مکاترونیک

مقدمه و مروری بر استاتیک

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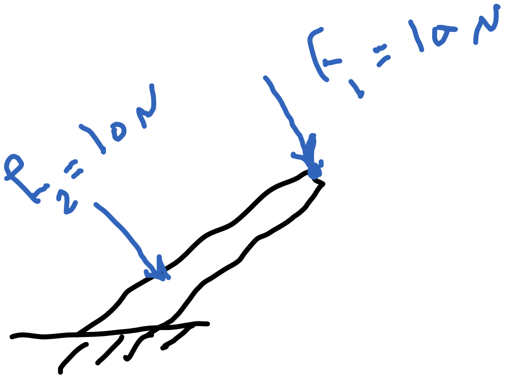
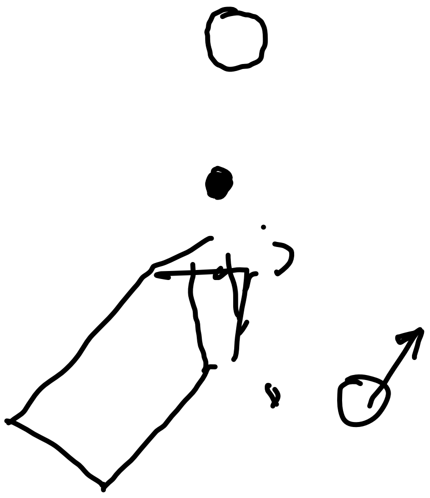
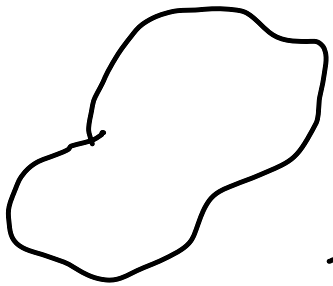
سرفصل مطالب

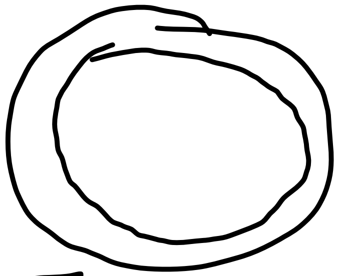
- مروری بر استاتیک
- مروری بر مقاومت مصالح
- مروری بر دینامیک و مدل‌سازی [illegible]
- مروری بر شبیه‌سازی سیستم‌ها
- مروری بر طراحی اجزای ماشینی
- مروری بر سیستم‌های هیدرولیکی و پنوماتیکی

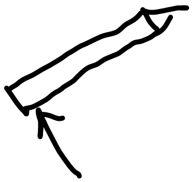


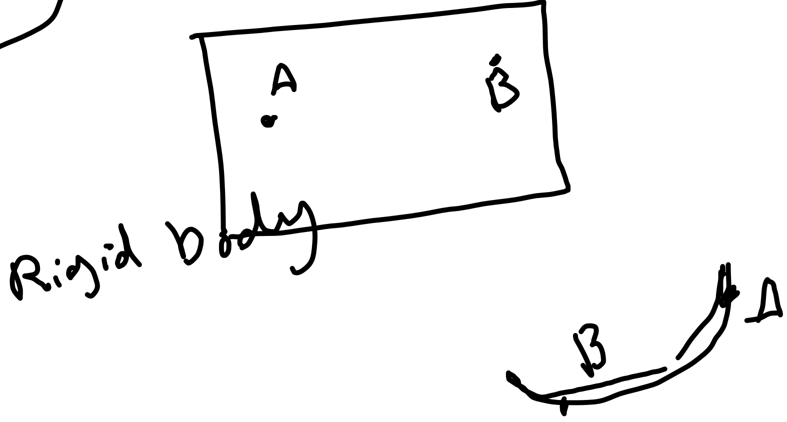
نیرو : عمل یک جسم روی جسم دیگر

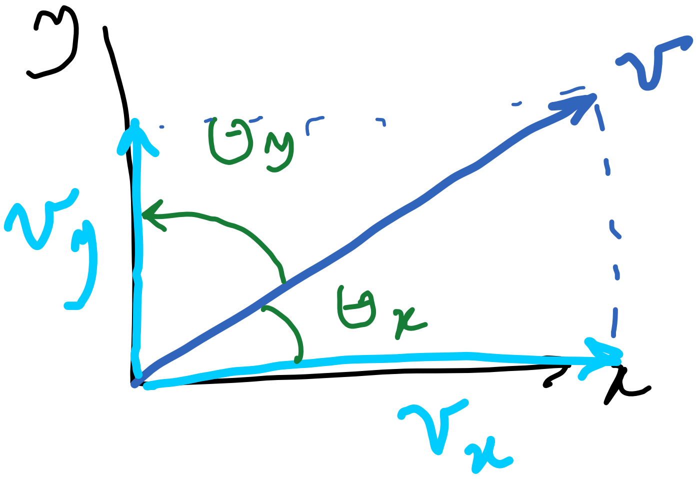






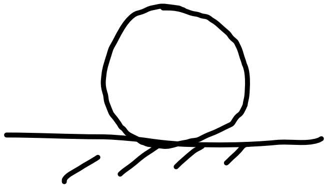




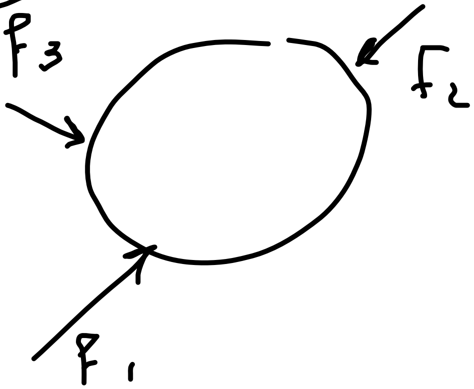


$$v_x = v \cos\theta_x$$

$$v_y = v \cos\theta_y$$



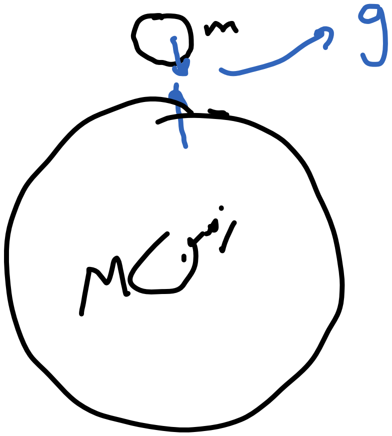
$$\boxed{\Sigma F = 0}$$

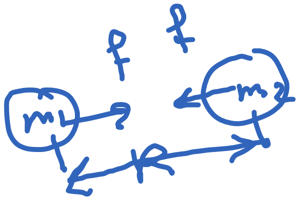


$$\Sigma F = ma$$

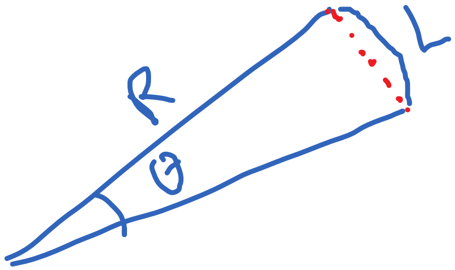
$F = ma \longrightarrow N = kg\, m/s^2$

$W = mg$, $g = 9.81\ m/s^2$

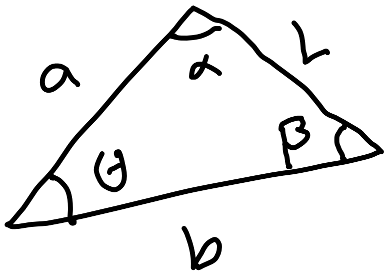




$$F = G\frac{m_1 m_2}{R^2}$$

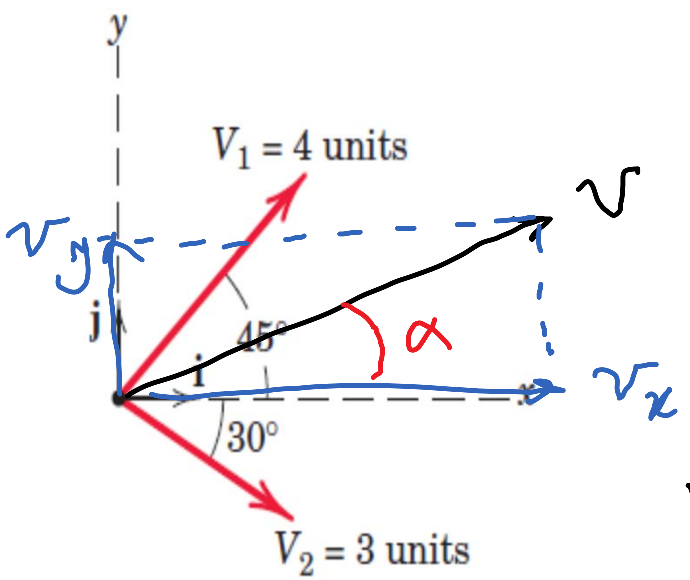


$$L = R\theta$$



$$L = a^2 + b^2 - 2ab\cos\theta$$

$$\frac{a}{\sin\beta} = \frac{L}{\sin\theta} = \frac{b}{\sin\alpha}$$



$$v_1 = 4\cos 45\, i + 4\sin 45\, j$$

$$V_2 = 3\cos 30\, i - 3\sin 30\, j$$

$$V = V_1 + V_2$$

$$= (4\cos 45 + 3\cos 30)\, i + (4\sin 45 - 3\sin 30)\, j$$

$$= v_x\, i + v_y\, j$$

$$|v| = \sqrt{v_x^2 + v_y^2}$$

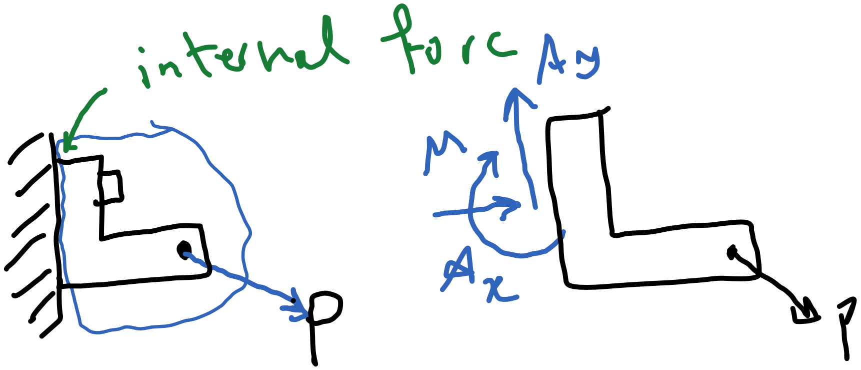
$$\operatorname{tg}\alpha = \frac{v_y}{v_x} \rightarrow \alpha = \operatorname{tg}^{-1} \frac{v_y}{v_x}$$

تکلیف سری اول

کتاب استاتیک مریام

ویرایش هفتم

1-1
1-2
1-3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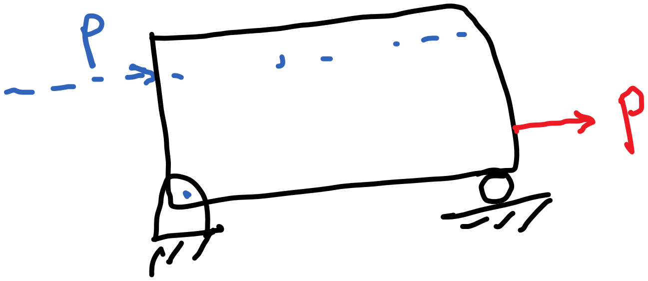
M
Ax
P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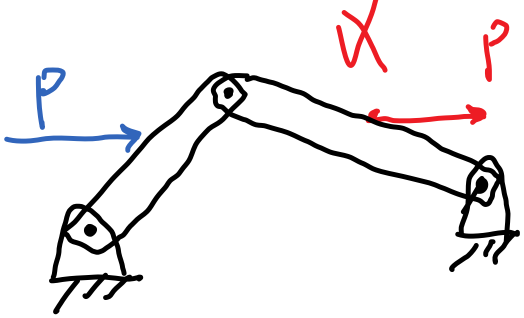
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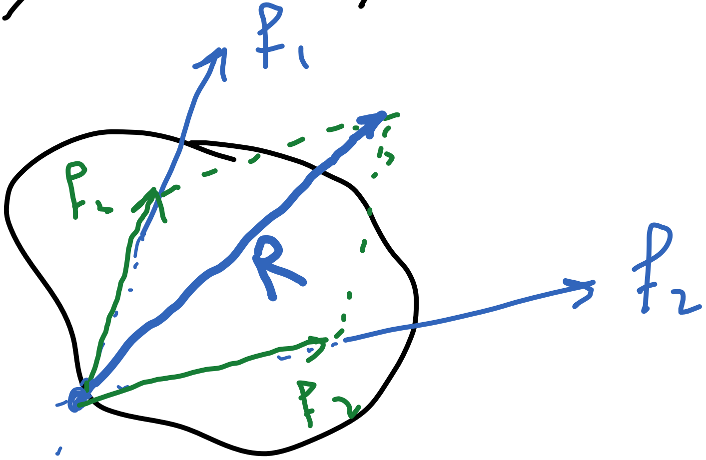
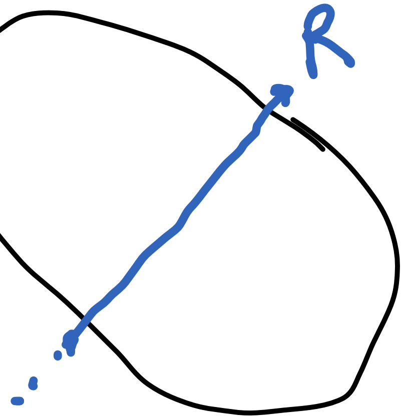
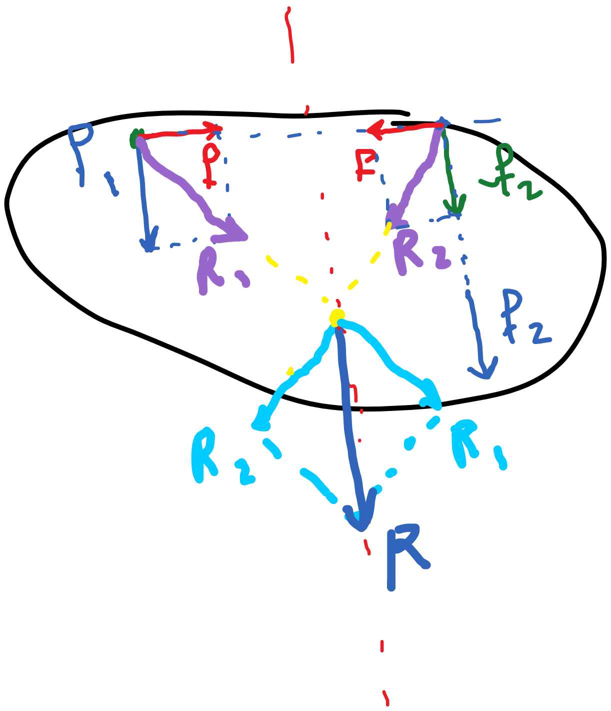
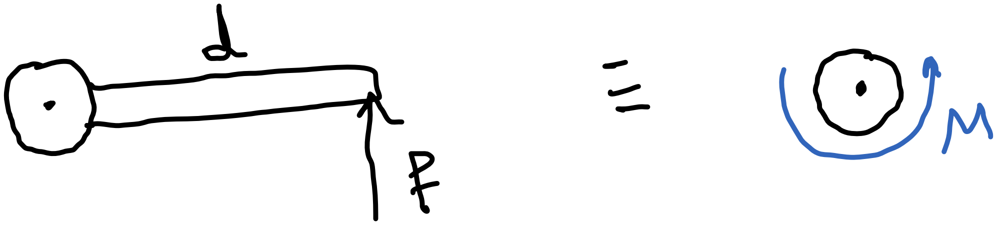

F1
F1
R
F2
F2


R



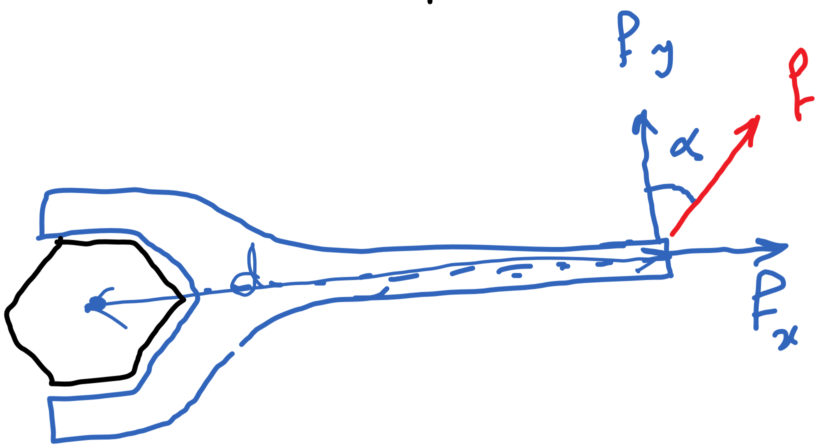
$$|R| = |P_1| + |P_2|$$

$$R = P_1 + f + P_2 - f$$



$M = Fd$

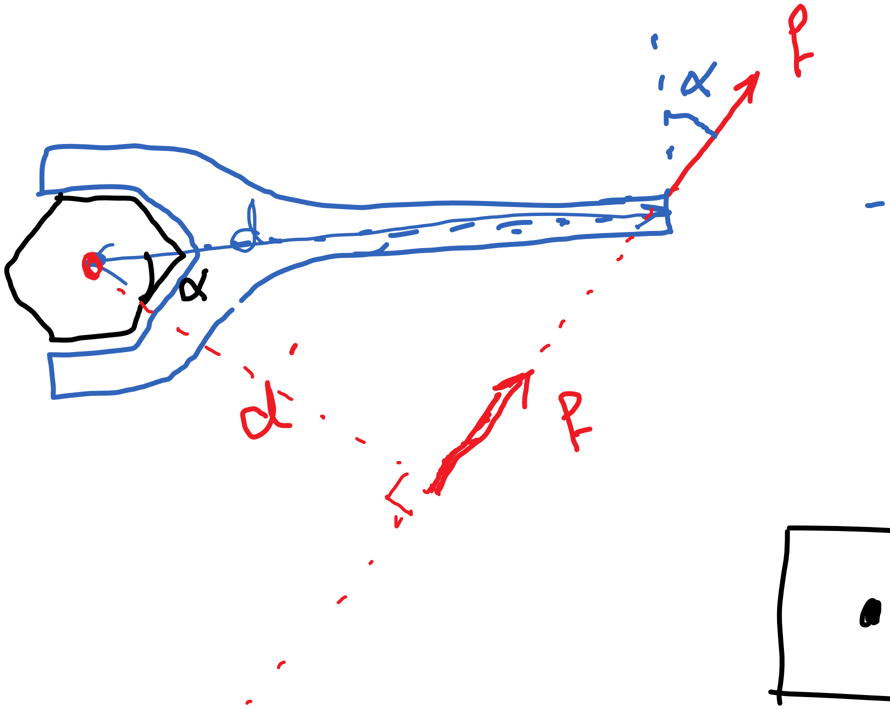
↳ N.m



$M = Fd = F \times 0 = 0$

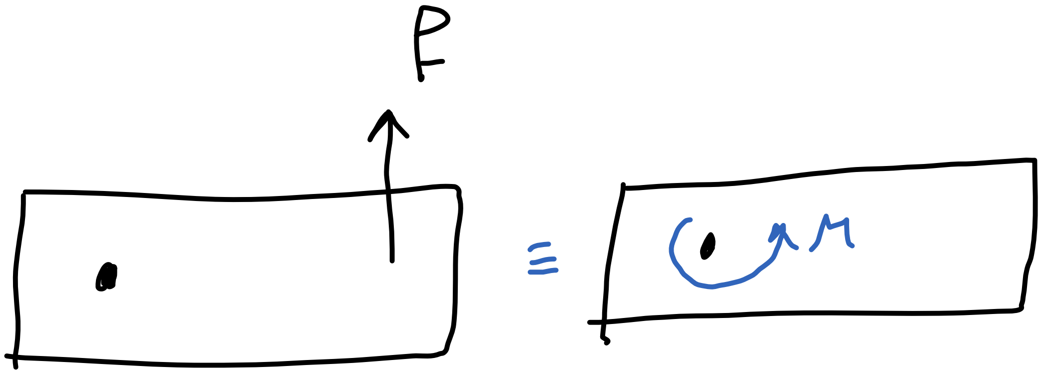
$M = F'd$

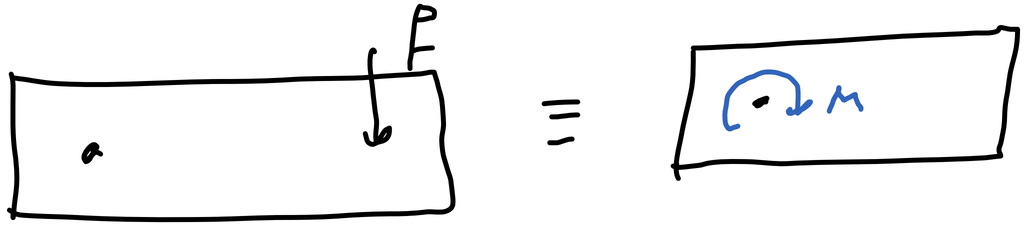
$M = F_y d = F \cos\alpha \, d$

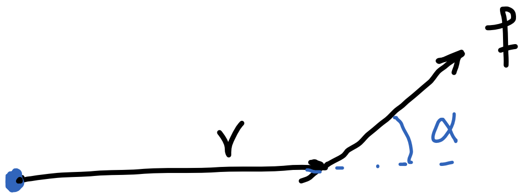


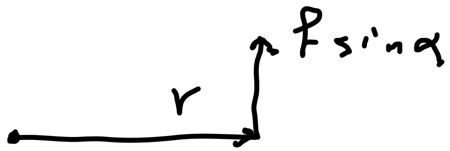
$$M = F\,d'$$

$$M = F\,d\cos\alpha$$









$$\vec{r} \times \vec{F} = |r|\,|F| \sin\alpha$$

جهت $r \times F$ برداری عمود بر صفحه‌ای که
از r و F می‌گذرد.

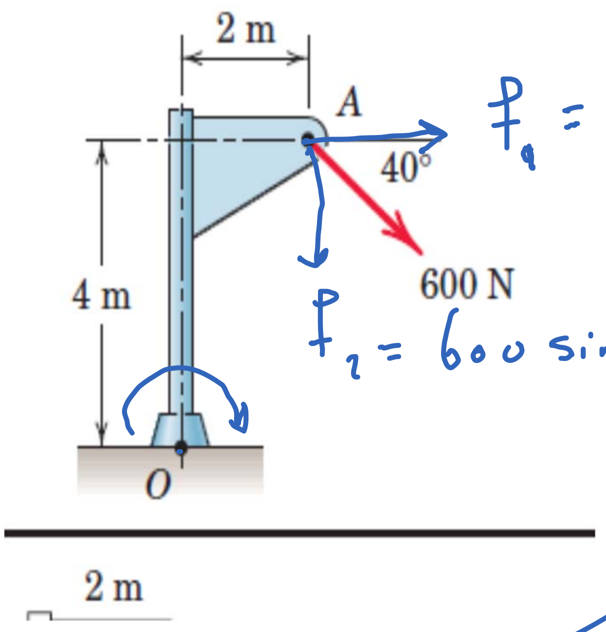
$$r \parallel F \rightarrow \alpha = 0 \longrightarrow M = 0$$

$$r \perp F \rightarrow \alpha = 90 \qquad M = rF$$

$$r = r_x i + r_y j + r_z k$$

$$f = f_x i + f_y j + f_z k$$

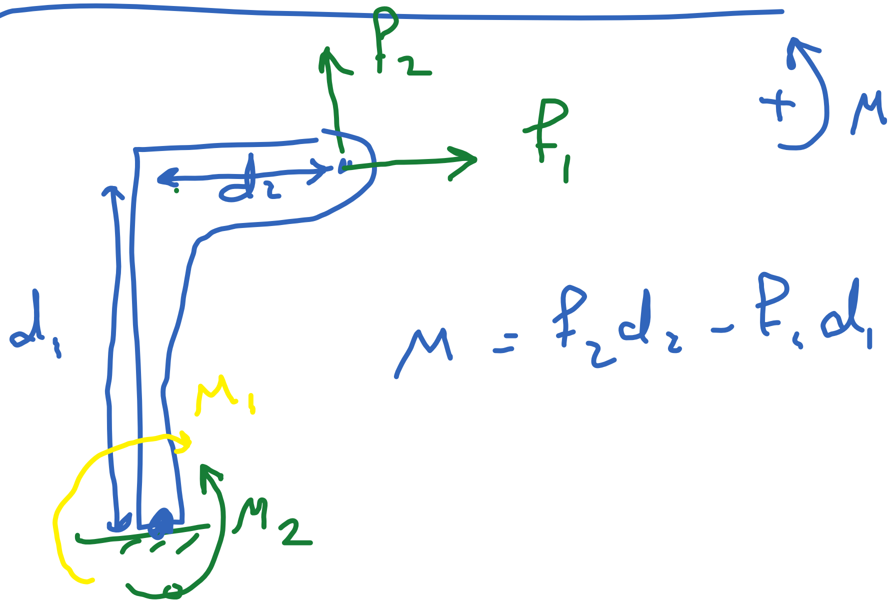
$$M = r \times f = \left| \begin{matrix} i & j & k \\ r_x & r_y & r_z \\ f_x & f_y & f_z \end{matrix} \right] = \left[\begin{matrix} r_y f_z - r_z f_y \\ r_z f_x - r_x f_z \\ r_x f_y - r_y f_x \end{matrix} \right] \begin{matrix} i \\ j \\ k \end{matrix}$$



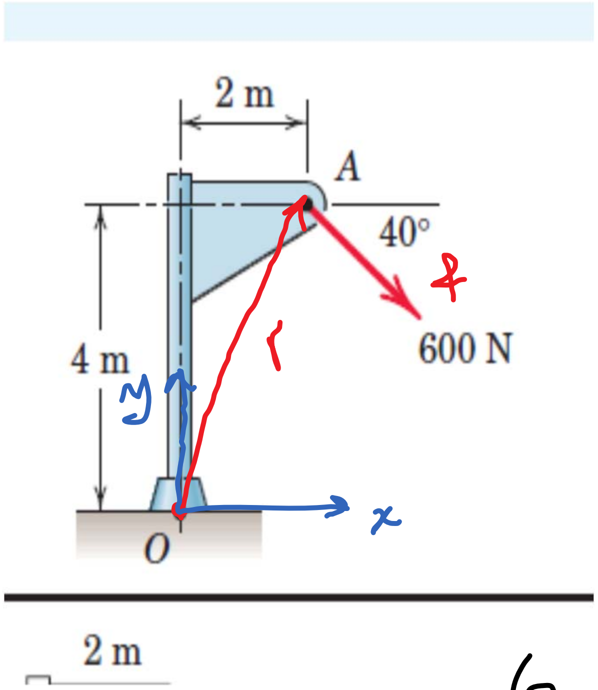
$F_1 = 600 \cos 40$

$F_2 = 600 \sin 40$

$M = F_1 \cdot 4 + F_2 \cdot 2$



$M = F_2 d_2 - F_1 d_1$

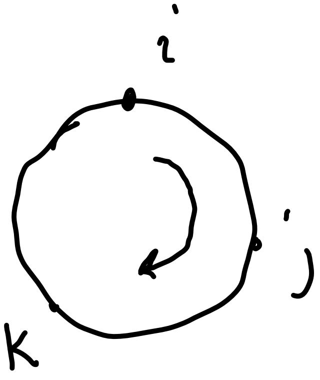


$M = r \times F$

$r = 2i + 4j$

$F = 600\cos 40\, i - 600\sin 40\, j$

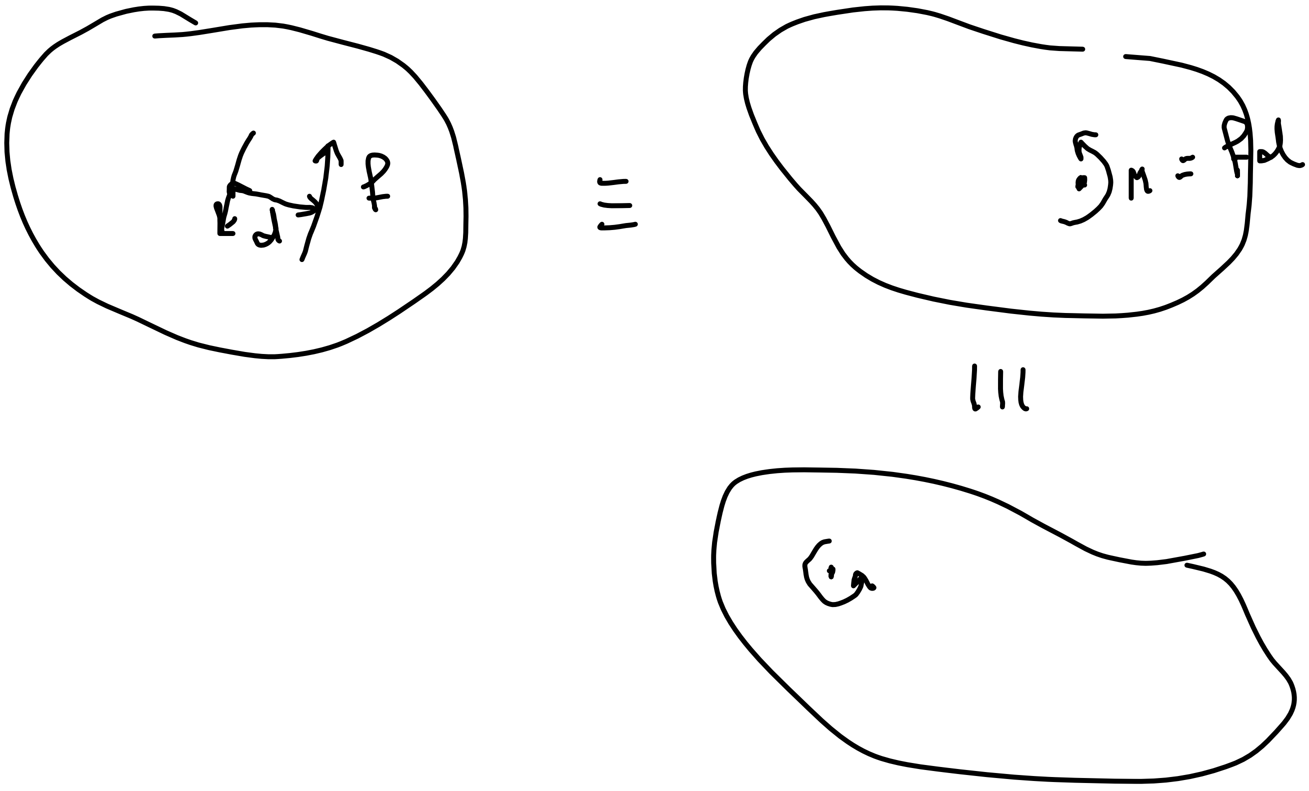
$M = (2i + 4j) \times (600\cos 40\, i - 600\sin 40\, j)$

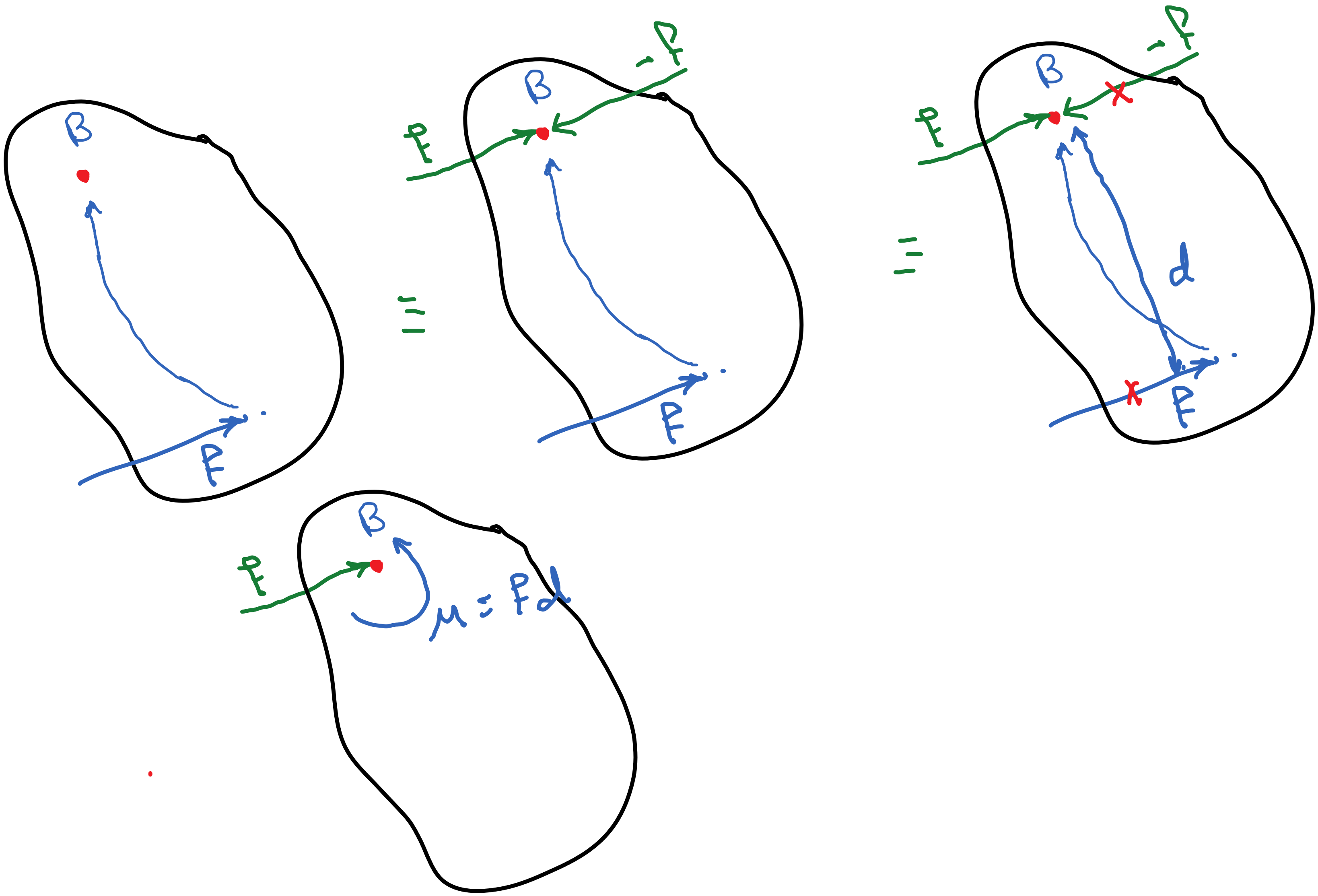


$$\left\{\begin{array}{lll} i \times j = k, & j \times i = -k, & i \times i = 0 \\ j \times k = i, & k \times j = -i, & j \times j = 0 \\ k \times i = j, & i \times k = -j, & k \times k = 0 \end{array}\right.$$

$M = (2i + 4j) \times (600 \cos 40 i - 600 \sin 40 j)$

$= -2 \times 600 \sin 40 K - 4 \times 600 \cos 40 K$


F
d
≡
M = Fd
≡


B
F
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-F
F
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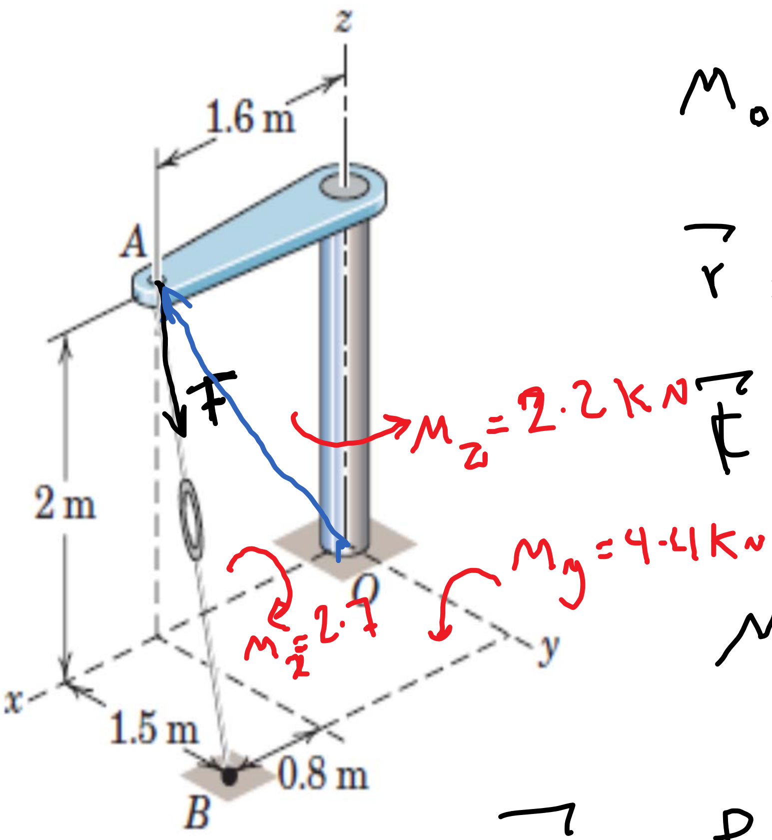
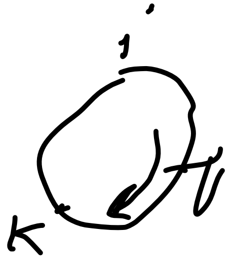
B
F
-F
d
F
B
F
M = Fd



$$M_o = r \times F = \overrightarrow{OA} \times F$$



$$\vec{r} = OA = 1.6\,i + 2\,k$$

$$\vec{F} = 2.4\,\frac{(0.8i + 1.5j - 2k)}{\sqrt{0.8^2 + 1.5^2 + 2^2}}\ \text{k}$$

$$M_o =$$

$$\vec{F} = F\,\vec{n}_{OA}$$

$$\sum \vec{F} = 0 \longrightarrow \begin{cases} \sum F_x = 0 \\ \sum F_y = 0 \\ \sum F_z = 0 \end{cases}$$

مسائل فضایی

۶ معادله و

تا ۶ مجهول می‌توان داشته باشیم

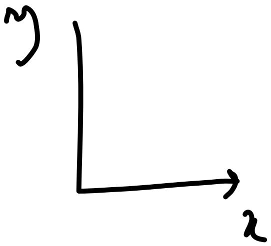
$$\sum \vec{M} = 0 \longrightarrow \begin{cases} \sum M_x = 0 \\ \sum M_y = 0 \\ \sum M_z = 0 \end{cases}$$

سه معادله

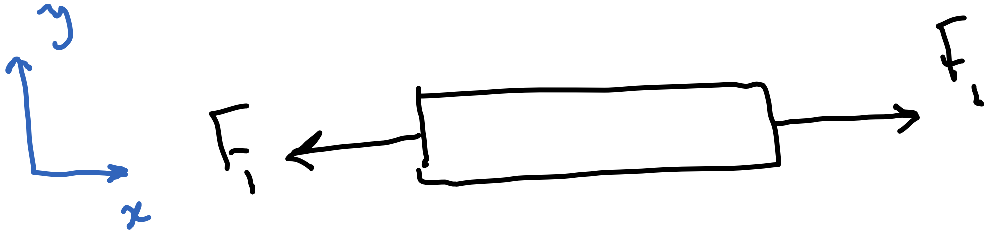
و تا سه مجهول می‌توان

محاسبه کرد.

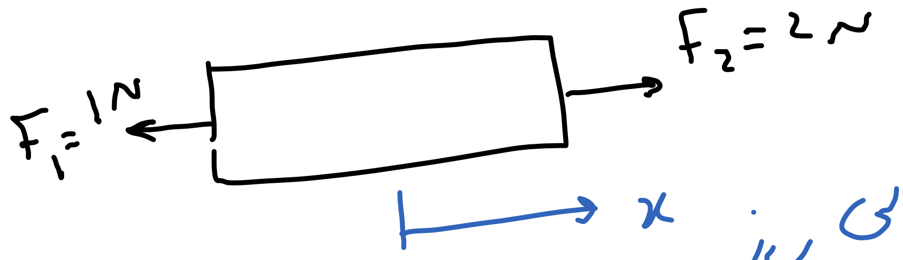
$$\begin{cases} \sum F_x = 0 \\ \sum F_y = 0 \\ \sum M_z = 0 \end{cases}$$



اگر بیشتر مجهول داشته باشد مسأله نامعین می‌شود.

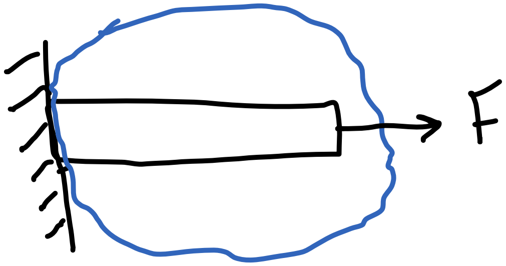


$$\sum F_x = F_1 - F_1 = 0$$



$$\rightarrow \sum F_x = F_2 - F_1 = 2 - 1 = 1N$$

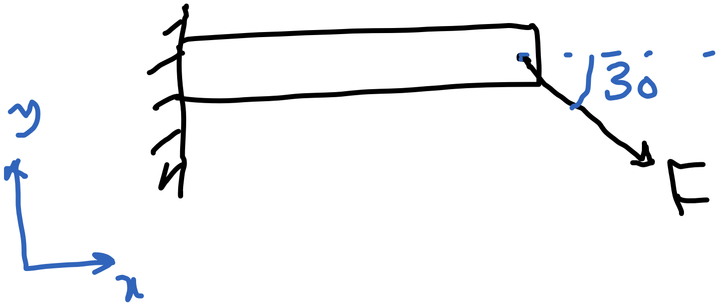
جابجایی ساکن نیست.

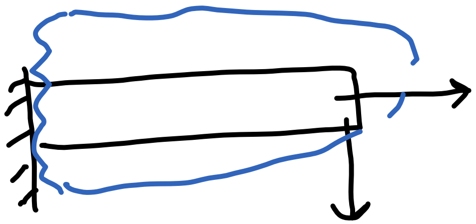


دیاگرام آزاد

Free body diagram

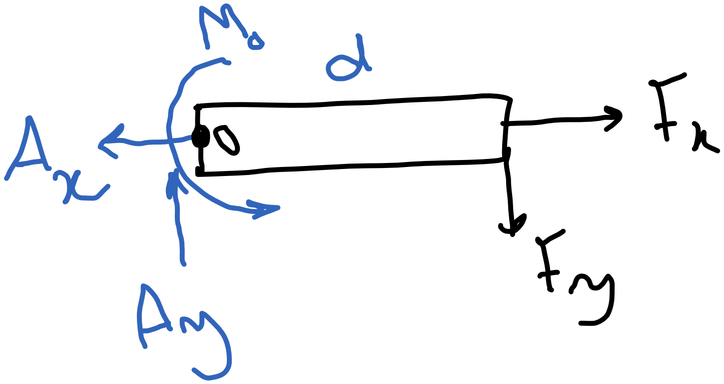
$$\sum F_x = 0 \Rightarrow F - A = 0 \Rightarrow A = F$$





$F_x = F\cos 30$

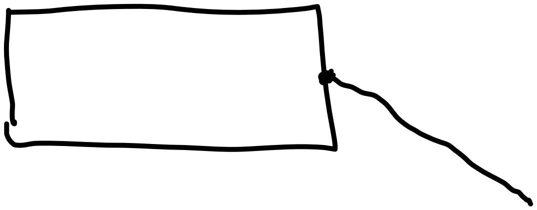
$F_y = F\sin 30$

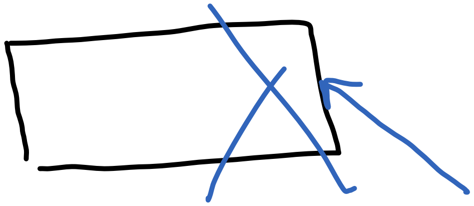


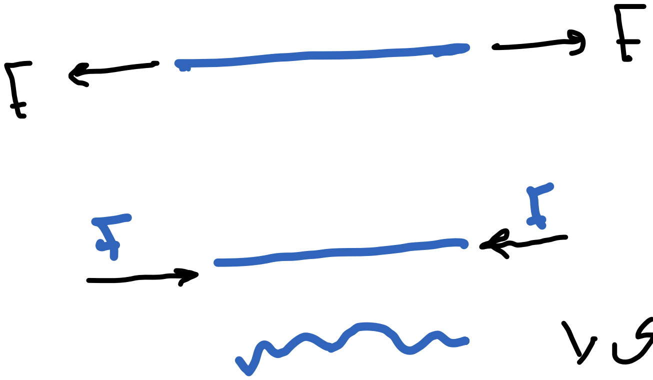
$\Sigma F_x = 0 \Rightarrow F_x - A_x = 0 \Rightarrow A_x = F\cos 30$

$\Sigma F_y = 0 \Rightarrow A_y - F_y = 0 \Rightarrow A_y = F\sin 3$

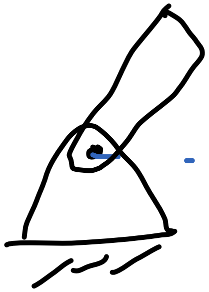
$\Sigma M_{oz} = 0 \Rightarrow M - F_y d = 0 \Rightarrow M_o = F_y d$

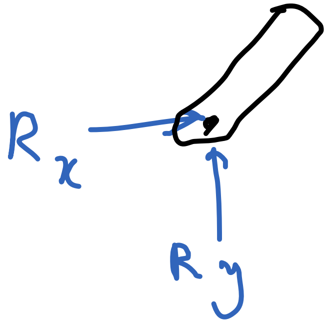




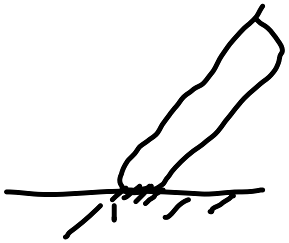


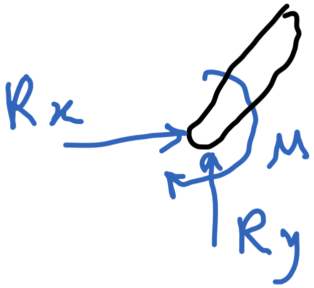
کابل نیروی فشاری را
تحمل نمی‌کند



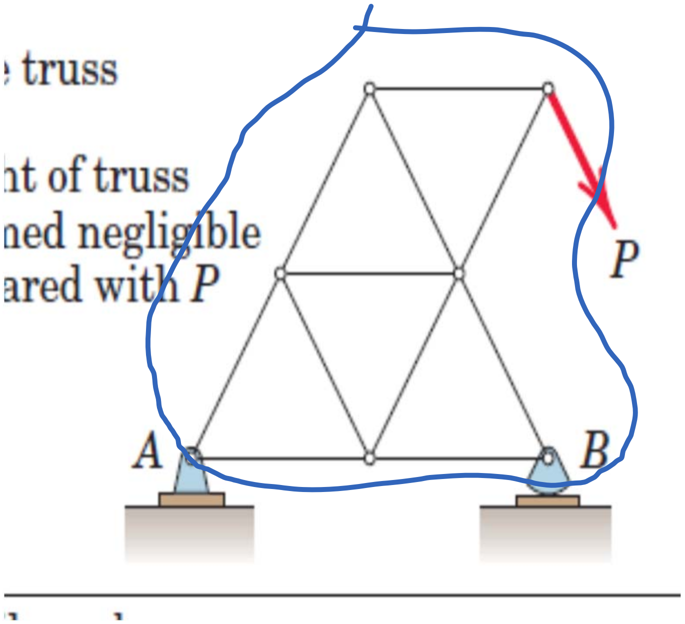


R_x
R_y





R_x
M
R_y



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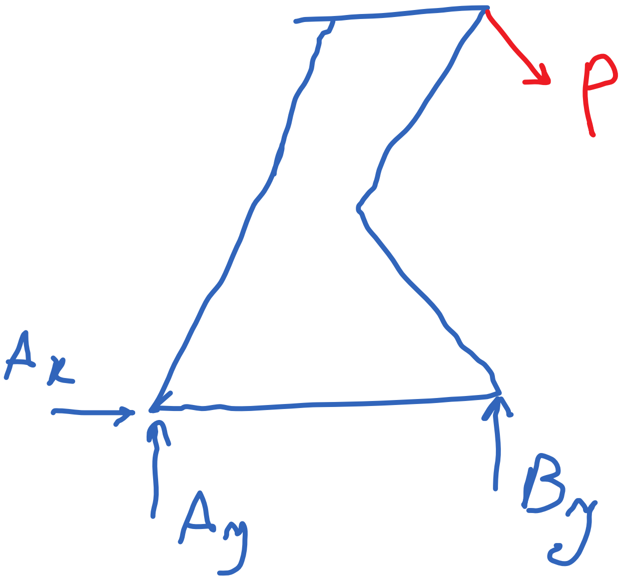

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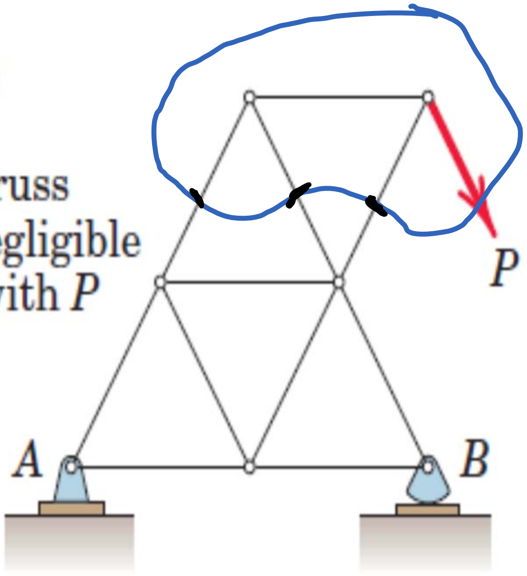
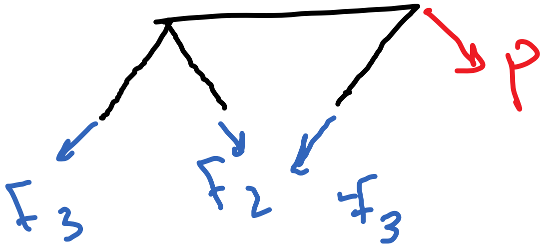
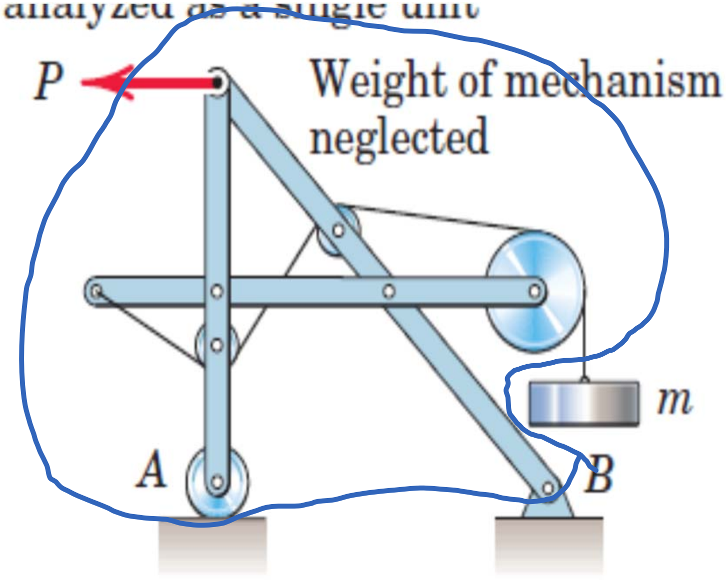
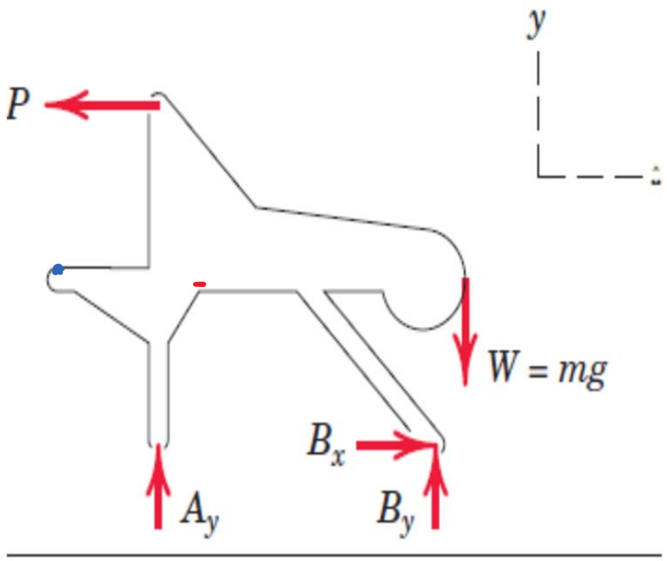


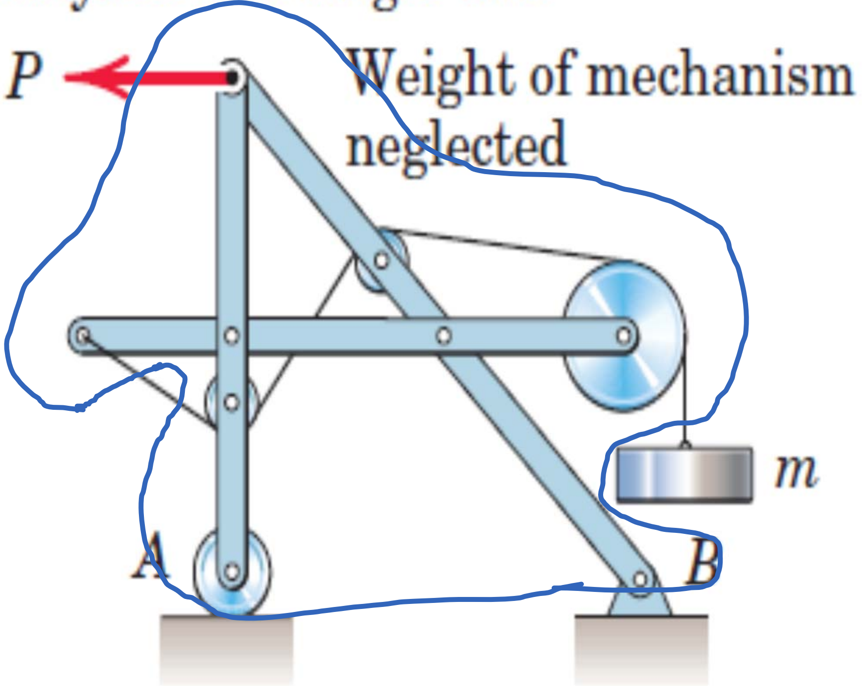


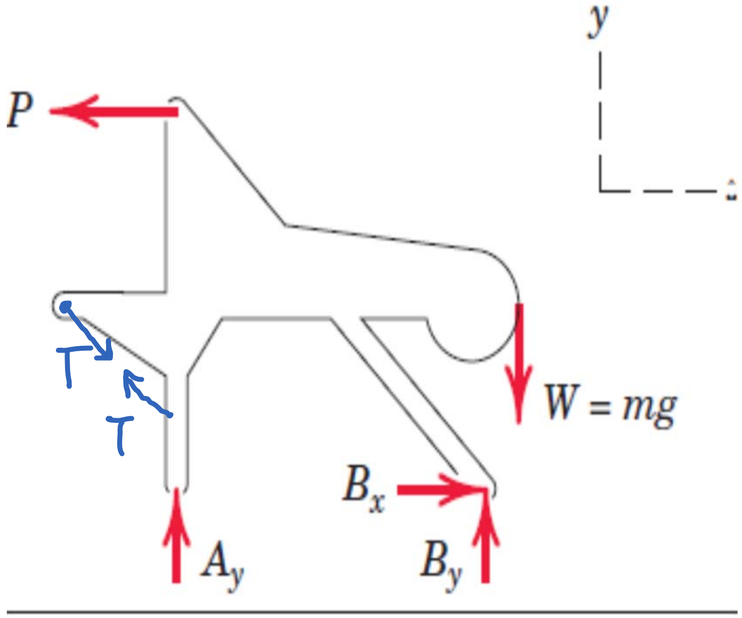
analyzed as a single unit



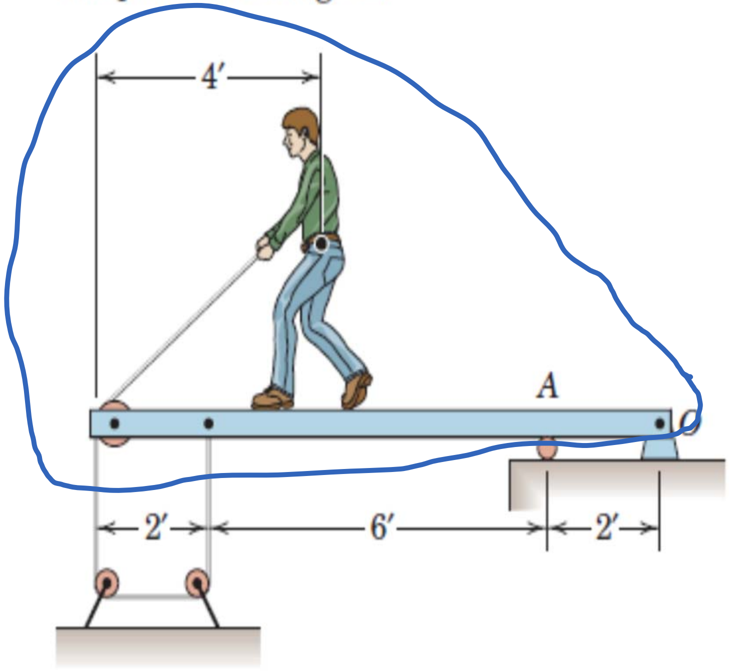


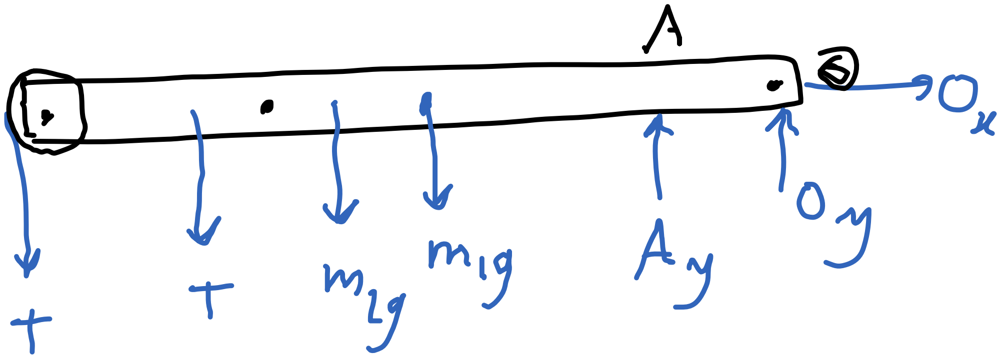
analyzed as a single unit





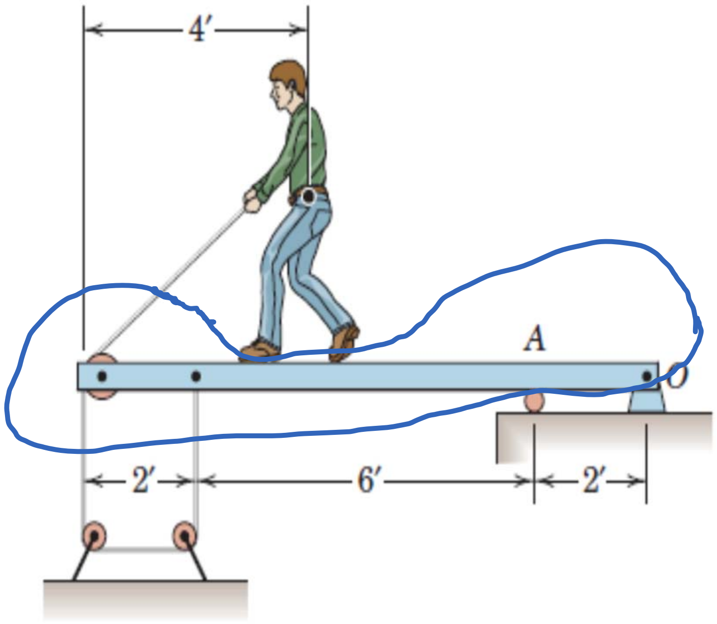
3/54 To test the deflection of the uniform 200-lb beam the 120-lb boy exerts a pull of 40 lb on the rope rigged as shown. Compute the force supported by the pin at the hinge *O*.



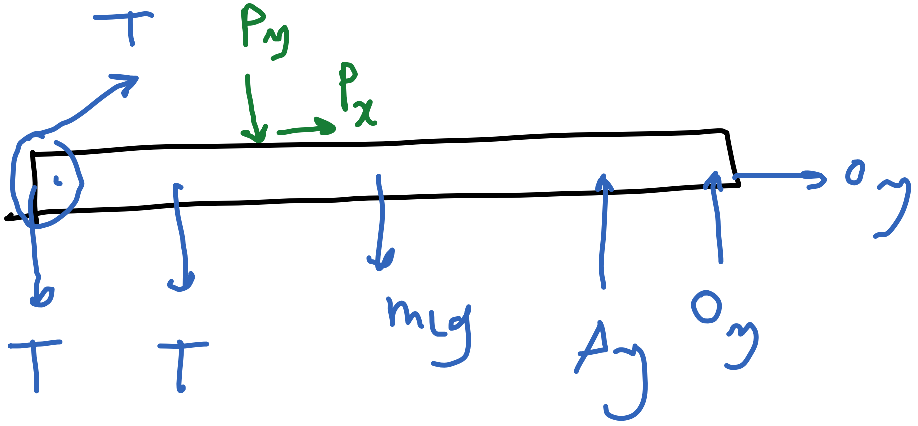


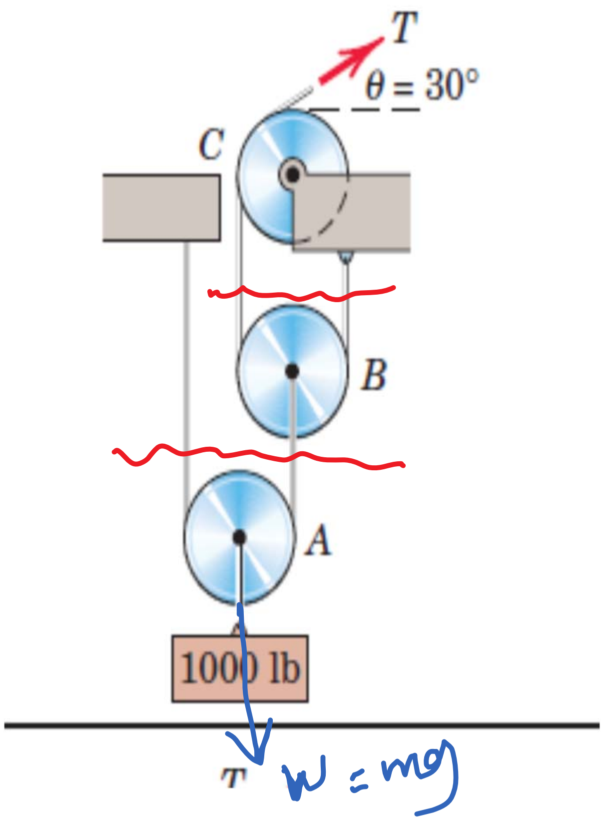
۳ مجهول،

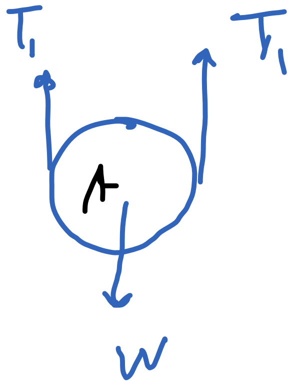
3/54 To test the deflection of the uniform 200-lb beam the 120-lb boy exerts a pull of 40 lb on the rope rigged as shown. Compute the force supported by the pin at the hinge O.



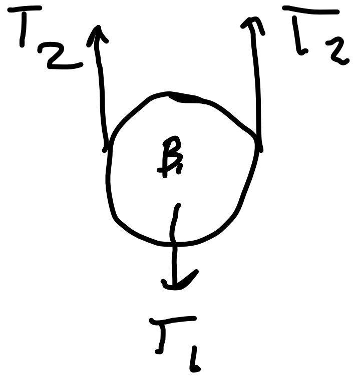
5 مجهول، نمی‌توان حل کرد.





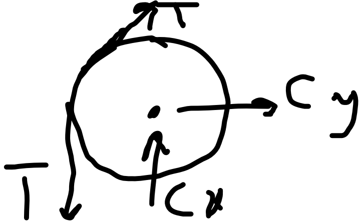


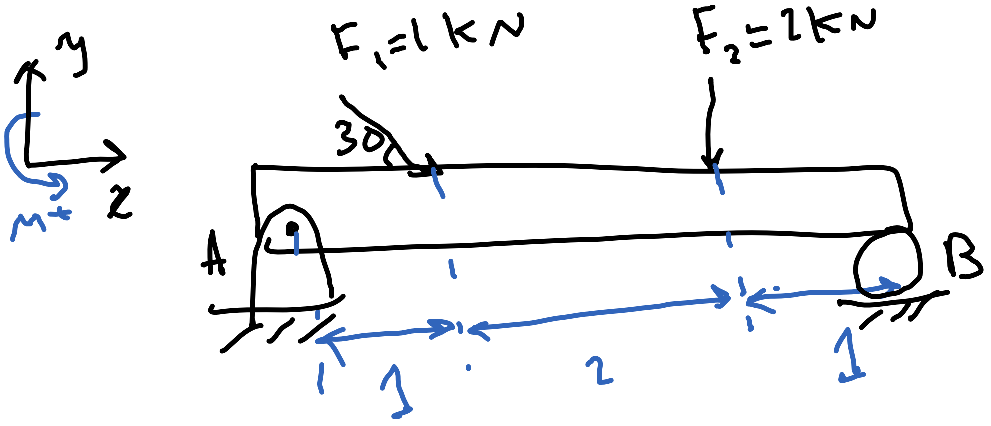
$\Rightarrow 2T_1 = W, \; T_1 = \frac{W}{2}$

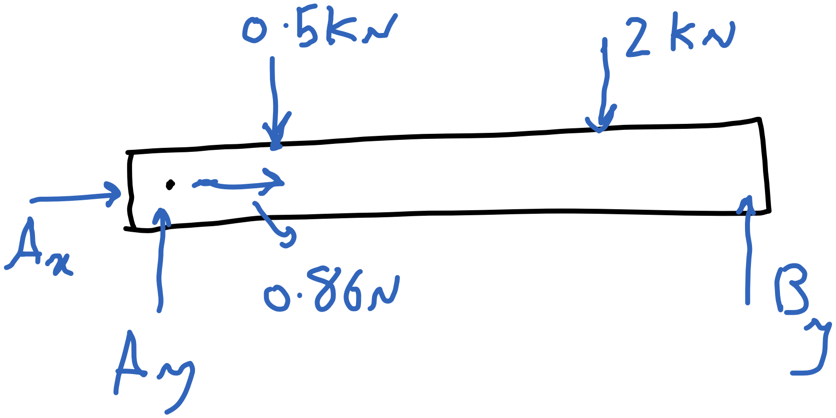


$\Rightarrow 2T_2 = T_1 \Rightarrow T_2 = \frac{T_1}{2}$

$T_2 = \frac{W}{4} = T$







$\Sigma F_x = 0 \Rightarrow A_x + 0.86 = 0 \quad \Rightarrow A_x = -0.86$ kN

$\Sigma F_y = 0 \rightarrow A_y - 0.5 - 2 + B_y = 0 \Rightarrow \quad A_y = \checkmark$

$\Sigma M_A = 0 \Rightarrow -0.5 \times 1 - 2 \times 3 + B_y 4 = 0 \Rightarrow B_y = \frac{6.5}{4}$

Sample problem, statics, Meriam. ed. 7th

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Problems

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3/B
3/C

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3/40
3/50

جواب مسائل در آخر کتاب آمده است.
می‌توانید جواب نهایی‌تان را چک کنید