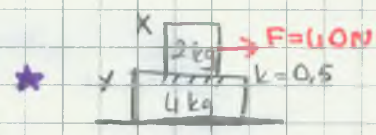
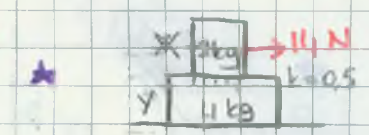


$F_e = f_s$
 $ma = mgk$
 $a = 10 \cdot 0,25$
 $a = 2,5 \text{ m/s}^2$
 $F = 10 \cdot 2,5$
 $= 25 \text{ N}$



$f_s \leftarrow 2b \rightarrow F$
 X) $F - f_s = m \cdot a_x$
 $40 - 10 = 2 \cdot a_x$
 $a_x = 15 \text{ m/s}^2$
 Y) $f_s = m \cdot a_y$
 $10 = 4 \cdot a_y$
 $a_y = 2,5 \text{ m/s}^2$



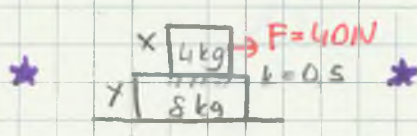
X) $f_s = 10$
 $14 - 10 = m \cdot a_x$
 $4 = 2 \cdot a_x$
 $a_x = 2 \text{ m/s}^2$
 Y) $f_s = 4 \cdot a_y$
 $10 = 4 \cdot a_y$
 $a_y = 2,5 \text{ m/s}^2$

büyük olamaz?

→ Birlikte hareket var!

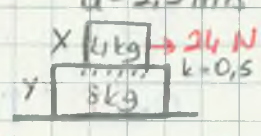
$F = (m_x + m_y) \cdot a_{ort}$

$14 = 6 \cdot a_{ort}$ $a_{ort} = \frac{7}{3} \text{ m/s}^2$



X) $f_s \leftarrow x \rightarrow 40 \text{ N}$
 $40 - 20 = 4 \cdot a_x$
 $a_x = 5 \text{ m/s}^2$

Y) $f_s = m_y \cdot a_y$
 $20 = 8 \cdot a_y$
 $a_y = 2,5 \text{ m/s}^2$



X) $f_s \leftarrow x \rightarrow 24 \text{ N}$
 $24 - 20 = 4 \cdot a_x$
 $a_x = 1 \text{ m/s}^2$

Y) $f_s = m_y \cdot a_y$
 $20 = 8 \cdot a_y$
 $a_y = 2,5 \text{ m/s}^2$

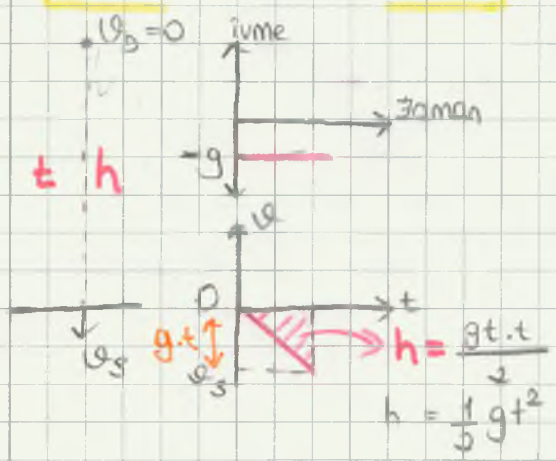
$F = m \cdot a_{ort} = 24 = 12 \cdot a_{ort}$ $a_{ort} = 2 \text{ m/s}^2$

- YERYÜZÜNDE HAREKET -

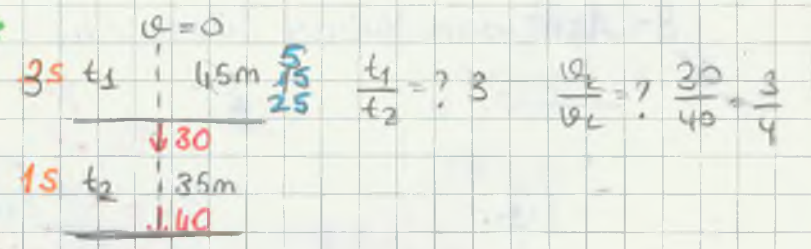
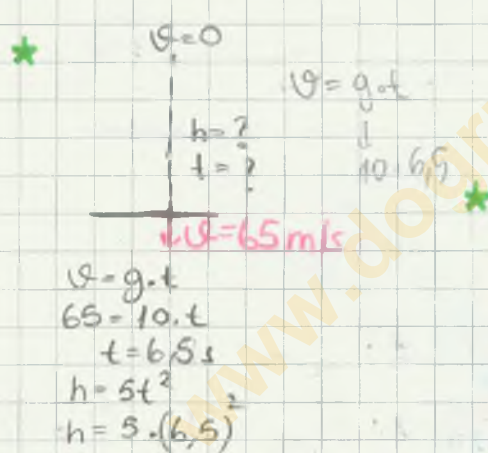
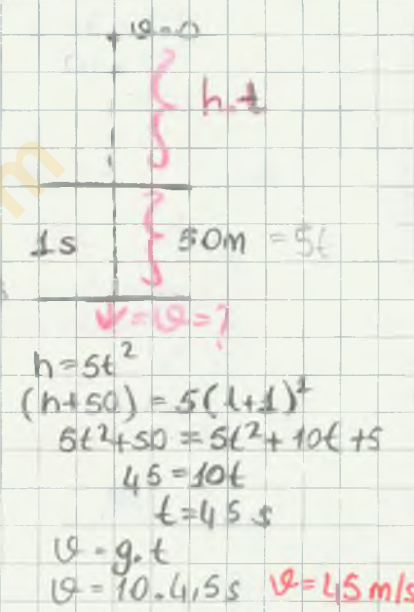
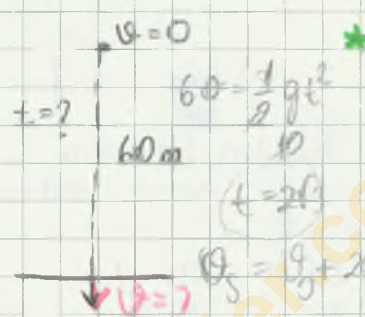
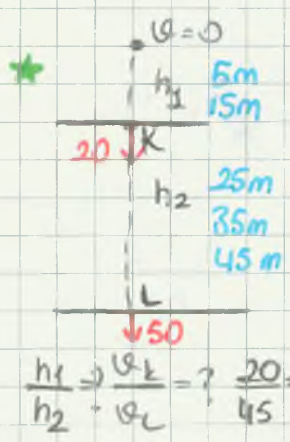
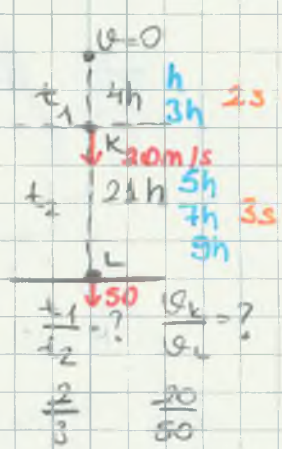
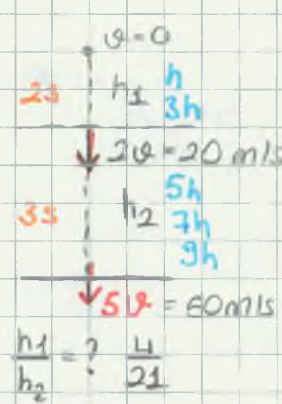
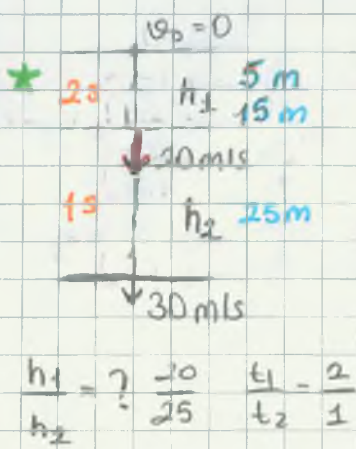
1- Serbest Düşme



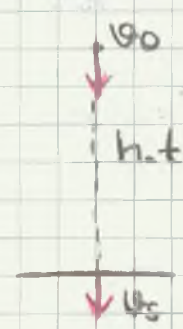
$v_0 = 0$
 $h = \frac{1}{2} g t^2$ ($h = 5t^2$)
 $v_s = v_0 + g t$ ($v_s = 10 \cdot t$)
 $v_s^2 = v_0^2 + 2gh$



0	5m	h	1.sn	$h = 5t^2$ $= 5m$
10	15m	3h	2.sn	$h = 5t^2$ $= 20m$
20	25m	5h	3.sn	$h = 5t^2$ $= 45m$
30	35m	7h	4.sn	$h = 80m$
40	45m	9h	5.sn	
50	55m			



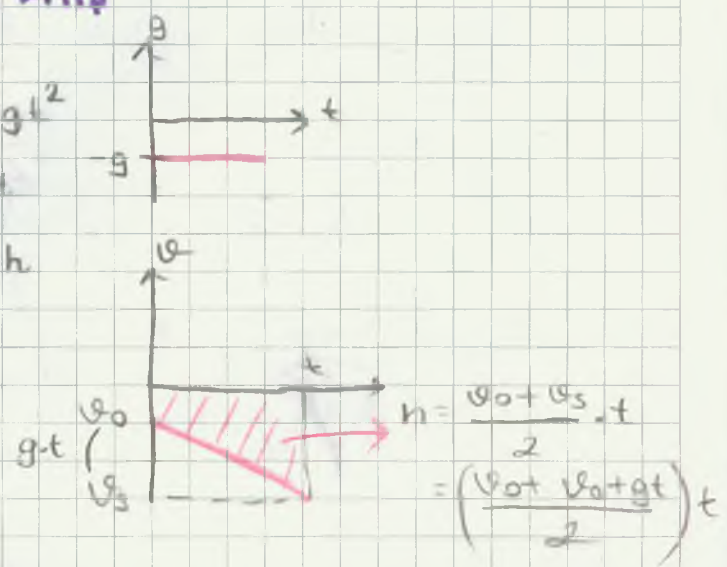
2- Yukarıdan Aşağı Düşey Atış



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

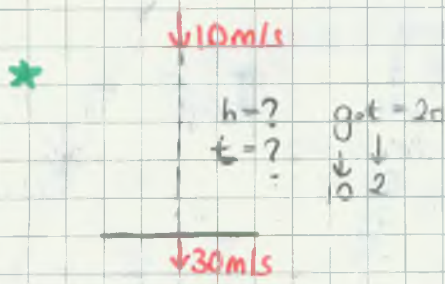
$$v_s = v_0 + g t$$

$$v_s^2 = v_0^2 + 2 g h$$

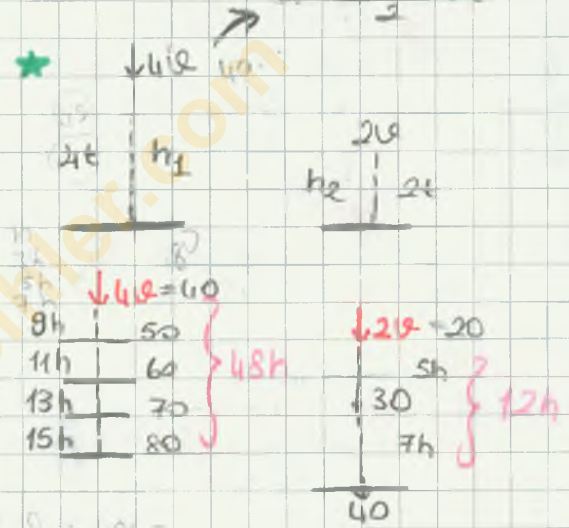
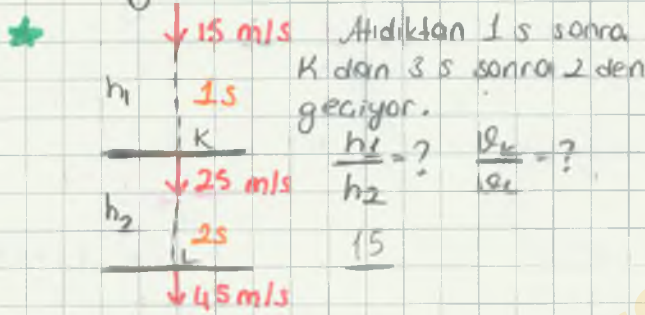
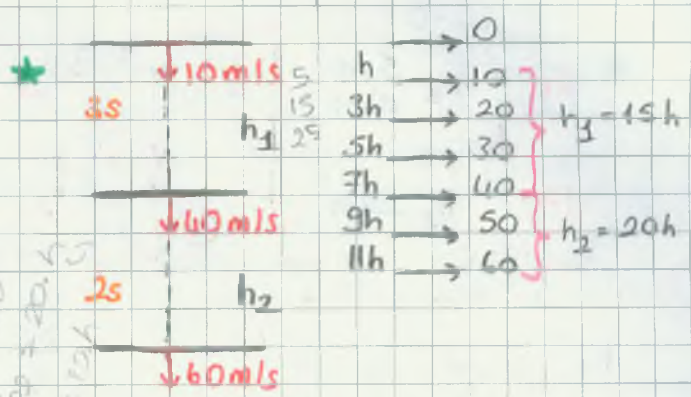
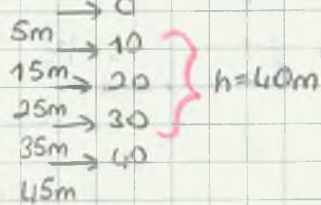


$$h = 10t + \frac{1}{2} \cdot 10 \cdot t^2$$

$$20 + 20 = 40$$



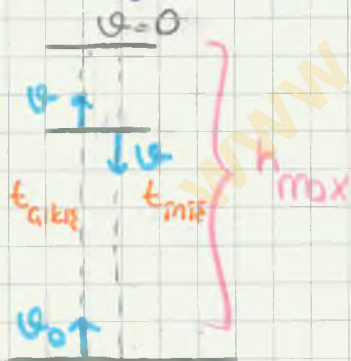
$$h = 10 \cdot 2 + \frac{1}{2} \cdot 10 \cdot 4$$



(0-K) 25² = 15² + 2 · 10 · h₁

(K-L) 45² = 25² + 2 · 10 · h₂

3- Aşağıdan yukarı Düşey Atış

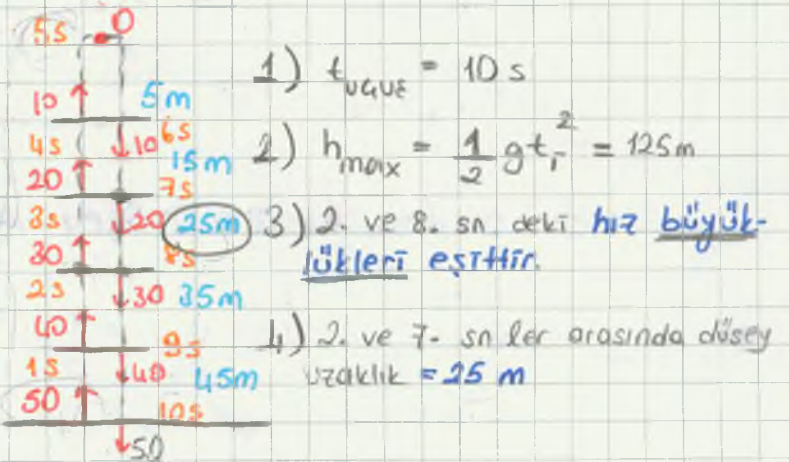


$$t_g = t_i$$

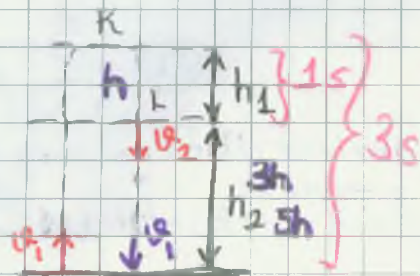
$$t_{uçuş} = 2t_g = 2t_i$$

$$h_{max} = v_0 t - \frac{1}{2} g t^2$$

$$= \frac{1}{2} g t_i^2$$

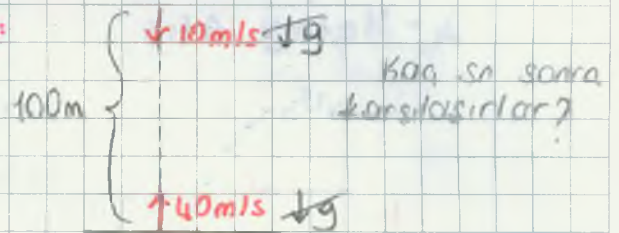


Örnek:



M den K'ya 3 s
K dan M'ye 1 s de
 $\frac{h_1}{h_2} = ?$ $\frac{1}{8}$ a

Örnek:



$$100 = (10 + 40) \cdot t$$

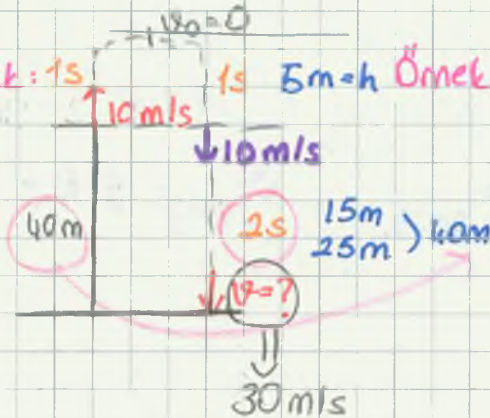
$$t = 2s$$

$$2) h = v_0 t - \frac{1}{2} g t^2$$

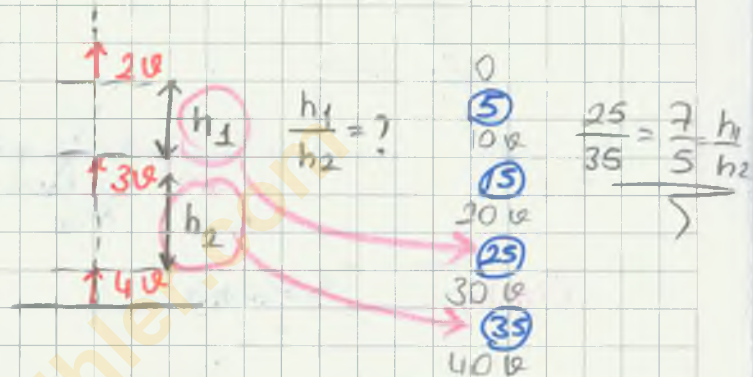
$$= 10 \cdot 2 - \frac{1}{2} \cdot 10 \cdot 4$$

? nerede karşılaşırlar?

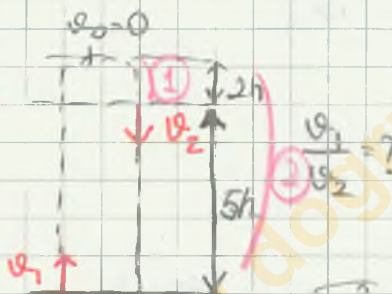
Örnek: 1s



Örnek: 1s 5m = h Örnek:



Örnek:



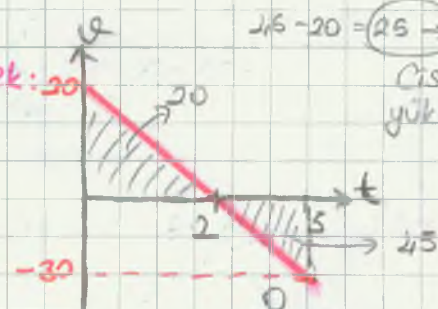
$$1) v_2^2 = v_0^2 + 2 \cdot g \cdot 2h$$

$$2) v_2^2 = v_0^2 + 2g \cdot 7h$$

$$\frac{v_1^2}{v_2^2} = \frac{14}{4}$$

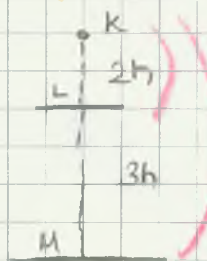
$$\frac{v_1}{v_2} = \frac{\sqrt{14}}{2}$$

Örnek: 20



$2.5 - 20 = 25 \rightarrow$ Gecektir.
Cismin atıldığı yükseklik?

Örnek:



K-L arasını t_1 ? $\frac{t_1}{t_2} = ?$
L-M arasını t_2

$$\frac{2h}{5h} = \frac{\frac{1}{2} g t_1^2}{\frac{1}{2} g (t_1 + t_2)^2}$$

$$\sqrt{5} t_1 = \sqrt{2} (t_1 + t_2)$$

$$\sqrt{5} t_1 - \sqrt{2} t_1 = \sqrt{2} t_2$$

$$t_1 (\sqrt{5} - \sqrt{2}) = \sqrt{2} t_2$$

$$\frac{t_1}{t_2} = \frac{\sqrt{2}}{\sqrt{5} - \sqrt{2}}$$

4- Yatay Atış



Düseyde : Serbest düşme

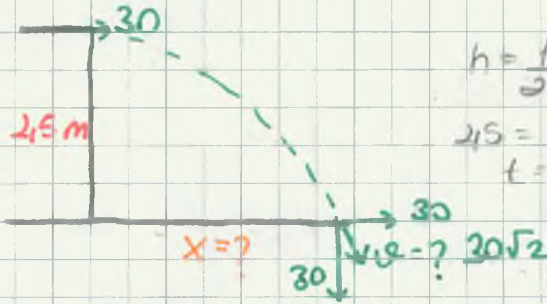
Yatayda : Sabit hızlı hareket

$$h = \frac{1}{2}gt^2$$

$$X = v_0 \cdot t$$

↳ menzil

Örnek:



$$h = \frac{1}{2}gt^2$$

$$X = v_0 \cdot t$$

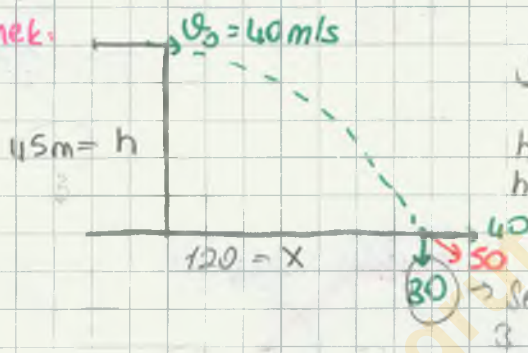
$$2,5 = 5t^2$$

$$t = 0,3 \text{ sn}$$

$$X = 30 \cdot 0,3 = 9 \text{ m}$$

$$v_{\text{düşey}} : g \cdot t = 10 \cdot 0,3 = 3 \text{ m/s}$$

Örnek:



3 sn de yere çarptığına göre :

$$h = 5t^2$$

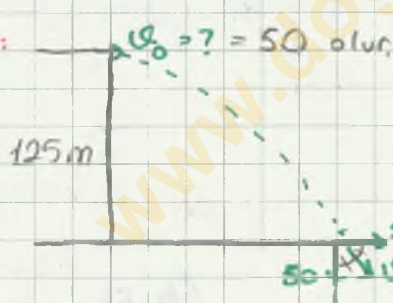
$$X = v_0 \cdot t$$

$$h = 5 \cdot 9 = 45 \text{ m}$$

$$X = 40 \cdot 3 = 120 \text{ m}$$

3 sn de 30 olur

Örnek:

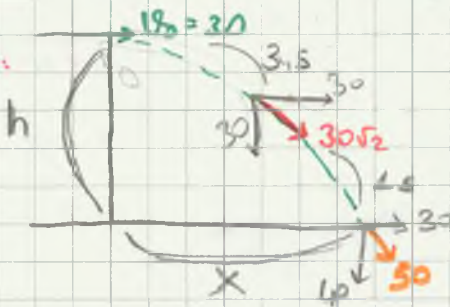


5 sn de yere çarpıyor.

$$h = 5t^2 = 5 \cdot 5^2 = 125 \text{ m}$$

$$X = 50 \cdot 5 = 250 \text{ m}$$

Örnek:



K dan geçtikten 1 s sonra yere çarpıyor.

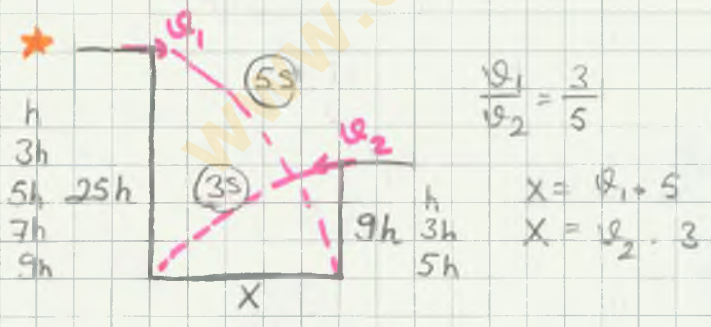
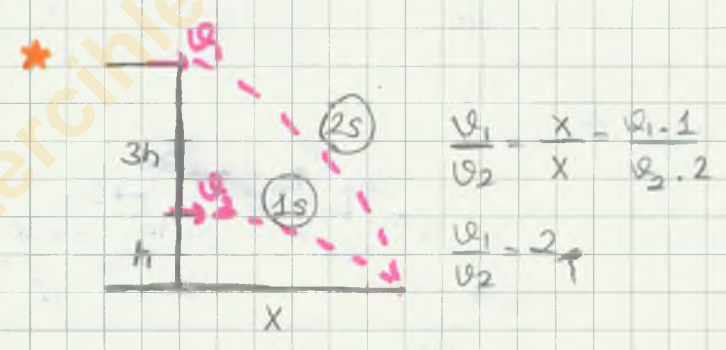
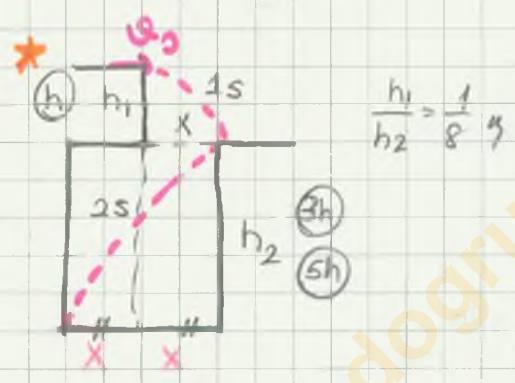
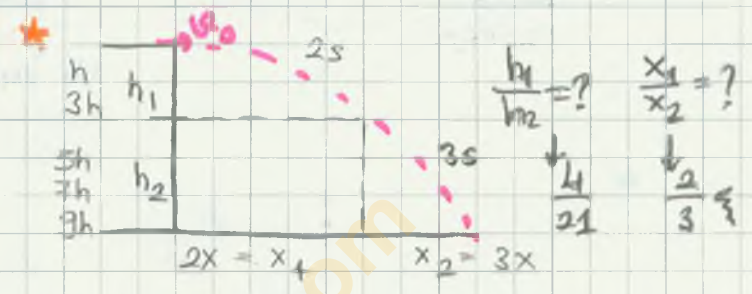
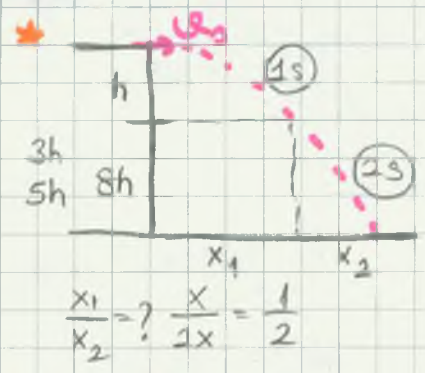
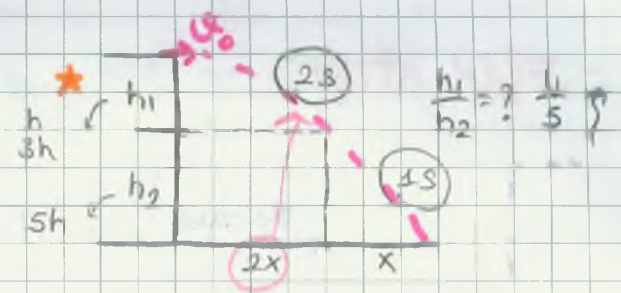
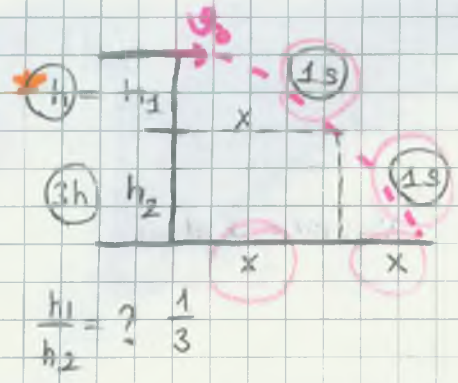
$$t_{\text{toplam}} = 4 \text{ s}$$

$$h = 5t^2$$

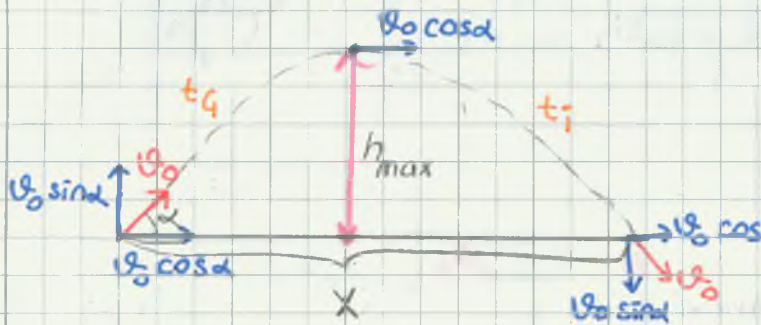
$$h = 5 \cdot 16 = 80 \text{ m}$$

$$X = v_0 \cdot t$$

$$= 30 \cdot 4 = 120 \text{ m}$$



- EĞİK ATIŞ -



$$v_0 \sin \alpha = g \cdot t_{up}$$

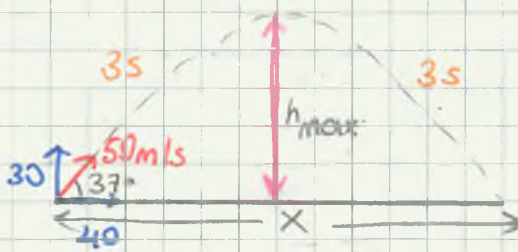
$$= v_0 \sin \alpha$$

$$t_1 = t_4$$

$$X: \text{menzil} = v_0 \cos \alpha \cdot t_{ucuz}$$

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

★



$$t_{ucuz} = 6 \text{ s}$$

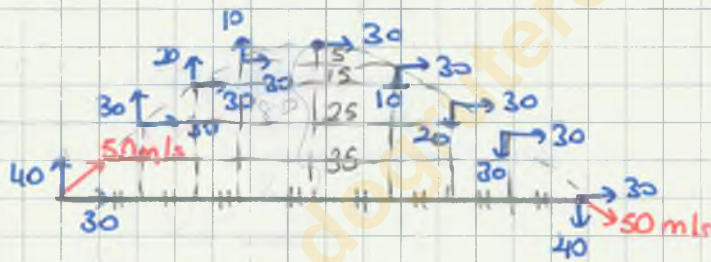
$$X = v_0 \cos \alpha \cdot t_{ucuz}$$

$$= 240 \text{ m}$$

$$h_{max} = \frac{1}{2} g t^2$$

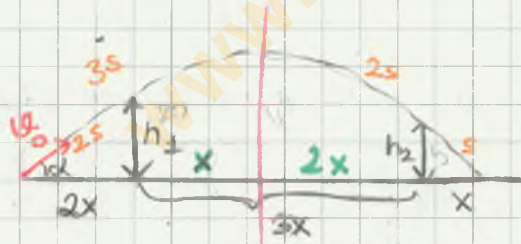
$$= 45 \text{ m}$$

★



$2v_0 \sin \alpha$
 $v_1 = v_0 \sin \alpha$
 $v_2 = v_0 \sin \alpha$

★

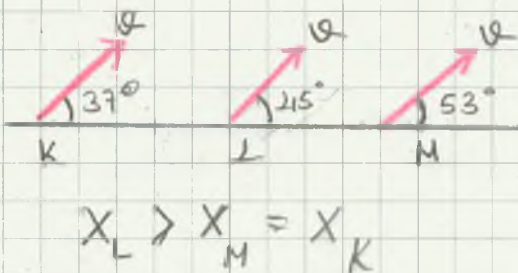


$$\frac{h_1}{h_2} = ?$$

$$h_1 = \begin{cases} h & 4 \text{ sn} \\ 3h & 5 \text{ sn} \\ 5h & 6 \text{ sn} \end{cases}$$

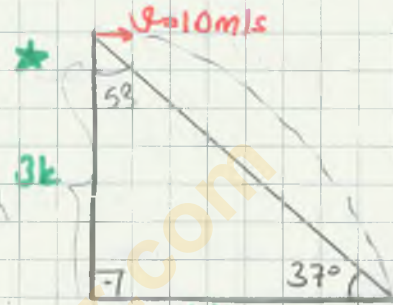
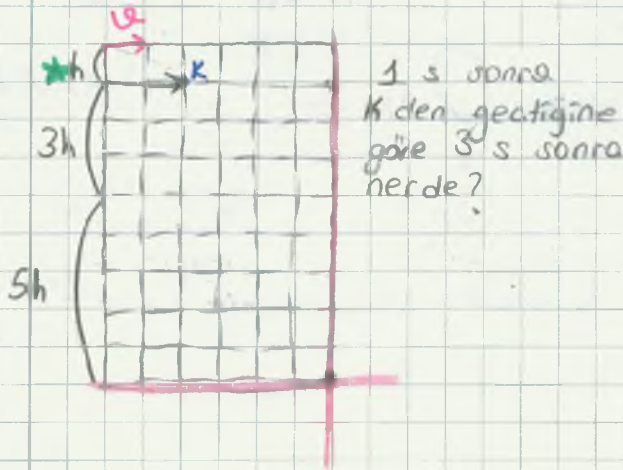
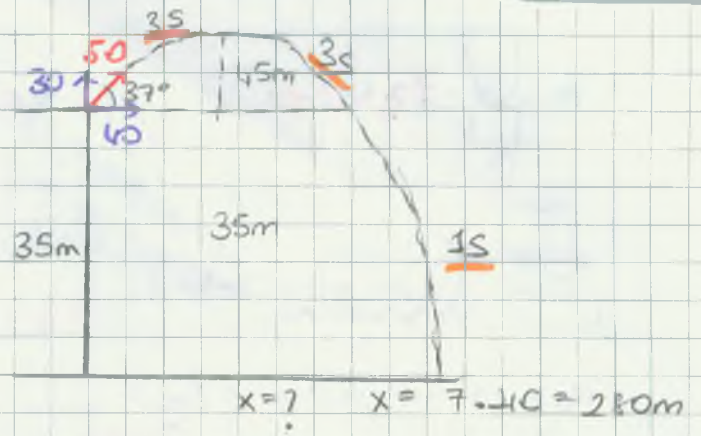
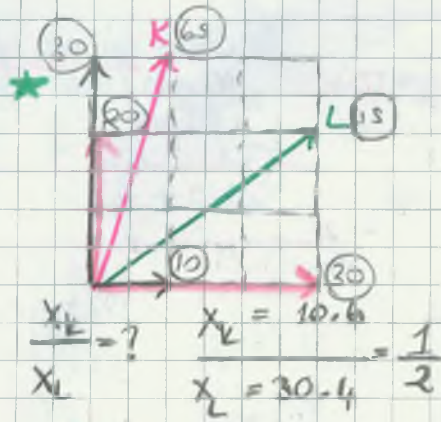
$$\Rightarrow \frac{h_1}{h_2} = \frac{8}{5}$$

! NOT !

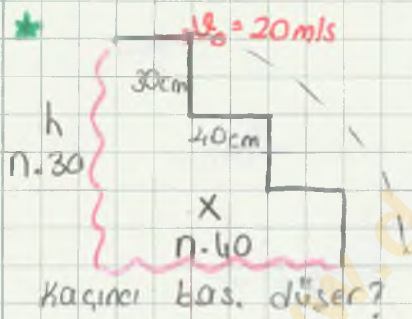


Eşit hızda eğik atılan 3 cisimden 45° olanın menzilli max iken 37° ve 53° olan açıların menzilleri eşittir.

$$X_L > X_M = X_K$$



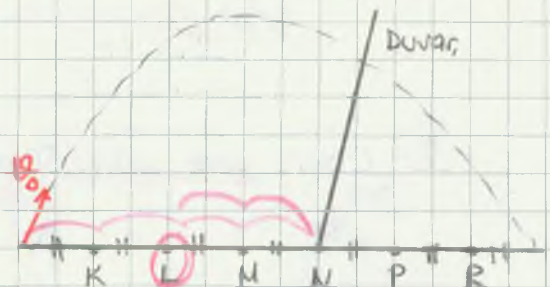
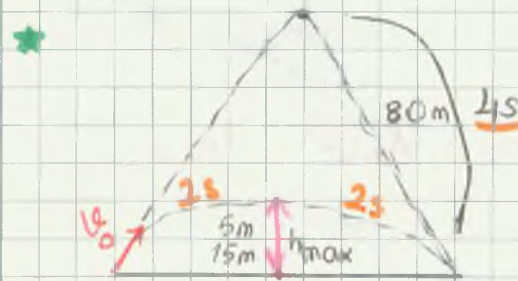
$h = \frac{5t^2}{2} = 3k$
 $X = 10t = 4k$
 $t = 3/2 = 1,5$
 $h = 5 \cdot (\frac{3}{2})^2$
 $X = 10 \cdot 1,5 = 15$



Kaçınıcı bas. düşer?

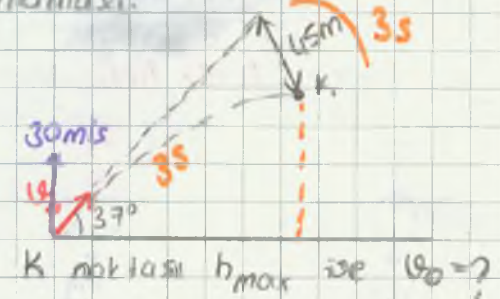
$h = n \cdot 30 = 5t^2$
 $X = n \cdot 40 = 20t$ m ye çevir.

$t = 3s$ $n \cdot 40 \cdot 10^{-2} = 20 \cdot 3$

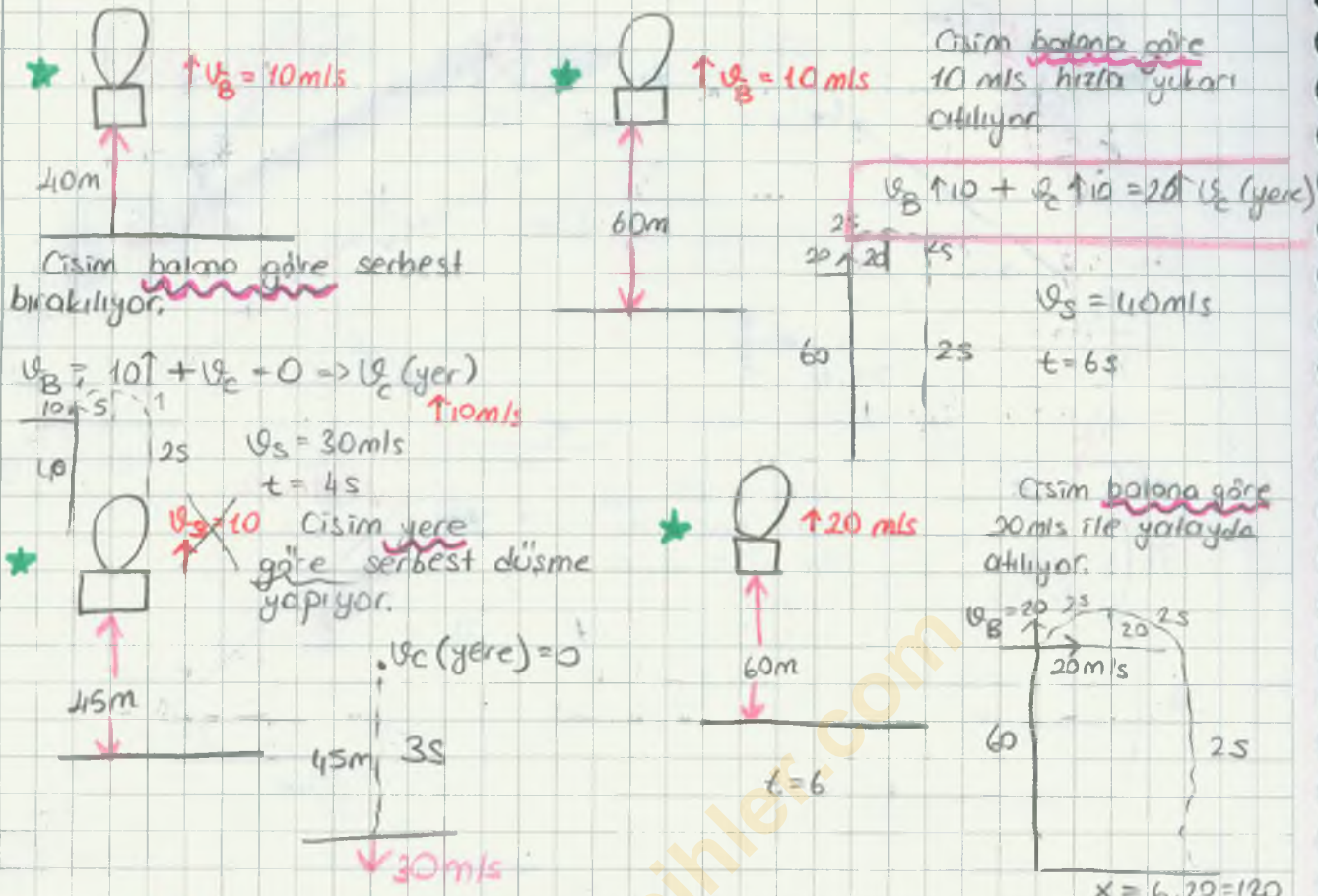


Duvar olmasaydı R noktasına çarpıp cisim duvara çarptıktan sonra hangi noktaya düşer?

Normalde menzili 6 buru olmazmamalı.



$v_0 = 50 m/s$



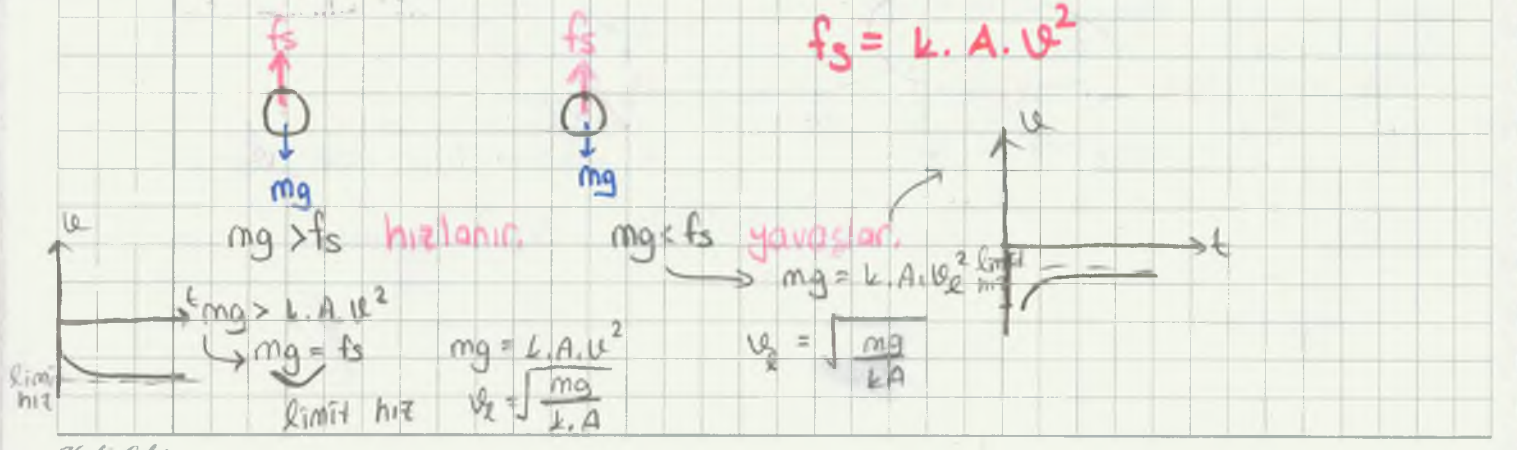
1- Cisim araca göre 50 m/s ile atılırsa;
 $40 + 30 = 70$ m/s, $t = 8$ sn, $X_c = 8 \cdot 70 = 560$
 $X_{araba} = 8 \cdot 40 = 320$ } cisim önde

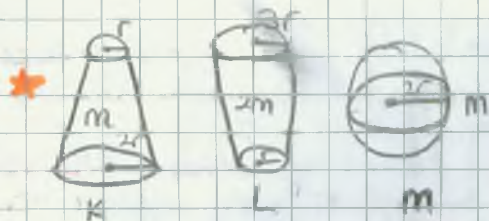
2- Cisim yere göre 50 m/s ile atılırsa;
 $40 + 30 = 70$ m/s, $t = 8$ sn, $X_c = 8 \cdot 30 = 240$
 $X_{araba} = 8 \cdot 40 = 320$ } araç önde

3- Cisim yere düşt. cisim ile araç arasındaki mesafe?

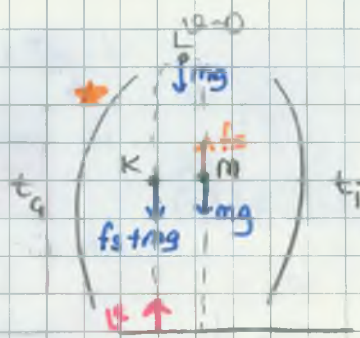
- LİMİT HIZ -

Hava ortamında cisim üzerine etki eden sürtünme kuvvetinin cismin ağırlığına eşit olmasıyla birlikte cisim sabit bir hıza ulaşır. Bu hız değerine **limit hız** denir.





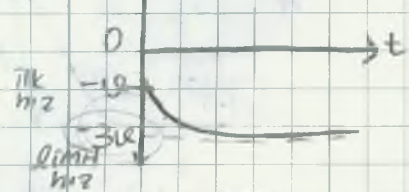
$K) mg = k \cdot 4\pi r^2 \cdot \rho_k^2$
 $L) 2mg = k \cdot 9\pi r^2 \cdot \rho_L^2$
 $M) mg = k \cdot 4\pi r^2 \cdot \rho_M^2$
 $\rho_k > \rho_L = \rho_M$



$K) F_{net} = f_s + mg$
 $L) F_{net} = mg$
 $M) F_{net} = mg - f_s$
 $F_k > F_L > F_M$
 $a_k > a_L > a_M$

$t_k < t_l$
 $a_k > a_l$

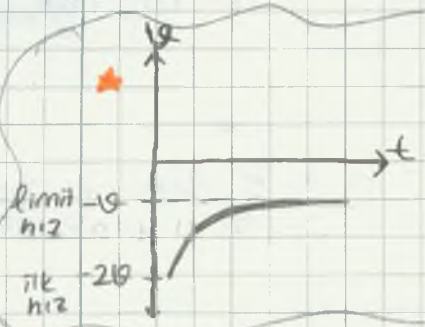
Atıldığı bndaki ivmesi kaç g dir?



$mg = f_s$ (limit hız)
 $mg = k \cdot A \cdot \rho^2 = k \cdot A \cdot 9\rho^2$

$mg - f_s = m \cdot a$
 $mg - k \cdot A \cdot \rho^2 = m \cdot a$
 $mg - mg = m \cdot a$
 $0 = m \cdot a$

$a = 9/8 m/s^2$



$mg = f_s$ (limit)
 $mg = k \cdot A \cdot \rho^2$

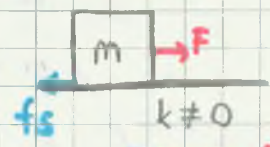
$mg - f_s = m \cdot a$
 $mg - k \cdot A \cdot 4\rho^2 = m \cdot a$
 $mg - 4mg = m \cdot a$

$a = 3g$

- İŞ, GÜÇ, ENERJİ -

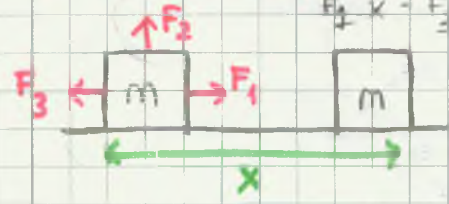
- İŞ -

$W = F \cdot x$
 metre
 Newton
 = Joule (skalär)

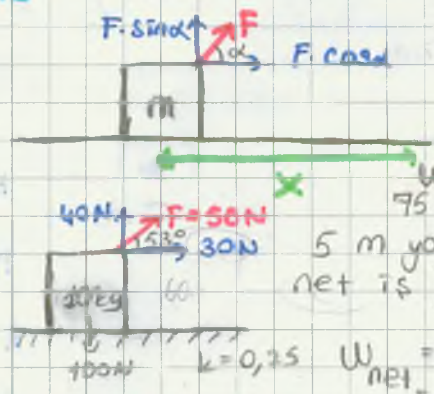


$F \cdot x - f_s \cdot x = W_{net}$

*** F ile x: paralel**



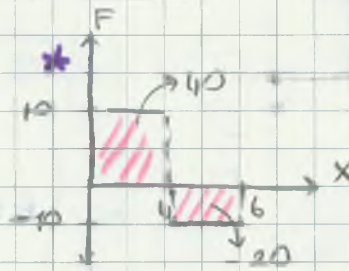
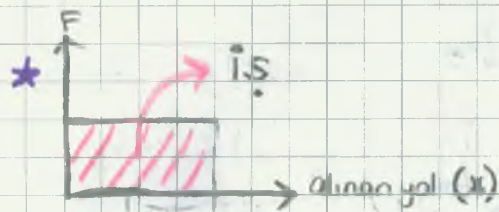
$F_1 \cdot x - F_3 \cdot x$
 $+F_1 \cdot x = F_1$ in yaptığı iş
 $-F_3 \cdot x = F_3$ " " "
 $F_2 \perp x$ oldu için iş yapmaz.



$W = F \cdot \cos \alpha \cdot x$

$W = F \cdot x$
 $75 = 15 \cdot 5$
 5 m yol alırken yaptığı net iş?
 $W_{net} = (30 - 15) \cdot 5$
 $= 75 \text{ joule}$

$W_{net} = (F_1 - F_3) \cdot x$
 $W = F \cdot x$
 $30 - 15$
 $15 \cdot 5$



$W_{net} = 20 \text{ Joule}$

- Enerji Korunumu -

$E_k = \frac{1}{2} m v^2$
 $E_p = mgh$

$E_i + W = E_s$
 $W = 0 \Rightarrow E_i = E_s$

$W = E_s - E_i$
 $W = \Delta E$

1

$E_i + W = E_s$
 $mgh + 0 = \frac{1}{2} m v^2$

2

$E_i + W = E_s$
 $\frac{1}{2} m v_1^2 + mgh + 0 = \frac{1}{2} m v_2^2$

3

$\frac{1}{2} m v^2 + 0 = mgh_{max}$

4

$E_i + W = E_s$
 $mgh - f_s \cdot x = 0$
 $k = 0,5$
 $m \cdot 10 \cdot 10 = m \cdot g \cdot k \cdot x$
 $100 = 10 \cdot 0,5 \cdot x$
 $x = 20m$

5

1- K noktasındaki hız?
 2- Kaç m yol alıp durur?

$E_i + W = E_s$
 $\frac{1}{2} m \cdot 100 + m \cdot 10 \cdot 20 = \frac{1}{2} m \cdot v_k^2 + m \cdot g \cdot 20$
 $10 \cdot 20 + \frac{1}{2} \cdot 100 = \frac{1}{2} \cdot v_k^2$

6

$E_i + W = E_s$
 $mgh + \frac{1}{2} m v^2 - f_s \cdot x = 0$
 $m \cdot 10 \cdot 20 + \frac{1}{2} m \cdot 100 = m \cdot 10 \cdot 0,5 \cdot x$
 $v = 0 \Rightarrow 2mgh = 4E_k$
 $\frac{3E_k}{3mgh + E_k} = \frac{E_k}{E_k} = 1$
 $\frac{v_k}{v_0} = ? = \frac{1}{\sqrt{3}}$

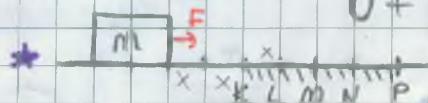
7

$E_i + W = E_s$
 $\frac{1}{2} m v^2 + 0 = mgh_{max}$
 $\frac{1}{2} \cdot 625 = 10 \cdot h_{max}$

$$E_i + W = E_s$$

$$W = F \cdot x$$

$$0 + F \cdot 3x - f_s \cdot 4x = 0$$



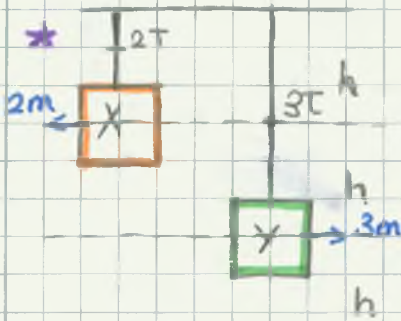
* F kuvveti L ye kadar uygulanıyor. Ke cisim P de duruyor $f_s = ? F$

$$E_i + W = E_s$$

$$0 + F \cdot 3x - f_s \cdot 4x = 0$$

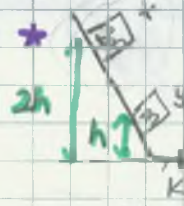
$$3Fx = 4f_s x$$

$$f_s = 3F/4$$



$$\frac{E_p(x)}{E_p(y)} = ? \frac{2mg \cdot 2h}{3mg \cdot h} = \frac{4}{3}$$

$$0 + F \cdot 3x - f_s \cdot 4x = 0$$



$$E_i + W = E_s$$

$$2mgh + 2f_s \cdot x = 0$$

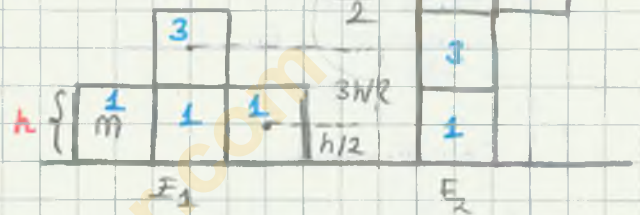
* X, M noktasında durduğuna göre Y nerede durur?

$$x) E_i + W = E_s$$

$$2mgh - f_s \cdot 2x = 0 \quad 2mgh = f_s \cdot 2x$$

$$y) mgh - f_s \cdot ? = 0$$

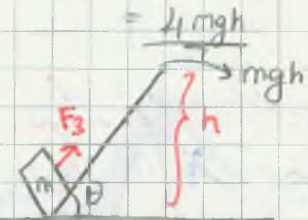
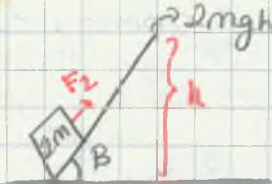
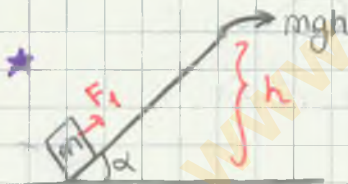
$$mgh = f_s \cdot ? \quad \frac{1}{2} \cdot 3x$$



a) $E_1 = ? \frac{6 \cdot 3}{14 \cdot 7}$ b) Sekil 1'i sekil 2 deki hale getirmek için yapılacak işi kuvvetine karşı yapılan iş kaç mgh olur?

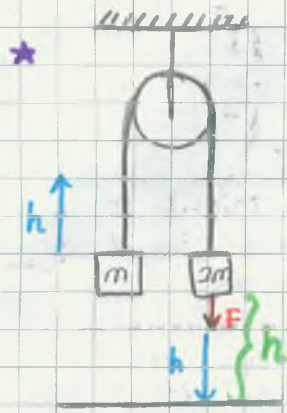
* Yerecekimi kuvvetine karşı yapılan iş E_p deki değişime eşittir.

$$b) E_{p(son)} - E_{p(ilk)} = 14 \cdot mgh \frac{1}{2} - 6mgh \frac{1}{2}$$



Cisimleri eğik düzlemin en üst noktasına çıkartmak için yerecekimi kuvvetine karşı yapılan işler?

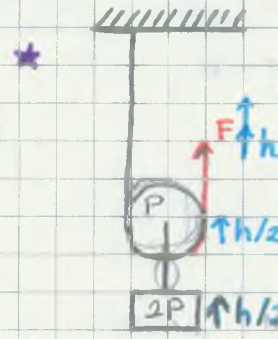
Yapılan işler de se (Potansiyel değişimini alırız)



2m kütleli cisim F kuvveti ile sabit hızla h kadar çekilirse yercekimi kuvvetine karşı yapılan iş kaç mgh olur? (-)

$$\begin{array}{r} -2mgh \\ + mgh \\ \hline + \\ \hline -mgh \end{array}$$

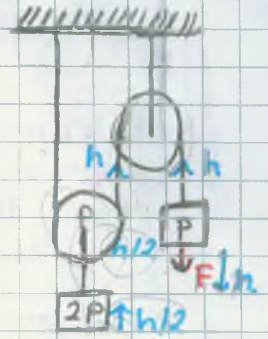
(-) olursa yercekimi bize karşı iş yapmış demektir.



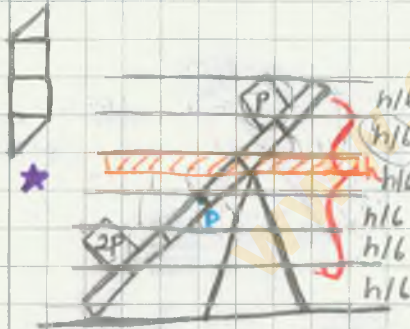
F kuvveti h kadar çekilirse yercekimi kuvvetine karşı yapılan iş kaç, Ph dir? (Makare ağırlığı : P)

$$\begin{array}{r} +2P \cdot \frac{h}{2} \\ + P \cdot \frac{h}{2} \\ \hline + \\ \hline \frac{3Ph}{2} \end{array}$$

ağırlı satır

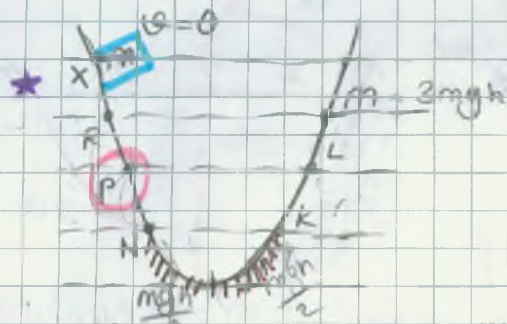


$$\begin{array}{r} -P \cdot h \\ +2P \cdot \frac{h}{2} \\ \hline + \\ \hline +P \cdot \frac{h}{2} \\ \hline + \\ \hline \frac{Ph}{2} \end{array}$$



h/6 P ağırlıklı homojen tırdes kutuk F kuvvetinin h/6 yardımı ile yatay konuma getirilene kadar yec. h/6 kuvv. karşı yapılan iş kaç Ph dir?

$$\begin{array}{r} 3 \cdot \frac{h}{6} \cdot 2P \\ +1 \cdot \frac{h}{6} \cdot P \\ -1 \cdot \frac{h}{6} \cdot P \\ \hline + \\ \hline +P \cdot h \end{array}$$

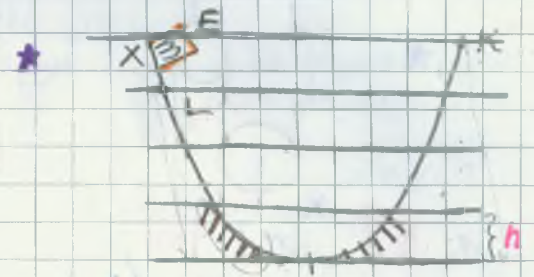


X noktasından serbest bırakılan cisim M noktasına kadar çıkabiliyor. Dönüşte nereye kadar çıkabiliyor?

$$4mgh - fs \cdot 2x = 3mgh$$

$$fs \cdot 2x = mgh$$

$E_f = W_{fs}$

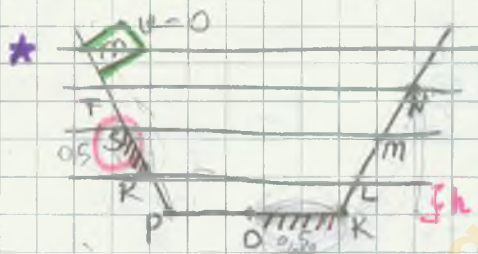


X noktasından E enerjisiyle atılan m kütleli cisim K noktasına kadar çıkıp dönüşte L noktasına çıkabilirken, E kaç mgh'dir?

$$E + 4mgh - fs \cdot 2x = 4mgh$$

$$4mgh - fs \cdot 2x = 3mgh$$

$$mgh = E$$

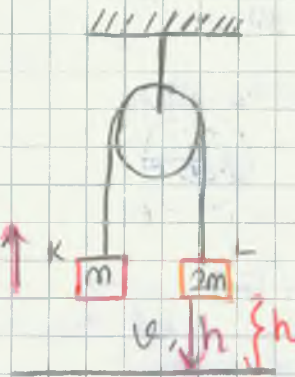


4h yüksekliğinden serbest bırakılan cisim N noktasına kadar çıkabilmekte S-R ve O-K arasındaki sürtünme sabit ve eşit olduğuna göre dönüşte nereye kadar çıkabilir?

$$4mgh - 2fs \cdot x = 3mgh$$

$$fs \cdot x = \frac{mgh}{2}$$

$$E_R = W = fs \cdot x$$



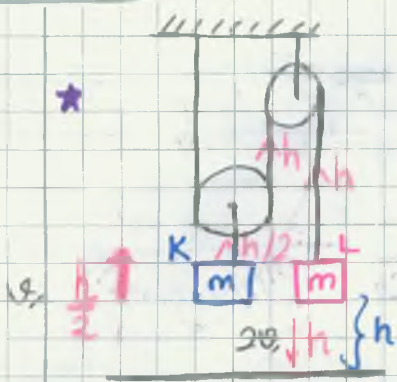
Serbest bırakılan sistemde 2 cisim yere çarptığında K'nın Ek'si kaç mgh'dir?

Kayıbedilenler = Kazanımlar

$$2mgh = mgh + \frac{1}{2}mv^2 + \frac{1}{2}(2m)v^2$$

$$mgh = 3 \frac{mv^2}{2} ?$$

$$\frac{mgh}{3}$$



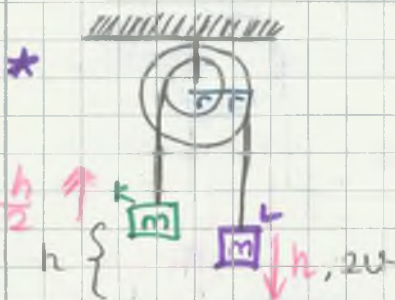
Sistem serbest bırakılıp 2 cisim yere düştüğünde K cisminin E_k si kaç mgh olur?

$$(-) = (+)$$

$$mgh = mgh + \frac{1}{2} m v^2 + \frac{1}{2} m v^2$$

$$\frac{mgh}{2} = \frac{5m v^2}{2}$$

$$\frac{mgh}{10} = E_k(k)$$



Sistem serbest bırakılıp 2 cisim yere düştüğünde 2 m'nin E_k sinin K E_p sine oranı nedir?

$$(-) = (+)$$

$$mgh = mgh + \frac{1}{2} m v^2 + \frac{1}{2} m (2v)^2$$

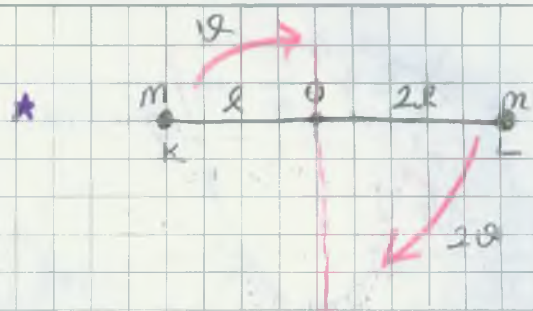
$$\frac{mgh}{2} = \frac{5m v^2}{2}$$

$$\frac{2mgh}{5} = 2m v^2$$

$$E_k(L)$$

$$\frac{E_k(L)}{E_p(K)} = \frac{mgh \cdot \frac{3}{2}}{\frac{2mgh}{5}}$$

$$= \frac{4}{15}$$



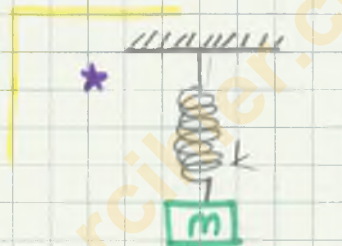
Sistem serbest bırakılıp büyük bir sey konumundan geçerken 2 cisimnin kinetik enerjisi kaç mgh olur?

$$(-) = (+)$$

$$mg \cdot 2l = mgl + \frac{1}{2} m v^2 + \frac{1}{2} m v^2$$

$$mgl = \frac{5m v^2}{2}$$

$$2m v^2 = \frac{4mgl}{5}$$



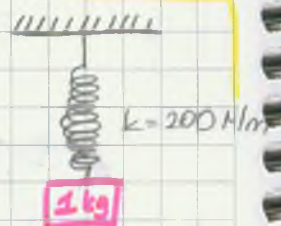
$$F_{yay} = k \cdot x$$

$$mg = k \cdot x$$

$$x = \frac{mg}{k}$$

$$E = \frac{1}{2} k x^2$$

$$= \frac{1}{2} k \left(\frac{mg}{k} \right)^2$$



$$F = k \cdot x$$

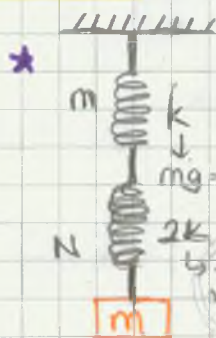
$$10 = 200 \cdot x$$

$$x = 1/20$$

$$E = \frac{1}{2} k x^2$$

$$E = \frac{1}{2} \cdot 200 \cdot \frac{1}{400}$$

$$= 1/4 \text{ Joule}$$



M yayında depolanan enerji E ise N yayında depolanan enerji kaç E?

$$mg = k \cdot x_1 \quad x_1 = \frac{mg}{k}$$

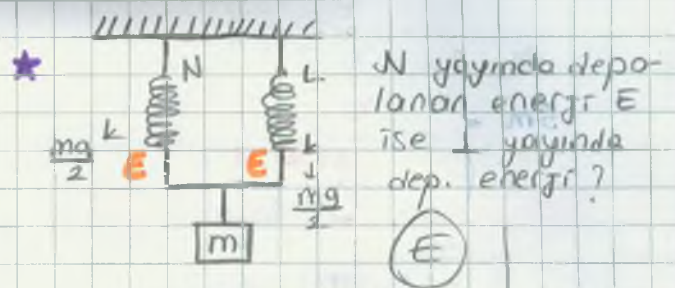
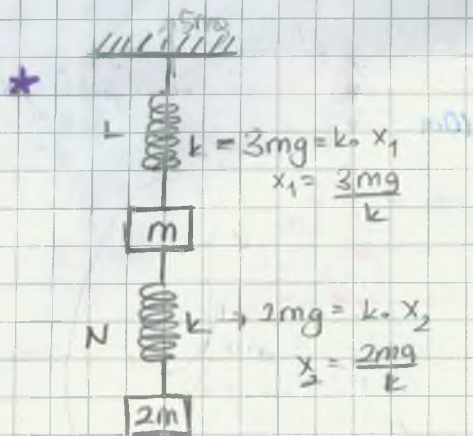
$$2k \cdot x_2 = mg$$

$$x_2 = \frac{mg}{2k}$$

$$E = \frac{1}{2} k \left(\frac{mg}{k} \right)^2$$

$$E_N = \frac{1}{2} k \left(\frac{mg}{2k} \right)^2$$

$$= \frac{E}{2}$$

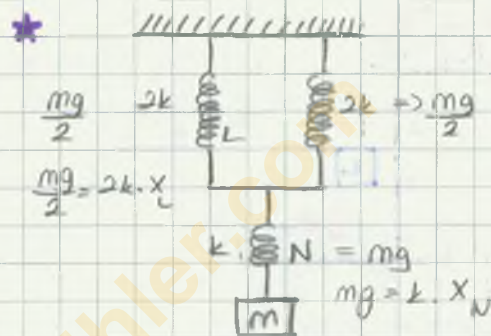


L yayında depolanmış enerji E ise N yayında depolanmış enerji kaç E?

$$E_L = \frac{1}{2} k \left(\frac{3mg}{k} \right)^2 = E$$

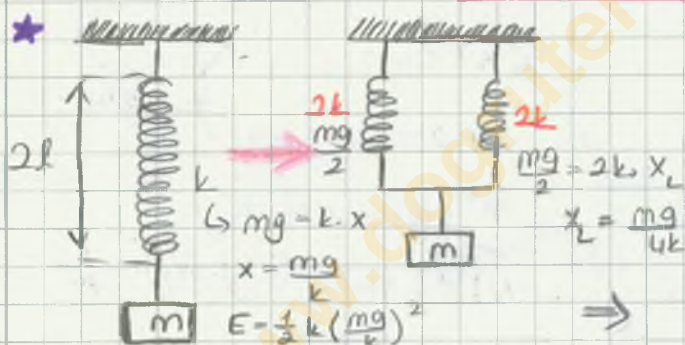
$$E_N = \frac{1}{2} k \left(\frac{2mg}{k} \right)^2$$

$$\frac{1}{2} = \frac{4E}{9}$$



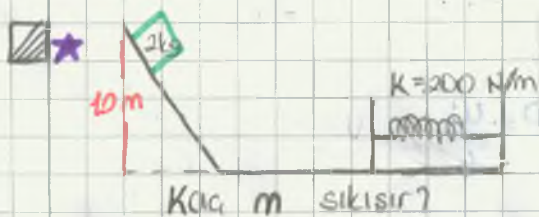
$$E_N = \frac{1}{2} k \left(\frac{mg}{k} \right)^2 = E$$

$$E_L = \frac{1}{2} 2k \left(\frac{mg}{4k} \right)^2 = \frac{E}{8}$$



$$\Rightarrow E_L = \frac{1}{2} 2k \left(\frac{mg}{4k} \right)^2 = \frac{E}{8}$$

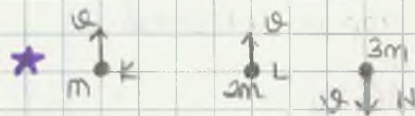
Depolanmış enerji E ise 2. şekilde E_L yay enerjisi kaçtır?



$$E_p + W = E_s$$

$$20 \cdot 10 = \frac{1}{2} 200 \cdot x^2$$

$$x = \sqrt{2m}$$



Yere çarpma hızları arasındaki ilişki?

$$K) mgh + \frac{1}{2} mv^2 = \frac{1}{2} mv^2$$

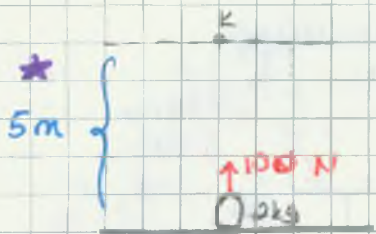
$$L) 2mgh + \frac{1}{2} 2mv^2 = \frac{1}{2} 2mv^2$$

$$M) 3mgh + \frac{1}{2} 3mv^2 = \frac{1}{2} 3mv^2$$

$$v_K = v_L = v_M$$

$$P = \frac{E}{t}$$

$$P = \frac{F \cdot x}{t} \rightarrow \text{Joule (enerji)}$$

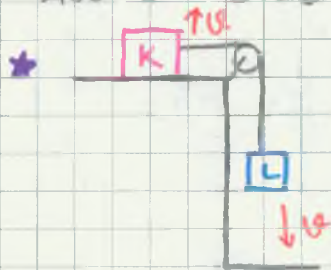


K noktasındaki hızı?

$$W = \frac{1}{2} m v^2 + mgh$$

$$100 \cdot 5 = \frac{1}{2} \cdot 2 \cdot v^2 + 2 \cdot 10 \cdot 5$$

$$200 \cdot v^2 \quad v = 20$$

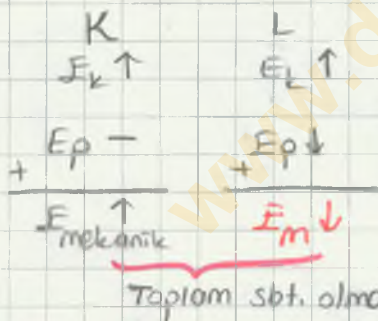


Sürtünmesiz ortamda serbest hareket eden cisim için:

I - Toplam mekanik enerji korunur.

II - K'nin mekanik enj artar

III - L'nin " " azalır



- güç -

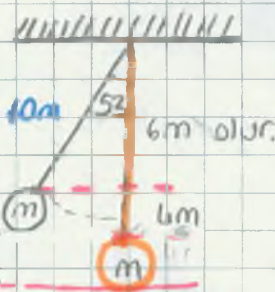
$$P = \frac{W}{t} = \frac{\text{Joule}}{\text{saniye}}$$

$$= \frac{F \cdot x}{t} = \frac{N \cdot m}{s}$$

$$= F \cdot v = N \cdot m/s$$

$$= mg \cdot v = kg \cdot m/s^2 \cdot m/s$$

Watt

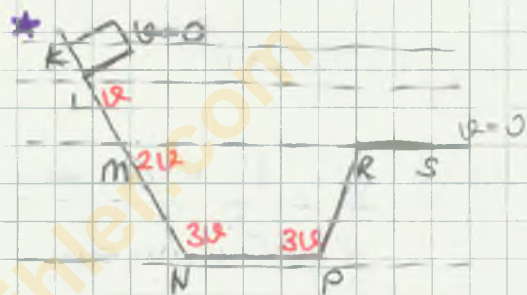


Disseyden geçerken hızı?

$$mgh = \frac{1}{2} m v^2$$

$$40 = \frac{1}{2} v^2$$

$$v = 4\sqrt{5}$$



Hangi aralıklar kesin sürtünmelidir?

K) $3mgh$

L) $2mgh + \frac{1}{2} m v^2$

M) $mgh + \frac{1}{2} m v^2$

N) $\frac{1}{2} m g v^2$

$mgh = \frac{1}{2} m v^2$

$mgh = \frac{3}{2} m v^2$

$mgh = \frac{5}{2} m v^2$

$$P = \frac{W}{t} \rightarrow \text{Watt} = \frac{\text{Joule}}{\text{saniye}}$$

Joule = watt · saniye : Enerji
kilowatt · saniye : "

$$mgh = 2mgh - \frac{1}{2} m v^2$$

- İTME (MOMENTUM) -

$$\vec{F}_{net} = m \cdot \vec{a}$$

$$F_{net} = m \cdot \frac{\Delta v}{\Delta t}$$

$$\vec{F}_{net} \cdot \Delta t = m \cdot \Delta v$$

itme
(N.s)

momentum değ.

$$\Delta P = P_{son} - P_{ilk}$$

(Kg.m/s)

vektörel

$$W = \Delta E$$

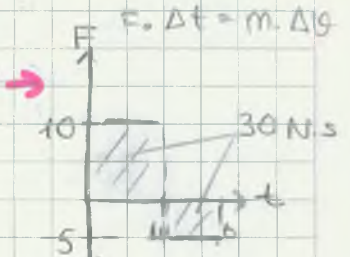
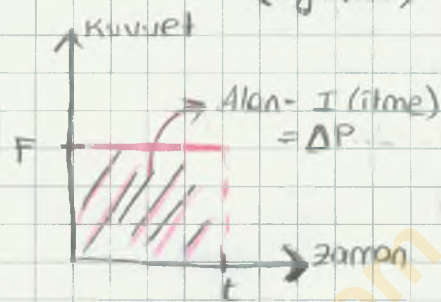
$$\vec{F}_{ilk} + W = E_{son}$$

$$\vec{I} = \Delta P$$

$$P_{ilk} + \vec{I} = P_{son}$$

Skaler

vektörel



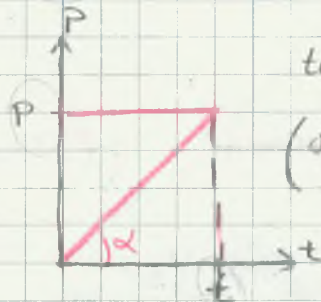
- 1- itme = ?
- 2- m = 2kg, v₀ = 0 → v_f = ?

- ① $\vec{I} = 30 \text{ N.s}$
- ② $\vec{I} = \Delta P$
 $= P_{son} - P_{ilk}$

$$30 = m(v_s - v_i)$$

$$30 = 2(v_s - 0)$$

$$v_s = 15 \text{ m/s}$$

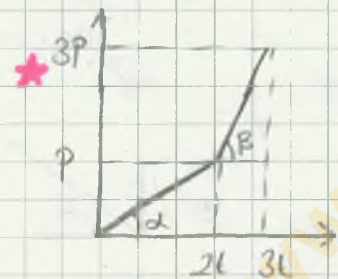


$$\tan \alpha = \frac{P}{t} = F$$

$$F \cdot \Delta t = \Delta P$$

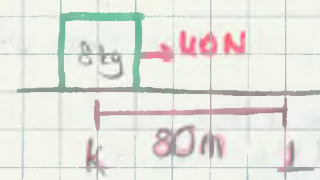
$$F = \frac{\Delta P}{\Delta t}$$

figim: Kuvvet



$$\tan \alpha = \frac{P}{t} = F_1$$

$$\tan \beta = \frac{2P}{t} = F_2$$



1- KL arasındaki itme?

$$I = F \cdot t$$

$$= \Delta P = P_{son} - P_{ilk}$$

$$(I = 40 \cdot t \quad F_{net} = m \cdot a \quad 40 = 8 \cdot a \quad a = 5 \text{ m/s}^2)$$

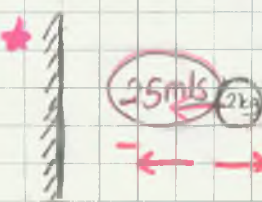
$$x = \frac{1}{2} a t^2 \quad 80 = \frac{1}{2} \cdot 5 \cdot t^2$$

$$I = 40 \cdot \sqrt{2} \quad I = 160\sqrt{2} \text{ N.s}$$

(0, 2)t → F₁

(2-3)t → F₂

$$\frac{F_1}{F_2} = \frac{1}{4} M$$



(Duvana çarpıp 30 m/s hızla geri dönüyor)

① I = ? m · v = ΔP

② Duvan ile etk. süresi 0,1 s ise duvarın itme kuvveti?

① $I = F \cdot \Delta t = m \cdot \Delta v$

$$I = P_f - P_i = m(v_f - v_i)$$

$$= 2(30 - (-25))$$

$$= 110 \text{ N.s}$$

② $I = F \cdot \Delta t$

$$110 = F \cdot 0,1$$

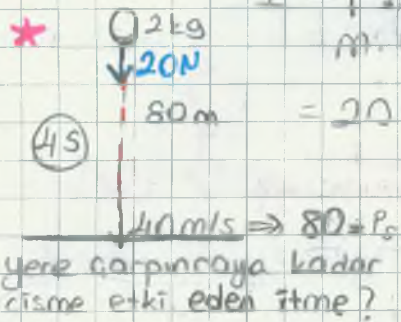
$$F = 1100 \text{ N}$$

$$I = F \cdot \Delta t$$

$$110 = F \cdot 0,1$$

$$I = F \cdot \Delta t$$

20 kg
 $I = F \cdot \Delta t$
 $m \cdot \Delta v$
 $= 20 \cdot 4$

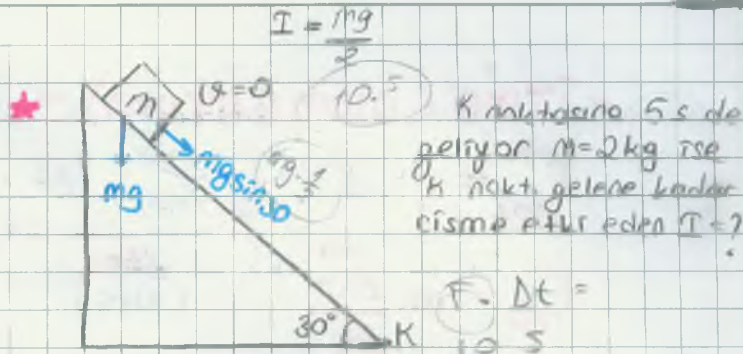


$$I = F \cdot \Delta t$$

$$= 20 \cdot 4$$

$$= 80 \text{ N} \cdot \text{s}$$

$$\Delta P = 80 \text{ N} \cdot \text{s}$$

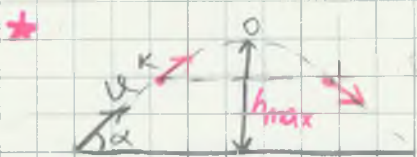


$$\frac{2 \cdot 10 \cdot 1}{2} = 10\text{N}$$

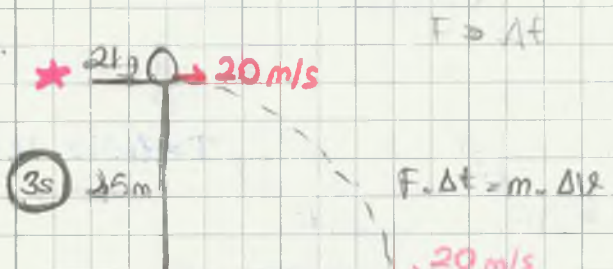
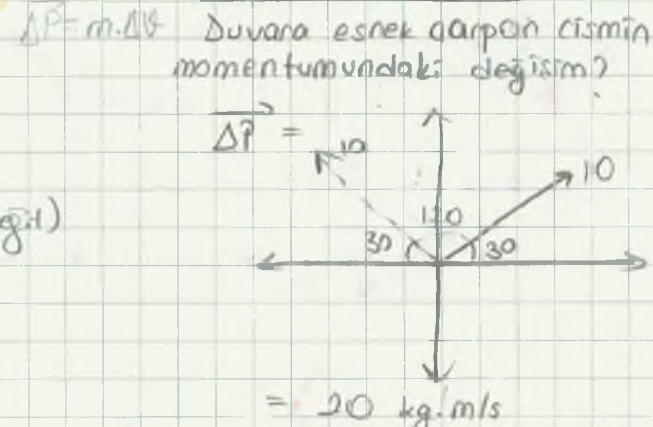
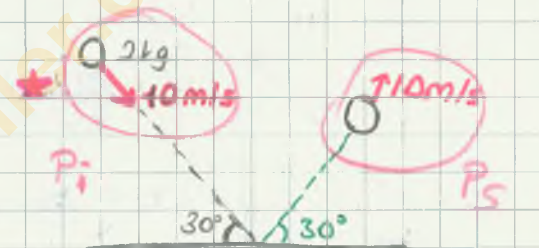
$$= F \cdot \Delta t$$

$$= 10 \cdot 5$$

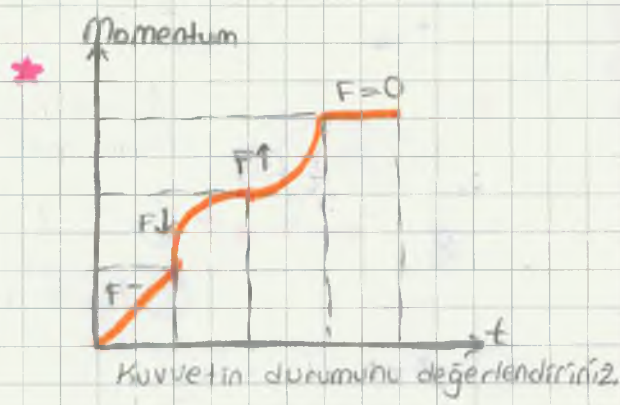
$$= 50 \text{ N} \cdot \text{s}$$

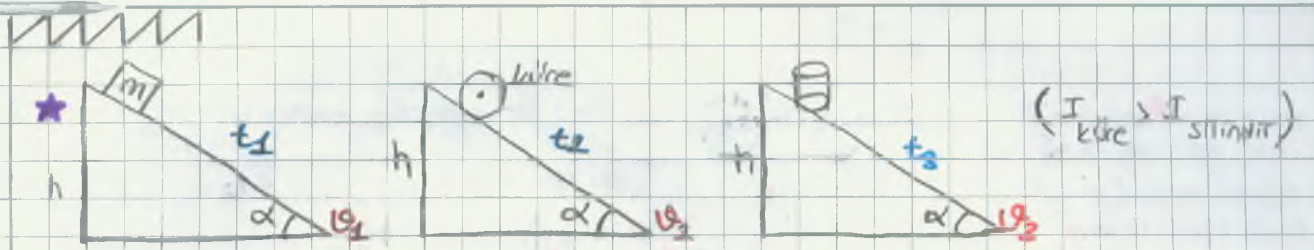


- ✓ I) Hareketi boyunca yatay momentumu sabittir.
 - ✗ II) h_{max} da momentumu sıfırdır.
 - ✗ III) K ve J nok'ta momentumları eşittir. (vektörel ald. için eşit değil) Hangileri doğrudur?
- Galileo I



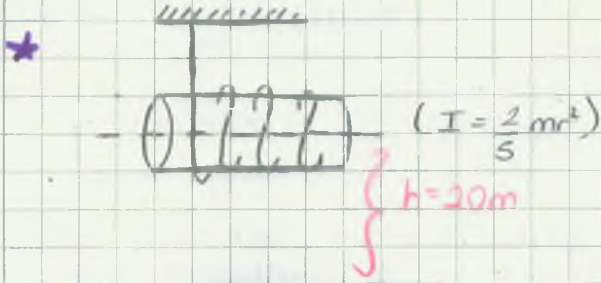
Hareketi boyunca cisme etki eden I ne?
 $\Delta v = 30 - 20$
 $\Delta P = 30 \cdot 2$
 $= 60 \text{ N} \cdot \text{s} = I$





$$v_1 > v_3 > v_2$$

$$t_1 < t_3 < t_2$$



$$mgh = \frac{1}{2} m v^2 + \frac{1}{2} \cdot \frac{2}{5} \cdot m r^2 \cdot \frac{v^2}{r^2}$$

$$10 \cdot 20 = \frac{1}{2} v^2 + \frac{1}{5} v^2$$

$$200 = \frac{7}{10} v^2 \quad \frac{2000}{7} = v^2 \quad v = 20 \sqrt{\frac{5}{7}} \text{ m/s}$$

- ESNEK ÇARPIŞMA -



Tam esnek çarpışma ;

1- Enerji korunur :

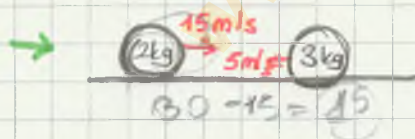
$$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_1'^2 + \frac{1}{2} m_2 v_2'^2$$

2- Momentum korunur :

$$P_{ilk} = P_{son}$$

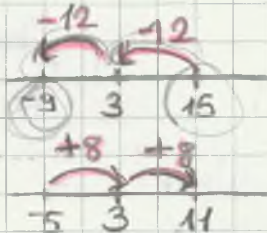
$$+ m_1 v_1 + m_2 (-v_2) = m_1 (-v_1') + m_2 v_2'$$

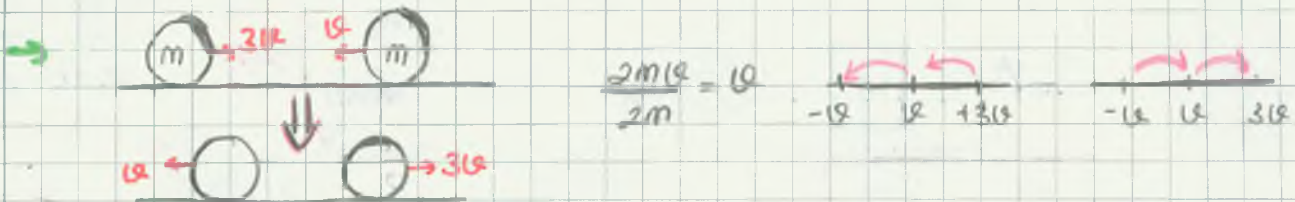
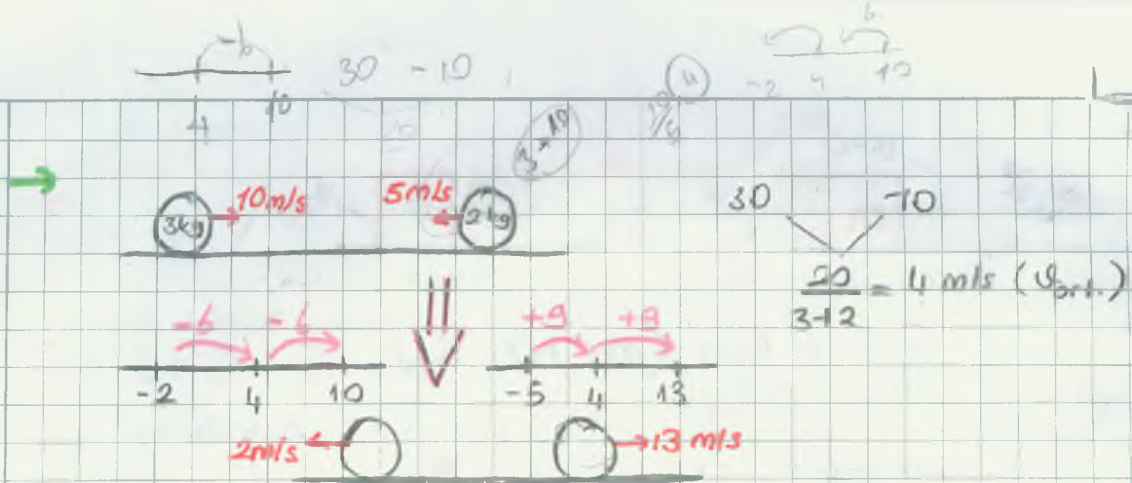
$$v_1 + v_1' = v_2 + v_2'$$



Esnek çarpışmadan sonraki hızları :

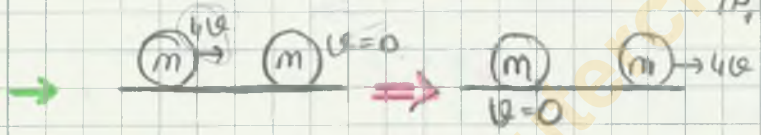
$$\frac{15}{2+2} = 3 \text{ m/s (} v_{ort.} \text{)}$$



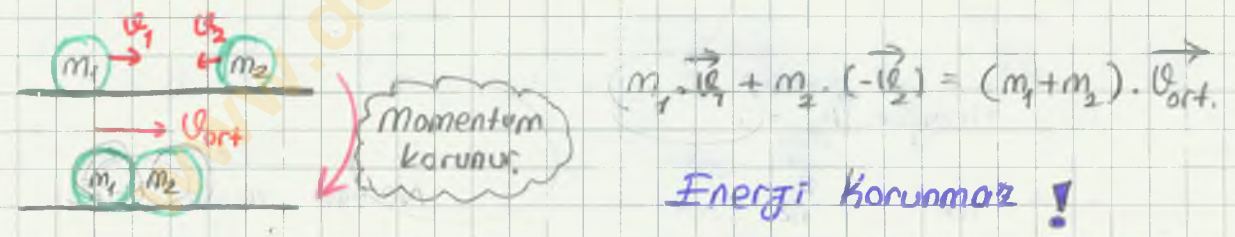


* Özel Durum i: $m_1 = m_2$ ise $v_1 = v_2$ hızları değiş tokuş olur.

* Özel Durum ii: $|p_1| = |p_2|$ ise aynı geri dönerler.



- ESNEK OLMAYAN ÇARPIŞMA -

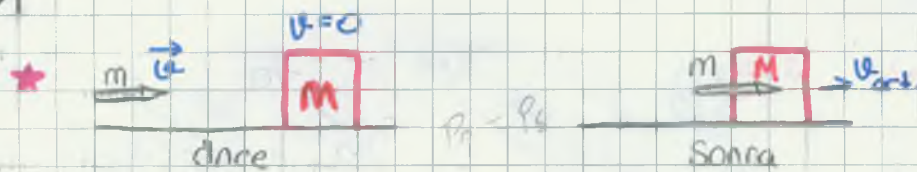


$$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} (m_1 + m_2) \cdot v_{\text{ort.}}^2 + W_{\text{ısı}}$$

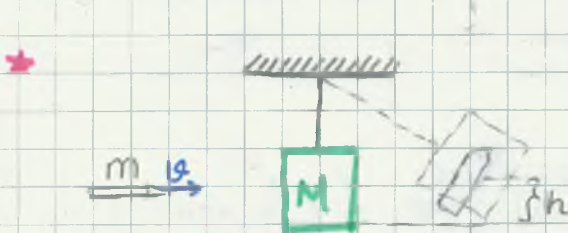
* $(3\text{kg } 10\text{ m/s } 2\text{kg } 5\text{ m/s})$ 1- $v_{\text{ort}} = ?$ 2- Isıya harcanan enerji?

① $\vec{P}_{\text{ilk}} = \vec{P}_{\text{son}}$
 $3 \cdot 10 + 2 \cdot (-5) = 5 \cdot v_{\text{ort.}} = 4 \text{ m/s}$

② $E_1 = \frac{1}{2} 3 \cdot 10^2 + \frac{1}{2} 2 \cdot 5^2$
 $= 175 \text{ joule}$
 $E_2 = \frac{1}{2} (3+2) \cdot 4^2$
 $= 20 \text{ joule}$
135 joule WISI



$$m \cdot v + 0 = (m + M) \cdot v_{ort}$$

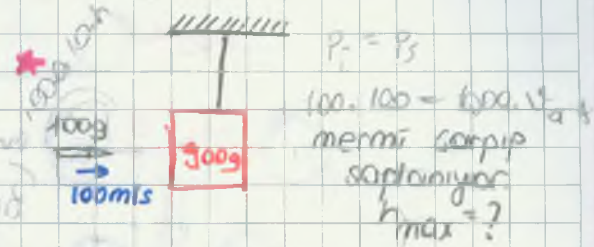


$$P_{ilk} = P_{son}$$

$$m \cdot v + 0 = (M + m) \cdot v_{ort}$$

$$E_{ilk} = E_s$$

$$\frac{1}{2} (m + M) \cdot (v_{ort})^2 = (M \cdot m) \cdot g \cdot h$$



$$P_{ilk} = P_{son}$$

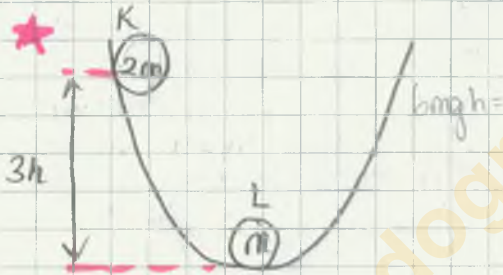
$$100 \cdot 100 + 0 = 1000 \cdot v_{ort}$$

$$v_{ort} = 10 \text{ m/s}$$

$$E_{ilk} = E_{son}$$

$$\frac{1}{2} 1000 \cdot 10^2 = 1000 \cdot 10 \cdot h_{max}$$

$$h_{max} = 5 \text{ m}$$

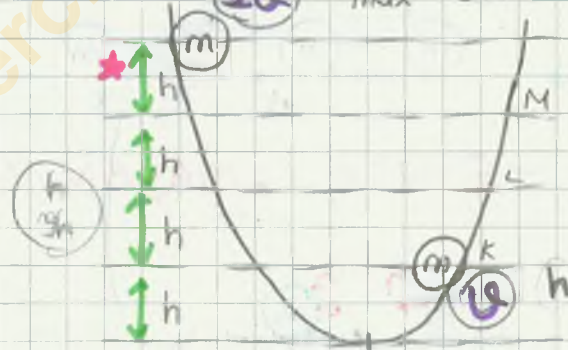


K'da yapışıp kuvvetleniyor. $h_{max} = ?$

$$E_{ilk} = E_{son} \quad P_{ilk} = P_{son}$$

$$2mg \cdot 3h = \frac{1}{2} 2m v^2 \quad 2m \cdot 6gh + 0 = 3m \cdot v_{ort}^2$$

$$v = \sqrt{6gh} \quad v_{ort} = \frac{2}{3} \sqrt{6gh}$$



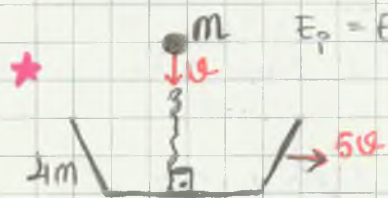
O'da sarpış yapışıyorlar. Nereye kadar gidebilirler? $P_1 = P_2$

$$m \cdot 2v - m \cdot v = 2m \cdot v_{ort}$$

$$v_{ort} = \frac{v}{2}$$

$$mgh = \frac{1}{2} m v^2$$

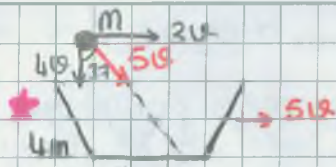
$$2mgx = \frac{1}{2} 2m \left(\frac{v}{2}\right)^2$$



$$E_p = E_s \quad \frac{1}{2} 3m \cdot \frac{4}{9} \cdot 6gh = 3mg \cdot x$$

Çisim arabaya sarpış yapışıyor. $v_{ort} = ?$

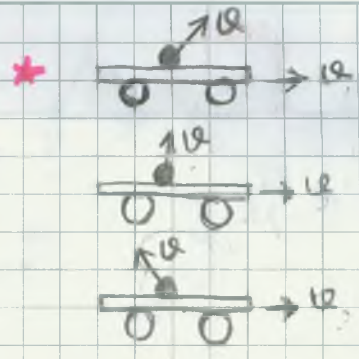
$$4m \cdot 5v + 0 = 5m \cdot v_{ort}$$



Cisim çarpıp yapışıyor

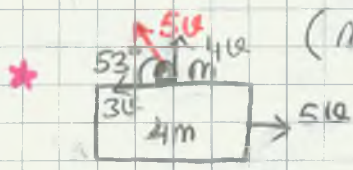
$$v_{ort} = ?$$

$$4m \cdot 5v + m \cdot 3v = 5m \cdot v_{ort}$$



Cisimler atıldıktan sonra arabaların hızları?

$$v_3 > v_2 > v_1$$



(Momentum yere göre hızlarda korunur.)

1- Cisim yere göre 5v ile atılırsa;

2- Cisim arabaya göre 5v ile atılırsa;

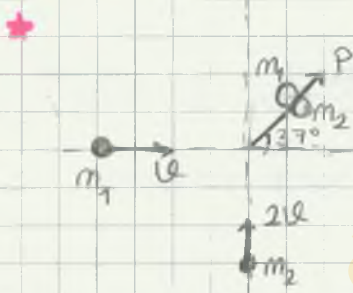
→ 2v arabaya göre

$$(5m) 5v = m \cdot (-3v) + 4m v_{son}$$

arabanın son hızı?

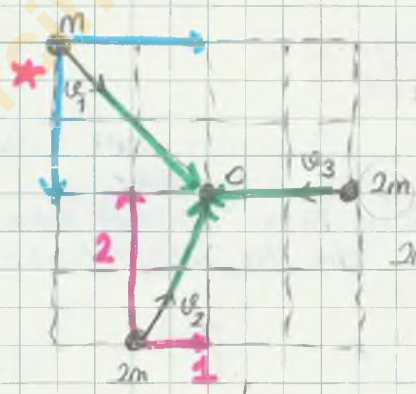
$$5m \cdot 5v = m \cdot (+2v) + 4m \cdot v_{son}$$

en başta yapışıklık



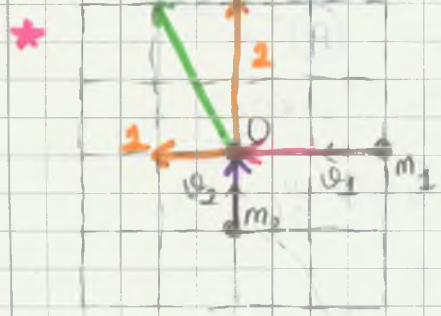
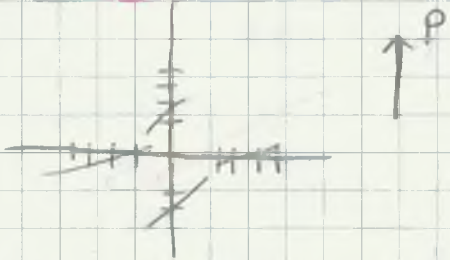
$$\frac{m_1 \cdot v}{m_2 \cdot 2v} = \frac{P \cdot \cos 37^\circ}{P \cdot \sin 37^\circ}$$

$$\frac{m_1}{m_2} = \frac{8}{3}$$



O noktasında çarpışıp yapışıyorlar hareket yönleri?

$$2m \cdot 2v$$

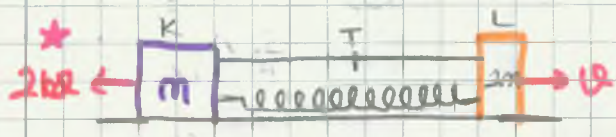
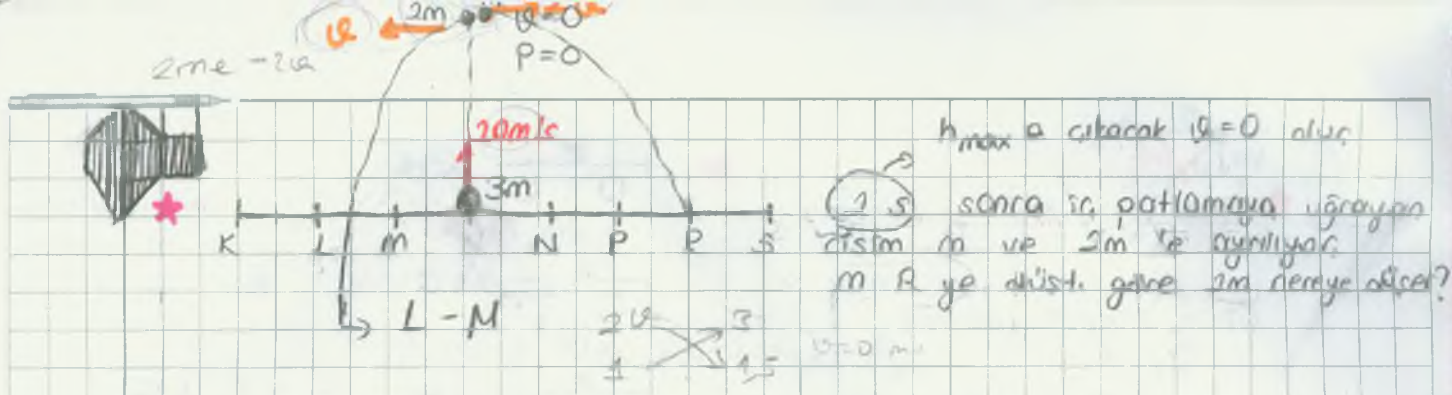


O noktasında çarpışıp yapıştıklarında momentumları P ise $\frac{m_1}{m_2} = ?$

$$\frac{m_1 \cdot 2v}{m_2 \cdot v} = \frac{1}{2}$$

$$\frac{m_1}{m_2} = \frac{1}{4}$$

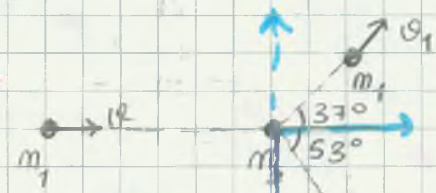
$$\frac{m_2 \cdot v_2}{m_1}$$



ip kesilirse $v_k = ?$

$$P_{ik} = P_s$$

$$0 = m \cdot v_1 - 2m \cdot v_2$$

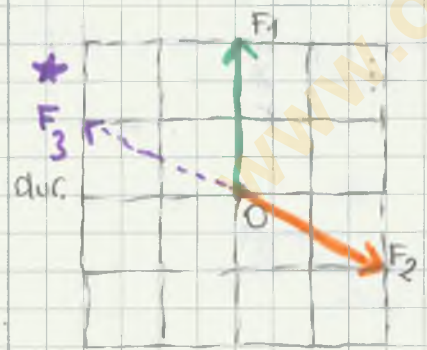


$$m_1 \cdot v + 0 = m_1 v_1 \cdot \cos 37^\circ + m_2 v_2 \cdot \cos 53^\circ$$

$$m_1 \cdot v \cdot \sin 37^\circ = m_2 v_2 \cdot \sin 53^\circ$$

- DENGGE -

Bir cisme etki eden net kuvvet (Bütün kuvvetlerin bileşkesi) "0" ise o cisim dengededir.
Cisim sabit hızla hareket ederse ivmesinin olmadığı dolayısıyla net kuvvet in "0" dır. bir durumdadır.



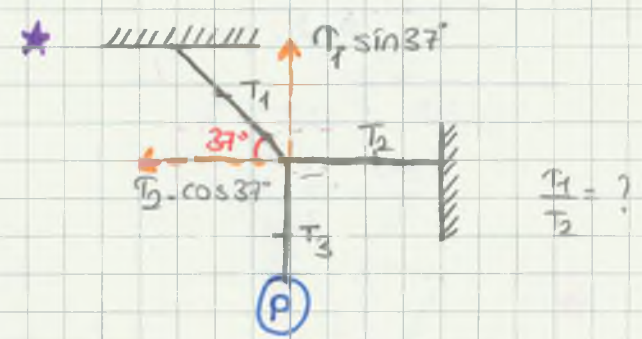
Üzerine 3 kuvvet etki eden O cisim dengede ise $F_3 = ?$

$$F_1: 0, 2$$

$$F_2: 2, -1$$

$$F_3: -2, 1$$

$$0, 0$$

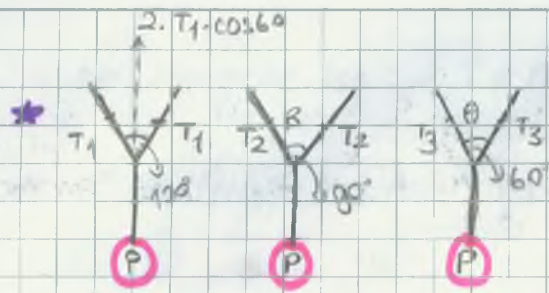


$$P = T_3 = T_1 \cdot \sin 37^\circ$$

$$T_2 = T_1 \cdot \cos 37^\circ$$

$$T_2 = T_1 \cdot \frac{4}{5}$$

$$\frac{T_1}{T_2} = \frac{5}{4}$$

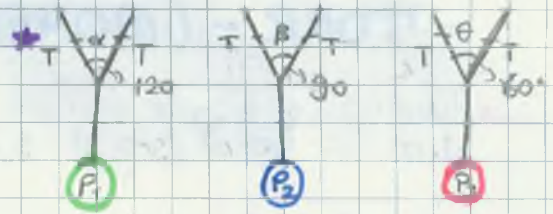


$\alpha > \beta > \theta$ ise T_1, T_2, T_3 ilişkisi?

$2 \cdot T_1 \cdot \cos 60 = P$
 $2 \cdot T_2 \cdot \cos 45 = P$
 $2 \cdot T_3 \cdot \cos 30 = P$

$T_1 \cdot \cos 60 = T_2 \cdot \cos 45 = T_3 \cdot \cos 30$

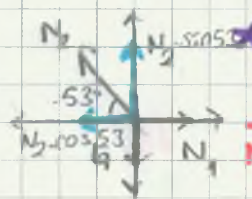
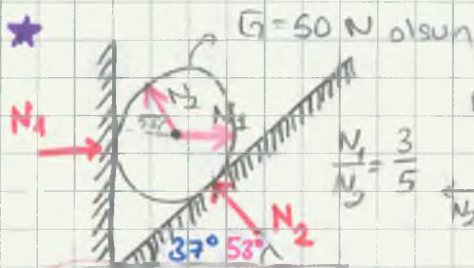
$T_1 > T_2 > T_3$



$\alpha > \beta > \theta$ ise P_1, P_2, P_3 ilişkisi?

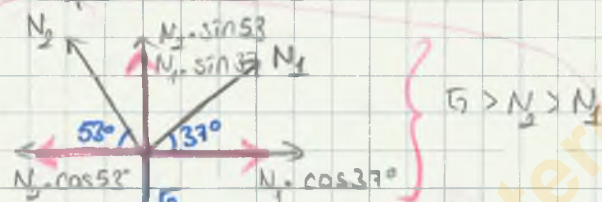
$2 \cdot P_1 \cdot \cos 60 = P$
 $2 \cdot P_2 \cdot \cos 45 = P$
 $2 \cdot P_3 \cdot \cos 30 = P$

$P_1 < P_2 < P_3$



İpini boyu uzatılırsa T ve N nasıl değişir?

α büyüdü.

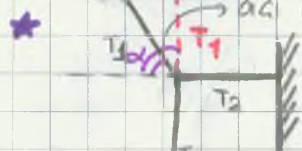
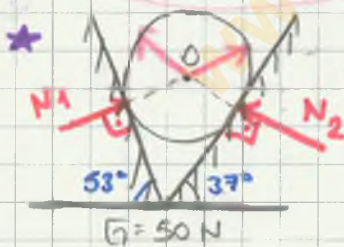


$G > N_2 > N_1$

$N_2 \cdot \cos 53^\circ = N_1 \cdot \cos 37^\circ$
 $N_2 \cdot \frac{3}{5} = N_1 \cdot \frac{4}{5}$
 $\frac{N_2}{N_1} = \frac{4}{3}$

$N_2 \cdot \frac{4}{5} - N_1 \cdot \frac{3}{5} = G = 50 \text{ N}$

GÖZÜM



O noktası değiştirilmeden ip K dan L ye getirilirse

T_1	T_2	T_3
↓	↓	↓
		P ye bağlı

$T_1 \cdot \sin \alpha = T_3 = P$
 $T_1 \cdot \cos \alpha = T_2$