Fizik 1 Tekrar

3 temel büyüklük vardır.

1- Kütle (kg)

2- Uzunluk (m)

3- Zaman (s)

Boyut Analizi

Büyüklük	Boyut	Birim
Kütle	Mass	kg
Uzunluk	Length	metre
Zaman	Time	saniye
Alan	L^2	m^2
Hacim	L^3	m^3
Hız	L/T	m/s
İvme	L/T^2	m/s^2
Kuvvet	$M.L/T^2$	$kg.m/s^2$

* Bir eşitliğin her iki tarafının boyutları aynı olmalıdır.
* Aynı boyuttaki nicelikler toplanıp çıkarılabilir.

Ör/

$$F = G.\frac{m_1.m_2}{r^2}$$

"G" boyut analizini yapınız.

$$\frac{M.L}{T^2} = "G".\frac{M^x}{L^2}$$

$$\frac{L^3}{M.T^2} = "G"$$

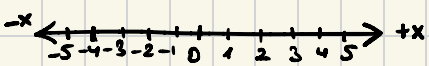
Birim Çevirme

1. $\frac{1km}{1000m} \cdot \frac{3600s}{1h}$

$1\ m/s = ?\ km/h$

$1\ \frac{m}{s}\left(\frac{3600s}{1h}\right)\cdot\left(\frac{1\ km}{1000m}\right) = 3{,}6\ km/h$

Bir Boyutlu Hareket



1) Yer değiştirme: $\Delta x = x_s - x_i$ (metre)

x_i = ilk konum | t_i = ilk zaman

x_s = son konum | t_s = son zaman

2) Ortalama Hız: $v_{ort} \equiv \frac{\Delta x}{\Delta t}\ (m/s)$

3) Ani Hız: $\lim_{\Delta t \to 0} v_{ort} \equiv v$

$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$

4) Ortalama ivme: $a_{ort} \equiv \frac{\Delta v}{\Delta t} = \frac{v_s - v_i}{t_s - t_i}\ (m/s^2)$

5) Ani ivme

$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv(t)}{dt}$

Türev Operatörü

$\lim_{\Delta t \to 0} \frac{\Delta}{\Delta t} \equiv \frac{d}{dt}$

Ör/ $-4t + 2t^2 = x$

a) 1sn ile 3sn arasında yer değiştirme

$4t - 4 = v$

$4 = a$

$(t=1)\ x_i = -2m$

$(t=3)\ x_s = 6m$

$\Delta x = 8m$

b) ort hız:

$8/2 = 4\ m/s$

$\frac{8-0}{2} = 4 m/s$

c) $t = 2,5$ sn'de cismin hızı

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{x_s - x_i}{\Delta t}$$

$t_s = t + \Delta t$

$x_s = -4(t+\Delta t) + 2(t+\Delta t)^2$

$$\lim_{\Delta t \to 0} \frac{-4t - 4\Delta t + 2t^2 + 4t\Delta t + 2\Delta t^2 + 4t - 2t^2}{\Delta t}$$

$$\frac{\Delta t(-4 + 4t + 2\Delta t)}{\Delta t} = -4 + 4t$$

$(t=2,5) = 6$

$$v = \frac{dx}{dt}\Big|_{t=2,5} \rightarrow -4 + 4t$$

$6m$

Sabit İvmeli Hareket ($a = sbt$)

- Ortalama ivme, ani ivmeye eşittir.

$$v_{ort} = \frac{x_{(t)} - x_i}{t} = \frac{v_i + v_{(t)}}{2}$$

(Düzgün ivmede geçerlidir.)

$$v_{(t)} = v_i + at$$

t anında v hızı
ilk hızı + ivme x zaman

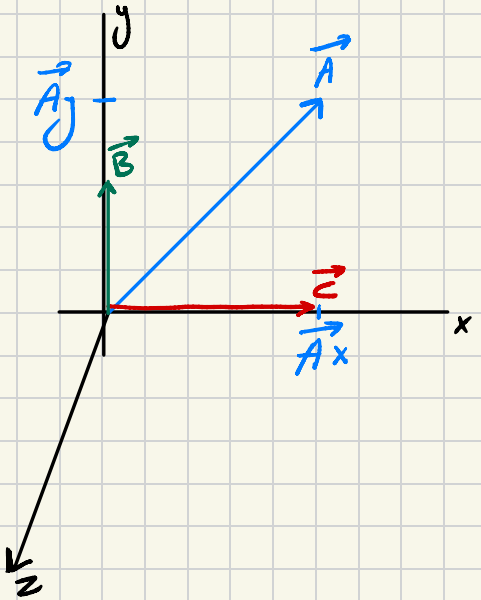
$$x_{(t)} = x_i + v_i t + \frac{1}{2} a t^2$$

$$x_s = x_i + v_0 t + \frac{at^2}{2}$$

$$v^2 = v_i^2 + 2a(x - x_i)$$

zamansız hız formülü

Vektörler



Birim Vektör: $|\hat{i}| = 1$ br

$|\hat{j}| = 1$ br

$|\hat{k}| = 1$ br

$\vec{B} = 3\hat{i}$

$\vec{C} = 4\hat{j}$

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$

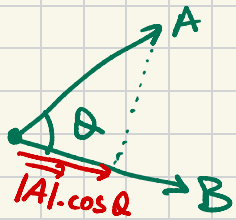
$$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

$\vec{A}$'nın uzunluğu

Vektörlerde Çarpım

1) Skaler Çarpım (iç çarpım)

$$\vec{A} \cdot \vec{B} = |\vec{A}| \cdot |\vec{B}| \cdot \cos\theta$$



$\hat{i} \cdot \hat{i} = |\hat{i}| \cdot |\hat{i}| \cdot \cos 0^\circ = 1$

$\hat{j} \cdot \hat{j} = |\hat{j}| \cdot |\hat{j}| \cdot \cos 0^\circ = 1$

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

$\hat{i} \cdot \hat{j} = |\hat{i}| \cdot |\hat{j}| \cdot \cos 90 = 0$

$\hat{i} \cdot \hat{k} = 0$

$\hat{j} \cdot \hat{k} = 0$

$$\vec{A} \cdot \vec{B} = A_x B_x \hat{i}\cdot\hat{i} + A_x B_y \hat{i}\hat{j} + A_x B_z \hat{i}\cdot\hat{k} + A_y B_x \ldots$$

$$\ldots\ldots\ldots\ldots$$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Ör/

$\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ (4, 9, 1)

$\vec{B} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ (9, 16, 25)

a) $6 - 12 - 5 = -11$

$6 - 12 - 5 = -11$

$-11 = \sqrt{14} \cdot \sqrt{50} \cos\theta$

$\cos^{-1}\left(\frac{-11}{\sqrt{14}\cdot\sqrt{50}}\right) = \theta$

a) A ve B skaler çarpım

b) A, B arası açı kaç derecedir?

b) $\sqrt{3^2 + (-4)^2 + 5^2} = 7.07$ ($\vec{B}$)

$\sqrt{2^2 + 3^2 + (-1)^2} = 3.74$ ($\vec{A}$)

$-11 = (7.07)(3.74)\cdot\cos\theta$

$\cos\theta = -0,38$

$\theta = 112.3^\circ$

2) Vektörel Çarpım

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

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

$|\hat{j} \times \hat{j}| = |\hat{j}| \cdot |\hat{j}| \cdot \sin 0^\circ = 0$

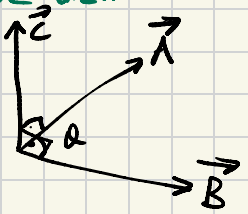
Vektörel Çarpımın Özellikleri

1) İki vektör çarpımı da bir vektördür.

2) $|\vec{C}| = |\vec{A} \times \vec{B}| = |\vec{A}| \cdot |\vec{B}| \cdot \sin\theta$

3) İki vektör çarpımı diğer vektörlere diktir.

Yani aynı düzlemde değildir.



4) $\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$

$\hat{i} \times \hat{j} = \vec{c}$

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

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

$$\vec{A} \times \vec{B} = (A_y B_z - A_z B_y)\hat{i} + (A_z B_x - A_x B_z)\hat{j} + (A_x B_y - A_y B_x)\hat{k}$$

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

$\vec{B} = \hat{i} - 5\hat{j}$

$\vec{A} \times \vec{B} = (2\hat{i} + 3\hat{j}) \times (\hat{i} - 5\hat{j})$

$-3\hat{k}$, 0 , 0 , $-10\hat{k}$

$\vec{A} \times \vec{B} = -13\hat{k}$

$|\vec{A} \times \vec{B}| = 13$

$(\vec{A} \times \vec{B}) \cdot \vec{A} = ?$

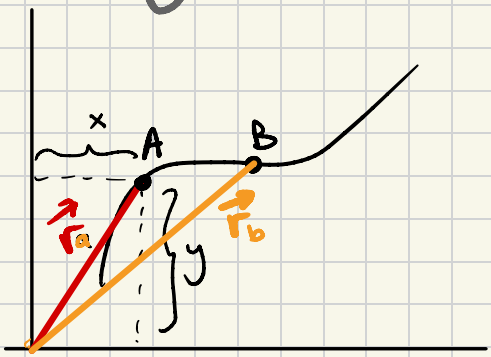
$\vec{c}$

0

$\vec{c} \perp \vec{A}$

$\vec{c} \perp \vec{B}$

İki Boyutlu Hareket



$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$
$$|\vec{r}| = \sqrt{x^2+y^2+z^2}$$

1) Yer değiştirme

$$\Delta\vec{r} = \vec{r}_B - \vec{r}_A = (x_B\hat{i} + y_B\hat{j}) - (x_A\hat{i} + y_A\hat{j})$$

2) Ortalama Hız

$$\vec{v}_{ort} = \frac{\Delta\vec{r}}{\Delta t} = \frac{\Delta x}{\Delta t}\hat{i} + \frac{\Delta y}{\Delta t}\hat{j} + \frac{\Delta z}{\Delta t}\hat{k}$$
$$\vec{v}_{ort} = v_{ort_x}\hat{i} + v_{ort_y}\hat{j} + v_{ort_z}\hat{k}$$

3) Anlık Hız

$$\vec{v} = \lim_{\Delta t \to 0}\frac{\Delta\vec{r}}{\Delta t} = \frac{d\vec{r}}{dt}$$

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

4) Ortalama İvme

$$\vec{a}_{ort} = \frac{\Delta\vec{v}}{\Delta t} = a_{ort_x}\hat{i} + a_{ort_y}\hat{j}$$

5) Ani İvme

$$\vec{a} = \lim_{\Delta t \to 0}\frac{\Delta\vec{v}}{dt} = \frac{d\vec{v}}{dt}$$

$$|\vec{a}| = \sqrt{a_x^2 + a_y^2} \qquad \vec{a} = \frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j}$$

Sabit ivmeli iki Boyutlu Hareket

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

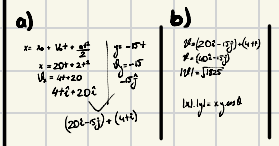
$$v_x = v_{0x} + a_x t$$

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

$$v_y = v_{0y} + a_y t$$

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

$$\vec{r} = \vec{r_0} + \vec{v_0}t + \frac{1}{2}\vec{a}t^2$$



$a_x = 4\,m/s^2$ $t=0$ anında orijinde başlayan

$a_y = 0$ $V_{0x} = 20\,m/s$

$V_{0y} = -15\,m/s$

a) Herhangi bir andaki hız vek. yazınız.

b) (t=5) için hız, sürat x ekseni ile açısı

c) Konum vek?

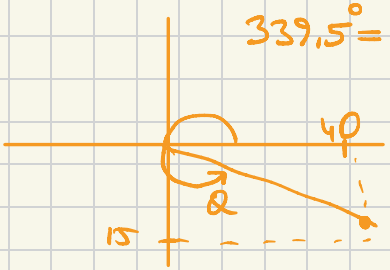
c) $\vec{r} = \vec{r_0} + \vec{v_0}t + \frac{1}{2}\vec{a}t^2$

$20\hat{i} - 15\hat{j}$

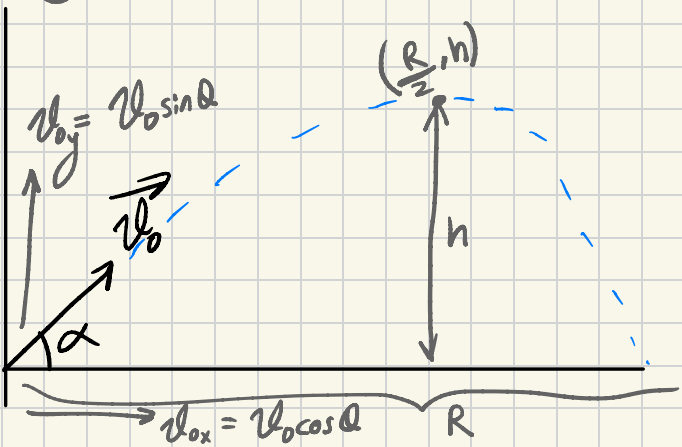
$\vec{a} = 4\hat{i}$

$\vec{v} = \vec{v_0} + \vec{a}t$

$\vec{v} = (20\hat{i} - 15\hat{j}) + (4\hat{i}t)$



Yatay Atış Hareketi



$$a = -g = -9.8 \ m/s^2$$

$$x = x_0 + v_o t + \frac{1}{2} a t^2 \quad (x_0 = 0)$$

$$x = v_o \cos\theta \cdot \frac{v_o \sin\theta \cdot 2}{g}$$

$$x = \frac{v_o^2 \cdot \sin(2\theta)}{g}$$

Maksimum uzaklık

1) Cismin ivmesi "g" ve sbt

2) Hava Direnci ihmal

$$v_y = v_{oy} + a_y t$$

$$v_y = v_o \sin\theta - gt$$

+ anında hızın y eksenindeki değeri

tepe noktasında $v_y = 0$

$$0 = v_o \sin\theta - g t_c$$

$$t_c = \frac{v_o \sin\theta}{g} = t_i$$

çıkış = iniş süresi

$$y = y_0 + v_{oy} t + \frac{1}{2} a_y t^2 \quad (a_y = -g)$$

$t = t_c$ olursa $y = h$

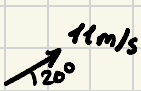
$$h = v_o \sin\theta \cdot \frac{v_o \sin\theta}{g} - \frac{1}{2} g \frac{v_o^2 \cdot \sin^2\theta}{g^2}$$

$$h = \frac{v_o^2 \cdot \sin^2\theta}{2g}$$

Maksimum yükseklik

Bir taş yerle 20° atılarak ($V_0 = 11\ m/s$)

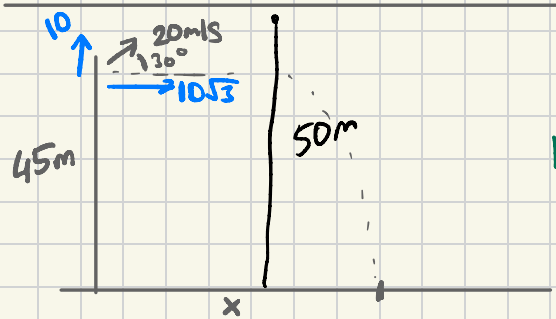
a) Yatayda ne kadar uzağa düşer?



$$x = \frac{V_0^2 \sin 40^\circ}{g} = \frac{121 \cdot \sin 40^\circ}{9.8} = 7.93 \text{ metre}$$

b) Taşın maks yüksekliği

$$h = \frac{V_0^2 \cdot \sin^2 Q}{2g} = \frac{121 \cdot \sin^2 20^\circ}{9.8} = 0,72 m$$



a) taş ne zaman yere çapar

$t_ç = 1sn$

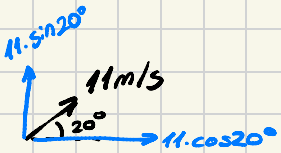
$h_{max} = 45 + 10 - 5 = 50$ | $3.16 + 1 = 4.16$

b) taşın yere çarpma hızı nedir?

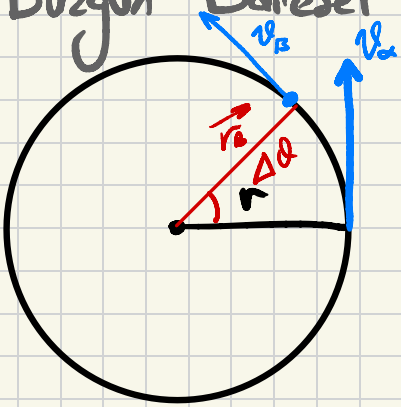
31.35 m/s

$1 = t_ç$

$10 \cdot 1 - \frac{1}{2} \cdot 10 \cdot 1 = 5m$

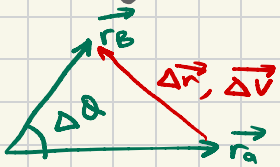


Düzgün Dairesel Hareket



$$\vec{a} = \frac{d\vec{v}}{dt}$$

merkezcil ivme: dairenin merkezine doğru olan ivme



$$|\vec{v_A}| = |\vec{v_B}| = v$$

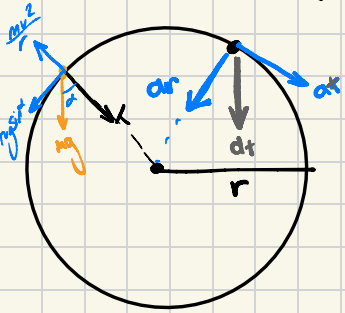
$$|\vec{r_A}| = |\vec{r_B}| = r$$

$$|\vec{a_{ort}}| = \frac{|\Delta\vec{v}|}{\Delta t}$$

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

$$v = \lim_{\Delta t \to 0} \frac{|\Delta\vec{r}|}{\Delta t} = \frac{|d\vec{r}|}{dt}$$ } anlık hız

$$|\vec{a}_{anlık}| = \frac{v^2}{r}$$ } merkezcil ivme



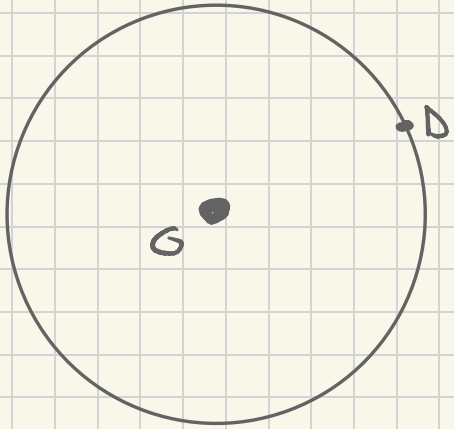
$$\vec{a_r} + \vec{a_x} = \vec{a_t}$$

Düzgün olmayan dairesel hareket

1- Hızın büyüklüğünün değişmesinden ivme $a_1 = \frac{dv}{dt}$

2- Hızın yönünden dolayı ivme $a_2 = \frac{v^2}{r}$

Dünyanın, güneş etrafında dönmesi sonucu merkezcil ivmesi yaklaşık nedir?

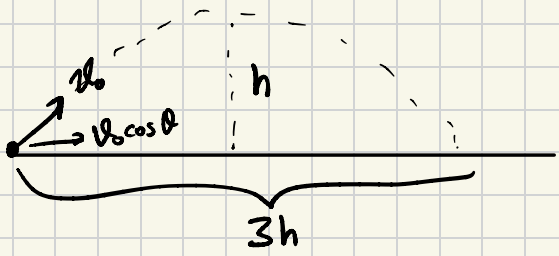


$$a = \frac{v^2}{r} \rightarrow a = \frac{4\pi^2 r^2}{t^2 \cdot r}$$

$$a = 5.93 \cdot 10^{-3} \ m/s^2$$

$$\underbrace{2\pi r}_{\text{yol}} = v \cdot t \quad \downarrow \quad \frac{2\pi r}{t} = v$$

Bir taş yerden belli bir açıyla fırlatıldığında menzil uzaklığı yüksekliğin 3 katı oluyor. Açı=?



$$\frac{v_0^2 \cdot \sin 2\theta}{g} = 3h$$

$$\frac{3 v_0^2 \cdot \sin^2\theta}{2g} = 3h$$

$$\frac{3 v_0^2 \cdot \sin^2\theta}{2g} = \frac{v_0^2 \cdot \sin 2\theta}{g}$$

$$3\sin^2\theta = 2\sin 2\theta$$

$$3s^2 = 2 - 4s^2$$

$$7s^2 = 2$$

$$s = \pm\sqrt{\frac{2}{7}}$$

Orijinde

$\vec{a} = 3\hat{j}\ m/s^2$

$\vec{v}_0 = 5\hat{i}\ m/s$

ise

a) herhangi anda konum vek

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

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

b) hız vek

$v = 5\hat{i} + 3\hat{j}t = \frac{d\vec{r}}{dt}$

c) t=2 için koordinat, sürat

$(10\hat{i}, 6\hat{j})$ / $5\hat{i} + 6\hat{j} = \vec{v}$

$\sqrt{25+36} = |\vec{v}|$

$m/s\ 7.81 = |\vec{v}|$

Hareket Yasaları

Kuvvet: $\vec{F}$

1) Temas Kuvvetleri
2) Alan Kuvvetleri

1- Eylemsizlik

$$\Sigma \vec{F} = 0$$
$$\vec{a} = 0$$

Kütle: Cismin hızının değişimine karşı gösterdiği direnç

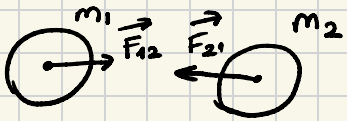
2- $F = m.a$ $(kg/m.s^2)$

$m_1 \rightarrow a_1$

$m_2 \rightarrow a_2$

$$\frac{m_1}{m_2} = \frac{a_2}{a_1}$$

3- Etki/Tepki Prensibi

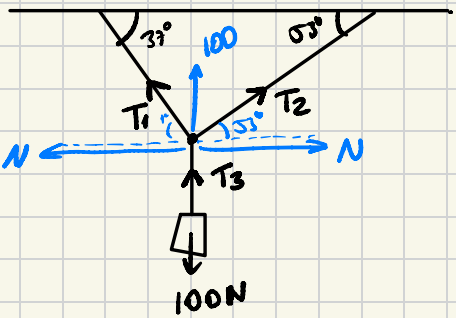


$$\vec{F}_{12} = -\vec{F}_{21}$$

4- Kütle Çekim Kuvveti

$$\vec{F}_g \quad \vec{a} = \vec{g}$$
$$\Sigma \vec{F} = m.\vec{a}$$
$$\vec{F}_g = m\vec{g}$$

Ağırlık = m.g



$$T_{2x} = T_2 \cos 53^\circ$$
$$T_{2y} = T_2 \cdot \sin 53^\circ$$
$$T_{1x} = T_1 \cdot \cos 37^\circ$$
$$T_{1y} = T_1 \cdot \cos 37^\circ$$

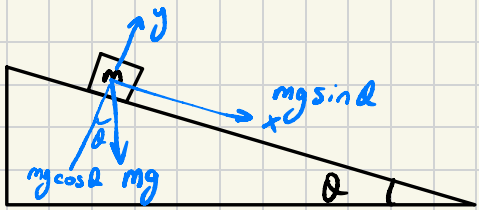
$$T_1 = \frac{T_2 \sin 37^\circ}{\cos 37^\circ} = \frac{3T_2}{4}$$

$$\frac{4}{5}(T_1 + T_2) = 100$$

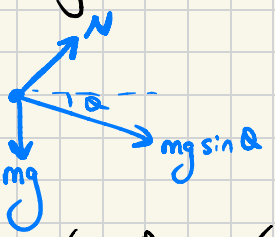
$$\frac{4}{5} \cdot \frac{7T_2}{4} = 100$$

$$T_2 = \frac{500}{7}$$

$$T_1 = \frac{1500}{28}$$



a) bloğun ivmesi



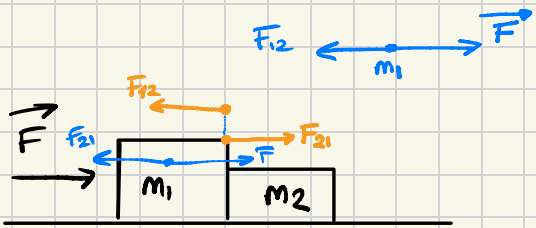
$mg\sin\theta = m.a_x$

$g\sin\theta = a_x$

b) eğik düzlemde "d" kadar yol katederse hızı ne olur.

$v^2 = v_0^2 + 2a_x.(x_s - x_0)$

$v = \sqrt{2g\sin\theta d}$



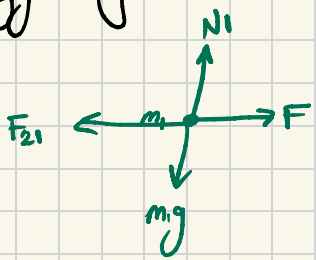
a) sistem ivme

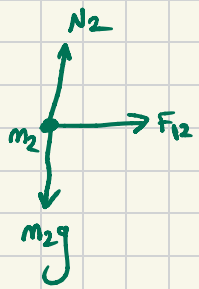
$\sum F_x = m.a_x$

$F = (m_1 + m_2)\,a_x$

b) 1.'nin 2.'ye uyguladığı kuvvet?

$\frac{F - F_{21}}{m_1} = a_1 = a_x$





$\frac{F}{m_1+m_2} = \frac{F - F_{21}}{m_1}$

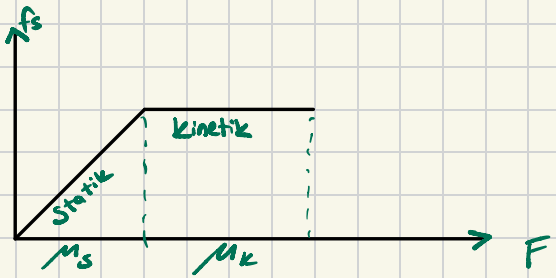
$F_{m_1} = F_{m_1} + F_{m_2} - F_{21}m_1 - F_{21}m_2$

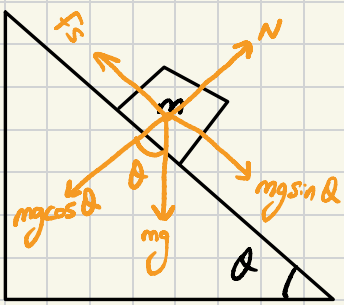
$F_{21} = \left(\frac{m_2}{m_1+m_2}\right).F$

$\frac{F_{12}}{m_2} = \frac{F}{m_1+m_2}$

$F_{12} = -F\left(\frac{m_2}{m_1+m_2}\right)$

Sürtünme Kuvveti





Ör/ $N = mg\cos\theta$

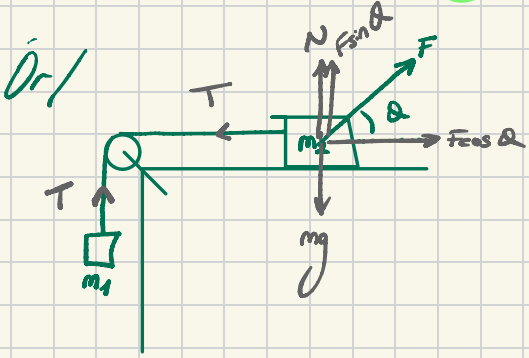
$$f_s = \mu_s N = \mu_s mg\cos\theta$$

Eğer $\Sigma F_x = 0$ ise hareket yoktur.

$$\mu_s = \frac{\sin\theta}{\cos\theta} = \tan\theta$$

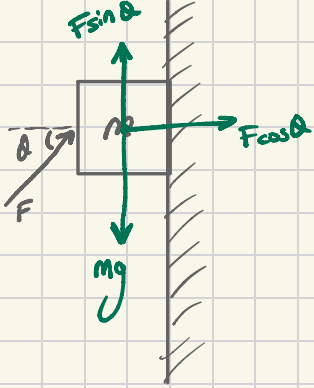
$$\mu_s = \tan\theta_c$$

Ör/



ivmeleri gösterin.

$$\frac{T - m_1 g}{m_1} = \frac{F\cos\theta - T - \mu(m_2 g - F\sin\theta)}{m_2}$$



$m = 3kg \qquad \theta = 50°$

Statik sürtünme $k = 0,25$ ise
cismi dengede tutacak muhtemel F nedir?

$N = F\cos\theta$

$f_s = \mu F\cos\theta$

$f_s = F\sin\theta + mg = \mu F\cos\theta$

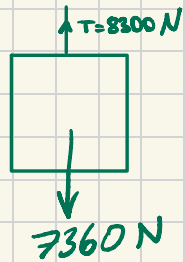
$F = \frac{mg}{\mu\cos\theta + \sin\theta} = 31.72\ N$

1. Durum

$F\sin\theta = mg + \mu F\cos\theta$

$F = 48.56\ N$

Ör/ 75 kilo insan tartılmak isteniyor.



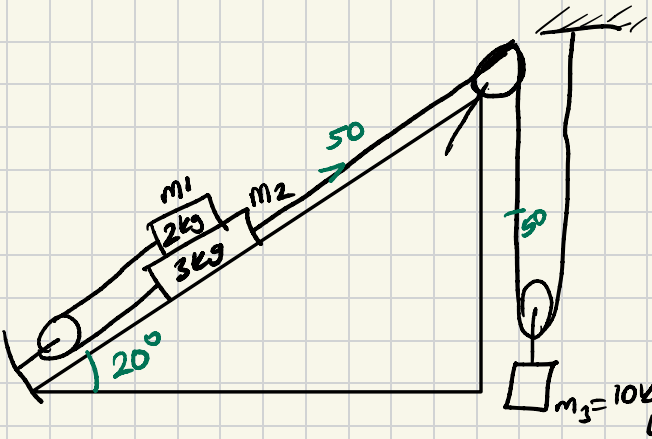
$\frac{940}{750} = 1,25\ m/s^2$

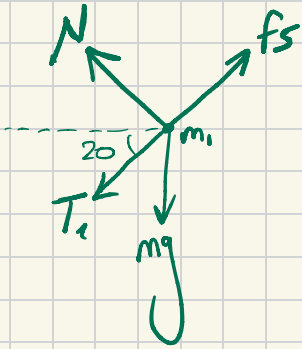
$9,8$

$+$

$11,05\ m/s^2$

$11.05 \cdot 75 = 82.8\ N$





$$m_1 a = T_1 + m_1 g \sin 20° - \mu_1 m_1 g \cos 20°$$

$$2a - 2 = T_1$$

$$m_2 a = T_2 - m_2 g \sin 20° - F_{s_2} - F_{s_1} - T_1$$

$$3a = T_2 - 75 - T_1$$

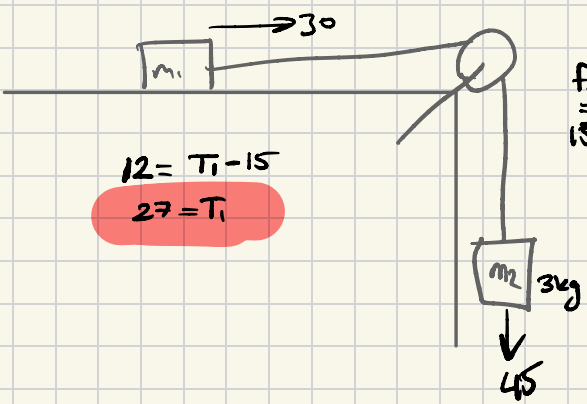
$$F_{s_2} = \mu_2 N_2$$

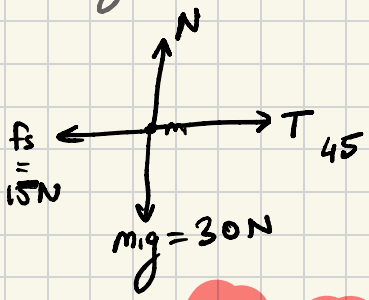
$$m_3 g - 2T_2 = m_3 \cdot \frac{a}{2}$$

Şekilde yukarıya doğru $A = 5\ m/s^2$'lik ivmeyle hareket etmekte olan asansörün içinde serbest bırakılan sistemde yatay doğrultudaki kinetik sürtünme katsayısı 0,5

$m_1 = 2kg$

$m_2 = 3kg$ old. göre blokların ivmeyi bulunuz.





$12 = T_1 - 15$

$27 = T_1$

$\frac{30}{5} = 6$

$45 - T_1 = 18$

$T_1 = 27$

2 koşu sporcusu durgun halden aynı anda 100 metre koşuya başlıyor. Her iki sporcu 10.2 sn de koşuyu tamamlıyor. 1. koşucu ivmesi = 2sn
2. koşucunun ivme = 3sn
ve sonra sbt hızda ilerliyorlar. Koşucuların hızları nedir?

$$x_{s_1} = \frac{1}{2} a_1 4 = 2a_1$$

$$x_{s_2} = \frac{1}{2} a_2 9 = 4{,}5 a_2$$

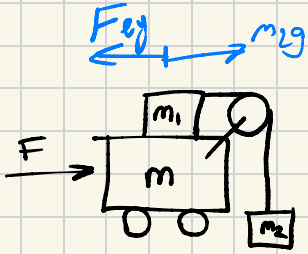
$$x_1 = v_{0x}(8.2) + 2a_1 = 100$$

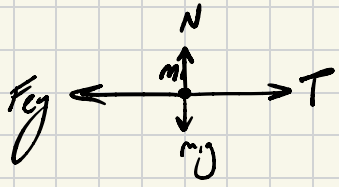
$$x_2 = v_{0y}(7.2) + 4{,}5 a_2 = 100$$

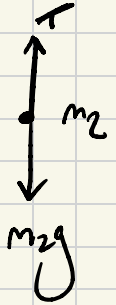
Blokların arabaya göre hareketsiz kalabilmesi için uygulanması gereken F = ?

(Tüm yüzeyler, tekerlekler, makara sürtünmesizdir.)

(İpteki gerilmeyi m_1 kütlesi meydana getirir.)







$$F = (m + m_1 + m_2)\, a$$

$$a = \frac{F}{m + m_1 + m_2}$$

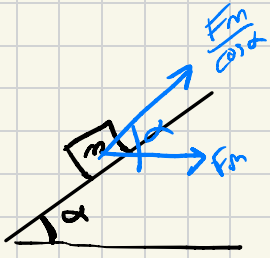
$$F_{ey} = \frac{F \cdot m_1}{m + m_1 + m_2} = T$$

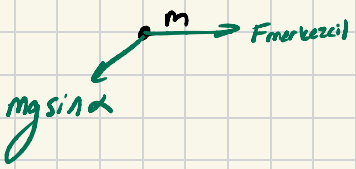
$$m_2 g =$$

Bir mühendis arabaların sürtünmeye güvenmeksizin savrulmadan dönebileceği eğimli bir otoyol istiyor.

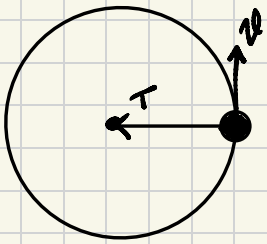
$v = 134\ m/s$'lik hız

Virajın yarıçapı = 50m



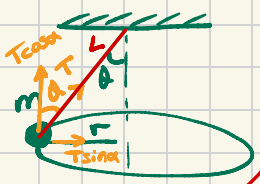


Dairesel Hareket



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

merkezcil kuvvet $(F_r) = m \cdot a_r = \frac{m \cdot v^2}{r}$



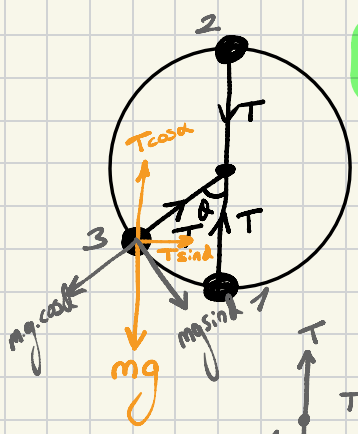
$T \sin\theta = \frac{m v^2}{r}$

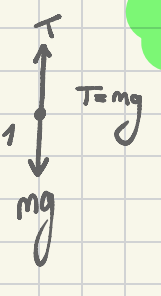
$T \cos\theta = mg$

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

$v = \sqrt{rg \cdot \tan\alpha}$

$v\sqrt{L \cdot g \cdot \sin\theta \cdot \tan\theta}$





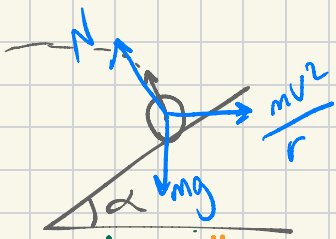
$T_2 = mg\left(\frac{v^2}{rg} - 1\right)$

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

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

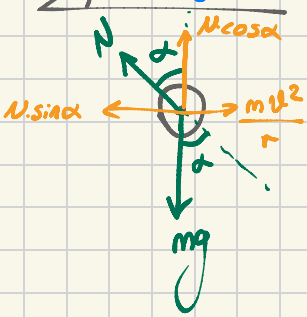
$T_3 = mg\left(\cos\theta + \frac{v^2}{rg}\right)$

$v = \sqrt{r \cdot g}$



Tekerlekle yol arasında sürtünmesiz ortamda ilerlemesi için açı = ?

$v = 13.4\ m/s \qquad r = 35\ m$



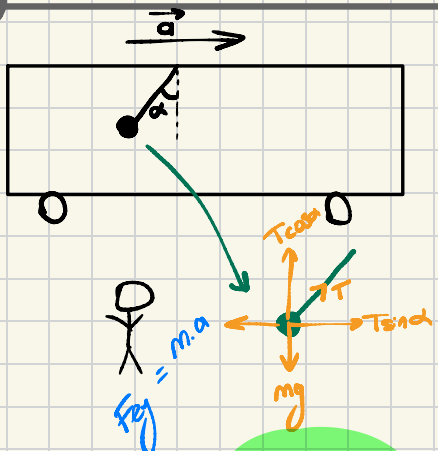
$$\frac{N\sin\alpha = \frac{mv^2}{r}}{N\cos\alpha = mg} = \tan\alpha = \frac{v^2}{r \cdot g}$$

$$v = \sqrt{r \cdot g \tan\alpha}$$

$$13.4 = \sqrt{35 \cdot (9.8) \cdot \tan\alpha}$$

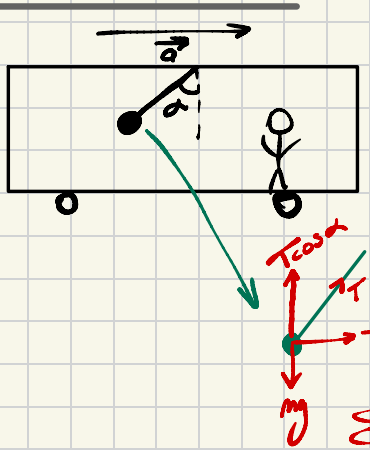
$$\alpha = 27.6^\circ$$

İvmeli Referans Sisteminde Hareket



$T\cos\alpha = mg$

$T\sin\alpha = m.a$



$\sum F_y = 0 \Rightarrow T\cos\alpha = mg$

$\sum F_x = 0$

$F_y = T\sin\alpha$

Direnç Ortamında Hareket

R = direnç kuvveti $\sim v, v^2$

$v_0 = 0$

$R = -k.v$

mg

$\sum F = m.a$

$mg - kv = m.\frac{dv}{dt}$

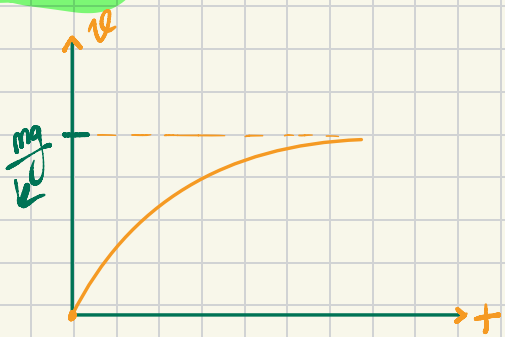
$\frac{dv}{dt} = g - \frac{kv}{m}$

$\int_0^v \frac{dv}{g - \frac{kv}{m}} = \int_0^t dt$

$v(t) = \frac{mg}{k}\left(1 - e^{-\frac{k.t}{m}}\right)$

$v(t) = \frac{mg}{k}\left(1 - \frac{1}{e^{k.t/m}}\right)$

$v_{limit} = \frac{m.g}{k}$



Cismin hızının v_{li} hızın %63.2 değerine ulaşması için gereken süreye **zaman sabiti** denir.

2gr kütleli cisim yağ içerisinde serbest bırakılıyor. Cisim yağdan bir direnç hissediyor.

$v_{li} = 5 cm/s$

a) zaman sabiti

b) hızın, limit hızın %90'a ulaşması için geçen süre

$\frac{m.g}{k} = v_{li}$

$v = v_l\left(1 - e^{-t/\tau}\right)$

$t = -5.1 \times 10^{-3} \ln(0.1) = 0.01$ sn

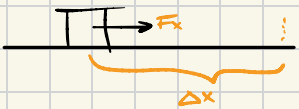
$\frac{2.(980)}{5} = 392 \, gram/saniye = k$

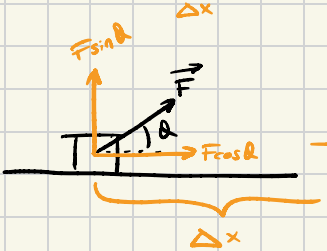
$k = \frac{m}{\tau(s)} \rightarrow g/s$ $\quad \tau = \frac{2}{392} \simeq 5.1 \, m/s$

İş ve Enerji

Sabit Kuvvetin Yaptığı İş

$$W \equiv F_x \cdot \Delta x$$





$W = F\cos\theta \cdot \Delta x$

Conclusion

* Kuvvet, yer değiştirme ile aynı yönde iş yapmalıdır.

Skaler çarpım gereğidir.

$W = F \cdot \Delta r \cdot \cos\theta$

$\vec{A} \cdot \vec{B} = |A|\,|B| \cdot \cos\theta$

$$W = \vec{F} \cdot \Delta\vec{r}$$

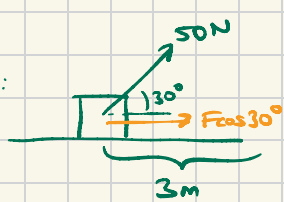
Skaler çarpım

$W = \vec{F} \cdot \Delta\vec{r}$

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

1 Joule= Bir cisme 1 Newton kuvvet uygulanması ile 1 metre yer değiştirmesi sonucu kazandığı enerjiye denir.

Soru:



W=?

$50 \cdot \cos 30^\circ \cdot 3 = \frac{150\sqrt{3}}{2} = 75\sqrt{3}$

Değişen Kuvvetin Yaptığı İş

$$W \simeq \Delta x_1 . F_1 + \Delta x_2 . F_2 + \dots\dots$$

$$W \simeq \sum_{i=1}^{6} F_i \, \Delta x_i$$

$$W = \lim_{\Delta x_i \to 0} \sum_{i=1}^{\infty} F_i \, \Delta x_i$$

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

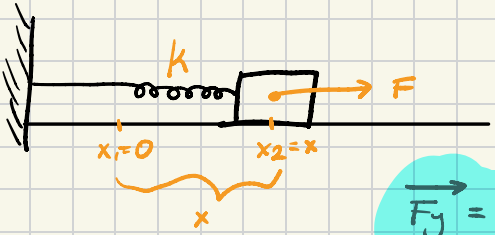
$$d\vec{r} = dx\,\hat{i} + dy\,\hat{j} + dz\,\hat{k}$$

$$\vec{F} . d\vec{r} = F_x . dx + F_y . dy + F_z . dy$$

Vektörel Çarpım

$$W = \int_{x_i}^{x_s} F_x . dx$$

Yay Kuvvetinin Yaptığı İş



$$\vec{F} = F_x . \hat{i}$$

$$F \sim x$$

$$\vec{F_y} = -k . x . \hat{i}$$

$$W = \int \Sigma \vec{F} . d\vec{r}$$

$$W = -k \int_0^x x \, dx$$

$$W = -\frac{1}{2} k x^2$$

İş - Kinetik Enerji Teoremi

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

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

$$W = \int m \cdot \frac{d\vec{v}}{dt} \cdot d\vec{r}$$

$$W = m \int d\vec{v} \cdot \frac{d\vec{r}}{dt}$$

$$W = m \int_{v_i}^{v_s} \vec{v} \cdot d\vec{v}$$

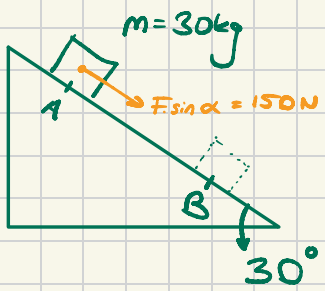
$$W = \frac{m \cdot v^2}{2} \Big|_{v_i}^{v_s}$$

$$W = \frac{1}{2} m \cdot v_s^2 - \frac{1}{2} m \cdot v_i^2$$

$$K_{(\text{kinetik enerji})} = \frac{1}{2} m v^2$$

$$W = \Delta K = K_s - K_i$$

Soru:



$\Delta x = 15m$

$v_A = 2 m/s$

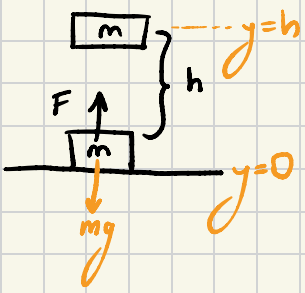
$v_B = ?$

$$150.15 = \frac{30 \cdot 2^2}{2} - \frac{30 \cdot v_B^2}{2}$$

$$150 = \frac{30(4 - v_B^2)}{2}$$

$$12.08 = \sqrt{146} = v_B$$

Kütle Çekim Potansiyel Enerjisi



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

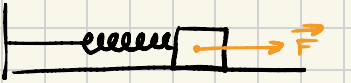
$$\Sigma \vec{F} = F\hat{j} = mg\hat{j}$$

$$d\vec{r} = dy\hat{j}$$

$$W = mgh$$

$$U = mgh \quad (\text{potenT})$$

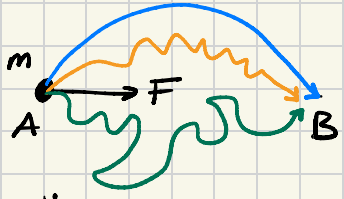
Elastik Potansiyel Enerji



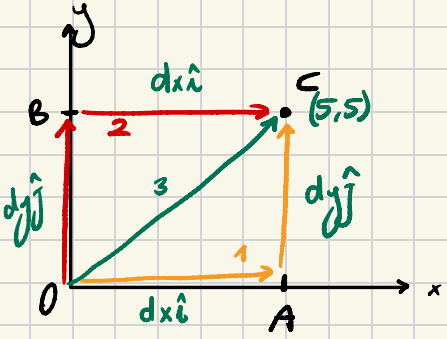
$$W = k\int_0^x x\,dx = \frac{1}{2}kx^2$$

$$U_y = \frac{1}{2}kx^2$$

Korunumlu Kuvvetler



Yapılan iş, yola bağlı değilse, yani gidilen yoldan bağımsızsa **korunumlu kuvvet** denir.



$$\vec{F} = 2y\hat{i} + x^2\hat{j}$$

Bu cisim üç farklı yolla gidiyor. Korunumlu kuvveti araştırınız.

$$W_{OA} = \int \vec{F} \cdot d\vec{r}$$

$$W_{OA} = \int_0^5 (2y\hat{i} + x^2\hat{j}) \cdot (dx\,\hat{i})$$

$$W_{OA} = 2\int_0^5 y\,dx = 0$$

$0 \rightarrow$ A'ya giderken iş yapılmadı.

$$W_{AC} = \int_0^5 (2y\hat{i} + x^2\hat{j}) \cdot dy\,\hat{i} = x^2 \int_0^5 dy = x^2 \left(y\Big|_0^5\right)$$

$$W_{AC} = 5^2 \cdot 5 = 125 \text{ Joule}$$

$$W_{OB} = \int (2y\hat{i} + x^2\hat{j}) \cdot (dy\,\hat{j})$$

$$\int x^2\,dy = 0$$

$$W_{BC} = \int (2y\hat{i} + x^2\hat{j}) \cdot dx\,\hat{i}$$

$$2y\int_0^5 dx = 2 \cdot 5 \cdot 5 = 50 \text{ Joule}$$

Korunumlu Kuvvetler bir sistemin potansiyel enerji fonksiyonlarından türetilebilirler.

$$\Delta K + \Delta U = 0$$

$$W = \int \vec{F} \cdot d\vec{r} = \Delta K = -\Delta U(x,y,z)$$

$$\vec{F} \cdot d\vec{r} = -dU(x,y,z)$$

$$\Downarrow$$

$$F_x dx + F_y dy + F_z dz = -dU(x,y,z)$$

$$\boxed{\vec{F} = -\vec{\nabla} U}$$

Soru: $U(x,y) = 3x^3y - 7x$ pot. enj fonksiyonu sisteme etki eden kuvveti bulunuz.

$$\vec{F} = -(9x^2y - 7)\,\hat{i} - (3x^3)\,\hat{j}$$

$$\vec{F_x} = -9x^2y + 7$$

$$\vec{F_y} = -3x^3$$

Soru: Bir cisme $F = 4x\,\hat{i} + 3y\,\hat{j}$ etki ediyor. $x = 5$ noktasına hareket ediyor. İşi bulunuz.

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

$$\Sigma \vec{F} = 4x\hat{i} + 3y\hat{j}$$

$$d\vec{r} = dx\,\hat{i}$$

$$W = \int_0^5 4x\,dx \qquad 2x^2 \Big|_0^5 = 50 \text{ joule}$$

Soru: 3 kg kütleli cismin hız vektörü $\vec{v} = (6\hat{i} - 1\hat{j})$ m/s ile hareket ediyor.

555 J

a) Cismin K = ?

$$\frac{mv^2}{2} \longrightarrow \frac{1}{2} \cdot 3 \underbrace{\left[(6\hat{i} - \hat{j}) \cdot (6\hat{i} - \hat{j})\right]}_{37} = \frac{101}{2} = 55.5 \text{ Joule}$$

b) Cismin hızı $(8\hat{i} + 4\hat{j})$ m/s değerine değişirse ne kadar iş yapılmış dur?

$$\frac{3}{2} \cdot (8\hat{i} + 4\hat{j})^2 = 120 \text{ Joule} \qquad 120 - 55 = 64 \text{ J}$$