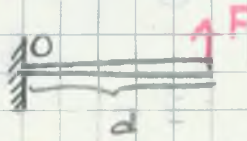


- TORK - (MOMENT)

→ Kuvvetin döndürme etkisine **tork** denir. Vektörel büyüklüktür. Birimi **N.m** dir. Yönü sağ el kuralı ile bulunur.

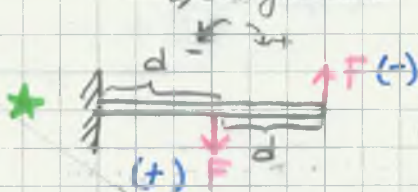


$$T = F \cdot d \quad T: \odot$$

↳ dik yükseklik

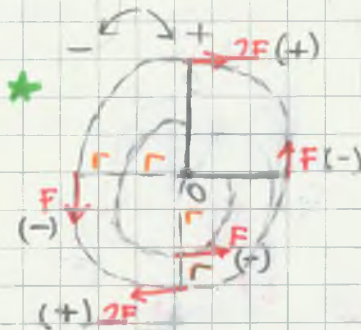


$$T = F \cdot 2d \quad T: \otimes$$



Torkun yönü

$$-F \cdot 2d + F \cdot d = -Fd \quad \odot$$



O noktasına göre torkun yönü ve büyüklüğü?

$$+2F \cdot r - F \cdot 2r + 2F \cdot 2r - F \cdot r - F \cdot 2r = +3Fr \quad \otimes$$



F_1 in O noktasına göre torku $\uparrow$ ise bileşke Tork?

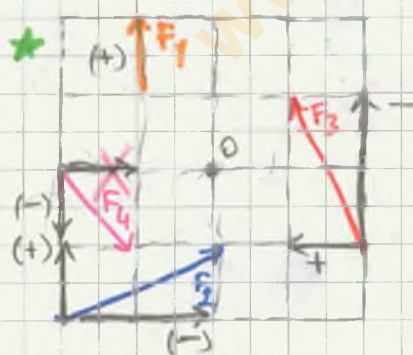
$$T_1: F_1 \cdot d_1 = 2 \cdot 2 = +4 = 4J$$

$$T_2: F_2 \cdot d_2 = 1 \cdot 1 = -1 = -1J$$

$$T_3: F_3 \cdot d_3 = 1 \cdot 2 = -2 = -2J$$

$$T_4 = 0$$

$$\frac{3T}{4} \quad \otimes$$



$$T_1 = 1 \cdot 1 = 1 = 1J$$

$$T_2 = 1 \cdot 2 = 2 = 2J$$

$$T_3 = 1 \cdot 1 = 1 = 1J$$

$$T_4 = 1 \cdot 2 = 2 = 2J$$

$$-6 = -6J$$

Cisim dengede ise: $\sum T = 0$

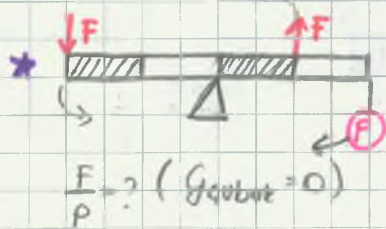
Hepsi dengede



$$\frac{P}{G} = ? \quad \frac{2}{3}$$

$$P \cdot 2 + P \cdot 1 = G \cdot 3$$

$$3P = 2G$$

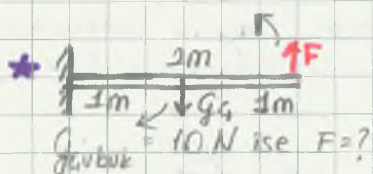


$$\frac{F}{P} = ? \quad (G_{\text{güç}} = 0)$$

$$F \cdot 2 + F \cdot 1 = P \cdot 2$$

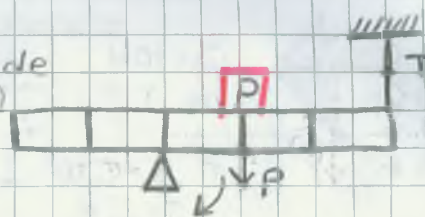
$$3F = 2P$$

$$\frac{F}{P} = \frac{2}{3}$$



$$F \cdot 2 = 10 \cdot 1$$

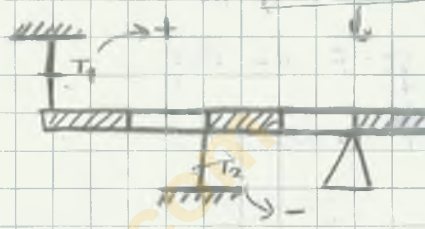
$$F = 5 \text{ N}$$



$\uparrow$ kaç P dir?

$$P \cdot 1 = T \cdot 3$$

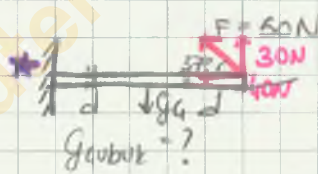
$$T = \frac{P}{3}$$



$$\frac{T_1}{T_2} = ?$$

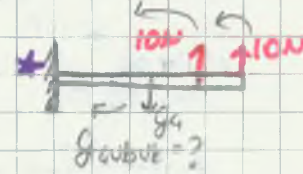
$$T_1 \cdot 4 = T_2 \cdot 2$$

$$\frac{T_1}{T_2} = \frac{1}{2}$$



$$G \cdot d = 30 \cdot 2d$$

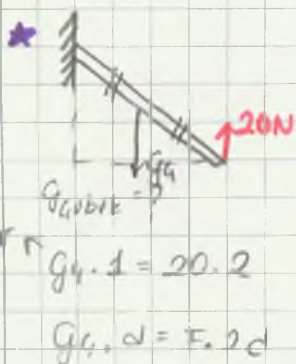
$$G = 60 \text{ N}$$



$$10 \cdot 3 + 10 \cdot 4 = G \cdot 2$$

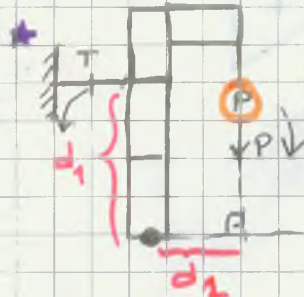
$$70 = G \cdot 2$$

$$G_{\text{güç}} = 35 \text{ N}$$



$$G \cdot 1 = 20 \cdot 2$$

$$G \cdot d = F \cdot 2d$$

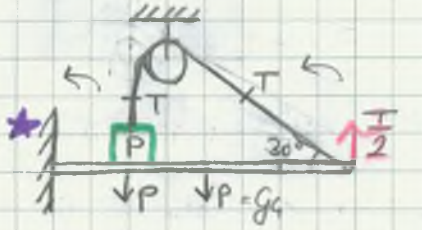
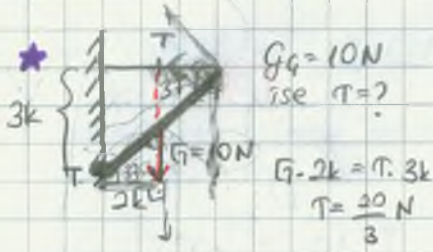


$$G_{\text{güç}} = 0 \quad \frac{T}{P} = ?$$

$$T \cdot d_1 = P \cdot d_2$$

$$T \cdot 2 = P \cdot 1$$

$$\frac{T}{P} = \frac{1}{2}$$

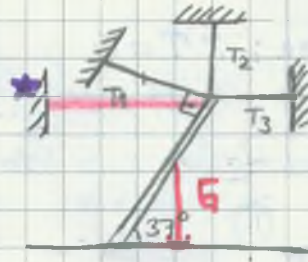


$G_1 = P$ ise $P = ?$

$P \cdot 1 + P \cdot 2 = T \cdot 1 + \frac{T}{2} \cdot 4$

$3P = 3T$

$P = T$



Tipler aynı aynı dengede
old. göre T_1, T_2, T_3
arasındaki ilişki?

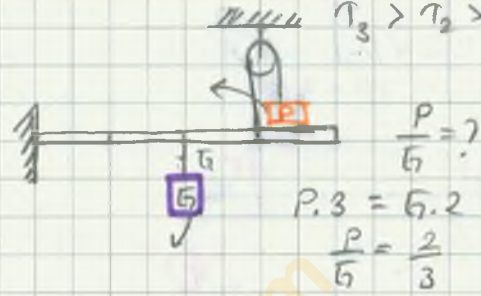
Tiplerin torkları eşittir

$T_1 \cdot 5k = G \cdot 2k$

$T_2 \cdot 4k = G \cdot 2k$

$T_3 \cdot 3k = G \cdot 2k$

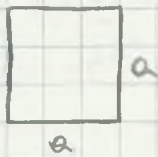
$T_3 > T_2 > T_1$



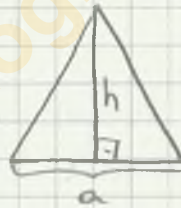
- Ağırlık Merkezi -

Ağırlığı bilinmeyen cisimlerde, cisim cubuk ise ağırlık yerine **uzunluk**, cisim levha ise ağırlık yerine **alan**, cisim 3 boyutlu katı cisim ise ağırlık yerine **hacim** kullanılır. Ve bu cisimler ancak ağırlık merkezlerinden asılırsa ya da ağırlık merkezlerinden destek üzerine bırakılırsa dengede kalabilirler.

$G = l$



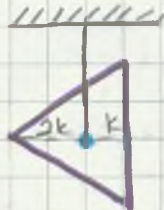
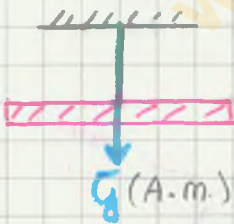
$G = a^2$



$G = \frac{a \cdot h}{2}$



$G = \pi r^2 h$



$\Rightarrow$ Dengede ise



P ağırlıklı cubuk dengede;

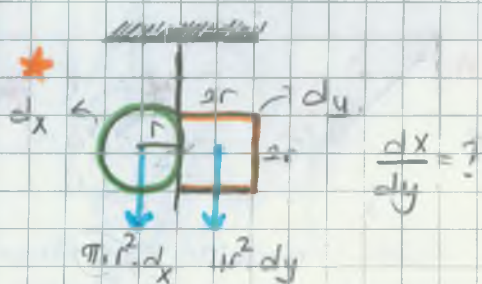


Dengede old. göre
 X kaç P dir?

$P \cdot X \cdot 1 = P \cdot 2$

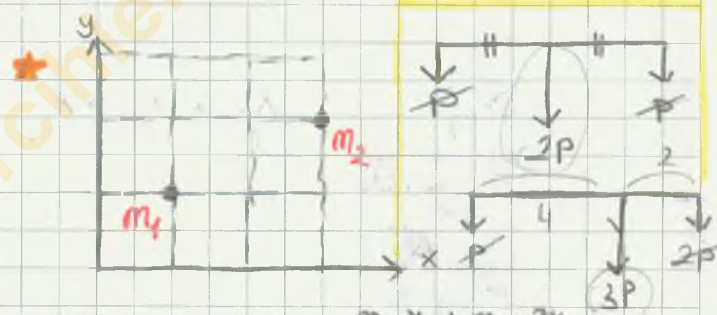
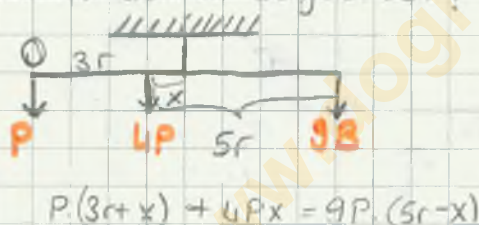
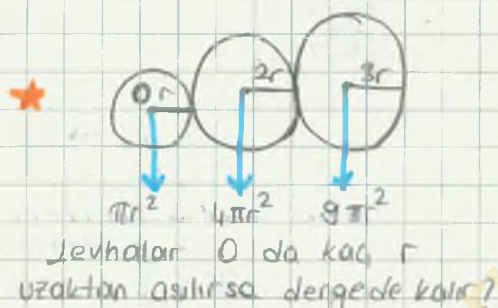
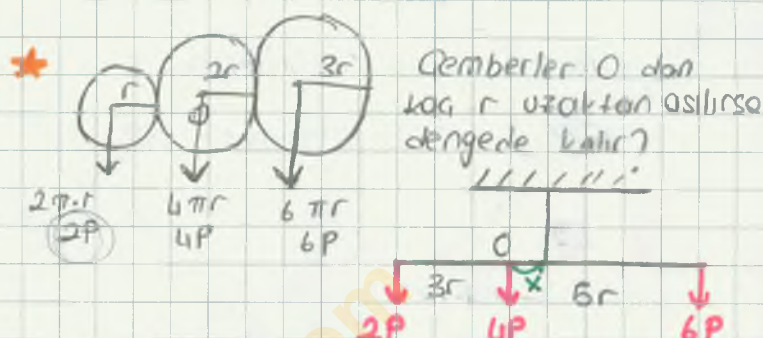
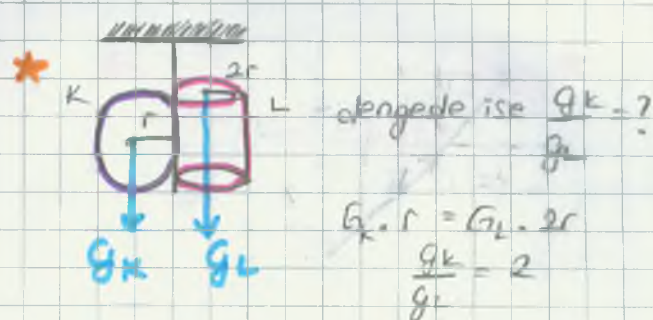
$X = 2P$

Y

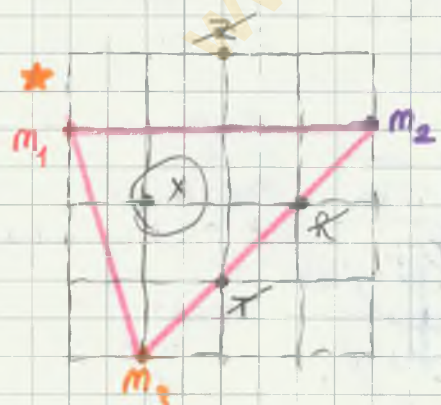


$d = \frac{m}{V}$
 $m = d \cdot V$
 $m = d \cdot \text{Alan}$
 $m = d \cdot \text{uzunluk}$

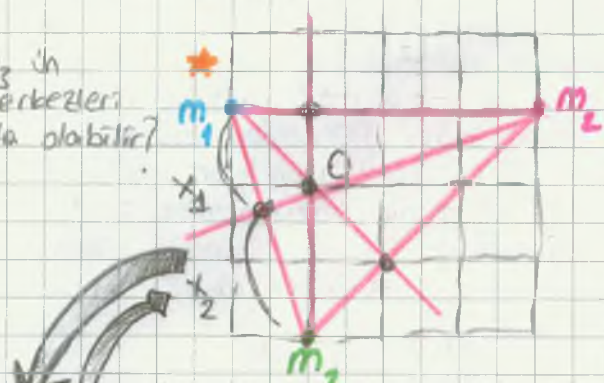
$\pi r^2 dx = 4\pi r^2 dy$
 $3dx = 4dy$
 $\frac{dx}{dy} = \frac{4}{3}$



$y(k.m) = \frac{m_1 y + m_2 2y}{m_1 + m_2}$



$m_1 > m_3 > m_2$

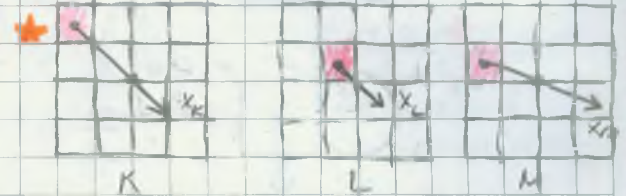


$m_3 \cdot 1 = m_2 \cdot 2 \Rightarrow \frac{m_3}{m_2} = 2 \Rightarrow m_3 > m_2$
 $m_1 \cdot 1 = m_2 \cdot 3 \Rightarrow \frac{m_1}{m_2} = 3 \Rightarrow m_1 > m_2$
 $m_1 \cdot x_1 = m_3 \cdot x_2$
 $x_2 > x_1 \Rightarrow m_3 < m_1$



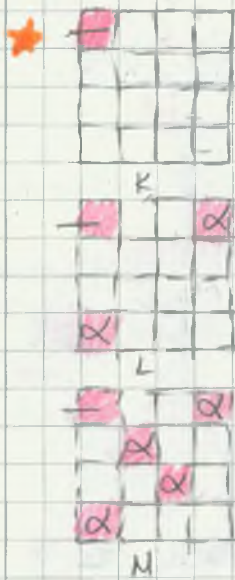
Taralı parça çıkartılırsa; 1

// // eklenirse; 2



Taralı parçalar çıkartılıncaya
K, L, M nin kayma miktarları arasında
hangi ilişki?

$$X_K > X_M > X_L$$



Parçalar çıkartılıncaya
K, L, M nin km nin
kayma miktarları?

$$X_M > X_L > X_K$$



Taralı parçalar
çıkartılıyor, denge-
nin bozulmaması için;

5, 7 → Çift kottu
6, 7 → " "
1, 2 ?
2, 3 } Çıkartılacak
2, 4 }



Taralı parçalar
Çift kottu yapılıyor.
Dengenin bozulmaması;

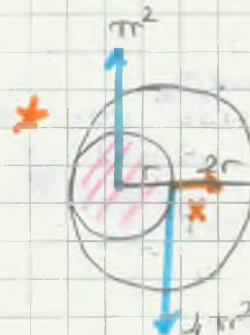
1, 2 → Çıkartılacak

3, 4 } Çift kottu
3, 5 }



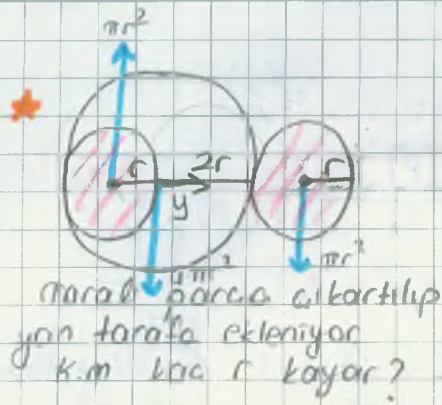
Taralı parçalar çıkartılıyor,
A, M nin değişmemesi için;

1, 2 Çift kottu
2, 3 Çıkartılacak



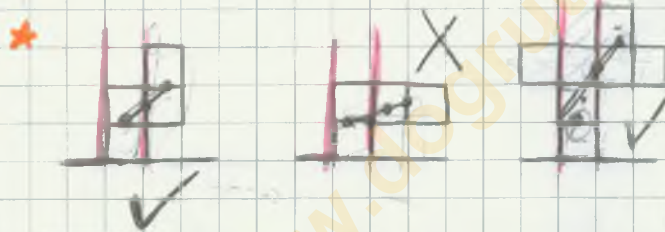
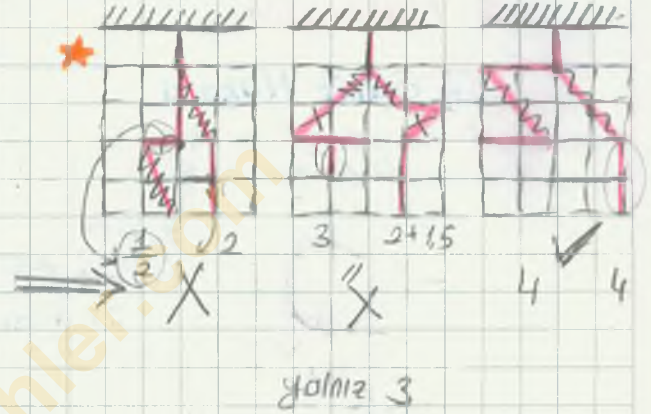
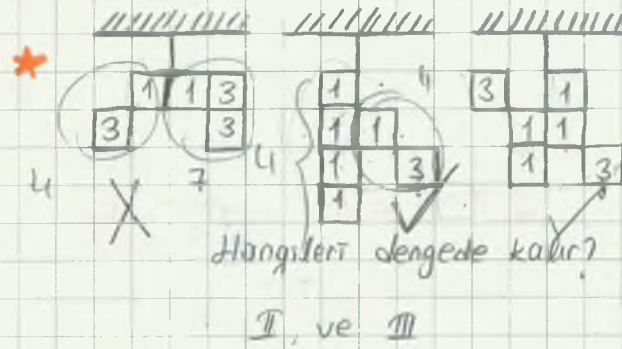
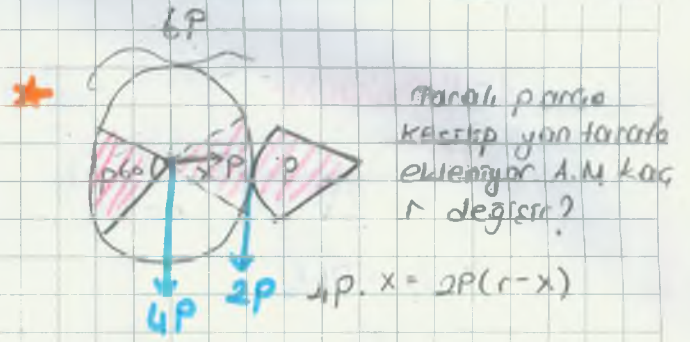
Taralı parça çıkartılıyor,
K, M kaç r kayar?

$$\begin{aligned} 4\pi r^2 \cdot x &= \pi r^2 \cdot (x+r) \\ 4x &= x+r \\ 3x &= r \\ x &= \frac{r}{3} \end{aligned}$$



$$= \pi r^2 (r+y) + \pi r^2 (3r-y)$$

$$= 4\pi r^2 y$$



- Basit Makineler -

Basit makinelerde işten kazanç ya da kayıp yoktur. Ya kuvvetten ya da yoldan kazanç vardır. Kuvvetten kazanç varsa yoldan kayıp, yoldan kazanç varsa kuvvetten kayıp vardır. **yük / Kuvvet**
1 den büyük ise kuvvetten kazanç vardır. $\frac{P}{F} > 1 \Rightarrow K.K$

$$\text{Yükün yaptığı iş} / \text{Kuvvetin yaptığı iş} = \text{VERİM}$$

1- Kaldıraçlar



$$F \cdot l_1 = P \cdot l_2$$

$$\frac{P}{F} = \frac{l_1}{l_2} > 1 \text{ ise kuvvetten kazanç vardır}$$

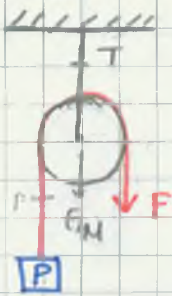


$$P \cdot l_1 = F \cdot l_2$$

$$\frac{P}{F} = \frac{l_2}{l_1} > 1 \text{ kuvvetten kazanç var}$$

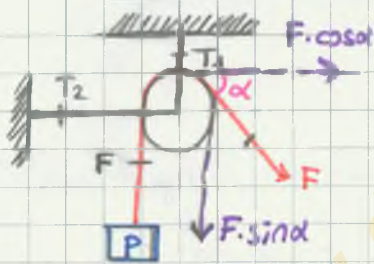
2- Makinalar

→ Sabit Makara



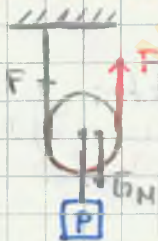
$$\begin{aligned} F &= P \\ T &= P + F + G_M \\ &= 2F + G_M \\ &= 2P + G_M \end{aligned}$$

$$2\pi r n = h \quad n = \frac{h}{2\pi r}$$

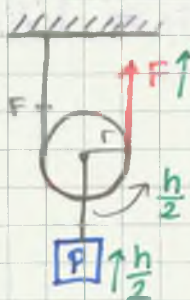


$$\begin{aligned} P &= F \\ T_1 &= P + F \sin \alpha \\ T_2 &= F \cos \alpha \end{aligned}$$

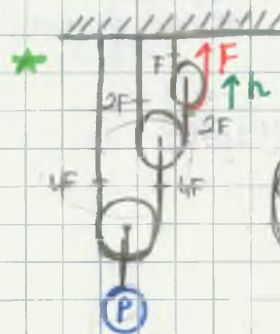
→ Hareketli Makara



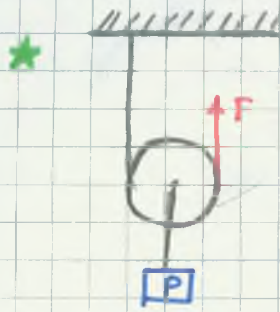
$$2F = P + G_M \text{ (yükselme miktarı için } G_M \text{ ise katılmaz.)}$$



$$\begin{aligned} 2F &= P \\ h \cdot m &= 2m \cdot \frac{h}{2} \\ 2\pi r \cdot n &= \frac{h}{2} \end{aligned}$$

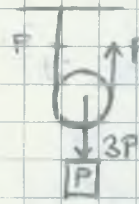


$$\begin{aligned} 8F &= P \\ h \cdot m &= 8m \cdot \frac{h}{8} \\ P \text{ yi } h \text{ kadar yükseltmek için} \\ 8h \cdot m &= 8m \cdot h \end{aligned}$$



1- P kaç F dir?

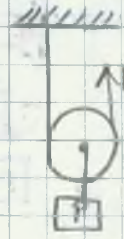
$$G_M = 3P$$



$$3F = 4P$$

$$F = 2P$$

2- F h kadar çekilirse P ne kadar yükselecektir?

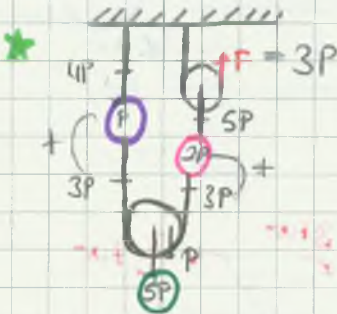


$$2F = P$$

$$h \cdot m = \frac{h}{3} \cdot 2m$$

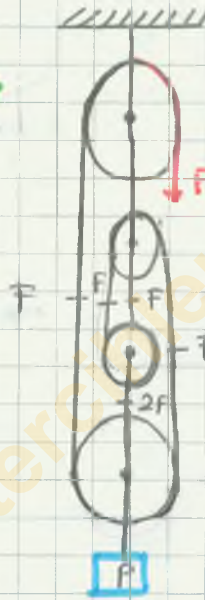
3- İlerim % kaçtır?

$$\frac{m \cdot \frac{h}{2}}{2m \cdot h} = \frac{1}{4} = \%25$$



$G_M = P$ ise $F = ?$

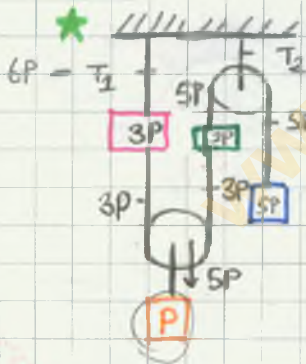
$$F = 3P$$



F h kadar indirirsek P ne kadar yükselecektir?

$$4F = P$$

$$h \cdot m = 4m \cdot \frac{h}{4}$$



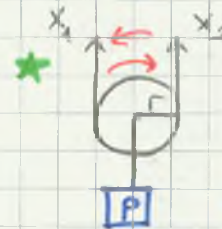
(Özdeş makaralar)

$$T_1 = 3P + 3P$$

$$= 6P$$

$G_M = 5P$ imiş.

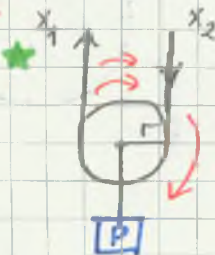
$$P + G_M = 6P$$



$\frac{x_1 + x_2}{2}$ yukarı çıkma miktarı

$\frac{x_1 - x_2}{2}$ etrafında dolanan ip

$$2\pi r \cdot n = \frac{x_1 - x_2}{2}$$

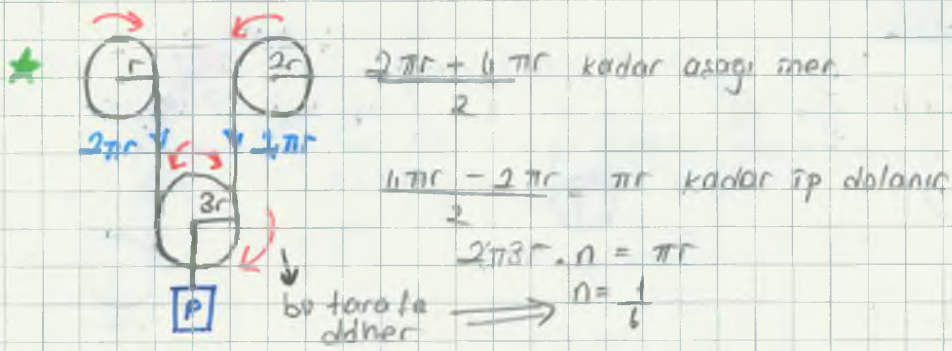


($x_1 > x_2$)

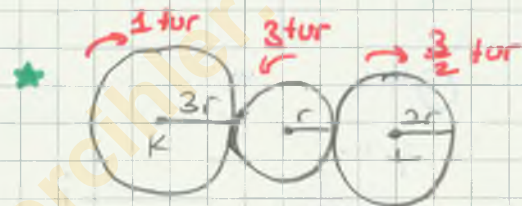
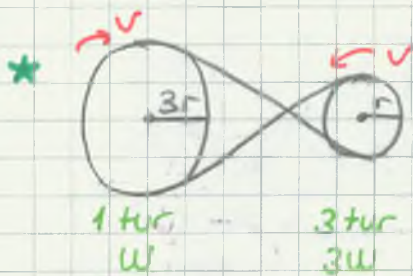
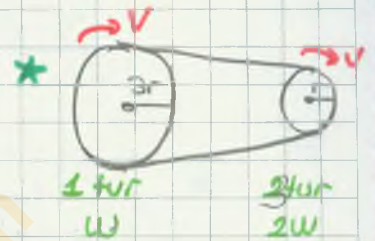
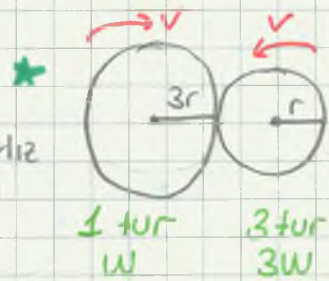
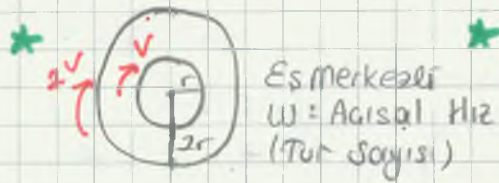
$\frac{x_1 - x_2}{2}$ ↑ yukarı çıkma miktarı

$\frac{x_1 + x_2}{2}$ ↻ dolanan ip

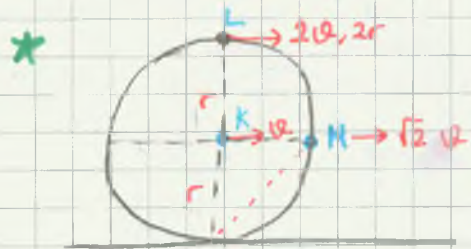
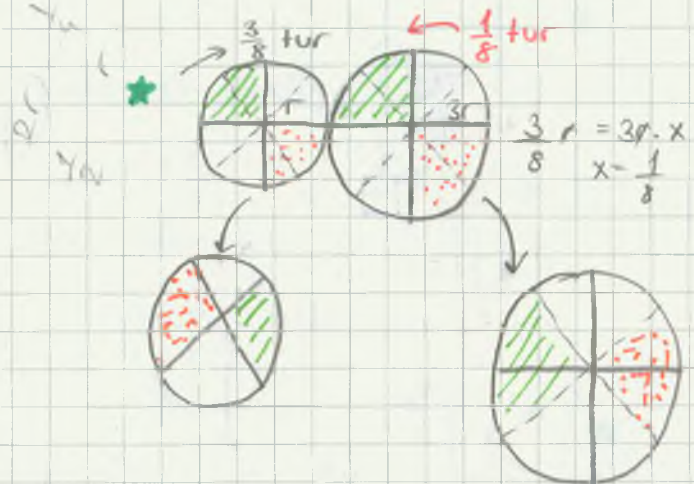
$$2\pi r \cdot n = \frac{x_1 + x_2}{2}$$

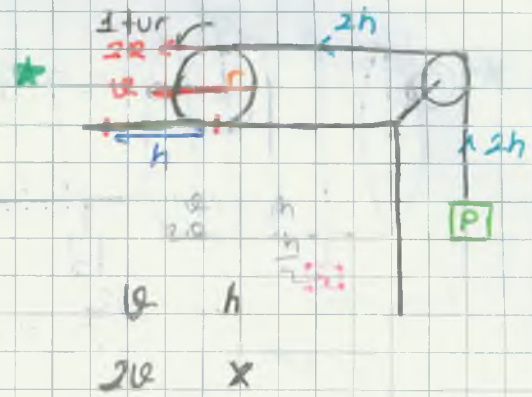
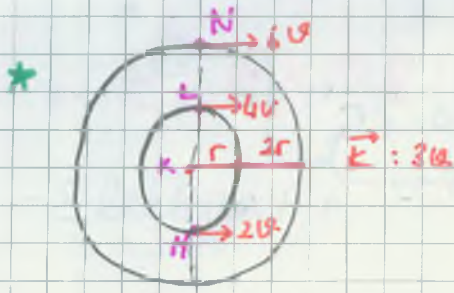


3- Kaskaklar

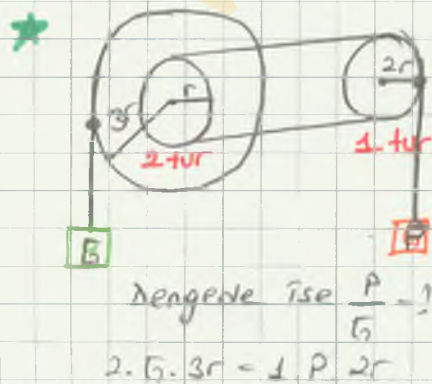
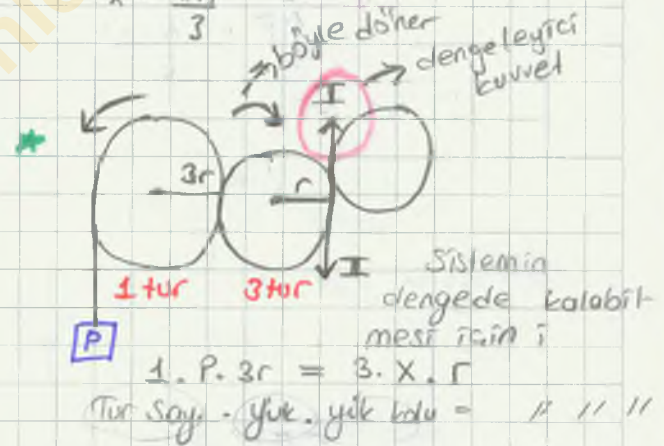
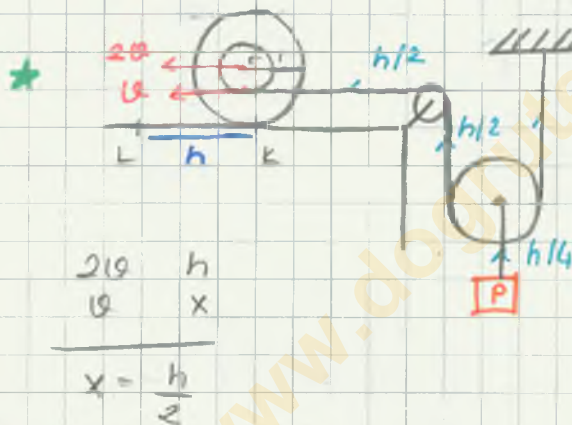
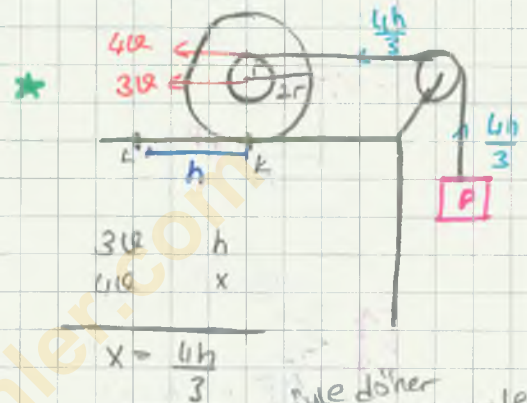
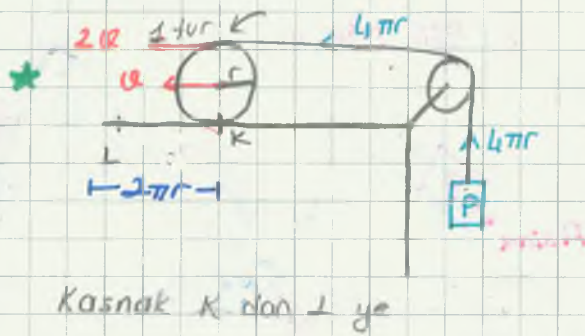


$$n_L \cdot 3r = n_R \cdot 2r$$

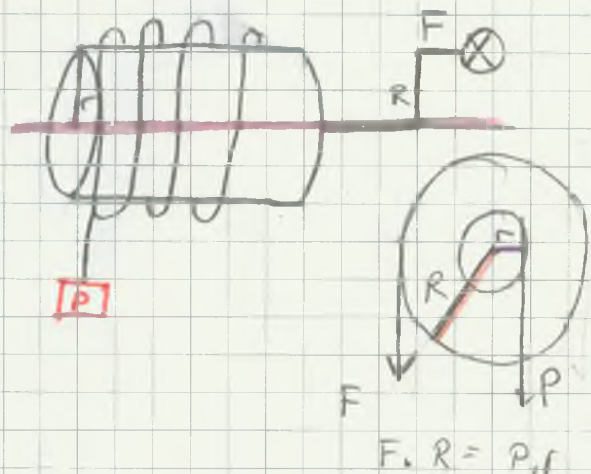


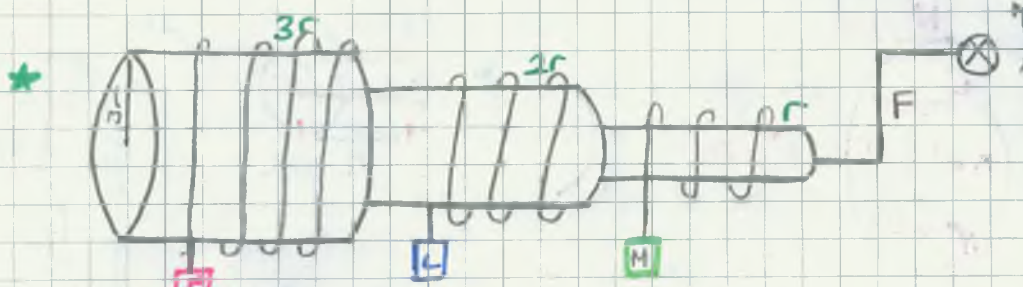


$$X = 2h$$



4- Çıkrık





Dengede ise :

$$3r \cdot K + M \cdot r = L \cdot 2r$$

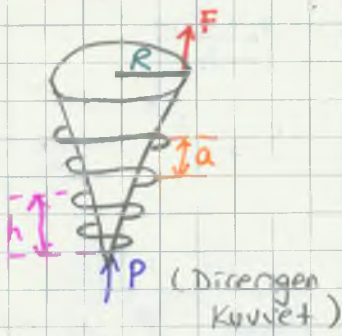
I. $L > K$ ✓

II. $K > M$

III. $L > M$

Kesin ?

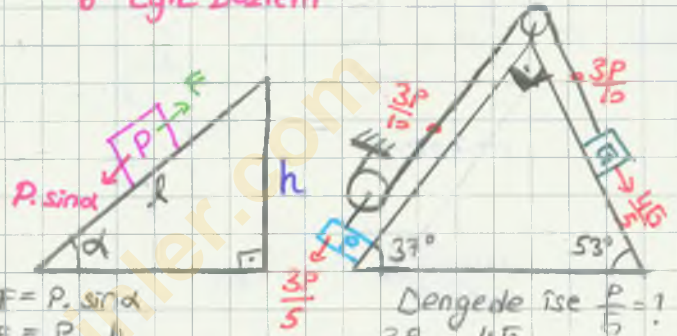
5- Vida



① $h = n \cdot a$
 tur vida
 sayısı adımı

② $F \cdot 2\pi r = P \cdot a$
 kuvvetten kazanç $= \frac{P}{F} = \frac{2\pi r}{a}$

6- Eğik Düzlem



$$F = P \cdot \sin \alpha$$

$$F = P \cdot \frac{h}{l}$$

$$\frac{P}{F} = \frac{l}{h} > 1$$

kuvvetten kazanç var.

Dengede ise $\frac{P}{F} = ?$
 $\frac{3F}{10} = \frac{4\sqrt{5}}{5}$
 $\frac{P}{5} = \frac{4}{3}$