{i} + 4t^2\hat{j})$ ⇒ find the velocity at $t=2s$ and finde acceleration at $t=2$. Scaler components have unit of meters.

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

$x = 1$ m/s $y = 4t^2$

$\vec{v} = v_x\hat{i} + v_y\hat{j} + v_z\hat{k}$

↳ türevini aldık

$v_x = \frac{dx}{dt} = \frac{d(1)}{dt} = 0$

$v_y = \frac{dy}{dt} = \frac{d(4t^2)}{dt} = 8t$

$v_z = 0$ //

$\vec{v} = 0\hat{i} + (8t)\hat{j}$ → v_y

↳ t=2 saniye.

$\vec{v} = 16\hat{j}$ (m)

↳ at t=2 second.

$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$

$\cancel{\frac{dv_x}{dt}}$ 0 $\frac{dv_y}{dt}$ $\cancel{\frac{dv_z}{dt}}$ 0

$\vec{a} = 8\hat{j}$

↳ $(8 m/s^2)\hat{j}$

$a_y \rightarrow \frac{d}{dt}(8t) \rightarrow a_y = 8$ //

~ Guadalupe Pineda Con Los Tres Ases ~

MOTION IN TWO AND THREE DIMENTIONS

Position and displacement in three dimentions.

$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ → each teern is vector compenents of $\vec{r}$.

If we have → $\vec{r} = -3\hat{i} + 2\hat{j} + 5\hat{k}$ position vector
Lets draw the vector.

If $\vec{r}$ is position vector, the displacement can be defined as

$\Delta r = \vec{r_f} - \vec{r_i}$

$= \vec{r_2} - \vec{r_1}$

$\Delta\vec{r} = (x_2\hat{i} + y_2\hat{j} + z_2\hat{k}) - (x_1\hat{i} + y_1\hat{j} + z_1\hat{k})$

$= (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$.

SAMPLE

↳ The position vector for particle is initialy

$\vec{r_1} = -3\hat{i} + 2\hat{j} + 5\hat{k}$ and then laiter is

$\vec{r_2} = 9\hat{i} + 2\hat{j} + 8\hat{k}$

what is the displacement from $\vec{r_1}$ to $\vec{r_2}$?

$\Delta\vec{r} = \vec{r_2} - \vec{r_1} = [9 - (-3)]\hat{i} + (2-2)\hat{j} + (8-5)\hat{k}$

$\Delta r = \underbrace{12\hat{i}}_{\Delta x} + \underbrace{3\hat{k}}_{\Delta z}$

$v = \dfrac{\Delta\vec{r}}{\Delta t}$

$v = \dfrac{\Delta x}{\Delta t}\hat{i} + \dfrac{\Delta y}{\Delta t}\hat{j} + \dfrac{\Delta z}{\Delta t}\hat{k}$

For $\Delta t \to 0$
instotenous velocity.

$\vec{v} = \dfrac{d\vec{r}}{dt}$

$\vec{v} = \dfrac{d}{dt}(x\hat{i} + y\hat{j} + z\hat{k})$

$= \underbrace{\dfrac{dx}{dt}}_{v_x}\hat{i} + \underbrace{\dfrac{dy}{dt}}_{v_y}\hat{j} + \underbrace{\dfrac{dz}{dt}}_{v_z}\hat{k} \Rightarrow \underbrace{\vec{v} = v_x\hat{i} + v_y\hat{j} + v_z\hat{k}}_{\text{Vector components.}}$

For an object given information is sumed as follow

$\vec{v}_0 = (-2\,m/s)\hat{i} + (4\,m/s)\hat{j}$

$\vec{a} = (-2\,m/s^2)\hat{i} + (3\,m/s^2)\hat{j}$

a) Find the velocity vector at $t=2$ second.

at $\rightarrow t=2s \longrightarrow \vec{v} = v_x\hat{i} + v_y\hat{j}$

$\vec{v}_x = v_{0x} + \underline{a_x t} = -2m/s + (-2m/s^2) \cdot 2s = -6m/s.$

$\vec{v}_y = v_{0y} + a_y t = +4m/s + (3m/s^2)\,2 = 10m/s$

$\vec{v} = \vec{v}_0 + \vec{a}t$

$\vec{v} = (-6m/s)\hat{i} + (10m/s)\hat{j}$

b) If $\vec{r}_0 = 0 \Rightarrow (x_0 = 0,\ y_0 = 0,\ z_0 = 0)$

at $t=2s \Rightarrow$ find $\vec{r} = ?$

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

$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$

$y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

$x = 0 + (-2m/s).(2s) + \frac{1}{2}(-2m/s^2)(2)^2 = -4-4 = -8m$

$y = 0 + (4m/s\,(2s) + \frac{1}{2}(3m/s^2)(2)^2 = 8+6 = 14m.$

$\vec{r} = (-8\hat{i} + 14\hat{j})m_{//}$

EXAMPLE The position components of an object are given as

$$x = (-0{,}31\, t^2 + 7{,}2\, t + 28)\ m$$

$$y = (0{,}22\, t^2 - 3.1 t + 30)\ m$$

a) Find the position vector at $t = 15$ second.

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

$t = 15\ s \Rightarrow x = -0{,}31(15)^2 + (7{,}2)(15) + 28 = 66\ m$

$y = \ldots\ldots = -57\ m$ — $\vec{r} = 66\hat{i} - 57\hat{j}\ (m)$

b) ($t = 15\ s$ and $t = 20\ s$)

Find the average velocity vector between.

$$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$$

$\vec{r}_2 = x_2\hat{i} + y_2\hat{j} \leftarrow t = 20$ sec.

$\vec{r}_1 = x_1\hat{i} + y_1\hat{j} \leftarrow t = 15$ saniye.

$t \to 20$ sec $\Rightarrow$ $x_2 = 48\ m$, $y_2 = -64\ m$? Nereden geldiniz?

$$\Delta r = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} = (48 - 66)\hat{i} + (-64 - 57)\hat{j}$$

$$= -18\hat{i} - 7\hat{j}$$

$$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \left(-\frac{18}{5}\hat{i} - \frac{7}{5}\hat{j}\right)\ m/s.$$

c) Find the (ins) velocity at $t = 17$ s.

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j}$$

$$= (-0{,}62\, t + 7{,}2)\hat{i} + (0{,}44 t - 3.1)\hat{j}$$

$$= (-0{,}62 \cdot (17) + 7{,}2)\hat{i} + (0{,}44(17) - 3.1)\hat{j}$$

$$= v_x\hat{i} + v_y\hat{j} \qquad |\vec{v}| = \sqrt{v_x^2 + v_y^2} \qquad \tan\theta = \frac{v_y}{v_x}$$

Chunk
Çaylan külae

EXAMPLE According to the given vectors (in meters),

$\vec{a} = -3\hat{i} + 3\hat{j} + 2\hat{k}$

$\vec{c} = 2\hat{i} + 3\hat{j} + \hat{k}$

$\vec{b} = -2\hat{i} - 4\hat{j} + 2\hat{k}$

a) Find $\vec{A} = \vec{a} \cdot (\vec{b} \times \vec{c})$ with unit.

b) Find $\vec{B} = \vec{a} \times (\vec{b} + \vec{c})$ " "

$\hat{i} \times \hat{i} = 0$

$|\hat{i}| \cdot |\hat{i}| \sin(0^\circ) = 0$

---

a) $(\vec{b} \times \vec{c}) = (-2\hat{i} - 4\hat{j} + 2k)(2\hat{i} + 3\hat{j} + \hat{k})$

$= -2(3)(i \times j) - 2(i \times k) - 4(2)(j \times \hat{i}) - 4(j \times k)$

$+ 2.2(k \times \hat{i}) + 2.3(k \times j)$

$= -6\hat{k} + 2\hat{j} + 8\hat{k} - 4\hat{i} + 4\hat{j} - 6\hat{i}$

$= -10\hat{i} + 6\hat{j} + 2\hat{k}$

$\rightarrow \vec{A}\ (-3)(-10) + (3)(6) + (2)(2)$

$\rightarrow +30 + 18 + 4 = 52\ m^3$

b) $(\vec{b} + \vec{c}) = \hat{j} + 3\hat{k}$

$\vec{a} \times (\vec{b} + \vec{c}) = (-3\hat{i} + 3\hat{j} + 2\hat{k}) \times (-\hat{j} + 3\hat{k})$

$= +3(i \times j) - 9(i \times k) + 9(j \times \hat{k}) - 2(\hat{k} \times \hat{j})$

$= +3k + 9\hat{j} + 9\hat{i} + 2\hat{i}$

$= (11\hat{i} + 9\hat{j} + 3\hat{k})\ m^2$

FORCE AND MOTION

20 EKİM 2015 SALI

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

$\vec{v} = \frac{\Delta \vec{r}}{\Delta t} \quad , \quad \vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

What isthe reason of accelaration?

FORCE

I

m •

$v = 0$

$\sum \vec{F}_{net} = 0$

m • ⟶ v = constant

inertial frame.

2 $F \propto a$

$\vec{F}_x = m\vec{a}_x$

$\vec{F}_x \longrightarrow \boxed{m_1} \longrightarrow \vec{a}_{1x}$

$\vec{F}_x \longrightarrow \boxed{m_2} \longrightarrow \vec{a}_{2x}$

$m_1 \neq m_2$

m_1 ismassive → small a_1x
m_2 is less massive → big a_2x

$\vec{F}_1 \longrightarrow \boxed{m} \longrightarrow \vec{a}_1$

$\vec{F}_2 \longrightarrow \boxed{m} \longrightarrow \vec{a}_2$

observations
measurements
definitions

$\frac{|\sum f_{net}|}{|\vec{a}|} \leftarrow \sum \vec{f}_{net} = m\vec{a}$

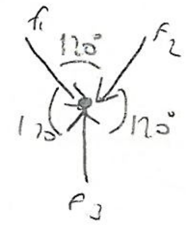
$\sum \vec{f}_{net} = 0 \qquad |\vec{f}_1| = |\vec{f}_2| = |\vec{f}_3|$

$f_1 = f_2 = f_3$

m •

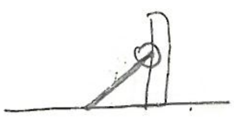
$F_{net} = 0$

$\sum F_{ext} = 0$



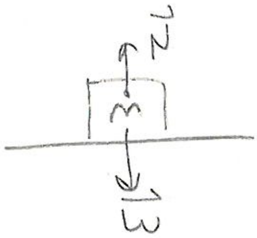
$\sum \vec{F}_{net} = \vec{f}_1 + \vec{f}_2 + \vec{f}_3$
$= 0$

3 Interaction Must Be



$\left.\begin{array}{l}\vec{F}_1 \\ \vec{F}_2\end{array}\right\}$ $|\vec{F}_1| = |\vec{F}_2|$

$\vec{f}_1 = -\vec{f}_2$



$\vec{N} = -\vec{W}$

$N = W$

$\vec{N}, \vec{W}$ are acting on the same object.

$$\sum \vec{F}_{net} = m . \vec{a}_{net}$$

$$\sum \vec{F_x} = m \vec{a_x}$$

$$\sum \vec{F_y} = m \vec{a_y}$$

$$\sum \vec{F_z} = m \vec{a_z}$$

$\rightarrow 1\ N = 1\ kg\ m/s^2$

1 N

1 newton

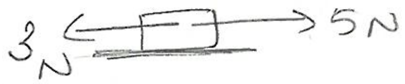
① system is moving or not

② choose a conveient coordinate axis.

③ Free body diagram

④ Apply Newton Laws.

EXAMPLE



frictionless surface

$\vec{F_3}$ also acts on the same object.

$F_3 = ?$ a) for stationary case

b) for moving situation to the left with a constant speed of 5 m/s.

ⓐ

$$\sum \vec{F}_{net} = 0$$

$$\sum \vec{F}_{net_x} = 0 \rightarrow F_1 + F_2 + F_3$$

$$= 5\hat{i} - 3\hat{i} + \vec{F_3}$$

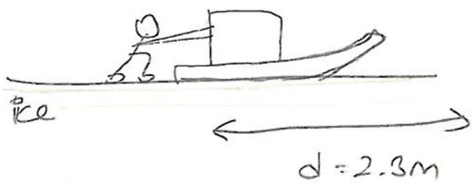
$$\vec{F_3} = -2\hat{i}\ N$$

$\rightarrow$ same

$\boxed{\text{No } \vec{a}}$

$\sum \vec{F}_{net} = 0 \rightarrow$ again.

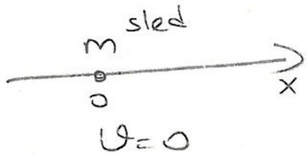
$m = 240\ kg$ sled



ⓐ when the sled is at rest

$\hookrightarrow$ means stopping

plot free body diagram



ⓑ $|\vec{F_x}| = 130N$

$$a_x = \frac{130N}{240kg} \cong 0.5\ m/s^2$$

$$\vec{a}_x = a_x \hat{i}$$

$$\vec{a}_x = 0.5\ \hat{i}\ m/s^2$$

After d displacement, find $\vec{v} = ?$

$v_f^2 - \cancel{v_i^2} = 2a$ (displacement)

0

$v^2 = 2(0,5)(2,3) \Rightarrow v \to 1,6$ m/s

$\vec{v} = v\hat{i} = 1,6\hat{i}$ m/s.

(d) $\Delta t = 4,5$ saniye

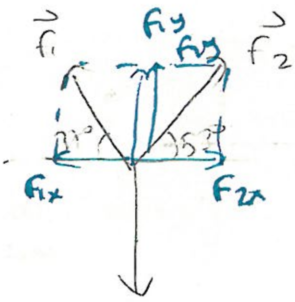
(sonra ters yönde aynı hızla gitmesi için gerekli kuvvet?)

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t} = \frac{-1,6\hat{i} - (1,6)\hat{i}}{\Delta t} \to$$

$$a = \frac{-3,2\hat{i}}{4,5} \text{ m/s}^2$$

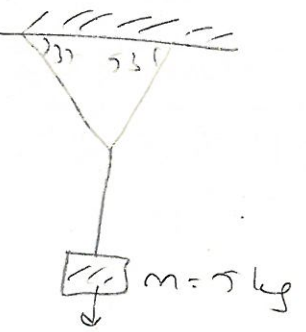
$$\vec{F} = m\vec{a} = 240\left(\frac{-3,2}{4,5}\right)\hat{i}$$

$$= -171\hat{i} \text{ N}$$



↑ free body diagram.

$\vec{F_1} = ?$ $\vec{F_2} = ?$



$w = mg = 50$ N

$\sum \vec{F} = 0$

$\sum \vec{F_x} = 0$

$\sum \vec{F_y} = 0$

$\vec{F_{1x}} =$

$\vec{F_{1x}} + \vec{F_{2x}} + \cancel{F_{3x}} = 0$

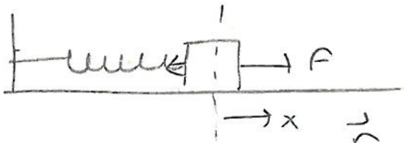
0

$\vec{F_1} = -30\cos 37°\hat{i} + 30\sin 37\hat{j}$

$\vec{F_2} = 40\cos 53°\hat{i} + 40\sin 53°\hat{j}$ N

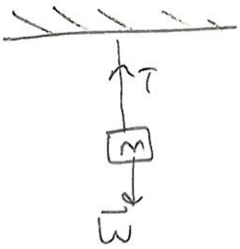
$\sum F_x = -F_1\cos 37° + F_2\cos 53° = 0$

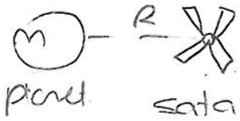
$\sum F_y = F_1\sin 37 + F_2\sin 53° - 50 = 0$

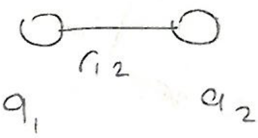


$\vec{F}_{spring} = -k\vec{x}$ → Hook low

$F = G\frac{Mm}{R^2} = mg'$ → g'







$\vec{F}_{Mm} = -\vec{F}_{mM}$

$F_{Mm} = F_{mM}$

diff obgect

$\vec{F}_{el} = k\frac{q_1 q_2}{r_{12}^2}$

↳ Bu Etki

Tepki

DEĞİL

↳ aynı cisme etki ediyor.

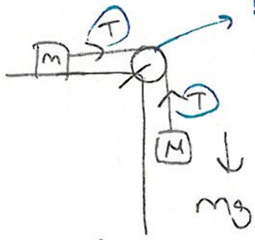
→ Bu Etki Tepki ?!

→ Bu DA!

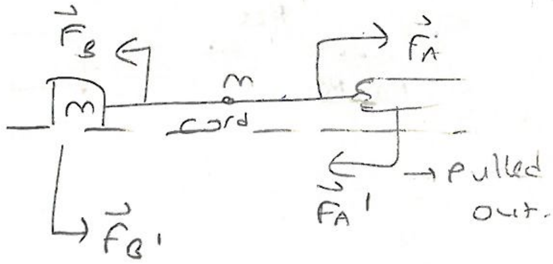
$\boxed{\text{DEĞİL}}$

makara

bunu gördüğün an kuvvetin yönünün değiştirdiğini anla!



$M > m$



↳ Bu da değil.

$|\vec{F}_A| = |\vec{F}_A'|$

$|\vec{F}_B| = |\vec{F}_B'|$

action and reaction forces

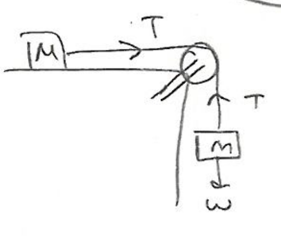
↳ Ama

F_A ve F_B etki tepki değil

çünkü aynı cisme etki ediyorlar.

cord.

$T = \frac{Mmg}{m+M}$!?



direction of the motion.

$a = m\frac{g}{(M+m)}$

$\Sigma F_y = 0$
$|\vec{T}| = |\vec{W}|$ constant velocity

Find the forces.

$T = ma$

$\boxed{T = mg - ma}$

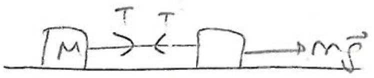
$\boxed{\Sigma F_y = ma_y}$

$\boxed{W - T = ma}$

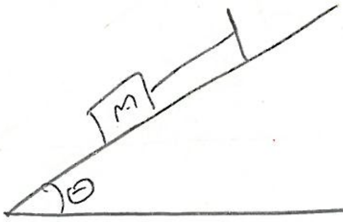
M → T

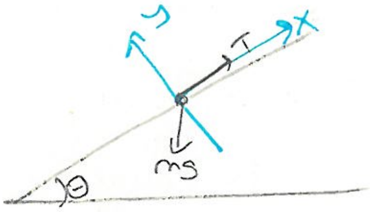
$\boxed{T = Ma}$

Find the forces



Aslında az önceki makaralı sistemden hiç farkı yok.





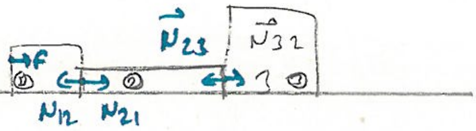
$\Sigma F_x = 0$

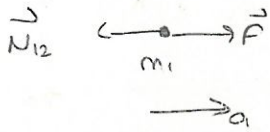
$\Sigma F_y = 0$

51 newton
51 N
yazmalısın.
NOT 51N ~~ewton~~ → 1 PUAN KAYBETTİRİR

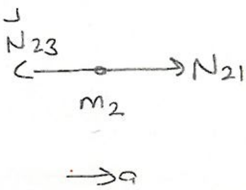
2007'de çıkmış

$\vec{a}$



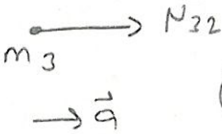


$F - N_2 = m_1 a.$



$N_{21} - N_{23} = m_2 a$

$\vec{F} = (m_1 + m_2 + m_3)\vec{a}$



$N_3 = m_3 a$

Equations of the motion.

$$\boxed{|\vec{N}_{12}| = |\vec{N}_{21}| = N_1}$$

$51 = (5+2+10)a \Rightarrow a = 3 m/s^2$

$$\boxed{|\vec{N}_{23}| = |\vec{N}_{32}| = N_2}$$

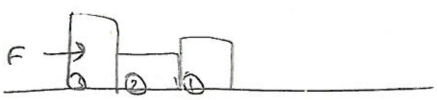
$51 = (5+2+10)a \Rightarrow a = 3 m/s^2 \Rightarrow N_2 = 10.3 = 30$ newton

Yerlerini değiştirdik.

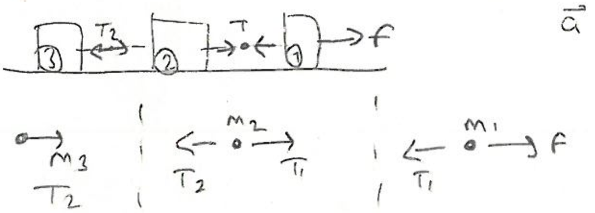
$F - N_1 = m_1 a,$ $\quad N_1 - N_2 = m_2 a$

$N_2 = m_3 a$ $\quad N_1 = ?$

3'ü de aynı

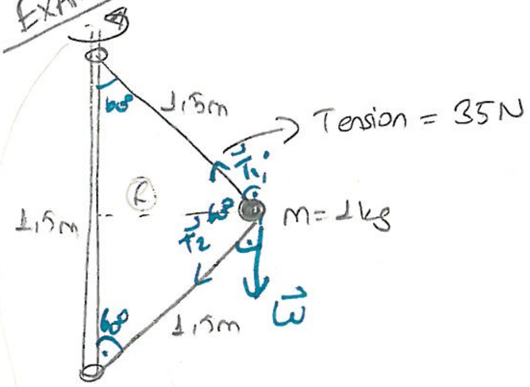


$\vec{a} = \vec{a}_1 = \vec{a}_2 = \vec{a}_3$



32

EXAMPLE

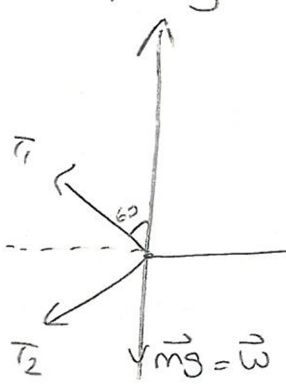


ⓐ Free body diagram?

ⓑ Net force: due to the tensions?

ⓒ find the velocity of the ball

↳ HOME.



$$mg + T_2 \cdot \cos 60° = T_1 \cos 60°$$

$$T_1 \sin 60° + T_2 \sin 60° = m\frac{v^2}{R}$$

↳ equation of the motion

↺ → dönseydi.

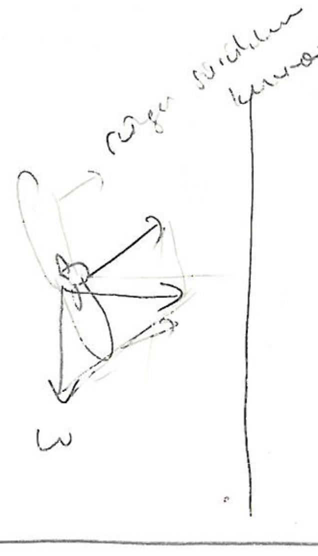
$$F_{cent} = m a_{cent}$$
$$\downarrow$$
$$m\frac{v^2}{R}$$

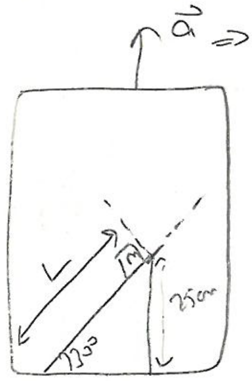
$$T_1 + T_2 =$$

$$\vec{T_1} = -T_1 \sin 60\,\hat{i} + T_1 \cos 60\,\hat{j}$$

$$T_2 = T_2 \sin 60\,\hat{j} - T_2 \cos 60\,\hat{j}$$

$$\sin 60° = \frac{R}{1,5} \qquad R = 1,5 \sin 60$$





m = 4 kg

m is freely mo

ⓐ Find the time required to arrive the end of the inclined surface

ⓑ Find the velocity at the ground of the elevator

$$\boxed{L = \frac{1}{2} a_x t^2}$$

$$m(g+a) \sin 30° = m\, a_{mass}$$

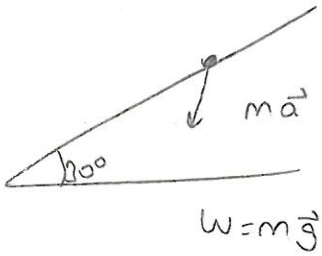
$$\sin 30° = \frac{25}{L}$$

$$L = \frac{25 \times 10^{-2}}{\sin 30°}$$

m ↓ mg

$$\vec{W} = m\vec{g}$$

$$m(\underbrace{a+g})$$



$m(a+g)$

$m(g+a)\sin 30 = m\,a_{mass}$

$a_{mass} = \dfrac{m(g+a)\sin 30^\circ}{m} = 9\ m/s^2$ → g Dokut.

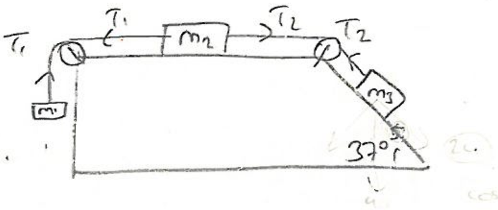
$L = \frac{1}{2} a_{mass} t^2 = \dfrac{0{,}25}{\sin 30^\circ}$

$t = \sqrt{\dfrac{2L}{a}} \Rightarrow 0{,}33\ s = t$

(b) $\underbrace{\cancel{v_i^2}}_{0}$ $v_f^2 - v_i^2 = 2\underbrace{a}_{mass}\,\underbrace{(\text{displacement})}_{L}$

v_f → $v_f = v_i + a_{mass} t$

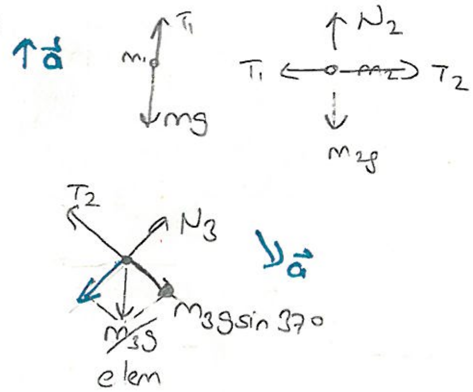
$= 3\ m/s$



$m_1 = 4\ kg$
$m_2 = 2\ kg$
$m_3 = 4\ kg$

Frictionless

(a)



Your first question should be:

Is This system moving or not?

$T_1 - m_1 g = m_1 a$

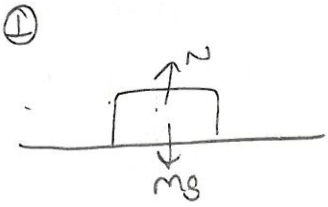
$T_2 - T_1 = m_2 a$

$m_3 g \sin 37^\circ - T_2 = m_3 a$

→ SOLUTION:
(fotokopide)

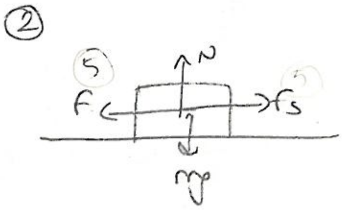
FRICTIONAL

1



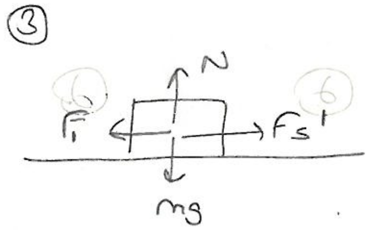
no motion

2



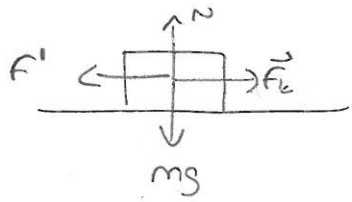
no motion

3



no motion

↳



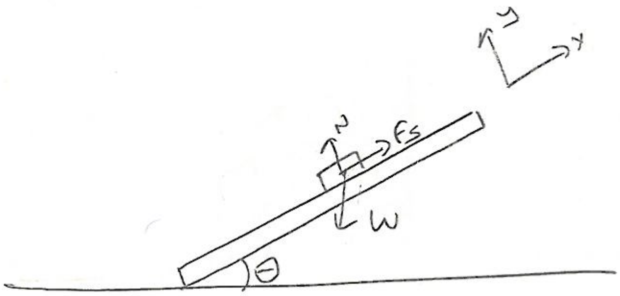
motion.

$|\vec{F}_k| < |\vec{F}_s|$

kinetik sürtünme < statik sürtünme.

$\boxed{F_s = \mu_s N}$ $\boxed{F_s = \mu_s mg}$

"frictional force's direction always zıt motion" ⇒



$\Sigma \vec{F} = \vec{F_s} + \vec{W} + \vec{N} = 0$

$\Sigma F_x = F_s - W \sin\theta = 0$

$\Sigma F_y = N - W \cos\theta = 0$

$f_s = W\sin\theta$

$N = W\cos\theta$

$\frac{f_s}{N} = \tan\theta$

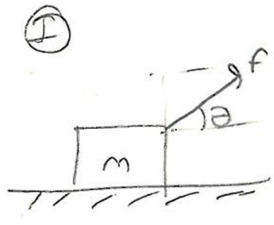
$\mu_s = \tan\theta$

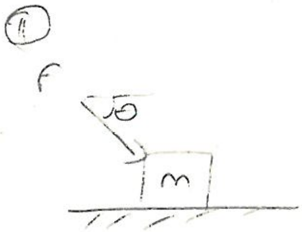
constant = v
↳ hareket yine aynı

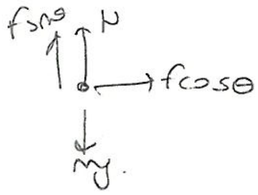
denklemler geçerli ama fs yerine fk yaz.

#

3 KASIM 2015 SALI







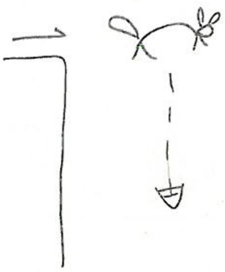
ⓐ Compare of kinetic frictions

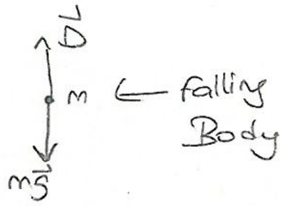
b " frictional forces.

DRAG FORCE / Terminal force

Normal force between two solid objects

Drag force " solid-fluid / liquid-gas





If D

$D = mg \Rightarrow v = \text{constant}$

terminal speed.

$$\boxed{D = \frac{1}{2} c \rho A v^2}$$

density of fluid

speed of the object

unitless coef

effecting surface area.

$$\frac{1}{2} c \rho A v^2 = mg$$

$$v_t = \sqrt{\frac{2mg}{c \rho A}}$$

A raindrop with radius $R = 1,5$ mm falls from a cloud that is height $h = 1200$ m above the ground.

$C_{drop} = 0,6$

$\rho_{air} = 1,2 \ kg/m^3$

$\rho_w = 1000 \ kg/m^3$

ⓐ $v_t = ?$

ⓑ If $D = 0$, find the speed of the raindrop just before impact.

$$\rho_w = \frac{m_{rd}}{V_{rd}}$$

$$V_t = \sqrt{\frac{8 R \rho_w g}{3 C \rho_{air}}} = \sqrt{\frac{8(1{,}5\times10^{-3})(1000)(9{,}8)}{3.(0{,}6)(1{,}2)}}$$

$$m_{rd} = \rho \frac{4}{3}\pi R^3 =$$

$V_t = 7{,}4$ m/s.

$$v = \sqrt{2gh}$$

$$v = \sqrt{2,9.8\,1200}$$

$$\boxed{v = 150 \text{ m/s}}$$

$v_i = 0$

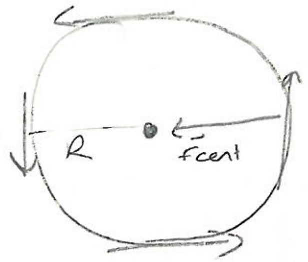
h

v_f

$$v_f^2 - \cancel{v_i^2} = 2gh$$

0

UNIFORM CIRCULAR MOTION

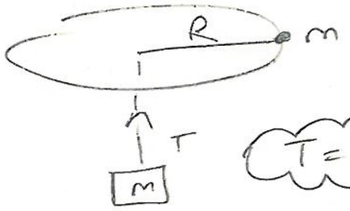


$$a = \frac{v^2}{R}$$

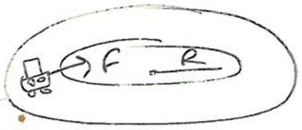
$$|v| = v$$

Fcent

$$\sum F = m a_c = m\frac{v^2}{R}$$



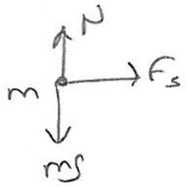
$$T = mg = m\frac{v^2}{R}$$



$\odot \longrightarrow \vec{F}_{cent}$

$\vec{v}$

$\mu_s = ?$

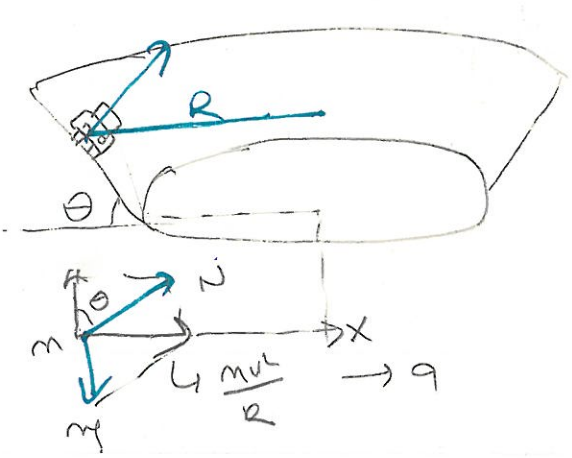


$$N = mg$$

$$F_s = m\frac{v^2}{R}$$

statik

$$\mu_s \cancel{m} g = \cancel{m}\frac{v^2}{R} \rightarrow \quad \mu_s = \frac{v^2}{R_g}$$



$$mg = N\cos\theta$$

$$N\sin\theta = \frac{mv^2}{R}$$

$$N\sin\theta = \frac{mv^2}{R}$$

$$N\cos\theta = mg$$

$$\tan\theta = \frac{v^2}{gR}$$

3 KASIM
SALI
2. Ders

Mecanical energy $\begin{cases} K \rightarrow m, \vartheta \\ \dot{U} \rightarrow \text{gravitational pot. en.} \end{cases}$

$\rightarrow$ elastic pot. en.

$U_{el} = \frac{1}{2} k x^2$

$K = \frac{1}{2} m \vartheta^2$

$\vec{F} \cdot \vec{r} = U_g$

F=const. mg.

$f = f(x) = -kx$

$\boxed{W = \Delta K = K_f - K_i}$

F will be conserved.

$E_i = E_f \implies \Delta E = 0$

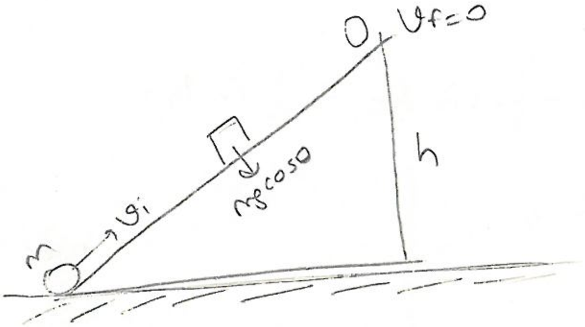
$\downarrow$ $U_i + K_i$ $\quad$ $\downarrow$ $U_f + K_f$

$\boxed{E_f - E_i = 0}$

$\rightarrow \Delta E \neq 0$

$\boxed{\Delta E = W}$

means you are losing this energy.



$E_f = \cancel{K_i}^{0} + mgh$

$E_i = E_f$

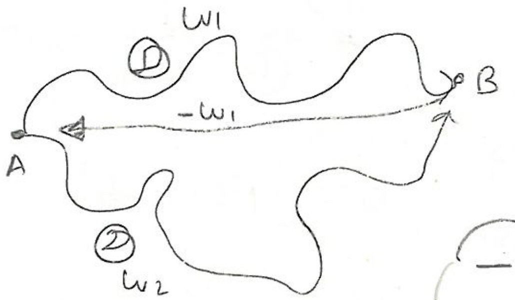
$E_f - E_i = W$

$\hookrightarrow$ unconserved forces.

$E_i = \frac{1}{2} m \vartheta_i^2 + U_i$

$\boxed{F_s = \mu_k \cdot mg \cdot \cos\theta}$

Bir enerjiyi başka bir enerjiye döndürmenin yolu iş yapmaktır.



$W_1 = W_2$

$W_1 = -W_1$

potansiyel enerjinin konuma bağlı.

$\boxed{-\frac{dU}{dr} = F}$

ise bu kuvvet korunumlu kuvvettir.

gravation $\rightarrow$ korunumlu

$F_s \rightarrow$ korunumsuz

ısıya dönüşüyor

IMPORTANT

0 $\quad$ $U = mgy$

mg $\downarrow$ $\quad$ y $\quad$ 0

$\boxed{-\frac{dU}{dy} = -mg}$

W_1, W_2 $\quad$ $W_2 = W_2$ ise

$W_1 = 0$ ise

$\boxed{-\frac{dU}{dr} = F}$

ÇIKMIŞ SORU

$F(x) = f_0 \left(\frac{x}{x_0} - 1 \right)$

$x = 0 \longrightarrow x = 2x_0$

displacement

Find the work done by this force?

↳ Gerçek Hesap.

$$W = \int_{x=0}^{x=2x_0} F(x)\,dx = \int \frac{f_0 x}{x_0}\,dx - \int f_0\,dx$$

$$= \frac{f_0}{x_0} \frac{x^2}{2} \Big]_0^{2x_0} - f_0 x \Big]_0^{2x_0}$$

$$= 2f_0 x - 2f_0 x_0 = 0$$

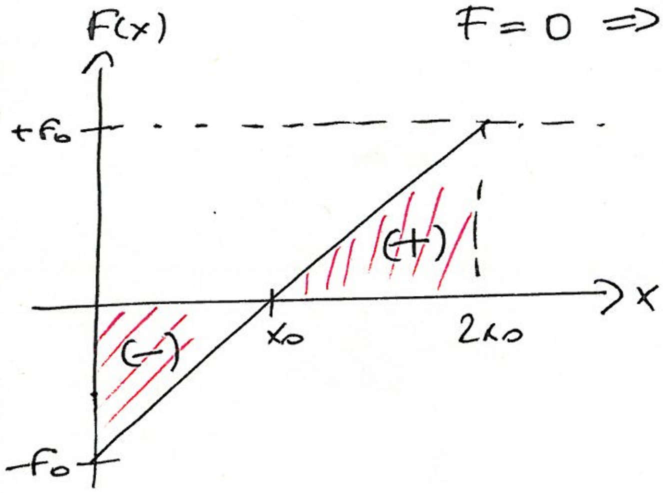
SECOND WAY

$F(x) = f_0 \left(\frac{x}{x_0} - 1 \right) = 0$

$x = 0 \Rightarrow f = -f_0$

$F = 0 \Rightarrow x = x_0$ → slope $= \frac{f_0}{x_0}$

$f = f_0 \Rightarrow x = 2x_0$



$W = -\frac{1}{2} f_0 x_0 + \frac{1}{2} f_0 x_0$

$= 0$

ÇIKMIŞ SORU

$F_x = 3x^2 + 1$

$F_y = 2x$

$F_z = 0$

$\vec{F} = F_x \hat{i} + F_y \hat{j} + F_z \hat{k}$

$(0,0,0) \rightarrow (2,2,0)$

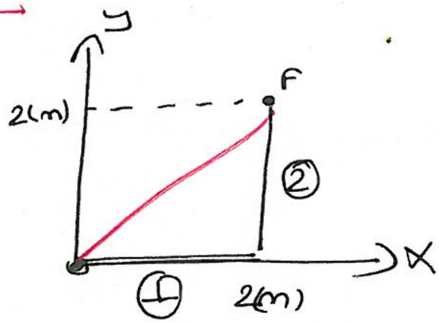
$x = 0 \qquad x = 2$

$y = 0 \qquad y = 2$

$z = 0 \qquad z = 0$

↳ elimine ettik hiç değişim yok.

- Bu kuvvet korunumlu bir kuvvetse - ↳ Bunu söylemesi lazım.



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

$W_I = \int F(x)\,dx$

$W_{II} = \int F(y)\,dy$) +

$$W_I = \int_{(0,0)}^{(2,0)} F(x)\,dx = \int (3x^2 + 1)\,dx$$

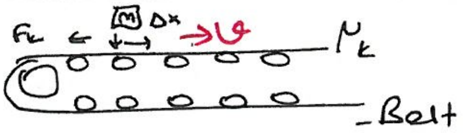
$$= \frac{3x^3}{3} + x \Big]_0^2 = \underline{\underline{10}} \text{ Joule.}$$

→ continued

$$W_{II} = \int_{(0,0)}^{(2,2)} F(y)\,dy = \int 2x\,dy = 2xy \Big]_{(0,0)}^{(2,2)} = 8 \text{ joule.}$$

$$W = W_I + W_{II}$$

$$\hookrightarrow W = 18 \text{ joule}$$



How much energy is dissipated by friction during this time.

$$\Delta x = \frac{1}{2}(v+0).t$$

$$W = \Delta K$$

$$\underbrace{mg\mu_k \Delta x}_{\text{iş.}} = \overbrace{\frac{1}{2}mv^2 - \frac{1}{2}m\cancel{v_i}^2}^{\text{Enerjideki değişim}}$$

$$0$$

$$= \frac{1}{2}mv^2$$

$$v = \frac{\mu_k t}{g} \quad \Big) \quad \Delta k = \frac{1}{2}m\frac{\mu_k^2 t^2}{g^2}$$

$\Delta K = W$

$\Delta U = -W$

$\Delta K + \Delta U = 0$

$E_T = \text{const}$

$(K_f - K_i) + (U_f - U_i) = 0$

$K_i + U_i = K_f + U_f$

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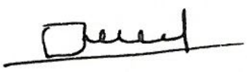


→ geri çağrıcı $\underline{\underline{-W}}$

$W_f = -\mu_k mgd$ → frictional force's work.

" Mekanik Enerji korunduğunda net iş sıfır.

↳ korunumlu kuvvet. "

eksiyi unutma!

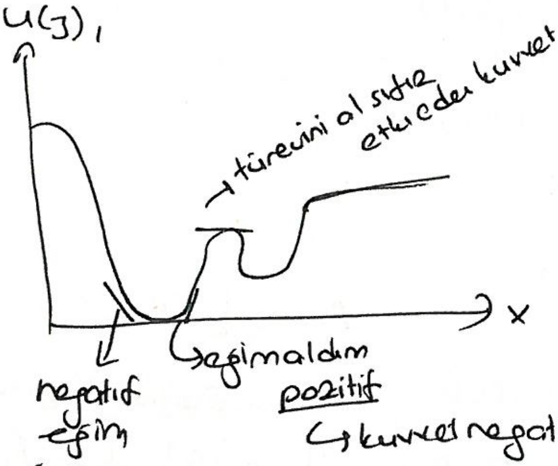
$$F_x = -\frac{du}{dy}$$

$$\Delta U = -\int_{x_i}^{x_f} F(x)\,dx \rightarrow -\frac{du}{dx} = F$$

$$F_z = -\frac{du}{dz}$$

$$\int du = -\int F_z\,dz$$

Korunumlu kuvvetler.



→ Potansiyel enerji grafiği.

↳ türevini alırsa
kuvveti bulursun.

↳ kuvvet negatif yönde.

↳ kuvvet
pozitif yönde. ↳ $-\frac{du}{dr} = F$ olduğu için.

$W_{nonconservative} = \Delta F$
↳ ΔF

↳ Çok önemli !

bir noktayı belirledik.
soldan sağa } uyguladığı kuvvet
sağın sola

} İP GERİLMESİ
TANIM.

→ Sınavda tanım da çıkabilir.
- T
- Fs
- Grafik noktaları
....

POWER

$P = \frac{dE}{dt}$ $P_{avg} = \frac{\Delta E}{\Delta t}$. $P = \frac{dW}{dt} = \frac{F \cdot dx}{dt} = \vec{F} \cdot \vec{v}$

↳ $\vec{v}$

P
ikisinin skaler
çarpımı da
P yapar.

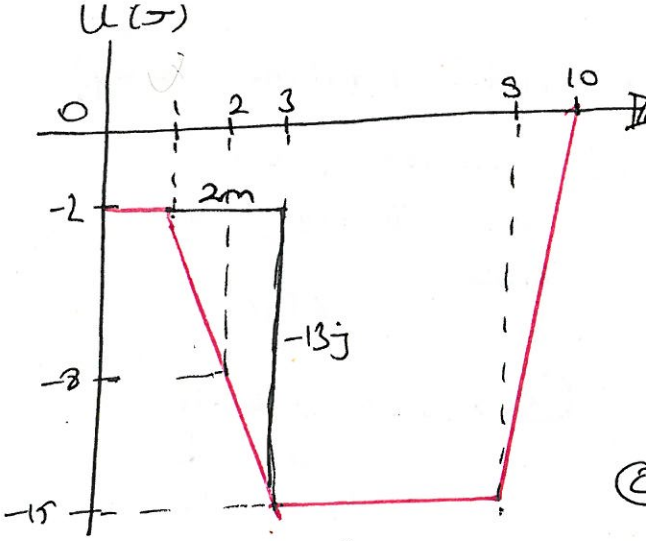
$m\vec{a} \cdot \vec{v}$ ←

dot product.
alman lazım.

→ SINAV KONULARI
BURAYA KADAR!

- Elastik
pot

TANIM ÇIKABİLİR.



$x = 2m \quad \vartheta = -1{,}5 \ m/s$

2 kg mass

(a) $F(x) = ?$ $(x=2)$

(b) $x = 2m \Rightarrow E = ?$

total mechanical energy.

(c) $x = 7m \Rightarrow \vartheta(x=7) = ?$

slope $= -\frac{13}{2}$

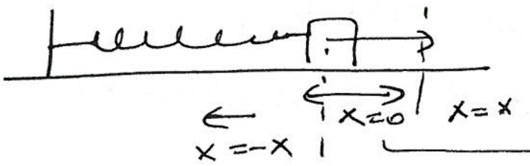
$$\frac{-du}{dx} = F = -(-13/2) \cong 6N$$

$$E = \frac{1}{2} \underset{2kg}{m} \underbrace{\vartheta^2_{x=2}}_{(1{,}5 m/s)} + \underbrace{U(x=2m)}_{-8j} = 2{,}4 - 8 = 5{,}6j$$

$x = 7m \Rightarrow E_{tot} = \text{const.} \quad \vartheta = (x = 7m) = ?$

$$\frac{1}{2} m \vartheta(x=7)^2 - 15 = -5{,}6.$$

$\cancel{\vartheta^2 \cong 20}$
$\cancel{\vartheta \cong \sqrt{20} m/s}$ } eksi olması lazım.

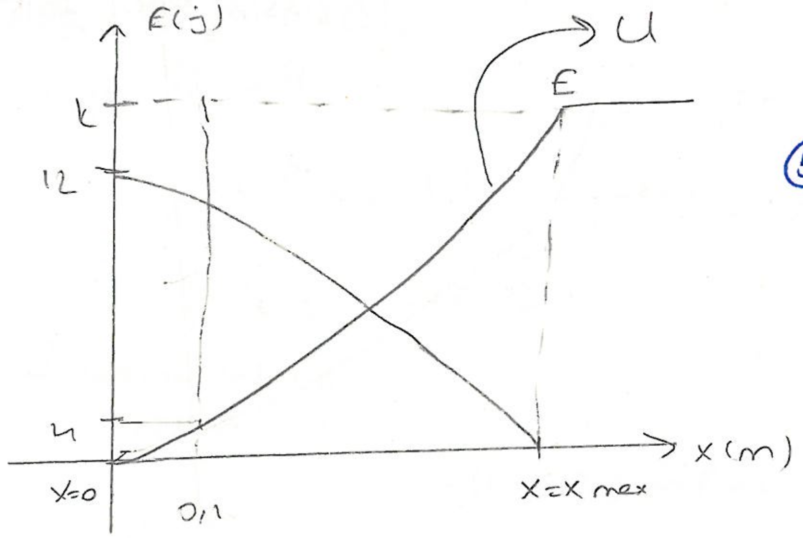


$F = -kx$ → equilibrium position.

$K = \frac{1}{2} m \vartheta^2$
$U = \frac{1}{2} k x'^2$) $E = K + U = \text{constant}$

(d) $E_1 = \underbrace{\frac{1}{2} k x^2}_{\frac{1}{2} k x_{max}^2 = U_{max}} + 0 = E_2 = \underset{0}{U(x=0)} + \underbrace{\frac{1}{2} m \vartheta_{max}^2}_{K_{max}} = \frac{1}{2} k x'^2 + \frac{1}{2} m (\vartheta(x'))^2$

$=$



ⓐ Find the total mec energy?

ⓑ Find the max speed and velocity for the mass?

$M=2$

ⓐ $x=0.2 \Rightarrow k \cdot 4$

$\downarrow \quad \downarrow$

$12 \quad 4$

$E = 12j + 4j = 16j$

$|\vec{v}| = v$

$\{v\} = \frac{m}{s} = \frac{L}{T} = L \cdot T^{-1}$

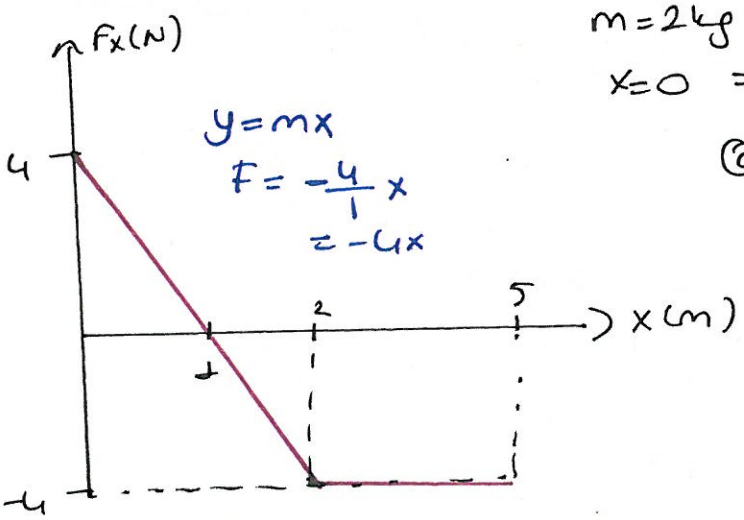
ⓑ $\frac{1}{2} k v_{max}^2 = E$

$\frac{1}{2} m v_{max}^2 = E$

$\frac{1}{2} m v_{max}^2 = 16j$

$M=2$

$v_{max} = 4$



$y = mx$

$F = -\frac{4}{1}x$

$= -4x$

$m = 2kg$

$x=0 \Rightarrow v = 4m/s$

ⓐ $x = 3m$ find $k=?$

ⓑ $k = 8j$ at which x?

$\frac{-du}{dx} = f$

$U = -\int f\,dx$

$2 < x < 5 \quad U = -\int_2^5 -4\,dx$

$U = +4x$

$0 \leq x \leq 2m \quad F(x) = ?$

$U = -\int -4x\,dx = \frac{4x^2}{2} = 2x^2$

$x \to 0$

$4 i \infty$

Fonksiyonları yazıyorsun.

$X = \underbrace{4}_{\text{in met}} - \underbrace{27}_{\text{met/s}} t + 0t^3$ → 1 in m/s³.

$X = 4 - 27t + t^3$

(a) $v(t)$, $a(t)$?

(b) $t = ?$ when $v = 0$?

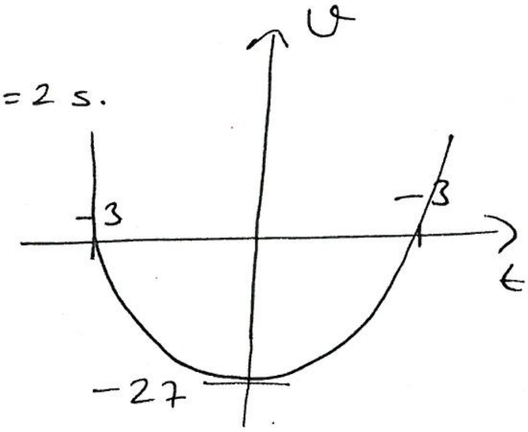
(c) describe the motion of the particle?

$v(t) = ?$ $\frac{dx}{dt} = -27 + 3t^2 = v_{inst}$ at $t = 2$ s.

→ at $t = 2$.

$-27 + 3t^2 = 0$

$a(t) = 6t$ $t = \pm 3$



$X = \underset{\text{in met}}{4} - \underset{\text{met/s}}{27}\,t + 0t^3$ ↳ 1 in m/s³.

$X = 4 - 27t + t^3$

(a) $v(t)$, $a(t)$?

(b) $t = ?$ when $v = 0$?

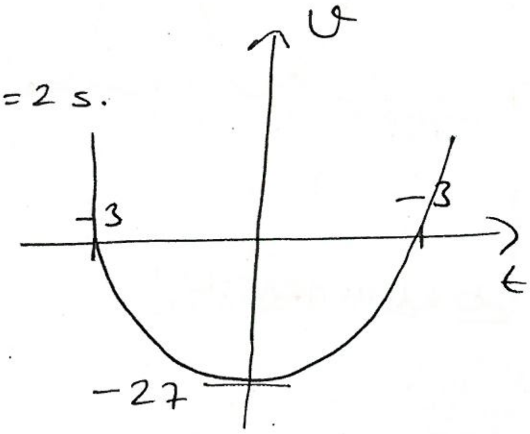
(c) describe the motion of the particle?

$v(t) = ?$ $\quad \frac{dx}{dt} = -27 + 3t^2 = v_{inst}$ at $t = 2$ s.

→ at t = 2.

$-27 + 3t^2 = 0$

$a(t) = 6t \qquad t = \pm 3$



Gıkmış soru

The potential energy of an object constrained to move in x-direction is given by

$U(x) = ax^4 + bx^2$, where $a = 5\,J/m^4$ and $b = -1\,J/m^2$

(a) Find the equilibrium points and state whether are stable or unstable.

(b) Draw a graphic of this potential energy as a function of x in the range of $-0.6\,m < x < +0.6\,m$.

(a) $U(x) = ax^4 + bx^2 \qquad a = 5 \qquad b = -1$

$U(x) = 5x^4 - x^2$

$\frac{du}{dx} = 0 \qquad 20x^3 - 2x = 0 \rightarrow 2x(10x^2 - 1) = 0$

$x^2 = \frac{1}{10} \qquad \boxed{x = \pm\frac{1}{3}}$

$\boxed{x = 0}$

equilibrium points

$x = 0$

$x = \frac{1}{3}$

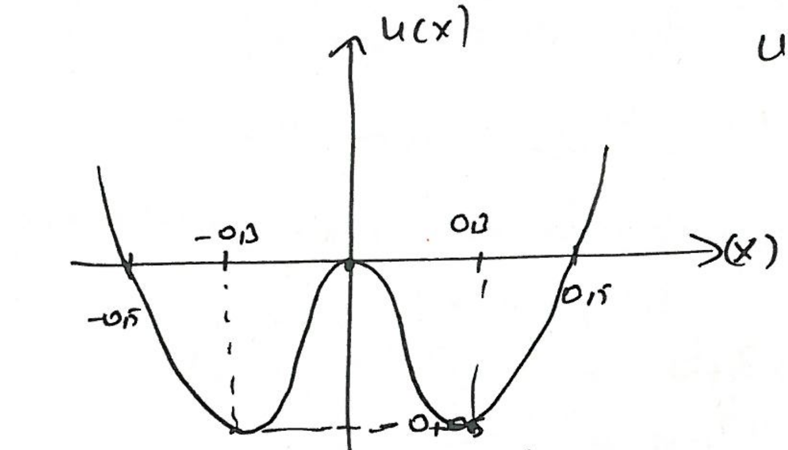
$x = \frac{-1}{3}$

(b) $U(x) = 0 \rightarrow 5x^4 - x^2 = 0$

$x^2(5x^2 - 1) = 0$

$x = 0$ $\qquad$ ↳ $x = \frac{1}{\sqrt{5}} \approx \frac{1}{\sqrt{4}}$

$\pm\, 0.5\,m.$



1st MIDTERM.

$U(x=0{,}3)$

$$\underbrace{5(0{,}3)^4}_{\approx 0{,}01} - \underbrace{(0{,}3)^2}_{\approx 0{,}1}$$

$$= -0{,}05\,J$$

$$U(x=0) = 0$$

95	100	A1
90	95	A2
85	90	A3
80	85	B1
75	80	B2
70	75	B3

– 1 ARALIK SALI –

2015

20 KASIM ARALIK?

Slayttan işledi.

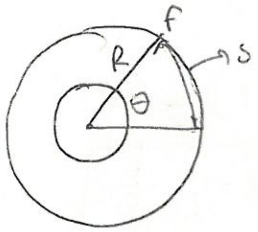
$$\frac{dP}{dt} = \frac{d}{dt}(M\vec{V}_{com}) = m \cdot \vec{a}_{com} = \vec{F}_{net}$$

$$F_{(t)} = \frac{dP}{dt} \longrightarrow \int_{t_i}^{t_f} d\vec{P} = \int_{t_i}^{t_f} \vec{F}(t)\,dt$$

$$\int_{t_i}^{t_f} dP = \int_{t_i}^{t_f} \vec{F}(t)\,dt$$

24 KASIM SALI – 27 KASIM CUMA

DERS İPTAL.



$$\frac{ds}{dt} = v \qquad \frac{2\pi}{T} = \omega \qquad \frac{d\omega}{dt} = \alpha$$

$$\frac{d\theta}{dt} = \omega \qquad v = \omega \cdot R$$

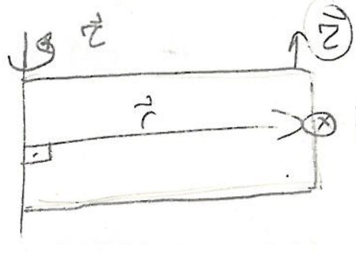
$$\frac{2\pi R}{T} = v$$

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

$$\frac{d^2\theta}{dt^2} = \alpha$$

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

$$\tau = I\alpha \qquad \vec{F} = m \cdot \vec{a}$$

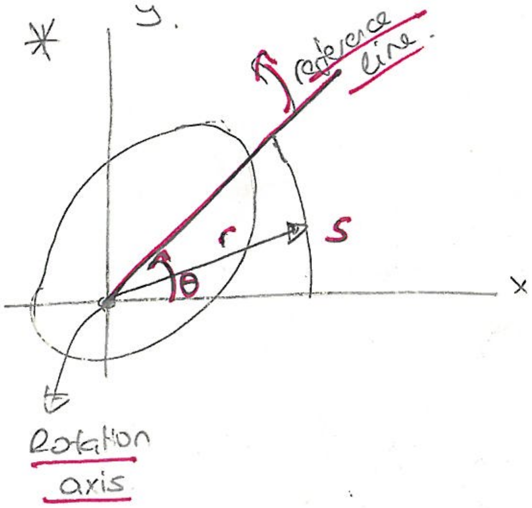


→ Tork

sağ el kuralı.

45

*

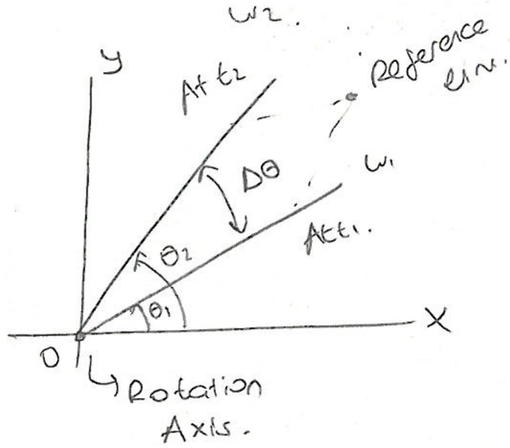


$$\theta = \frac{s}{r}$$

Instantaneous Angular Velocity

$$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$$

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



*Counter clock wise. → pozitif.
* Clock wise. → negatif

We have two alternatives.

$$\omega_{avg} = \frac{\theta_2 - \theta_1}{t_2 - t_1} = \frac{\Delta\theta}{\Delta t} \quad \text{radians / second.}$$

$$\alpha_{avg} = \frac{\omega_2 - \omega_1}{t_2 - t_1} = \frac{\Delta\omega}{\Delta t}$$

unit is radians/second^2

$$\alpha = \frac{d\omega}{dt} \qquad \alpha = \lim_{\Delta t \to 0} \frac{\Delta\omega}{\Delta t}$$

Instantaneous Angular Acceleration.

ANGULAR VELOCITY VECTOR

* Right - Hand Rule.

$$v = \frac{ds}{dt} = \frac{d(r\theta)}{dt} = r\frac{d\theta}{dt}$$

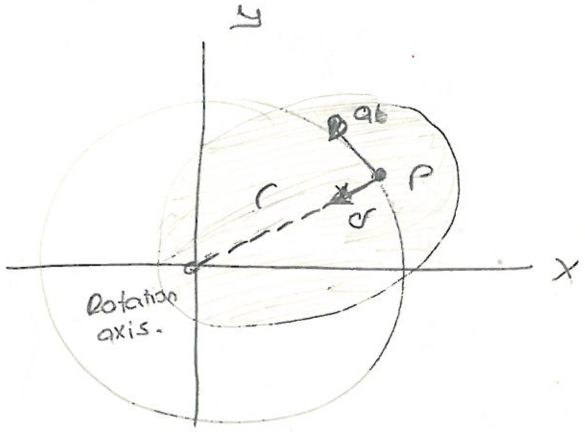
$$v = r.\omega$$

Translational Motion		Rotational Motion
x	$\longleftrightarrow$	θ
v	$\longleftrightarrow$	ω
a	$\longleftrightarrow$	α

$$v = v_0 + at \Leftrightarrow \omega = \omega_0 + \alpha t$$

$$x = x_0 + v_0 t + \frac{at^2}{2} \Leftrightarrow \theta = \theta + \omega_0 t + \frac{\alpha t^2}{2}$$

THE ACCELARATION OF POINT P is A VECTOR



$$a_r = \frac{v^2}{r} = \omega^2 r$$

→ radial component

$$a_t = r\alpha$$

↳ "tangential" component.

$$\sqrt{a_t^2 + a_r^2} = a$$

* A wheel rotates with a constant angular acceleration of 3.50 rad/s². If the angular speed of the wheel is 2.00 rad/s at $t_i = 0$, ⓐ through what angle does the wheel rotate in 2.00?

ⓑ what is the angular speed at $t = 2.00$ s?

$\alpha = 3,5$ rad/s²

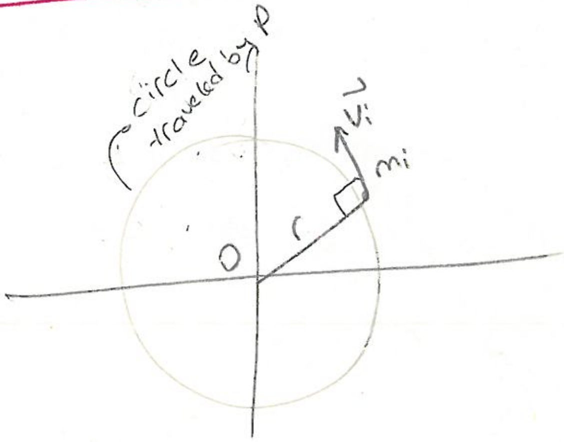
↑ $w = 2$ rad/s

$$\omega_f = \omega_i \pm \alpha t$$

$$\theta_f = \theta_i \pm \omega_i t \pm \frac{1}{2}\alpha t^2$$

→ Slaytta çözüm.

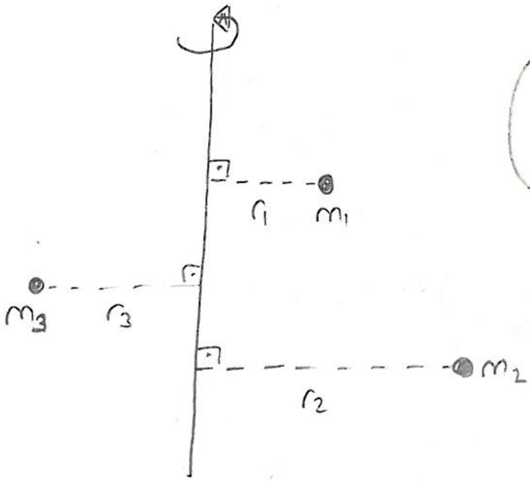
KINETIC ENERGY OF ROTATION



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

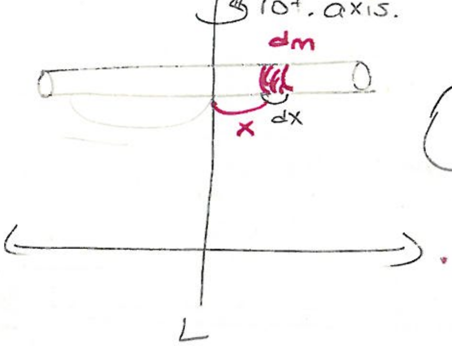
$$K = \frac{1}{2} m w^2$$

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



$$J = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2$$

$$I = \sum_{i=1}^{n} m_i r_i^2$$



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

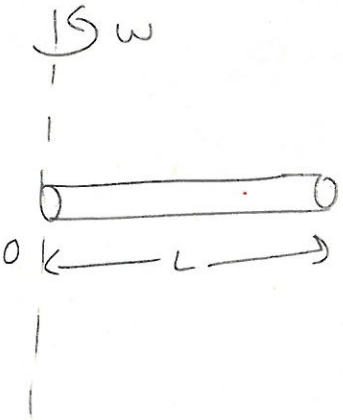
$$dm = \lambda . dx$$

$$\boxed{dm = \frac{M}{L} dx.}$$

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

$$I = \int_{-L/2}^{L/2} x^2 \frac{M}{L} dx = \frac{1}{12} ML^2$$

karşılaştır.



$$I = ? \quad \frac{M}{L} \int_0^L x^2 dx = \frac{1}{3} ML^2.$$

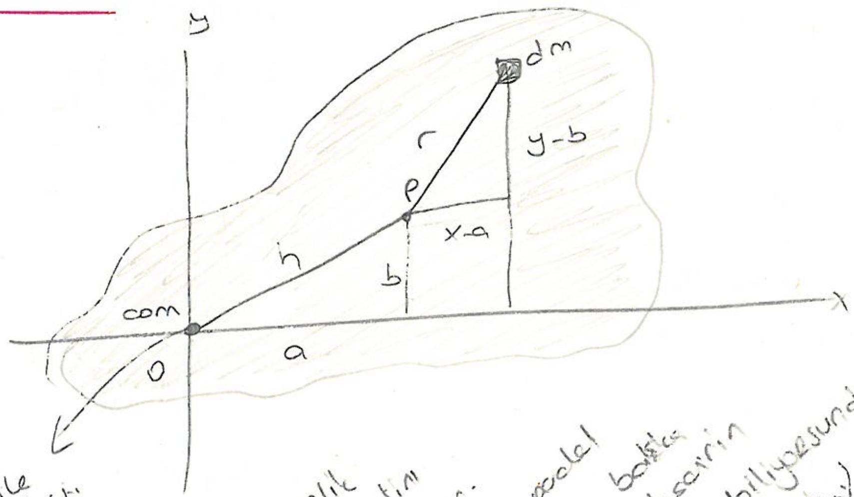
SONUÇ:

* Dönme ekseine olan kütle dağılımının uzaklığıyla
kütle ne kadar uzaksa I o kadar büyük.

$$K_R = \frac{1}{2} I_z w^2$$

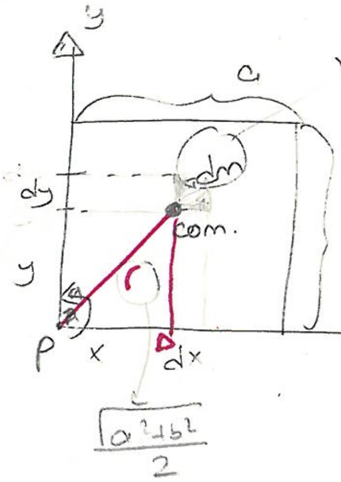
Rational kinetic energy.

$$I = I_{com} + Mh^2$$



kütle merkezi buradan geçiyor

Bir eksen. Eylemsizlik momentini biliyorsun. Buna paralel olan başka bir eksenin de bilinmesi (a kadar) arası dikeysel (h).



bütün alanı kapsıyor.

$$\frac{M}{P} = \frac{dm}{dxdy} \qquad dm = \left(\frac{M}{ab}\right) dx\,dy$$

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

$$= \int_0^a \int_0^b (x^2+y^2)\left(\frac{M}{ab}\right) dx\,dy$$

center of mass a

$$I_P = I_{com} + M\left(\frac{a^2+b^2}{4}\right) \to h \qquad I_D = I_{com} + M\left(\frac{b}{2}\right)^2$$

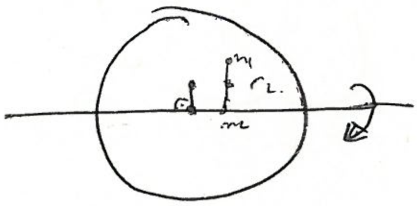
SLAYT → önemli.

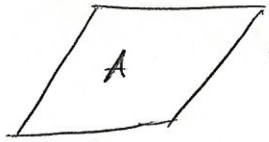
Rotational Inertia

4 ARALIK CUMA 2015

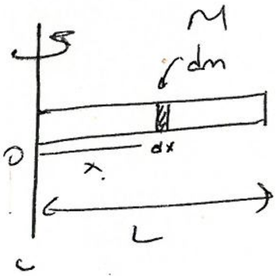
$$I = \sum_{i=1}^{N} r_i^2 m_i$$

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





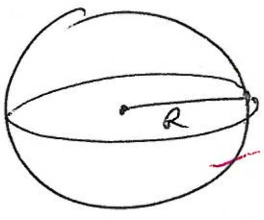
$$\sigma = \frac{M}{A}$$



$$* \ \lambda = \frac{M}{L} = \frac{dm}{dx}$$

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

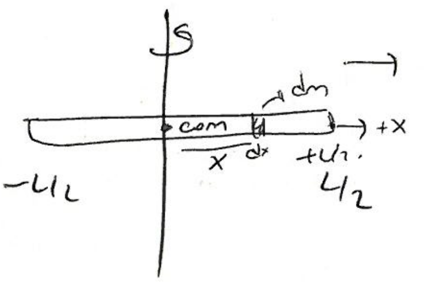
*



$$\rho = \frac{M}{V}$$

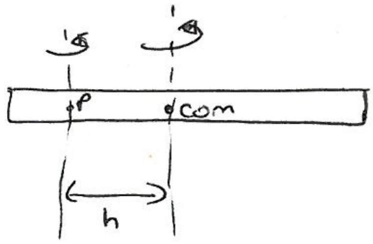
$$I = \int x^2 dm = \frac{M}{L}\int_0^L x^2 dx$$

$$I = \left(\frac{M}{L}\right)\frac{L^3}{3} = \frac{1}{3}ML^2.$$



$$\to I_{com} = \frac{1}{12}ML^2.$$

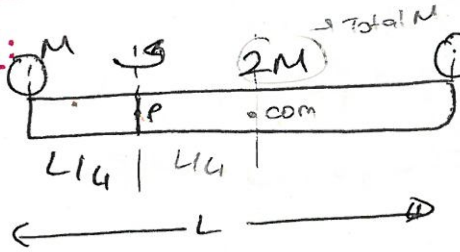
\# There is A Light That Never Goes Out. \#



$$I_p = I_{com} + Mh^2$$

* $dm = \lambda\, dx$ → linear
  $dm = \rho\, dV$ → volume
  $dm = \sigma\, dA$ → surface.

EXAMPLE:



* $I_p = ?$

Find the rot. intertia of the system respect to p point.

$$I_{P_{rot}} = I_{com} + 2m\left(\frac{L}{4}\right)^2$$

$$I_{P_{rot}} = \underbrace{\frac{1}{12}\, 2m}_{\text{total M.}} L^2 + \frac{1}{8} ML^2 \to \int r^2 dm = I$$

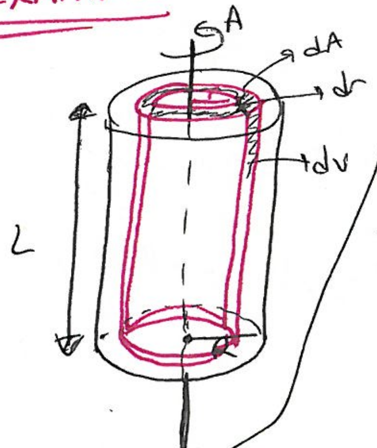
\+ Topla.

$$I_{p\ particles} = M\left(\frac{L}{4}\right)^2 + M\left(\frac{3L}{4}\right)^2 \to \sum_{i=1}^{2} r_i^2 m_i$$

→ parcacik icin ayrı
→ cubuk icin ayrı yaptik topladık.

* → Sadece cembersel durumda radyal ekseni kullanabilirsin.

*** EXAMPLE**



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

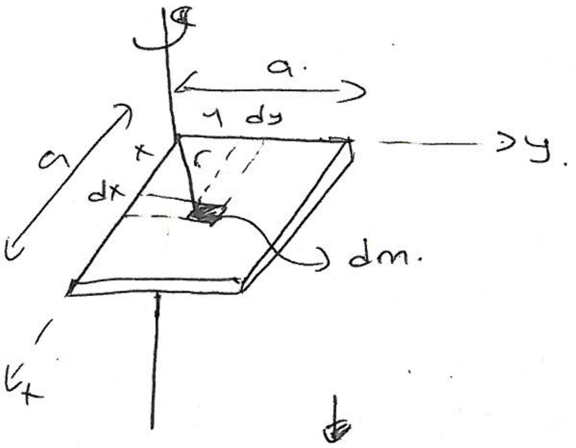
$$\rho = \frac{M}{V} = \frac{dm}{dV} = \frac{dm}{\underbrace{2\pi r dr L}_{dA}} \Rightarrow dm = \frac{M}{\pi r^2 L} 2\pi r dr L = \underbrace{\frac{2Mrdr}{R^2}}_{dm}$$

$V \to \boxed{\pi r^2 L}$

→ dV = volume of cylindrical shell.

$$I_A = \int r^2 dm = \frac{2M}{R^2}\int_0^R r^3 dr = \frac{2M}{R^2}\frac{R^4}{4} = \frac{1}{2}MR^2$$

Sonuç: Uzunluğa bağlı değil.
Sonuç L'ye bağlı çıkmadı. → Eylemsizlik momenti.



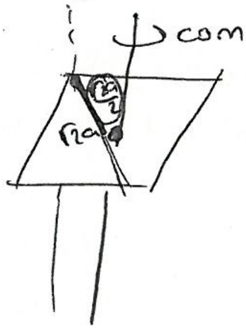
$$* \; \sigma = \frac{M}{A} = \frac{M}{a^2}$$

$$\frac{dm}{dA} = \frac{dm}{dx \cdot dy} \qquad dm = \frac{M}{a^2}\, dx\,dy$$

$$I_p = \int r^2 dm = \int_0^a \int_0^a (x^2+y^2)\, \frac{M}{a^2}\, dx\,dy$$

→ Böyle yapılın verilmez sınavda.

yerine koy. ①



$$I_p = I_{com} + M\left(\frac{a^2}{2}\right) \rightarrow \left(\frac{\sqrt{2}a}{2}\right)^2.$$

→ köşeye uzaklığı.

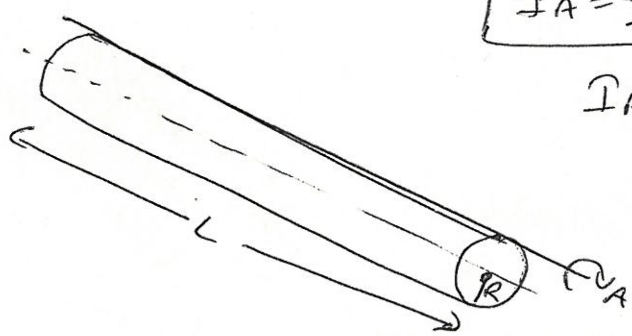
Bunu sordugunda.

② Icomlu çek.

$$\boxed{I_A = \underbrace{\tfrac{1}{2}MR^2}_{I_{com}} + \underbrace{MR^2}_{Mh^2}}$$

$$I_A = \frac{3}{2}MR^2$$

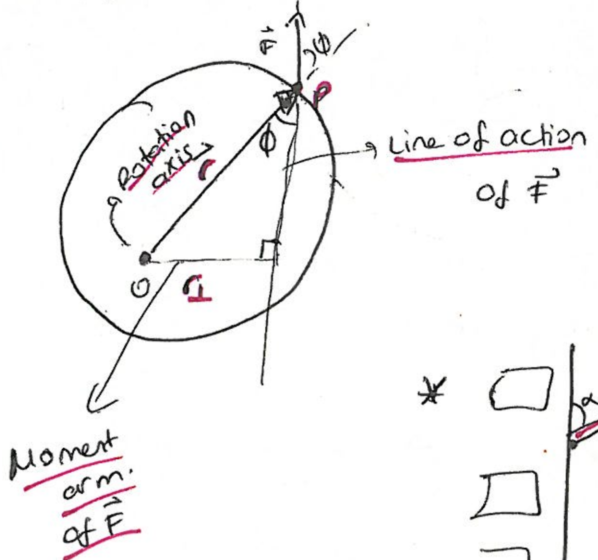
*



≈ Onu görseniz sanarsınız o bir derviş yeniliyorsunuz ≈

TORQUE

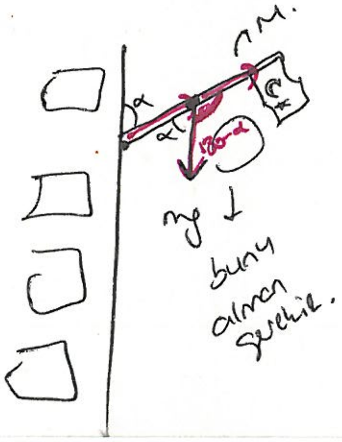
$$\tau = r \times F = r \cdot F \cdot \sin\phi = r_\perp F = r F_\perp$$



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

$$\cancel{\vec{\tau} = \vec{F} \times \vec{r}} \rightarrow \text{DO NOT}$$

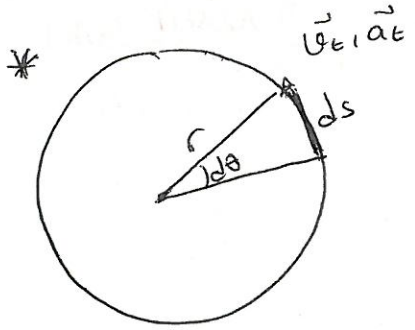
*



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

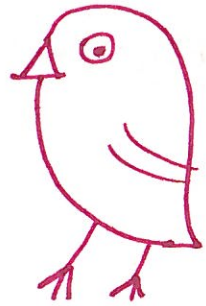
$$\tau = r \cdot w \cdot \sin$$

*



$$ds = r\,d\theta$$

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



$a_r = \frac{v^2}{r}$ $\quad v_t = r.w.$

$$a_t = \frac{dv_t}{dt} = r\underbrace{\frac{dw}{dt}}_{\alpha} = r\alpha.$$

WORK AND ROTATIONAL KINETIC ENERGY.

$$W = \int_{\theta_i}^{\theta_f} \tau\,d\theta$$

$$\Delta K = \frac{1}{2} I w_f^2 - \frac{1}{2} I w_i^2.$$

$$\boxed{W = \Delta K}$$

$x \longleftrightarrow \theta$

$v \longleftrightarrow w$

$a \longleftrightarrow \alpha$

$v = v_0 + at \longleftrightarrow w = w_0 + \alpha t$

$k = \frac{1}{2}mv^2 \longleftrightarrow K_R = \frac{Iw^2}{2}$

POWER

Strawberry Fields Forever.

$$P = \tau w$$

tork

açısal hızı

SLAYTTAN BAKMALISIN.

BUNU ÖĞREN!

THEY MAY ASK.

*

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

N·m

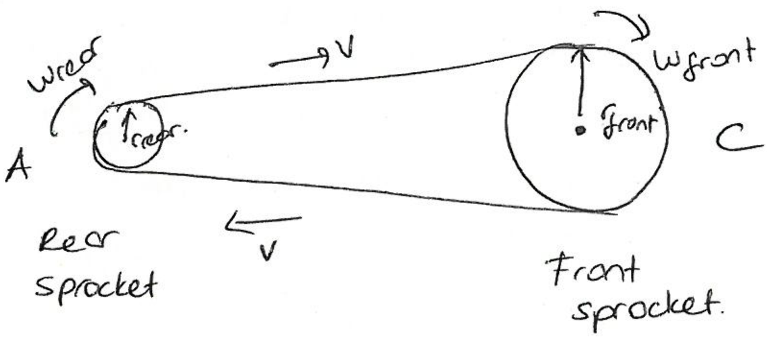
↳ unit of Tork. (2)

$W = \tau \cdot \theta$ ↳ rad.

J

↳ τ = J/rad (1)

↳ unit of Tork.



Slaytta çıkmış soru var.

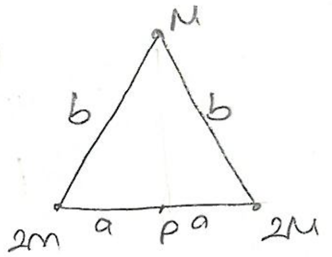
$V = r \cdot w$ $\quad w_A \cdot r_A = w_C \cdot r_C.$

$w_C = \alpha \cdot t$ → the angular speed of wheel C.

QUESTIONS

8 ARALIK SALI
2015

1. The rigid body shown in the figure consists of 3 particles connected by massless its to be rotate. How much work is required to take the body from rest to an angular speed of $w = 5.0$ rad/s.



↳ rotational axis.

$M = 0.4$ kg

$a = 30$ cm

$b = 50$ cm

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

$$I = 2M(a^2) + M(b^2 - a^2) + 2Ma^2$$

$$\cong 0.2 \text{ kg} \cdot m^2$$

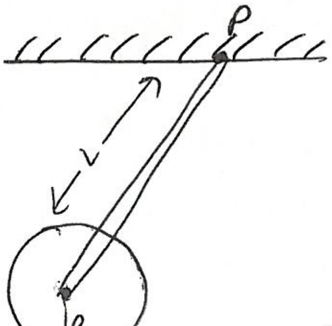
$$W = \frac{1}{2} I$$

Bu kızla
bana bir oda
bir yatak bir
kütüphane yeter

Son Feci Bisiklet

ÇIZGI FILIMLER MI IZLESEK
HIÇBIR YERE DE GITMESEK
HIÇ KIMSELERI GÖRMESEK
AMA AÇLIKTAN ÖLMESEK İYİ!

2.



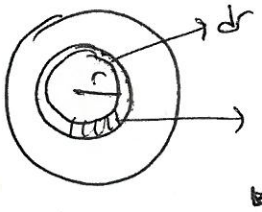
a = I = ?

b = position of com of the system

rod has M

disk " M

$$I = \int_0^R r^2 dm$$

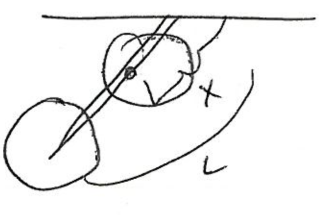


$$\frac{dm}{dA} = \frac{M}{\pi r^2}$$

$\downarrow$ $2\pi r dr$

paralel axis teorem.

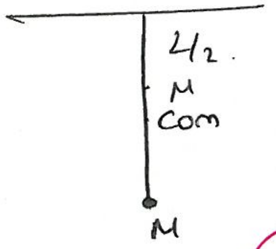
$$I = I_{rod} + I_{disk} + ML^2$$



I'ya Mx^2 daha eklenecek.

$$\rightarrow \quad I = I_{rod} + I_{disk} + ML^2 + Mx^2$$

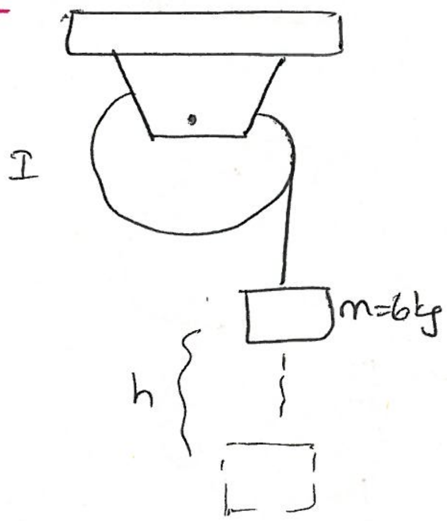
Sorunun Devamı



$$Y_{com} = \frac{M_1 Y_1 + M_2 Y_2}{M_1 + M_2} = \frac{m\left(\frac{L}{2}\right) + mL}{2M} = \frac{3}{4}L$$

$$T = 2\pi\sqrt{\frac{I}{mgh}} \rightarrow \text{PERİYOT}$$

3-



$R = 0{,}2\ m$

$I_p = 0{,}4\ kgm^2$

$K_{box} = 6\ J$

ⓐ K_{rot} of the whell

ⓑ $h = ?$

$$K_{box} = \frac{1}{2} m v^2 = 6$$

$$= \sqrt{2}$$

$$v \cong 1{,}4\ m/s$$

$$K_{disk} = \frac{1}{2} I \omega^2$$

$$\omega \cdot R = v \qquad \boxed{\omega = 7\ rad/s}$$

ⓐ $K_{rot} = \frac{1}{2}\, 0{,}4 \cdot 49 \cong 10\ J$

ⓑ $\underset{0}{K_0 + V_0} = K_{total} + \overset{pot.}{U_h} = (K_{box} + K_{rot}) + mg(-h)$

$$(6\ J + 10\ J) + mg(-h)$$

$$\boxed{h = \frac{16}{6 \times 10} \cong 0{,}3\ m}$$

$\vec{P}_i = \vec{P}_F$ $\qquad$ $\vec{P} = m\vec{V}$ $\qquad$ Sistem çeşitleri izolated

$\vec{L}_i = \vec{L}_f$ $\qquad$ $\vec{l} = \vec{r} \times \vec{P}$ $\qquad$ $\frac{dP}{dt} = 0$ → there is no external force

↳ angular momentum.

$\frac{dL}{dt} = 0$

L → constant.

Two rules for conservertion of Linear Momentum

1- Isolated system $F_{net} = 0$

2- Closed system Σm = carnstant isn't changing

İLK VE SON MEKANİK ENERJİLER EŞİTTİR.

ANGULAR MOMENTUM

1- $\vec{\Sigma}_{net} = 0$

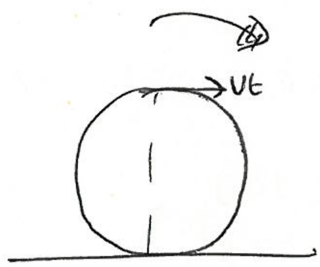
2- ΣI = constant

$$\frac{dP}{dt} = m\frac{dV}{dt} = m.a = F$$

$$\frac{dL}{dt} = I.\frac{dw}{dt} = I\alpha = \tau$$

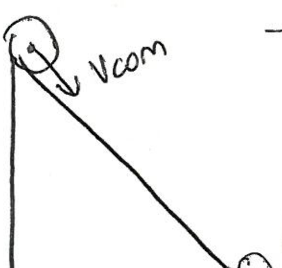
$$\underbrace{\vec{\tau} = \vec{r} \times \vec{F}}_{\tau} = I.\alpha$$

$$\vec{l} = \underbrace{\vec{r} \times \vec{P}}_{l} = I.w$$



Dönen cisimlerde açısal hız ve açısal ivme her noktada aynıdır

$$V_t = 2Rw = 2V_{com}$$



→ $\frac{1}{2} m V_{com}^2 + mgh$

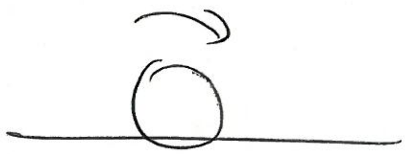
kin en $= \frac{1}{2} m V_{com}^2 + \frac{1}{2} I w^2 + U$ → potansiyel energy

Öteleme kinetik translational $\rightarrow \frac{1}{2} M v_{com}^2$

Dönme Kinetik E. rational kinetik $= \frac{1}{2} I . w^2$

SORULAR Öteleme kinetik enerjinin toplam enerjiye oranı.

sürtünme hareketin zıttı yönünde.



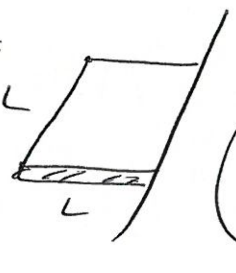
$\rightarrow$ fs bu tarafa doğrudur.

kaymadan yuvarlanıyorsa

Statik $\leftarrow$ μ_s

sürtünme katsayısı alınır.

KARE



$I = \frac{1}{3} M' L^2 \rightarrow$ kare

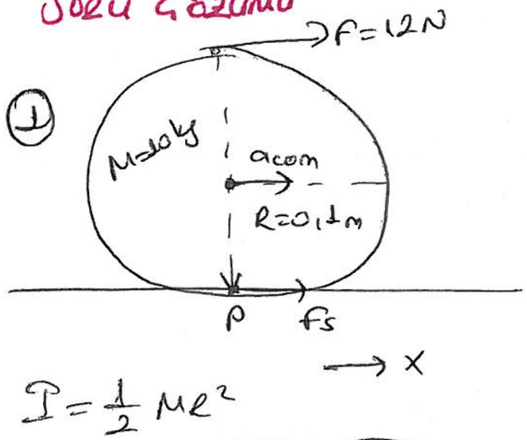
$I = \frac{1}{3} M L^2 \rightarrow$ rod

EK DERS

SORU ÇÖZÜMÜ

10 ARALIK PERŞEMBE 2015

1)



$I = \frac{1}{2} M R^2$

$I_p = I_{com} + MR^2 = \frac{3}{2} MR^2$

$I_{com} = \frac{1}{2} MR^2$

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

$\Sigma \tau = I \alpha$

$\tau = 2RF = I_p \alpha$

$2RF = (I_{com} + MR^2)\alpha$

$2RF = \frac{3}{2} MR^2 \alpha \leftarrow \frac{a_{com}}{R}$

$\alpha = 16 \, rad/s^2$

$a_{com} = 1,6 m/s^2$

$v = w . r$

α

$\alpha R = a_{com}$

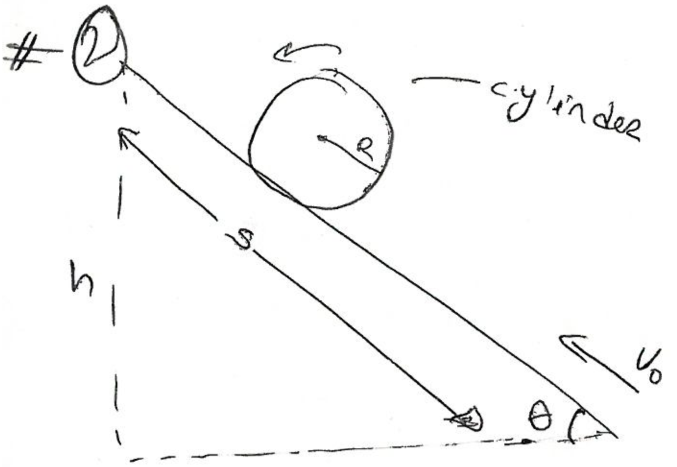
$F - f_s = M a_{com}$

$12 - f_s = 10 (1,6)$

$f_s = -4 N$

$f_s = 4 \hat{i} (N)$

(2)



(a) Find $s = ?$

(b) $K_{rot} / K_{total} = ?$

$K_{rot} =$

Sürtünme kuvveti eğik düzlemde her zaman yukarı doğru

(a) $E_i = E_f$

$$\frac{1}{2} I w_i^2 + \frac{1}{2} M V_0^2 = mg \overbrace{s \cdot \sin\theta}^{h}$$

$\frac{1}{2} mR^2$

$\frac{V_0}{R}$

$$S = \frac{1}{mg\sin\theta}\left[1 M V_0^2 + \frac{1}{4} mR^2 w_0^2\right]$$

$$\boxed{S = \frac{3}{4} \frac{V_0^2}{g \cdot \sin\theta}}$$

(b) $K_{tot} = K_{rot} + K_{trans}$

$$= \frac{1}{2} I w_0^2 + \frac{1}{2} M V_0^2$$

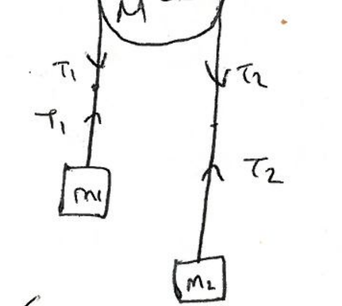
$$\frac{K_{rot}}{K_{tot}} = \frac{1}{2} W_0^2 \Big/ \frac{1}{2}\left[I W_0^2 + mR^2 W_0^2\right]$$

$$\boxed{= I / I + mR^2}$$

$$\boxed{V_f^2 - V_i^2 = 2 a_{com} s}$$

EXAMPLE

(3)



$m_1 = 400 g$

$m_2 = 600 g$

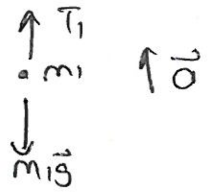
$M = 500 g$

(a) $a = ?$ accel. of the blocks.

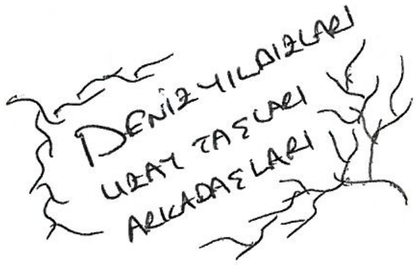
(b) Tensions in the cord.

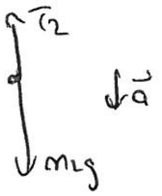
iki gerilme eşit olsaydı döndüremezdik.

Soluf



$$T_1 - m_1 g = m_1 a_1$$

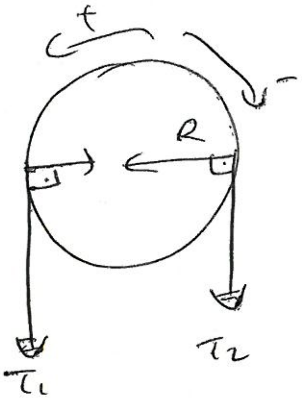




$$m_2 g - T_2 = m_2 a$$

+

$$T_1 - T_2 + (m_2 - m_1)g = (m_1 + m_2)a.$$

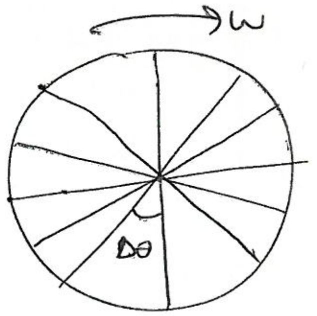


$$\Sigma \tau_{net} = -T_2 R + T_1 R = I\alpha.$$

$$I \to \frac{1}{2} m R^2.$$

$$(T_1 - T_2) R = I\alpha$$

Soru 3

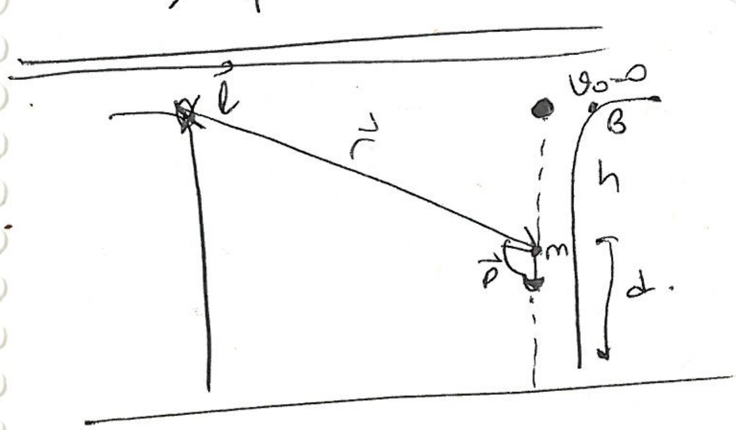


$$w = \frac{\Delta\theta}{\Delta t}$$

$$d = vt$$

$$w = \frac{\Delta\theta}{t} = \frac{2\pi/12}{t}$$

Tork'un yönü dönme yönü değildir. Dönme yönü w'nın, α'nın yönüdür.



$$\vec{L} = \vec{l}_1 + \vec{l}_2$$

$$|\vec{l}| = I.w. \quad \vec{l} = \vec{r} \times \vec{p}$$

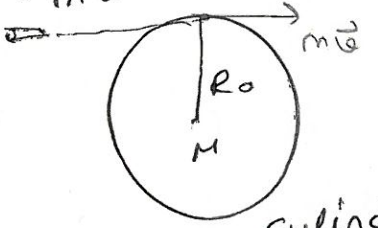
$$* \frac{d\vec{p}}{dt} = \vec{F} \Rightarrow \vec{P} = m \cdot \vec{v} \quad \rightarrow F_{net} = 0 \quad \rightarrow \frac{d\vec{P}}{dt} = 0 \quad \vec{P}_i = \vec{P}_f$$

$m = cst$

$$* \frac{d\vec{L}}{dt} = \vec{\tau} \rightarrow |\vec{l}| = I \cdot \omega \quad \rightarrow \quad \frac{d\vec{L}}{dt} = 0 = L_i = L_f$$

$$\vec{l} = \vec{r} \times \vec{p}$$

$* \, m\vec{v}$ $\qquad \omega_i = 0$



cylindee.

ⓐ $\omega_f = ?$

ⓑ $K_i \overset{?}{=} K_f$

$\Delta K = 0 ?$

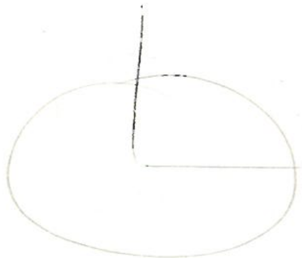
Solve

$L_i = L_f$ $\qquad \vec{L}_i = \vec{r} \times \vec{P}$

$L_i = R_o m v$

$$R_o m v = I_f \omega_f$$
$$= \left[\frac{1}{2} M R_o^2 + m R_o^2\right] \omega_f$$
$$\Rightarrow \omega_f = ?$$

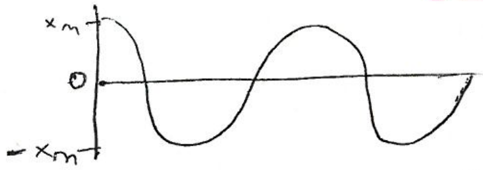
$$\omega_f = \frac{m \cdot v}{\left(\left(\frac{M}{2}\right) + m\right) R_o}$$



$L_i = L_f$

$I_i \omega_i = I_f \omega_f$

CHAPTER 15 : Oscillations

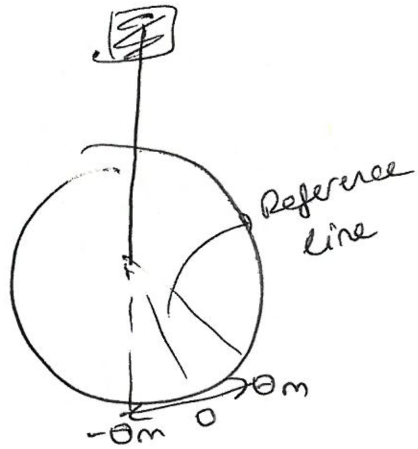


$$x(t) = x_m \cos(\omega t + \phi)$$

ω ↳ angular frequency

amlitude

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

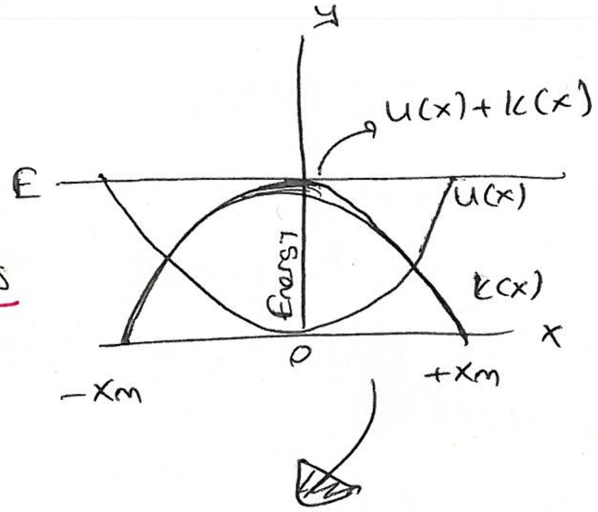


→ Slayttan işlendi.

→ The Force Law for Simple Harmonic Motion

$$a = -\omega^2 x$$

Newton's second Law $\quad F = ma = -m\omega^2 x$



Energy in Simple Harmonic Motions

Potential Energy

$$U = \frac{1}{2}kx^2 = \frac{1}{2}kx_m^2\cos^2(\omega t + \phi)$$

Kinetic Energy

$$K = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2 x_m^2 \sin^2(\omega t + \phi) = \frac{1}{2}k x_m^2 \sin^2(\omega t + \phi)$$

Mechanical Energy

$$E = U + K = \frac{1}{2}k x_m^2 \left[\cos^2(\omega t + \phi) + \sin^2(\omega t + \phi)\right] = \frac{1}{2}k x_m^2$$

→ faz açısı daima radyan cinsinden verilir.

$$\theta(t) = \theta_m \cos(\omega t + \phi)$$

restoring torque $\quad \tau = -k\theta$

↳ torsion constant of the wire

$$\omega = \sqrt{\frac{C}{I}} = \sqrt{\frac{mgL}{I}} \; ; \; T = 2\pi\sqrt{\frac{I}{C}} = 2\pi\sqrt{\frac{I}{mgL}}$$

The Simple Pendulum.

The net torque

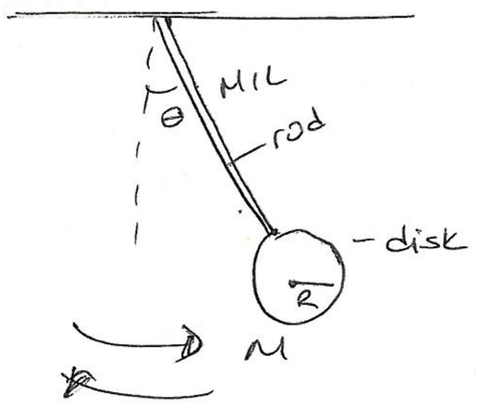
$$\tau = -L F_g = -Lmg\sin\theta$$

θ less than $5°$

$$\sin\theta \approx \theta$$

$$\tau \approx -(Lmg)\theta$$

SLAYT!



$x(t) = x_m \cos(\omega t + \phi)$

$v(t) = \frac{dx}{dt}$

$F = -kx = ma$

$-kx - bv = ma$

$$\boxed{kx - b\frac{dx}{dt} = m\frac{d^2x}{dt^2}}$$

→ If ω is increasing T is increasing to.

always changing.

Resonace → $\omega = \omega_0$

↳ genliğin sonsuza yani enerjinin sonsuza gitmesi.

köprü, rüzgar osilasyon yapıyor.

$\sqrt{k/m}\ \omega_0$ $\qquad x_m =$

→ KONU BİTTİ

CHAPTER ..

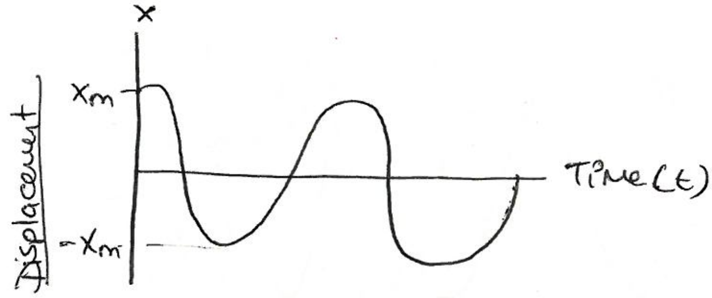
SIMPLE HARMONIC MOTION (SHM)

— SLAYTTAN NOTLAR —

$$x(t) = x_m \cos(\omega t + \phi)$$

ω ↳ angular frequency.

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



Velocity of SHM

$$v(t) = \frac{dx(t)}{dt} = \frac{d}{dt}\left[x_m(\cos(\omega t+\phi))\right] = -\omega x_m \sin(\omega t+\phi)$$

v_m → velocity amplitude

ϕ ↳ phase angle.

$$v(t) = -v_m \sin \omega t$$

$v_m \rightarrow \omega x_m$

velocity amplitude.

ACCELERATION OF SHM

$$a(t) = \frac{dv(t)}{dt} = \frac{d}{dt}\left[-\omega x_m \sin(\omega t+\phi)\right]$$

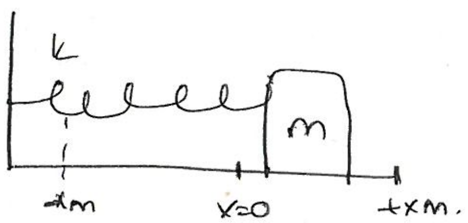
$$= \omega^2 x_m \cos \omega t$$

↳ a_m.

acceleration amplitude = maximum value of $a(t)$.

$$a(t) = a_m \cos \omega t$$

Sıkılırsan
güneşten
gece oluruz
erkendeeer
sen isterseeeer
karşılığında tek
istediğim geçmişin
geleceğin
beeeniiiiim
olsuuun



frictionless floor.

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

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

THE FORCE LAW FOR SIMPLE HARMONIC MOTION

$$a = -\omega^2 x$$

Newton's II. LAW $\quad F = ma = -m\omega^2 x$

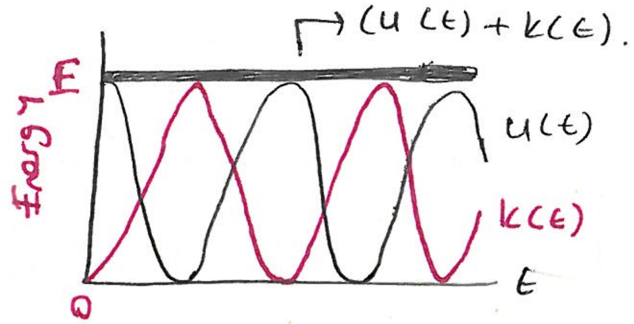
$$= -(m\omega^2)x$$

opposite in sign of x

$$F = -Cx$$

↳ C is a constant.

ENERGY IN SIMPLE HAMONIC MOTION



Potential Energy.

$$U = \frac{1}{2} k x^2 = \frac{1}{2} k x_m^2 \cos^2(\omega t + \phi)$$

Kinetic Energy

$$K = \frac{1}{2} m v^2 = \frac{1}{2} m \omega^2 x_m^2 \sin^2(\omega t + \phi)$$

$\omega^2 \rightarrow \frac{k}{m}$

$$= \frac{1}{2} k x_m^2 \sin^2(\omega t + \phi)$$

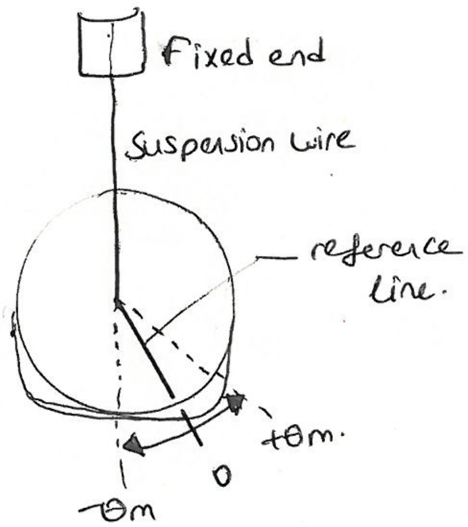
MECHANICAL ENERGY

$$E = U + K = \frac{1}{2} k x_m^2 [\cos^2(\omega t + \phi) + \sin^2(\omega t + \phi)]$$

$$\rightarrow = \frac{1}{2} k x_m^2$$

AN ANGULAR SIMPLE HARMONIC OSCILLATOR; TORSION PENDULUM

another type of oscilating system.



A disk suspended from a wire that twists as m rotates by an angle θ

restoring torque $\boxed{\tau = -k\theta}$

torsion constant of the wire

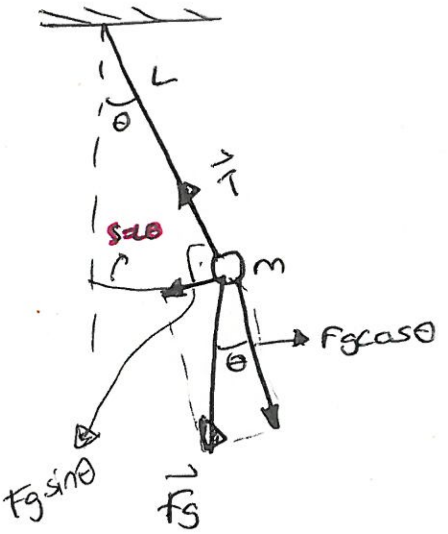
angular form of Hooke's Law

$$\theta(t) = \theta_m \cos(\omega t + \phi)$$

$$\omega = \sqrt{\frac{C}{I}} = \sqrt{\frac{k}{I}}$$

$$T = 2\pi \sqrt{\frac{I}{C}} = 2\pi \sqrt{\frac{I}{k}}.$$

THE SIMPLE PENDULUM



The net torque

$$\tau = -L F_g = -Lmg\sin\theta$$

θ less than 5°

↳ $\sin\theta \approx \theta$.

$\tau \approx -(Lmg)\theta$

$$\omega = \sqrt{\frac{C}{I}} = \sqrt{\frac{mgL}{I}}\ ;\ T = 2\pi\sqrt{\frac{I}{C}} = 2\pi\sqrt{\frac{I}{mgL}}.$$

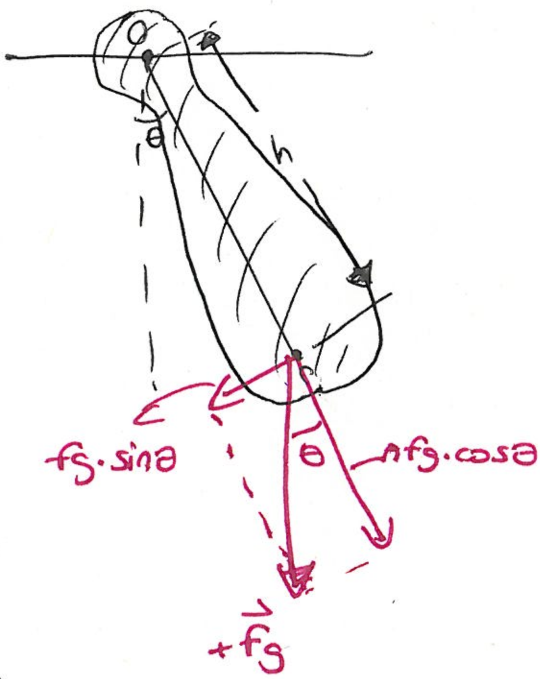
PHYSICAL PENDULUM

$\tau = -mgh\sin\theta$

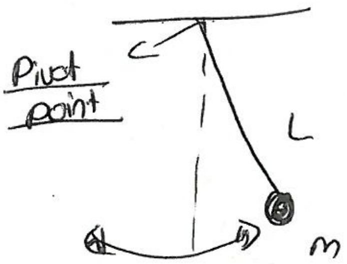
$\tau = -(mgh)\theta$

$$T = 2\pi\sqrt{\frac{I}{mgL}} = 2\pi\sqrt{\frac{mL^2}{mgL}}$$

$$T = 2\pi\sqrt{\frac{I}{C}} = 2\pi\sqrt{\frac{I}{mgh}}$$



$$I = I_{com} + mh^2$$



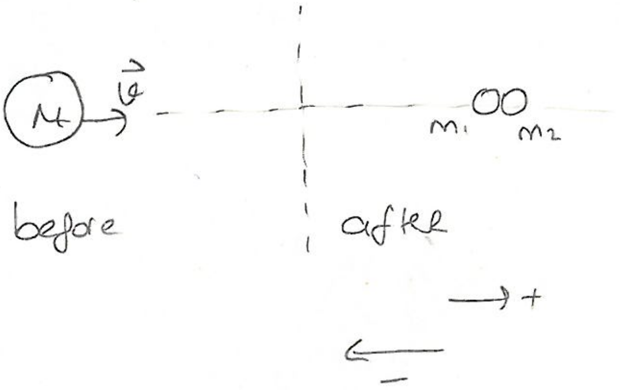
$$T = 2\pi\sqrt{\frac{I}{mgh}}$$

$$T = 2\pi\sqrt{\frac{L}{g}}$$

* ÇIKMIŞ SORULAR 15 ARALIK SALI

A body of mass $M=8kg$ is travelling at $v=2m/s$ with no external force acting. At a certain instant an internal explossion occurs, splitting the body into two chunks of $m_1=m_2=4kg$ mass each. The explossion gives the chunks an additional 16j of kinetic en. Chunks do not leave the line of original direction. Find the speed and diretion of motions related with each chunk after explosion

$$\vec{P}_i = \vec{P}_f$$



$$Mv = m_1 v_1 + m_2 v_2$$

$$8 \times 2 = 4v_1 + 4v_2$$

$$v_1 + v_2 = 4m/s \quad (1)$$

Kinetic energy Conservation.

$$\frac{1}{2}Mv^2 + 16j = \frac{1}{2}m v_1^2 + \frac{1}{2}m_2 v_2^2$$

$16+16$

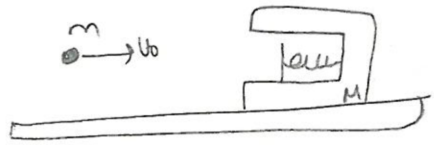
$$32 = \frac{1}{2}4v_1^2 + \frac{1}{2}4v_2^2 \quad \boxed{v_1^2 + v_2^2 = 16} \quad (2)$$

$$(v_1+v_2)^2 = v_1^2 + v_2^2 + 2v_1v_2$$

$$16 = 16 + 2v_1 \cdot v_2 \quad < 0$$

$v_1 = 0 \quad v_2 = 4m/s$

$v_1 = 4m/s \quad v_2 = 0.$



$$\frac{U_{spring}}{\frac{1}{2} m V_0^2} = ?$$

1) $m v_0 = (m+M) v \Rightarrow v = \frac{m v_0}{(m+M)}$

$$\frac{1}{2} m v_0^2 = \frac{1}{2} k x^2 + \frac{1}{2} (m+M) v^2$$

$\hookrightarrow U_{spring}$

$$U_{spring} = \frac{1}{2} m V_0^2 - \frac{1}{2} (m+M) V^2$$

$$= \frac{1}{2} v_0^2 - \frac{1}{2} (m+M) \left(\frac{m v_0}{m+M}\right)^2$$

$$= \frac{1}{2} m V_0^2 \left[1 - \frac{m}{m+M}\right]$$

What fraction of the initial kinetic energy of the ball is stored in the spring?

$$\frac{U_{spring}}{\frac{1}{2} m v_0^2} = 1 - \frac{m}{m+M}$$

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

A centrifuge has a radius of 10 meter and in starting rotate according to $\theta = 0{,}3t^2$ where t is in seconds θ in radyan. When $t = 5$ second what are the centrifuge's this motion angular velocity

ⓐ $w = ?$

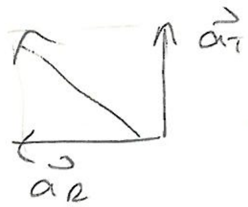
ⓑ $v = ?$

ⓒ tangental acceleration $a_T = ?$

ⓓ radial acceleration $a_R = ?$

ⓔ $|\vec{a}| = ?$

$a = \sqrt{a_T^2 + a_R^2}$



$$W = \frac{d\theta}{dt} = 0{,}6t \Big]_{t=5s} \quad rad/s = 3 rad/s.$$

$\hookrightarrow \theta = 0{,}3t^2$

$v = wR \Rightarrow 3 \cdot 10 = 30 m/s$

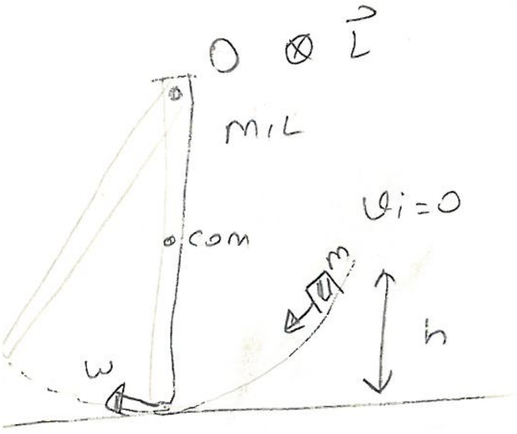
$a_T = \alpha . R$

$$\hookrightarrow \alpha = \frac{dw}{dt} = \frac{d^2\theta}{dt^2} = 0{,}6 rad^2/s$$

$a_T = (0{,}6) \cdot 10 = 6 m/s^2$.

$a = \sqrt{a_T^2 + a_R^2}$

$= \sqrt{6^2 + 96^2} \approx 90 m/s^2$



Hem ötelenmenin
hem dönmenin etkileri

Çarpışma lineer momentum
dönme olursa açısal ″ . } korunur.

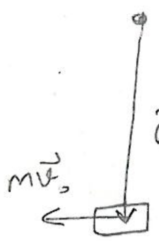
$w = ?$

$I_{com} = \frac{1}{12} ML^2$
(rod)

$L = I \cdot w$

$P = m \cdot v$

$L = \vec{r} \times \vec{P}$
$\hookrightarrow m\vec{v}$



$L_i = L_f$

$mgh = \frac{1}{2} m v_0^2$

$L_i = ?$

$I_i w_i = I_f w_f$

$v_0 = \sqrt{2gh}$

→ respect to O

$I_O = I_{com} + M\left(\frac{L}{2}\right)^2$

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

$I_f \cdot w$

$L_{initial} = L_{final}$

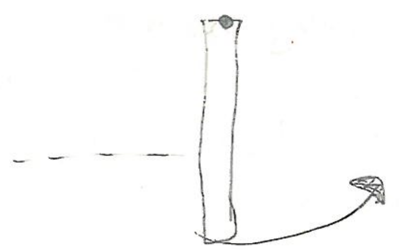
$L_{initial} = m v_0 L = mL\sqrt{2gh}$

$mL\sqrt{2gh} = \left[\frac{1}{3}M + m\right] L^2 w$

$L_{final} = I_f = I_O + mL^2$

$= \frac{1}{3} ML^2 + mL^2$

$$\boxed{w = \frac{m\sqrt{2gh}}{\left(\frac{M}{3} + m\right) L}}$$

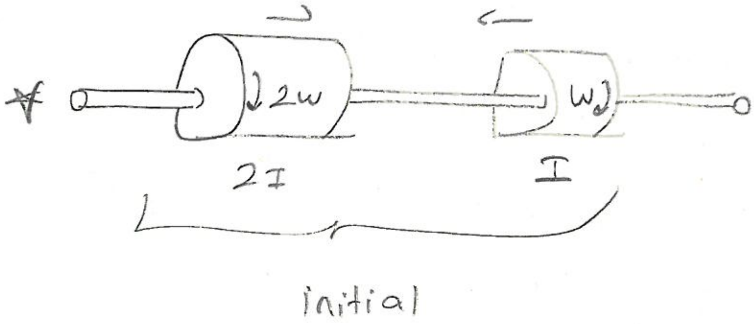


$\tau = \frac{dL}{dt}$

$\vec{\tau} = \vec{r} \times \vec{F}$ → $I\alpha$

$\vec{L} = \vec{r} \times \vec{P}$ → Açısal momentum en genel hali.
→ Iw.

$F = \frac{dP}{dt}$.



ikisinin de yönü aynı olduğu için topladık.

$L_i = L_f$

$\hookrightarrow 2I\,2w_i + I w_i = 5I w_i$

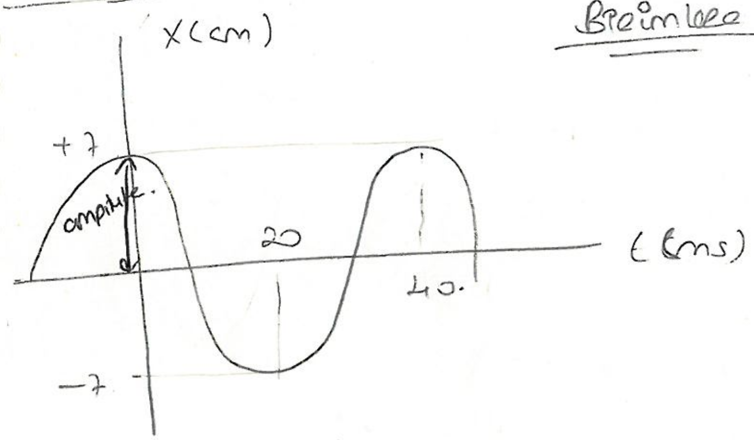
$L_f = (2I + I)\, w_f$

$L_i = L_f \Rightarrow$ $5 I w_i = 3 I w_f$

$w_f = 1{,}6\, w$

sağ el kuralı

Birimlere dikkat.



$x(t) =$ $m = 20g$ block.

ⓐ $x(t) = ?$

$v(t) = ?$

$a(t) = ?$

ⓑ $K_{max} = ?$

ⓒ k-spring constant.

$X(t) = X_{max} \cos(wt)$ $\longrightarrow$ $w = \frac{2\pi}{T}$ $\rightarrow \frac{2\pi}{40 \times 10^{-3}} \cong 150\, m/s$

$\downarrow$

$X(t) = \underset{m}{(0{,}07)} \cos(\underset{rad/s}{150 \cdot t})$

ⓑ $K_{max} = \frac{1}{2} m V_{max}^2$

$= 1{,}1\, j$

$\hookrightarrow K_{max} = U_{max}$ $\rightarrow$ git.

$v(t) = \frac{dx(t)}{dt} = -(0{,}07) \cdot (150) \sin(150t)$

$= -v_{max}$

$\downarrow$

$10{,}5$

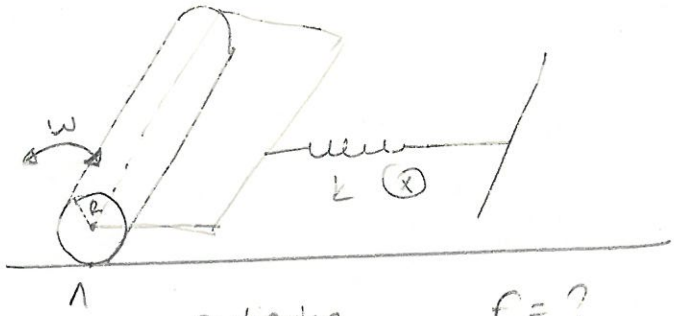
maximum acceleration

$a(t) = \frac{dv}{dt} = -(10{,}5) \cdot (150) \cos(150t).$

$K_{max} = \frac{1}{2} m V_{max}^2$
$= 1{,}1 \, J$

$(1{,}1 \, J) = \frac{1}{2} k x_{max}^2$

$\boxed{k \cong 450 \, N/m}$



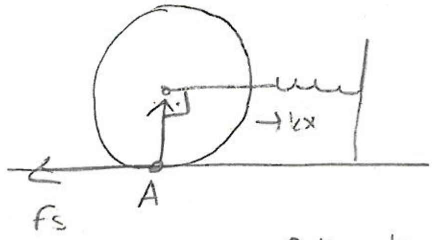
cylinder.

$f = ?$

$\omega = 2\pi f$

$f = \frac{1}{T}$

$\boxed{\frac{1}{2} mR^2 = I_{com}}$



A noktasında fs'in döndürme etkisi yoksa A noktasından incelediğimizde kx döndürür.

$\tau_A = R.kx.$ → A nok. akreden tork.

$\tau = I \cdot \alpha$ net torkum.

$kx = m \frac{d^2x}{dt^2}$

$\omega = \sqrt{\frac{k}{m}}$

$x = x_m \cos \omega t$

$kxR = I_A \cdot \alpha$

$kxR = \underbrace{\left[\left(\frac{1}{2} MR^2\right) + mR^2\right]}_{I_A} \cdot \alpha$

$S = R.\theta$ Dairesel olduğu için.

$x = R.\theta$

$\underbrace{kR^2}_{C \text{ (sabit)}} \theta = \underbrace{\left(\frac{3}{2} MR^2\right)}_{I} \frac{d^2\theta}{dt^2}.$

$kx = m \frac{d^2x}{dt^2}$

$\omega = \sqrt{\frac{k}{m}}$

→ buna benzettik.

$\omega = \sqrt{\frac{C}{I}} = 2\pi f.$