

Fizik 1 Tekrar

3 temel büyüklük vardır.

1- Kütte (kg)

3- Zaman (s)

2- Uzunluk (m)

Boyuş Analizi

Büyüklük	Boyuş	Birim
Kütte	Mass	kg
Uzunluk	Length	metre
Zaman	Time	saniye
Alan	L^2	m^2
Hacim	L^3	m^3
Hz	L/T	m/s
İume	L/T^2	m/s^2
Kurvet	$M \cdot L/T^2$	$kg \cdot m/s^2$

* Bir esitin her iki tarafının boyutları aynı olmalıdır.

* Aynı boyutta nicelikler toplayıp çıkırlabilir.

Ör/

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

"G" boyut analizini yapınız.

$$\frac{M \cdot L}{T^2} = "G" \cdot \frac{m \cdot L}{L^2}$$

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

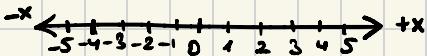
Birim Çevirme

$$1 \frac{1\text{m}}{1\text{s}} \cdot \frac{3600\text{s}}{1\text{h}}$$

$$1 \frac{\text{m}}{\text{s}} = ? \frac{\text{km}}{\text{h}}$$

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

Bir Boyutlu Hareket



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

$$\begin{array}{l|l} x_i = \text{ilk konum} & t_i = \text{ilk zaman} \\ x_s = \text{son konum} & t_s = \text{son zaman} \end{array}$$

4) Ortalama ıvme:

$$a_{\text{ort}} = \frac{\Delta v}{\Delta t} = \frac{v_s - v_i}{t_s - t_i} \quad (\text{m/s}^2)$$

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

5) Ani ıvme

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

3) Ani Hız: $\lim_{\Delta t \rightarrow 0} v_{\text{ort}} = v$

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

Türk Operatörü

** $\lim_{\Delta t \rightarrow 0} \frac{\Delta}{\Delta t} = \frac{d}{dt}$

$$\text{Or} / -4t + 2t^2 = x$$

a) 1sn ile 3sn arasında ger degistirmek

$$4t - 4 = 12 \quad | \quad \begin{array}{l} (t=1) \quad x_i = -2 \text{ m} \\ (t=3) \quad x_s = 6 \text{ m} \end{array}$$

$$4 = a$$

b) ort hız:

$$8/2 = 4 \text{ m/s}$$

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

c) $t=2.5$ sn'de cismin hızı:

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

$$x_s = t + \Delta t$$

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

$$v = \frac{dx}{dt} \Big|_{t=2.5} \rightarrow -4 + 4t$$

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

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

$$(t=2.5) = 6$$

Sabit īume; Hareket ($a = s bt$)

- Ortalama īume, ani īume ye eşittir.

$$V_{\text{ani}}(+) = V_i + a t$$

+ anında V hızı
ilk hızı + īme x zaman

$$V_{\text{ort}} = \frac{x(t) - x_i}{t} = \frac{V_i + V(t)}{2}$$

Düzenli īmede
gesertidir.

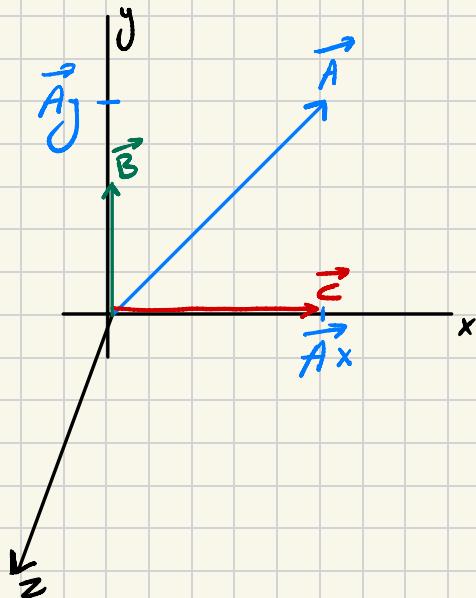
$$x(t) = x_i + V_i t + \frac{1}{2} a t^2$$

$$x_s = x_i + V_i t + \frac{a t^2}{2}$$

$$V^2 = V_i^2 + 2a(x - x_i)$$

zamansız hız
formülü

Vektörler



Birim Vektör: $|\hat{i}| = 1 \text{ br}$

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

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

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

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

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

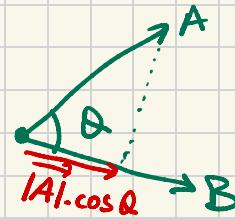
$$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

\vec{A}' nin uzunluğu

Vektörlerde Çarpım

1) Skaler Çarpım (iq çarpımı)

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



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

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

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

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

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

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

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



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

Or/

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

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

4 9 1
1 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) $\sqrt{3^2 + (-4)^2 + 5^2} = \overrightarrow{B}$

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

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

$$\cos \theta = -0.38$$

$\theta = 112.3^\circ$

2) Vektörel Çarpım

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

Vektörel Çarpının Özellikleri:

1) İki vektör çarpımı da bir vektördür.

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

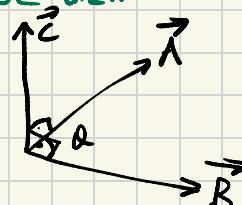
3) İki vektör çarpımı diğer vektörlere dikdir.

Yani aynı düzleme değildir.

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

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

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



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

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

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

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

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

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

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

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

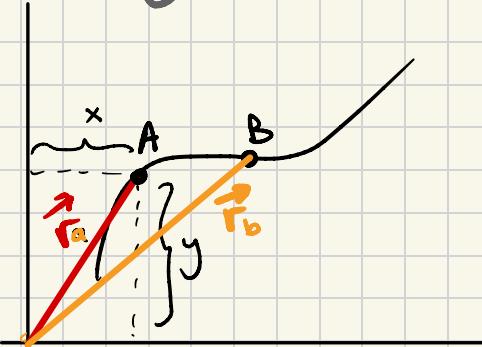
$$|\vec{A} \times \vec{B}| = 13$$

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

$$\overbrace{\vec{c}}^{\parallel} \cdot \vec{a} = 0$$

$$\vec{c} + \vec{a} \rightarrow \\ \vec{c} \perp \vec{b}$$

iki Boyutlu Hareket



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

$$|\vec{r}| = \sqrt{x^2 + y^2 + z^2}$$

1) Yer değiştirmeye

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

2) Ortalama hız

$$\overline{\vec{v}}_{\text{ort}} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\Delta x}{\Delta t} \hat{i} + \frac{\Delta y}{\Delta t} \hat{j} + \frac{\Delta z}{\Delta t} \hat{k}$$

$$\overline{\vec{v}}_{\text{ort}} = v_{\text{ort},x} \hat{i} + v_{\text{ort},y} \hat{j} + v_{\text{ort},z} \hat{k}$$

3) Anlık hız

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

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

4) Ortalama ivme

$$\vec{a}_{\text{ort}} = \frac{\Delta \vec{v}}{\Delta t} = a_{\text{ort},x} \hat{i} + a_{\text{ort},y} \hat{j}$$

5) Anlık ivme

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

$$|\vec{a}| = \sqrt{a_x^2 + a_y^2}$$

$$\vec{a} = \frac{d v_x}{dt} \hat{i} + \frac{d v_y}{dt} \hat{j}$$

Sabit i̇umeli iki Boyutlu Hareket

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

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

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

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

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

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a} t^2$$

a)

$$\begin{aligned} x &= x_0 + v_{0x}t + \frac{1}{2}a_x t^2 \\ y &= y_0 + v_{0y}t + \frac{1}{2}a_y t^2 \end{aligned}$$

b)

$$\begin{aligned} x &= (20i - 15j) \times (4s) \\ y &= (60i - 45j) \times (4s) \\ 110 &= \sqrt{1225} \end{aligned}$$

c)

$$\begin{aligned} x &= 20i - 15j \\ y &= 60i - 45j \end{aligned}$$

$a_x = 4 \text{ m/s}^2$ $t=0$ anında originde başlayan

$$a_y = 0$$

$$v_{0x} = 20 \text{ m/s}$$

$$v_{0y} = -15 \text{ m/s}$$

$$c) r = r_0 + \vec{v}_0 t + \frac{1}{2}\vec{a} t^2$$

a) Herhangi bir andaki hız vek. yazınız.

$$20i - 15j$$

b) ($t=5$) için hız, sırasıyla x eksenile göre,

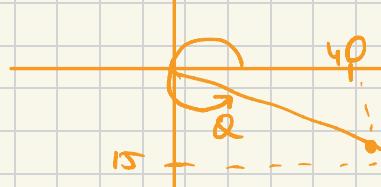
c) Konum vek?

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

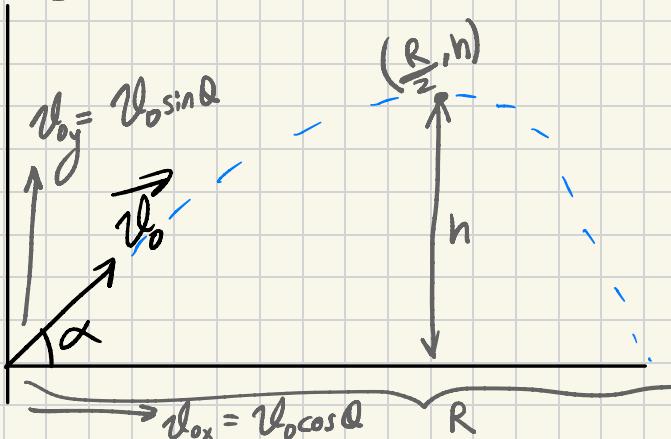
$$\vec{v} = \vec{v}_0 + \vec{a}t$$

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

$$339,5^\circ = \varphi$$



Yatay Atış Hareketi



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

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

$$x = v_0 \cos \theta \frac{v_0 \sin \theta \cdot 2}{g}$$

$$x = \frac{v_0^2 \cdot \sin(2\theta)}{g}$$

Maksimum uzaklık

- 1) Cismin iumesi "g" ve sbt+
- 2) Harek Direnzi ihmal

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



+ anında
hizin y
elde edilece
degeri

$$v_y = v_0 \sin \theta - gt$$

tepe noktasında $v_y = 0$

$$0 = v_0 \sin \theta - gt_0$$

$$t_0 = \frac{v_0 \sin \theta}{g} = t_i$$

atış = iniş süresi

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

$$t = t_0 \text{ olursa } y = h$$

$$h = v_0 \sin \theta \cdot \frac{v_0 \sin \theta}{g} - \frac{1}{2} g \frac{v_0^2 \sin^2 \theta}{g^2}$$

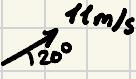


$$h = \frac{v_0^2 \cdot \sin^2 \theta}{2g}$$

Maksimum yükseklik

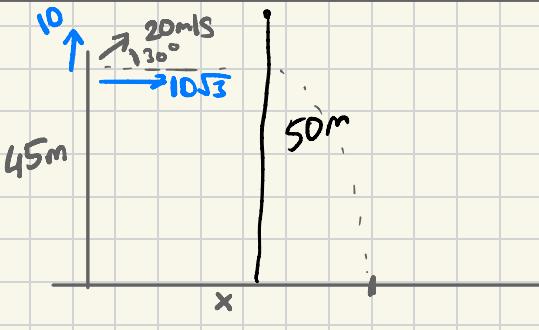
Bir toş yerle 20° açılıarak ($V_0 = 11 \text{ m/s}$)

a) Yatayda ne kadar uzaga düşer?


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

b) Toşın maks yükseklik

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



a) toş ne zaman yere çarpar?

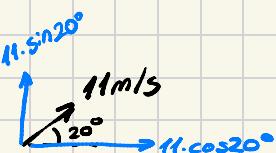
$$t_f = 15 \text{ s}$$

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

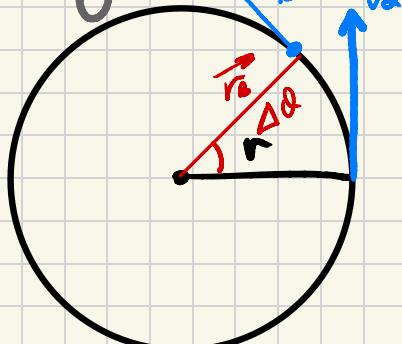
b) toşın yere çarpmaya hızı nedir?

$$31.35 \text{ m/s}$$

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

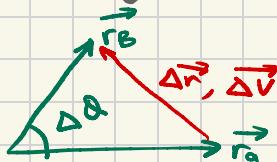


Dürgün Dairesel Hareket



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

merkezil iume: dairenin merkezine doğru olan iume



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

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

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

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

$$v = \lim_{\Delta t \rightarrow 0} \frac{|\Delta r|}{\Delta t} = \frac{|\vec{dr}|}{dt}$$

} anlitik hiz

$$|\vec{a}_{ankit}| = \frac{v^2}{r}$$

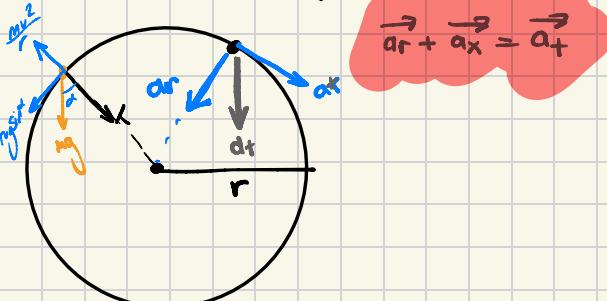
} merkezil iume

Dürgün olmayan dairesel hareket

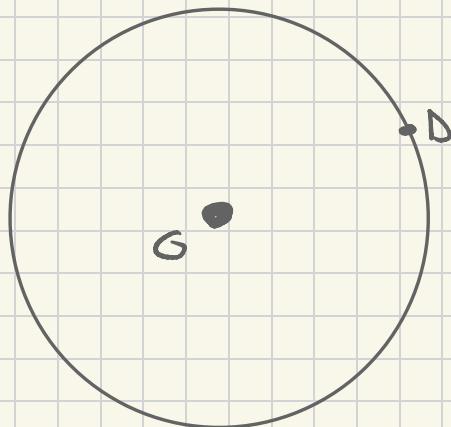
1- Hizin büyüklüğünün değişmesinden iume $\vec{a}_1 = \frac{d\vec{v}}{dt}$

2- Hizin yönünden dolayı iume

$$\vec{a}_2 = \frac{v^2}{r}$$



Dünya'nın, güneş etrafında dönmesi sonucu
merkezil i̇mzisi: yankısalik nedir?



$$a = \frac{\pi l^2}{r} \rightarrow$$

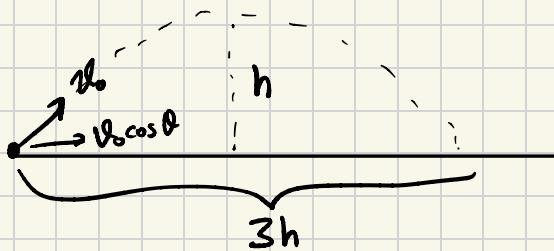
$$a = \frac{4\pi^2 r^2}{T^2 \cdot r}$$

$$\underbrace{2\pi r}_{\text{yol}} = \cancel{l} +$$

$$\frac{2\pi r}{\cancel{l}} = \frac{1}{T}$$

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

Bir tane yoldan belli bir açıyla fırlatıldığında menzil uzaklığı yüksekliğinin 3 katı oluyor. $A\alpha = ?$



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

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

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

$$3 \sin^2 \alpha = 2 \sin 2\alpha$$

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

$$7s^2 = 2$$

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

Orjinde

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

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

ise

a) herhangi anda konum vek

$$x = 10_0 + \frac{1}{2}at^2$$

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

b) hız vek

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

c) $t=2$ için koordinat, sürat

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

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

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

Hareket Yasaları

Kuvvet: \vec{F}

- 1) Temas Kuvvetleri
- 2) Alan Kuvvetleri

1- Eylemsizlik

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

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

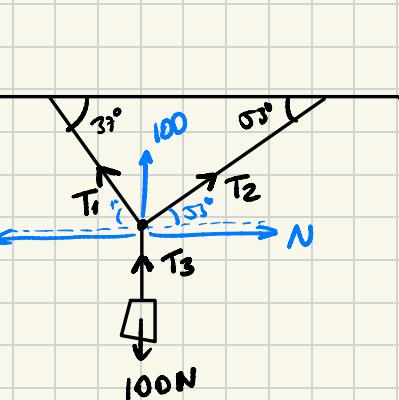
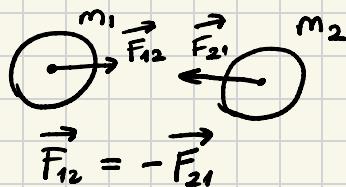
Kütle: Cismin hızının değişimine karşı gösterdiği direnç

2- $F = m \cdot a$ ($\text{kg}/\text{m.s}^2$)

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

$$m_2 \rightarrow a_2$$

3- Etki/Tepki Prensibi



$$\begin{aligned} T_2x &= T_2 \cos 33^\circ \\ T_2y &= T_2 \cdot \sin 33^\circ \\ T_1x &= T_1 \cdot \cos 33^\circ \\ T_1y &= T_1 \cdot \sin 33^\circ \end{aligned}$$

4- Kütle Gekim Kuvveti

$$\begin{aligned} \vec{F}_g &= \vec{a} = \vec{g} \\ \sum \vec{F} &= m \cdot \vec{a} \end{aligned}$$

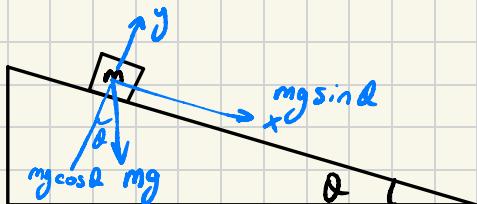
$$\vec{F}_g = m \vec{g}$$

$$\text{Ağırlık} = m g$$

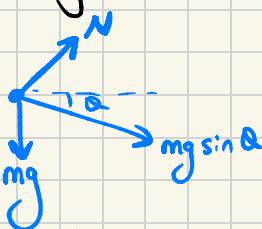
$$T_1 = \frac{T_2 \sin 33^\circ}{\cos 33^\circ} = \frac{3T_2}{4}$$

$$\begin{aligned} \frac{4}{5} (T_1 + T_2) &= 100 \\ \frac{3T_2 + T_2}{4} &= 100 \\ \frac{4T_2}{5} &= 100 \end{aligned}$$

$$\begin{aligned} \frac{500}{7} &= T_2 \\ \frac{1500}{28} &= T_1 \end{aligned}$$



a) bloğun kuvvetleri:



$$mg \sin \theta = ma_x$$

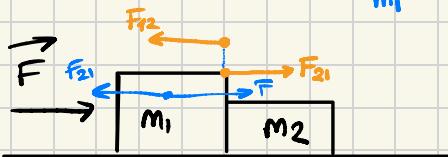
$$g \sin \theta = a_x$$

b) eğik düzleme "d" kadar yol
katederse h_2 ne olur?

$$\ell^2 = \ell_0^2 + 2a_x \cdot \underbrace{(x_s - x_0)}_d$$

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

$$F_{12} \leftarrow \overrightarrow{F} \rightarrow m_1$$



a) sistem iisme

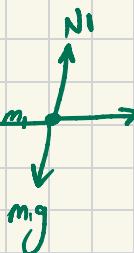
$$\sum F_x = m \cdot a_x$$

b) 1.'nin 2.'ye uyguladığı
kuvvet?

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

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

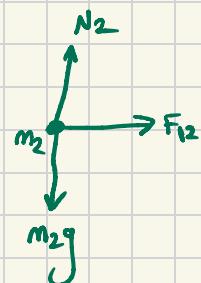
$$F_{21} \leftarrow \overrightarrow{F} \rightarrow m_1$$



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

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

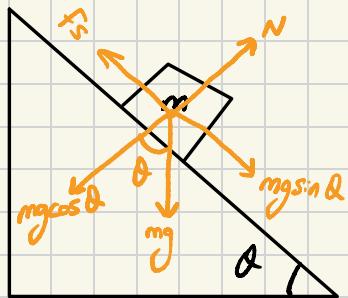
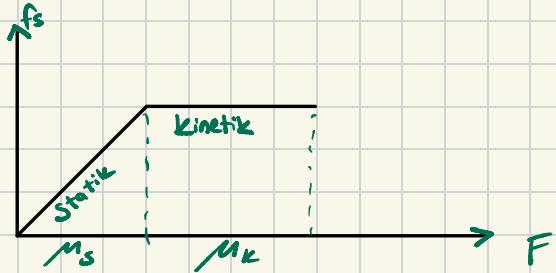
$$F_{21} = \left(\frac{m_2}{m_1 + m_2} \right) \cdot F \rightarrow$$



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

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

Sürünme Kuvveti



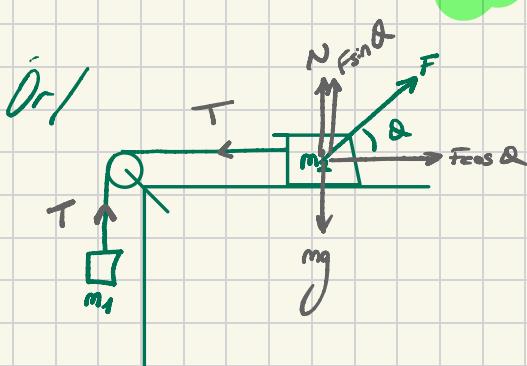
$$\text{Ör/ } N = mg \cos \theta$$

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

Eğer $\sum F_x = D$ ise hizdigi yolda tırmanır:

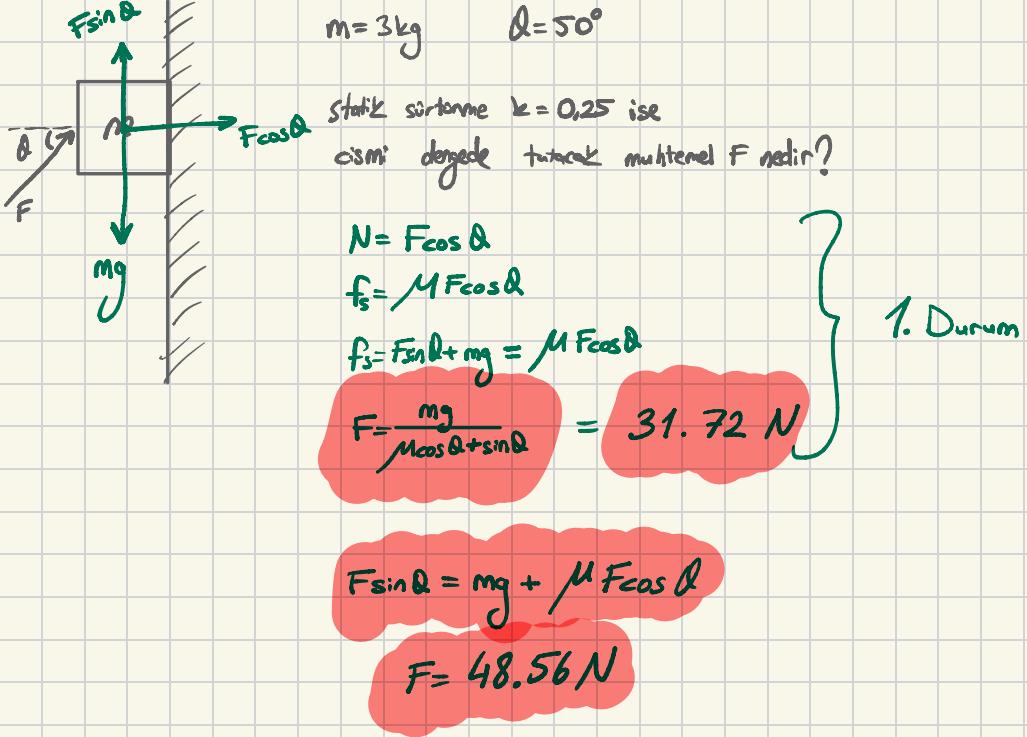
$$\mu_s = \frac{\sin \theta}{\cos \theta} = \tan \theta$$

$$\mu_s = \tan \theta_c$$



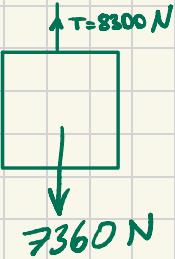
İvmeleri göstereniz.

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



Ör/

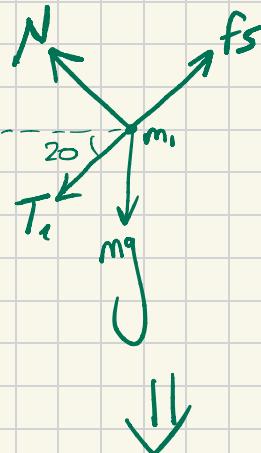
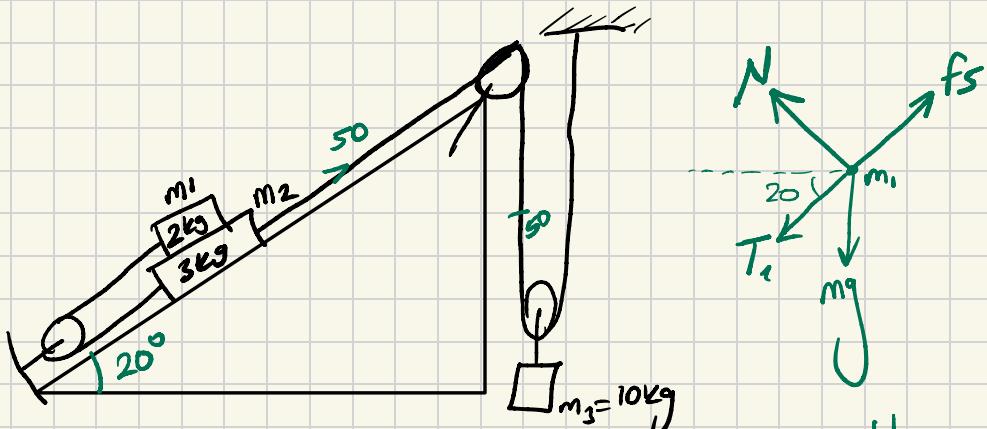
75 kilo insan tuttılacak isteniyor.



$$\frac{940}{750} = \frac{1,25 \text{ m/s}^2}{9,8}$$

$$+ \frac{}{11,05 \text{ m/s}^2}$$

$$11,05 \cdot 75 = 82,8 \text{ N}$$



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

$$2a - 2 = T_1$$

$$m_2 a = T_2 - m_2 g \sin 20^\circ - F_{s2} - F_{s1} - T_1$$

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

$$F_{s2} = \mu_2 N_2$$

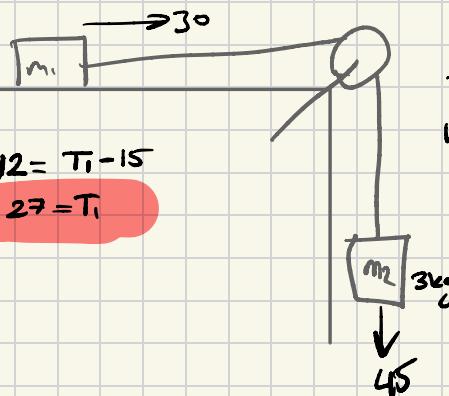
$$m_3 g - 2T_2 = m_3 \cdot \frac{a}{2}$$

Sekilde yukarıda doğu $A = 5 \text{ m/s}^2$ 'lik ivmeyle hareket etmekte olan asansörin içinde serbest bırakılan sistende jatayolds kinetik sürtünme katsayısı 0,5

$$m_1 = 2 \text{ kg}$$

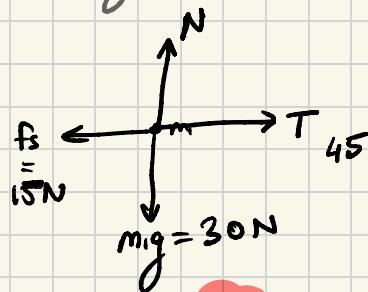
$$m_2 = 3 \text{ kg}$$

old. göre blokların ivmesi bularuz.



$$12 = T_1 - 15$$

$$27 = T_1$$



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

$$45 - T_1 = 18$$

$$T_1 = 27$$

2 koşu sporcusu durgun holden aynı anda 100 metre koşuyor başlıyor.
 Her iki sporcunun 10.2 sonda koşuya başlamıyor. 1. koşucunun hızı = $2sn$
 2. koşucunun hızı = $3sn$
 ve sonra sırasıyla hızda artıyorlar. Koşucuların hızları nedir?

$$x_{s_1} = \frac{1}{2} a_1 t^2 = 2a_1$$

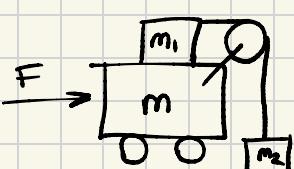
$$x_{s_2} = \frac{1}{2} a_2 t^2 = 4,5a_2$$

$$x_1 = \sqrt{0_X^{(82)} + 2a_1} = 100$$

$$x_2 = \sqrt{0_y^{(7.2)} + 4,5a_2} = 100$$

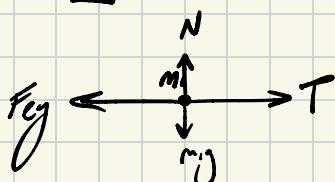
Blokların orabanga göre hareketsiz kalabilmesi için uygulanması gereken $F = ?$

Fey



(Top yüzüpler, tekerlekler, makas, sürtünmezidir.)

(iptek gerilmesi m1 katlesi moydosu getirir.)



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

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

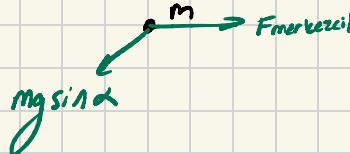
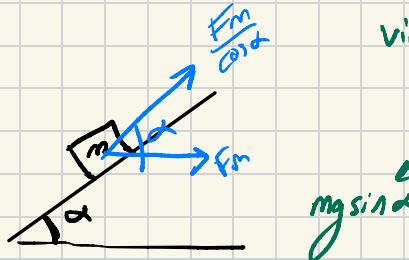
$$F_{\text{Fey}} = \frac{F \cdot m_1}{m+m_1+m_2} = T$$

$$m_2 g =$$

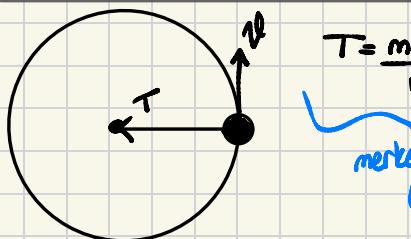
Bir mühendis arabaların sürünmeye güvenmeksızın savulmadan dönebileceğini
görmeli bir otogel istiyor.

$$v = 134 \text{ m/s'lik hız}$$

$$\text{virajın yarıçapı} = 50 \text{ m}$$



Dairesel Hareket



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

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

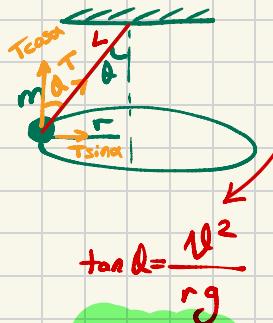
$$T_2 = mg \left(\frac{v^2}{r \cdot g} - 1 \right)$$

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

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

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

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



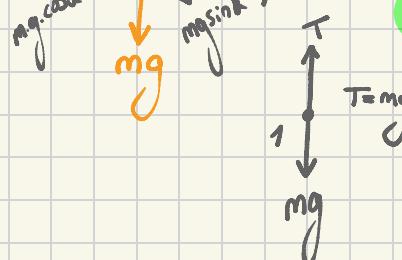
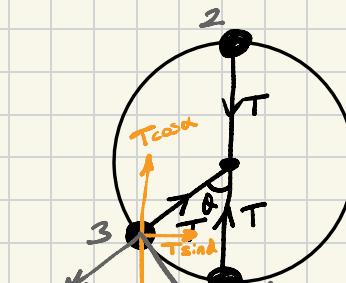
$$T_{\sin \alpha} = \frac{m v^2}{r}$$

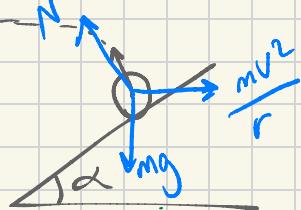
$$T_{\cos \alpha} = mg$$

$$\tan \alpha = \frac{v^2}{r \cdot g}$$

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

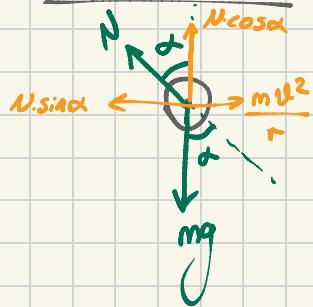
$$v = \sqrt{L \cdot g \cdot \sin \alpha \cdot \tan \alpha}$$





Tebritteki yel arasında sırtlanmaz ortamda
ilerlemesi için ağırlık $a_g = ?$

$$v = 13.4 \text{ m/s} \quad r = 35 \text{ m}$$



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

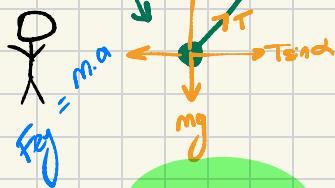
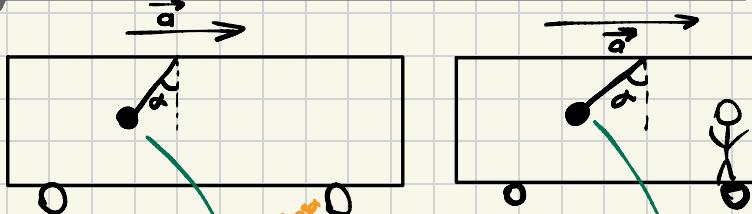
$$N\cos\alpha = mg$$

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

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

$$\alpha = 27.6^\circ$$

Eşemli referans Sisteminde Hareket



$$T\cos\alpha = mg$$

$$T\sin\alpha = M.a$$

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

$$\sum F_x = 0 \Rightarrow T\sin\alpha = M.a$$

$$F_y = T\sin\alpha$$

Direnç Ortamında Hareket

$$R = \text{direnç Kuvveti} \sim v, v^2$$

$$v_0 = 0$$

$$\sum F = m \cdot a$$

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

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

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

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

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

$$v_{\text{limit}} = \frac{mg}{k}$$



$$R = -k \cdot v$$



Cismiin hızının lim hızına
%63.2 degerine ulaşması için
gereken süreye zaman sabiti denir.

2gr kotleli cisim yag içerişinde serbest
birakılıyor. Cisim yagden bir direnç hissediyor.

$$v_{\text{in}} = 5 \text{ cm/s}$$

a) zaman sabiti:

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

$$\frac{mg}{k} = v_{\text{in}}$$

$$v = v_{\text{in}} \left(1 - e^{-\frac{kt}{m}} \right)$$

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

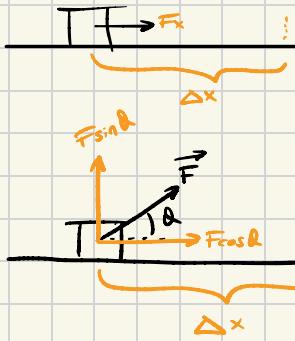
$$\frac{2 \cdot (980)}{5} = 392 \text{ gram/saniye} = k$$

$$k = \frac{m}{T(s)} \rightarrow \text{s/s} \quad T = \frac{2}{392} \approx 5.1 \text{ m/s}$$

İs ve Enerji

Sabit Kuvvetin Yaptağı İş

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



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

Conclusion

* Kuvvet, yer değiştirmesi ile gittiğinde iş yapmaktadır.

Skaler çarpım gereklidir.

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

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

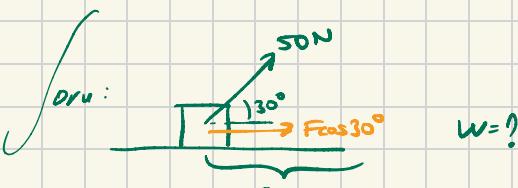
$$W = \vec{F} \cdot \vec{\Delta r}$$

Skaler çarpım

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

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

1 joule = Bir cisim 1 Newton kuvvet uygulanması ile 1 metre yer değiştirmesi sonucu kazandığı enerjiye denir.



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

Degisken Kuvvetin Yaptigi is



$$W \approx \Delta x_1 \cdot F_1 + \Delta x_2 \cdot F_2 + \dots$$

$$W \approx \sum_{i=1}^n F_i \Delta x_i$$

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

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

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

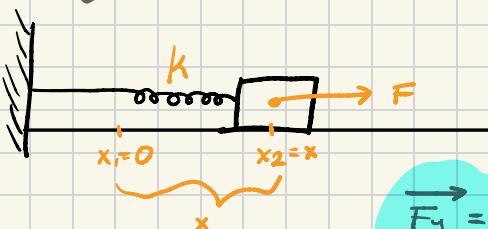


$$\vec{F} \cdot d\vec{r} = F_x \cdot dx + F_y \cdot dy + F_z \cdot dz$$

Vektörel Görümlü

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

Yay Kuvvetinin Yaptigi is



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

$$F \sim x$$

$$\vec{F}_y = -k \cdot x \cdot \hat{i}$$

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

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

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

İS - Kinetik Enerji Teoremi

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

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

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

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

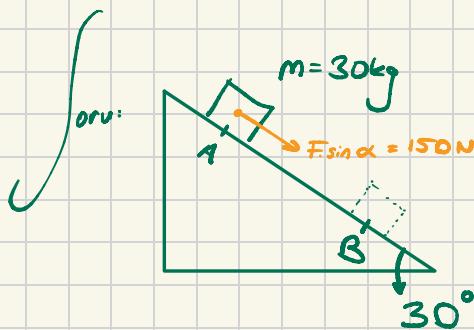
$$W = m \int_{v_i}^{v_s} v \cdot dv$$

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

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

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

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

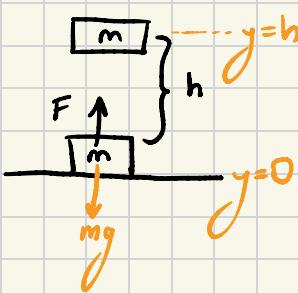


$$150 \cancel{\text{N}} = \frac{30 \cdot 2^2}{2} - \frac{30 \cdot v_B^2}{2}$$

$$150 = \frac{15}{2} (4 - v_B^2)$$

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

Kütte Gekim Potansiyel Enerjis:



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

$$\sum \vec{F} = \vec{F}_g = mg\hat{j}$$

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

$$W = mgh$$

$$U_{(\text{pot. enj.})} = mgh$$

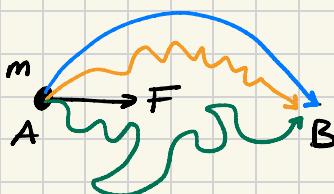
Elastik Potansiyel Enerji



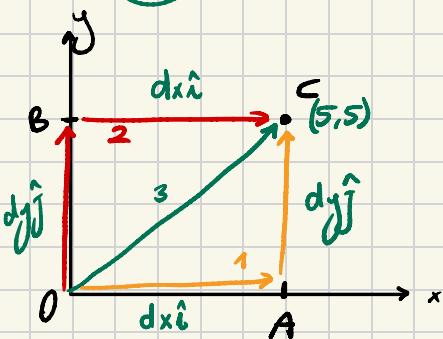
$$W = k \int_0^x dx = \frac{1}{2} kx^2$$

$$U_{\text{el}} = \frac{1}{2} kx^2$$

Korunumlu Kuvvetler



Yapılan iş, yola bağlı değilse, yani giden yoldan
bağımsızsa **Korunumlu Kuvvet** denir.



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

Bu cisim üç farklı yolla gidiyor. Korunumlu kuvveti arastırınız.

$$W_{0A} = \int \vec{F} \cdot d\vec{r}$$

$$W_{0A} = \int_0^5 (2y\hat{i} + x^2\hat{j}) \cdot (dx\hat{i})$$

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

$0 \rightarrow A$ 'da \vec{j} denken
is gepland.

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

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

$W_{0B} = \int (2y\hat{i} + x^2\hat{j}) \cdot (dy\hat{j})$ $\int x^2 \, dy = 0$	$W_{BC} = \int (2y\hat{i} + x^2\hat{j}) \cdot dx\hat{i}$ $2y \int_0^5 dx = 2 \cdot 5 \cdot 5 = 50 \text{ Joule}$
--	---

Konstantlu Kuvvetler bir sistemin potansiyel enerji fonksyonlarından türetilebilirler.

$$\Delta K + \Delta U = 0$$
$$W = \int \vec{F} \cdot d\vec{r} = \Delta K = -\Delta U(x, y, z)$$
$$\vec{F} \cdot d\vec{r} = -dU(x, y, z)$$
$$\Downarrow$$
$$F_x dx + F_y dy + F_z dz = -dU(x, y, z)$$
$$\vec{F} = -\vec{\nabla} U$$

$$\int \partial U: U(x, y) = 3x^3y - 7x$$

sisteme etki eden kuvveti bulunuz.

pot. enj fonksiyonu

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

$$\vec{F}_x = -9x^2y + 7$$
$$\vec{F}_y = -3x^3$$

Soru: Bir cisim $F = 4x\hat{i} + 3y\hat{j}$ etki ediyor.
 $x=5$ noktasında hareket ediyor. işi bulunuz.

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

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

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

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

Soru: 3 kg küteli cismin hız vektörü $\vec{v} = (6\hat{i} - 1\hat{j}) \text{ m/s}$ ile
 hareket ediyor. 555 J

a) Cismin $K_i = ?$

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

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

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

$$120 - 55.5 = 64.5$$