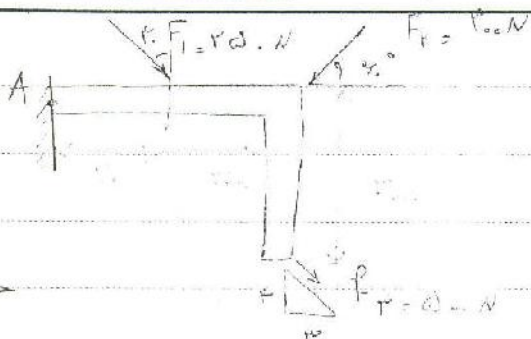


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درست است یا نه؟

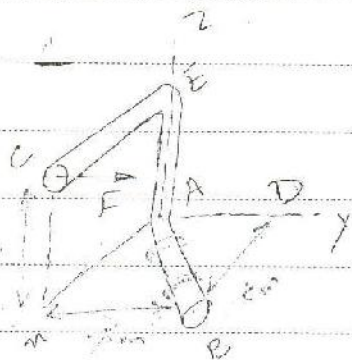
$$M_A = r \times F$$

$$M_{1A} = d_1 \cdot F_{1y} = r \times F \cdot \cos \alpha = 223 \text{ N.m} \quad \text{Clockwise}$$

$$M_{2A} = d_2 \cdot F_{2x} = a \times F \cdot \sin \alpha = 1299 \text{ N.m}$$

$$M_{3A} = a \times F_{2y} - F \times F_{2x} = a \left( \frac{F}{a} \cdot a \right) - F \times \left( \frac{F}{a} \times b \right) = 600 \text{ N.m} \quad \text{Clockwise}$$

$$M_A = M_{1A} + M_{2A} + M_{3A} = 2022 \text{ N.m}$$



$$M_{AB} = U_{AB} \cdot (F \times F)$$

$$M_{AB} = (M_{FB}) U_{AB}$$

$$F = r_{AE} \wedge r_{AD} \wedge r_{BC} \wedge r_{BD}$$

$$U_{AB} = \frac{r_{FB}}{|r_{AB}|} = 0.1894 \hat{i} + 0.447 \hat{j}$$

$$r_{AD} = -1.2 \hat{j}$$

$$M_{FB} = \begin{vmatrix} 0.1894 & 0.447 & 0 \\ 0 & -1.2 & 0 \\ -6 & 0 & -3 \end{vmatrix} = -53.67 \text{ N.m}$$

$$M_{AB} = M_{FB} U_{AB} = \begin{bmatrix} -48 \\ -24 \end{bmatrix} \text{ N.m}$$

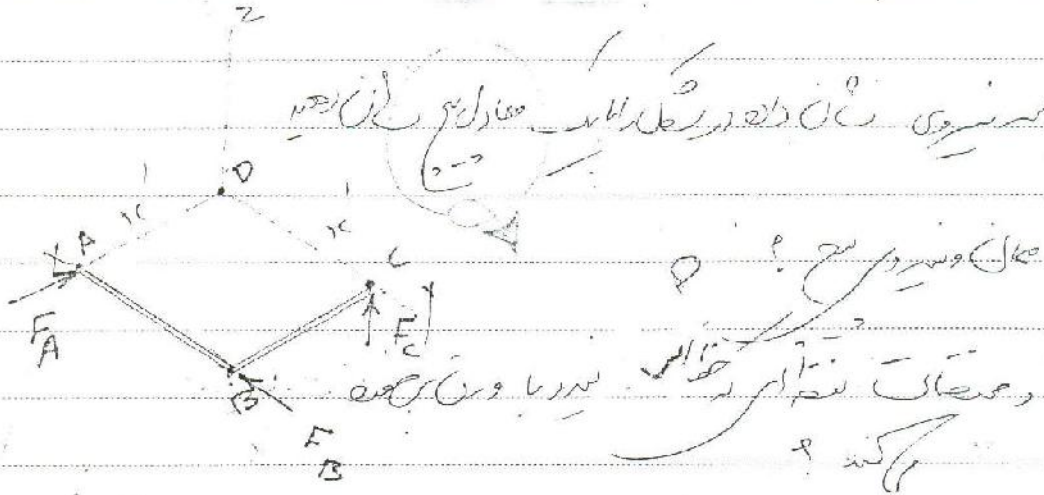
1 foot = 12 inch

12' = 1 foot  
12" = 1 inch

12 inch = 1 foot

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$$F_A = 80 \text{ lb}$$

$$F_B = 60 \text{ lb}$$

$$F_C = 40 \text{ lb}$$

$$\vec{R} = 80\hat{i} - 60\hat{j} + 40\hat{k}$$

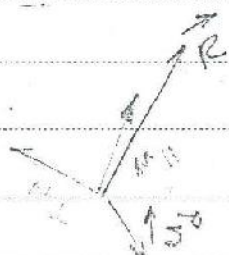
$$\vec{M} = 12 \times 40\hat{i} - 12 \times 60\hat{k}$$

$$= 480\hat{i} - 720\hat{k}$$

$$M_{||} = \frac{\vec{R} \cdot \vec{M}}{|\vec{R}|} = \frac{(80\hat{i} - 60\hat{j} + 40\hat{k}) \cdot (480\hat{i} - 720\hat{k})}{|\vec{R}|} = \frac{38400 - 43200}{|\vec{R}|}$$

$$= \frac{-4800}{|\vec{R}|}$$

$$\vec{M}_{\perp} = \vec{M} - M_{||}\hat{R} = 480\hat{i} - 720\hat{k} - \left(\frac{-4800}{|\vec{R}|}\right)\hat{R}$$



$\vec{u}_d$

$$d = \frac{|\vec{M}_{\perp}|}{|\vec{R}|} \Rightarrow d = \frac{4800}{|\vec{R}|}$$

در این مسئله از آن جهت که بردار  $\vec{R}$  موازی با  $\vec{U}_1$  است

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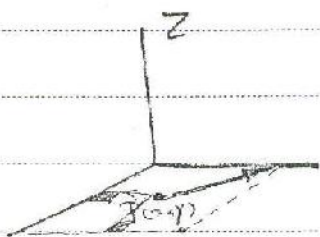
$$\hat{U}_R = \frac{\vec{R}}{|\vec{R}|} = \frac{7.43\hat{i} + 5.57\hat{j} + 3.71\hat{k}}{10}$$

$$\hat{U}_1 = \frac{\vec{M}_1}{|\vec{M}_1|} = \frac{7.58\hat{i} + 1.579\hat{j} + 1.815\hat{k}}{8.15}$$

$$\vec{U}_d = \vec{U}_R \times \vec{U}_1 = 0.10669\hat{i} - 0.1525\hat{j} + 0.446\hat{k}$$

$$\vec{d} = d\hat{U}_d = 3.727\hat{i} - 3.315\hat{j} + 2.485\hat{k}$$

کل عمود دینو رجا، هم! معادلی  $\vec{d}$  موازی با  $\vec{U}_d$  است



نقطه  $\vec{R}$ !  
 و  $\vec{M}_1$  موازی با  $\vec{R}$  است

$$\vec{R} = -80\hat{i} - 60\hat{j} + 40\hat{k}$$

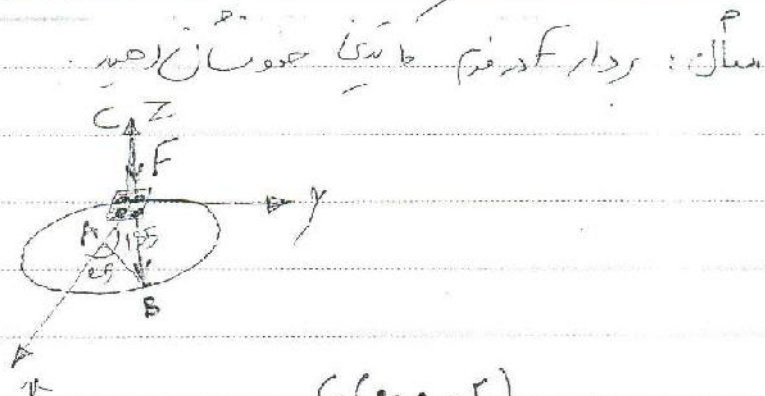
$$\vec{M}_P = (7\hat{j}) \wedge (-80\hat{i}) + (12 - x)\hat{i} \wedge (-60\hat{j})$$

+ (



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$$C(0, 0, r)$$

$$|F| = 0.00 N$$

Force along BC line

$$\vec{F} = |F| \vec{U}_F$$

$$\vec{U}_F = \frac{\vec{CB}}{|\vec{CB}|}$$

$$C = r\hat{k}$$

$$B = (1 + 0.545)\hat{i} + (0)\hat{j}$$

$$\vec{CB} = 1.545\hat{i} - r\hat{k}$$

$$|\vec{CB}| = \sqrt{(1.545)^2 + r^2}$$

$$\vec{U}_F = 0.6269\hat{i} + 0.2597\hat{j} - 0.7345\hat{k}$$

$$\vec{F} = 300 \vec{U}_F$$

$$|F| = \dots$$



Subject:

Year:

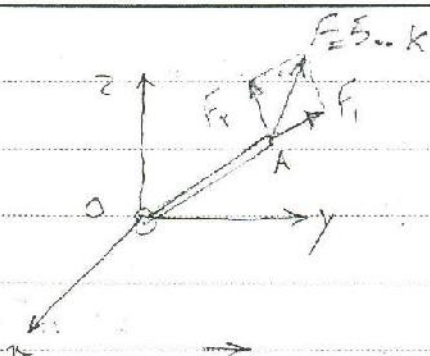
Month:

Date:

( )

A

matlab



$\vec{F}$   
:  $\vec{u}_{OA}$

$$A(x, y, z) \text{ m}$$

$$\vec{u}_{OA} = \frac{\vec{OA}}{|\vec{OA}|}$$

$$F_1 = \text{Proj}_{OA} \vec{F} = (\vec{F} \cdot \vec{u}_{OA}) \vec{u}_{OA}$$

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

$$\vec{u}_{OA} = \frac{\vec{r}_{OA}}{|\vec{r}_{OA}|} = 0.333\hat{i} + 0.666\hat{j} + 0.666\hat{k}$$

$$|F_1| = 500 \times 0.666 = 333 \text{ N}$$

$$\vec{F}_1 = |F_1| \vec{u}_{OA} = \{ 110.9\hat{i} + 221.8\hat{j} + 221.8\hat{k} \} \text{ N}$$

ملاحظة:  $F_1$  و  $F_2$  متعامدان  $F_1 \cdot F_2 = 0$

$$F_2 = F - F_1 \quad F_1 \cdot F_2 = 0$$

Subject:

Year.    Month    Date.    ( )

Dr. Aghdam

unknown = equations

<

>

مکانیک

دینامیک - استاتیک

استاتیک - دینامیک

Statistics

بازه: معادلات ایستاتیکی در دسترس نیست!

Structures



$$3 + 3 = 6$$

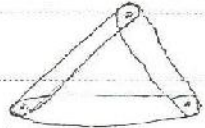
$$6 - 2 = 4$$

درجه آزادی

درجه آزادی

x y

حل تری



3 درجه آزادی

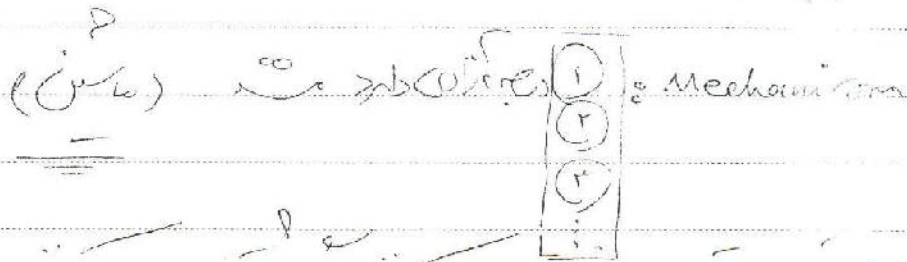
درجه آزادی در دسترس نیست! درجه آزادی در دسترس نیست!

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درجه آزادی عناصر و معین درجه آزادی عناصر اجزای است

(م)



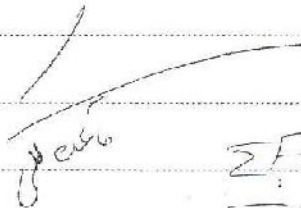
اصولاً در سازه‌ها و در سازه‌ها و در سازه‌ها و در سازه‌ها

را می‌بینیم

سازه‌ها: Truss ضراب

قاب: Frame

مکانیسم: Mechanism



$$\sum F_x = 0$$

$$\sum M = 0$$

Truss: درجه آزادی هر عضو عضو است

7  
سازه‌ها در سازه‌ها در سازه‌ها در سازه‌ها



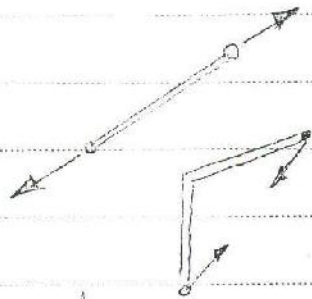
Subject:

Year.

Month

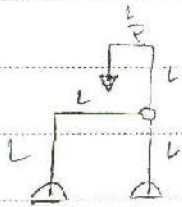
Date.

( )



معموداتی  
مماسی

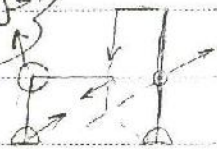
معموداتی



در مجموع 3 نیروی در  $F$  و 3 واکنش

این یک جسم بلندی است و در هر نقطه از آن نیروی در

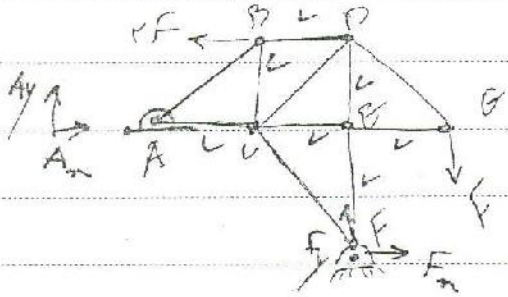
در هر نقطه از آن



در هر نقطه از آن

در هر نقطه از آن

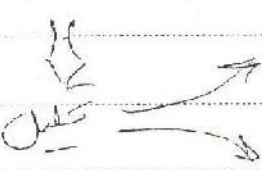
ضایعات



تأثیر است

3 واکنش

4 مجهول است



داخل

Subject:

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۱ - برای حل مسئله  
 ۲ - رسم بردارها و معادلات

① برای هر نیرو  
 $\sum F_x = 0$   
 $\sum F_y = 0$

از بردارهای کشیده شده برای هر نیرو  
 معادلات بردار در دو جهت عمود بر هم  
 ->

در هر جهت  
 اگر بردارها را  
 در جهت مثبت  
 درجه اول:  $\sum F_x = 0$

$$\sum F_x = 0 \quad A_x + F_x - F_3 = 0$$

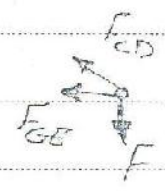
$$\sum F_y = 0 \quad A_y + F_y - F_2 = 0$$

$$\sum M_2 = 0 \quad 2F_x L - F_x 3L + F_x L + F_y \times 2L = 0$$

$$F_y = \alpha$$

در جهت مثبت  
 $\Rightarrow A_x = F + 2\alpha$   
 $A_y = F - \alpha$   
 $F_x = F - 2\alpha$

$G_{xy} = 0$



که  $F_{GD} = 4PF$   
 $F_{GE} = -F$





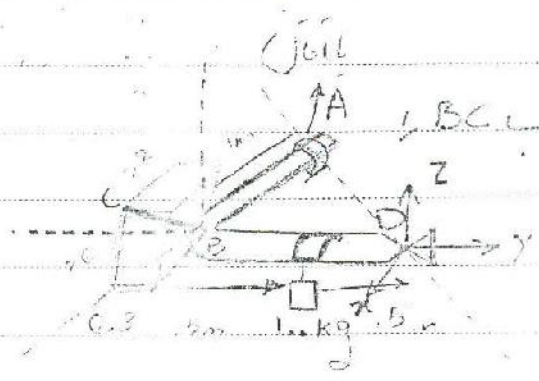
Subject:

Year:

Month:

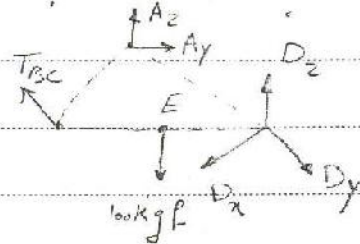
Date:

دینا اسٹیٹکس کا از علی ایڈوانسڈ مینوفیکچرنگ



اداریہ  $T_A$   
 ممبروں کی تعداد 100 ہے  
 ممبروں کی تعداد 100 ہے

Find:  $T_{BC} = ?$



$$\sum M_{AD} = 0 \quad \frac{M_{AD}}{AD} = \left( \vec{r}_{AE} \wedge \vec{W} + \vec{r}_{CB} \wedge \vec{T}_{BC} \right) \cdot \vec{U}_{AD}$$

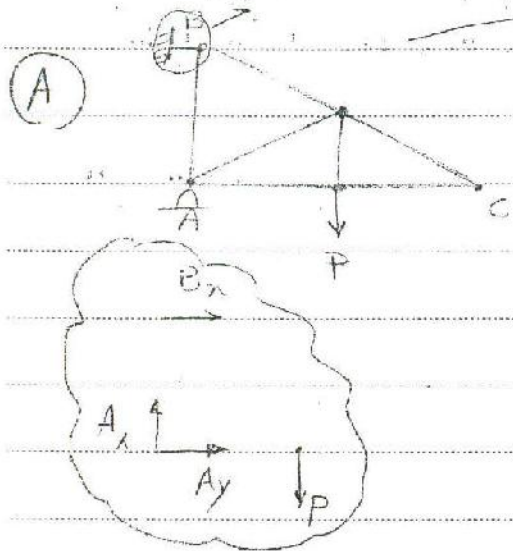
$$\vec{T}_{BC} = |T_{BC}| \vec{U}_{BC} \quad \vec{U}_{BC} = \frac{0.12\hat{i} - 0.3\hat{j} + 1.6\hat{k}}{\sqrt{0.12^2 + 0.3^2 + 1.6^2}} = \frac{0.12\hat{i} - 0.3\hat{j} + 1.6\hat{k}}{1.7}$$

$$\vec{U}_{AD} = \frac{-\hat{i} - \hat{j}}{\sqrt{2}} = \frac{-1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j}$$

$$\vec{W} = (-100 \times 9.81)\hat{k} \quad T_{BC} = 572 \text{ N}$$

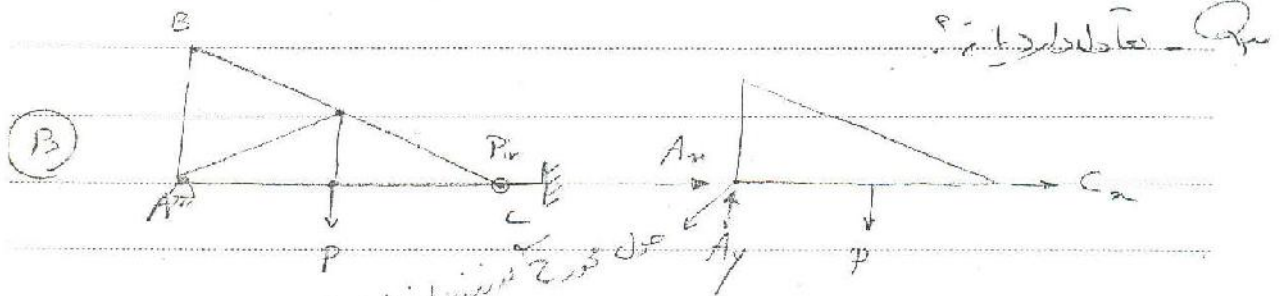
! اس کے علاوہ AB کے پوائنٹوں پر بھی دیکھیں

کتابت کنید و در سال 503 هجری قمری در روز 3 شنبه 13 شهریور 1353  
 عضو دبیر هی

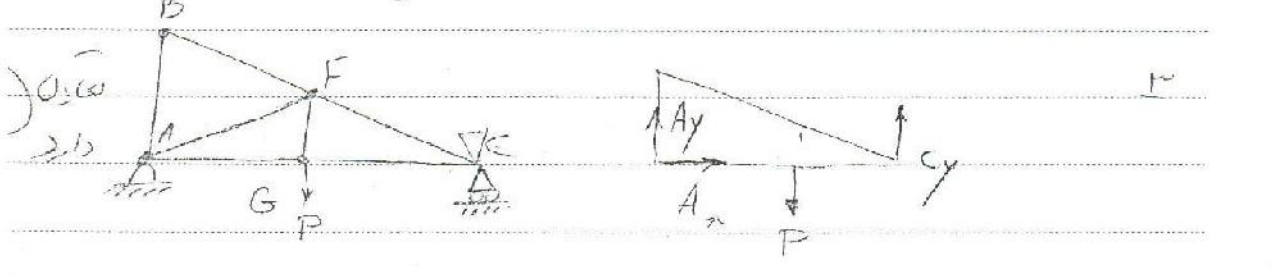


در صورتی که در این صورت  
 1. تکیه  
 2. تکیه  
 3. تکیه  
 4. تکیه  
 5. تکیه  
 6. تکیه  
 7. تکیه  
 8. تکیه  
 9. تکیه  
 10. تکیه

در این صورت که در این صورت  
 1. تکیه  
 2. تکیه  
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 5. تکیه  
 6. تکیه  
 7. تکیه  
 8. تکیه  
 9. تکیه  
 10. تکیه



در این صورت که در این صورت  
 1. تکیه  
 2. تکیه  
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 4. تکیه  
 5. تکیه  
 6. تکیه  
 7. تکیه  
 8. تکیه  
 9. تکیه  
 10. تکیه



ماده: مهندسی مکانیک / مهندسی عمران / مهندسی معماری

Subject:

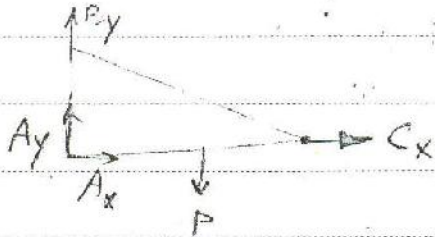
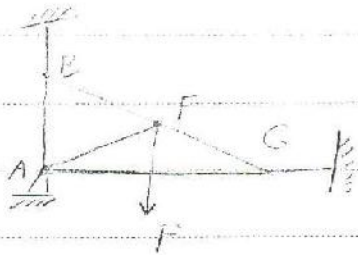
Year. Month. Date. ( )

نام استاد: آقای دکتر / نام دانشجو: آقای / نام خانوادگی: خانم

تاریخ: / /

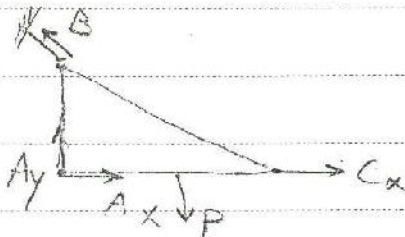
عنوان: تحلیل سازه / تحلیل استاتیکی / تحلیل دینامیکی

(D)



این سازه را تحلیل کنید  
نیروهای داخلی را مشخص کنید  
ماده: مهندسی مکانیک

(E)



ماده: مهندسی مکانیک / مهندسی عمران / مهندسی معماری

عنوان: تحلیل سازه / تحلیل استاتیکی / تحلیل دینامیکی

نام استاد: آقای دکتر / نام دانشجو: آقای / نام خانوادگی: خانم



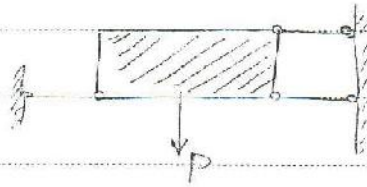
Subject:

Year.

Month.

Date.

( )

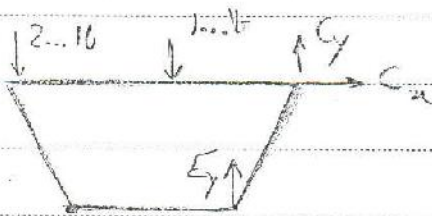
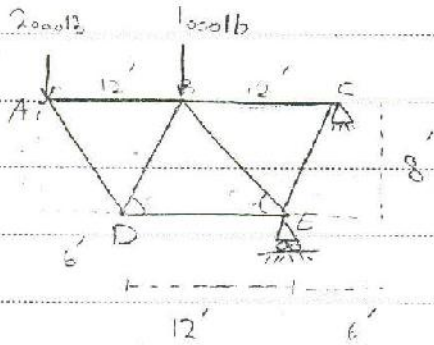


درای جهت برداشتن  $y$

تعداد بارها

ببار صیرط عملی است. محلول دست داریم و می توانیم بارها را از مرکز خارج

خریبا



$$\sum \mathcal{M}_C = 0 \Rightarrow 12 \times 1000 + 24 \times 2000 - 6E_y = 0$$

$$\Rightarrow E_y = 10 \text{ k}$$

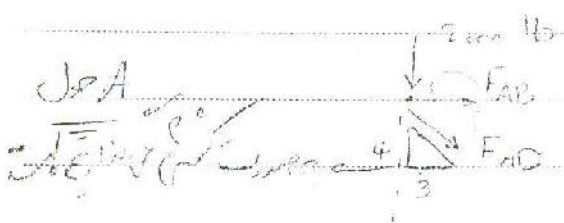
$$\sum F_x = 0 \Rightarrow C_x = 0$$

$$\sum F_y = 0 \Rightarrow C_y = -7 \text{ k}$$

Subject: \_\_\_\_\_

Year: \_\_\_\_\_ Month: \_\_\_\_\_ Date: ( )

mod :                     



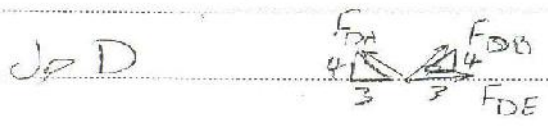
$\sum F_y = 0$

$$F_{AD} \times \frac{4}{5} = 10 \dots \rightarrow F_{AD} = 12.5 \text{ K}$$

$$\sum F_x = F_{AD} \times \frac{3}{5} + F_{AB} = 0$$

$$-12.5 \times \frac{3}{5} + F_{AB} = 0$$

$$F_{AB} = 7.5 \text{ K}$$

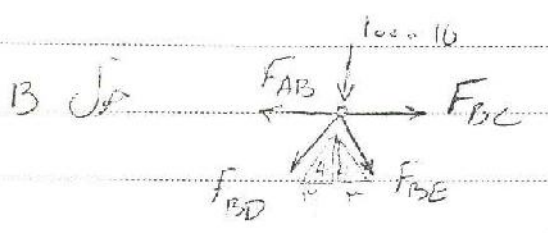


$\sum F_x = 0$

~~$$F_{DE} + F_{DB} \times \frac{3}{5} - F_{AD} \times \frac{3}{5} = 0$$~~

$$F_{DE} + \frac{3}{5} (F_{DB} - F_{AD}) = 0$$

$$F_{DE} = 3 \text{ K}$$



$\sum F_y = 0 \rightarrow 10 + \frac{4}{5} (F_{BD} + F_{BE}) = 0$

$$F_{BE} = -3.75 \text{ K}$$

$\sum F_x = 0$

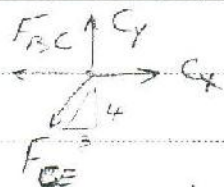
$$F_{BE} \left( \frac{3}{5} \right) = \dots$$

$$\rightarrow F_{BC} = 5.25 \text{ K}$$

Subject:

Year:      Month:      Date: ( )

C حل :



$$\sum F_x = 0$$

معادلات  
المعادلات  
المعادلات

$$\sum F_y = 0 \rightarrow \frac{4}{5} F_{CE} = P_{max} C_y$$

$$\rightarrow \frac{4}{5} C_y = -8.75 = F_{CE}$$

$$\sum F_x = 0$$

حل - 15  
5

مبدأ التوازن في نقطة C :  $C_x$        $C_y$        $F_{CE}$

$$\rightarrow \text{نقطة J} \begin{cases} F_{IJ} = 0 \\ F_{JI} = F_{HJ} \end{cases}$$

$$\text{I} \begin{cases} F_{HI} = 20 \text{ kN} \\ \dots \end{cases}$$

$$\text{B} \begin{cases} F_{BE} = -25 \text{ kN} \\ \dots \end{cases}$$

$$\text{D} \begin{cases} F_{DE} = -25 \text{ kN} \\ \dots \end{cases}$$

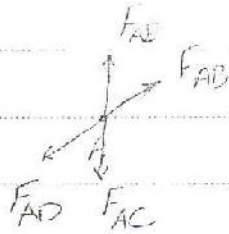
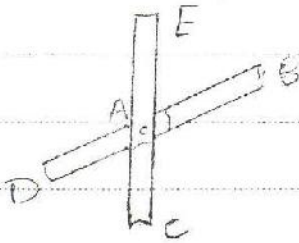
$$\text{H} \begin{cases} F_{HI} = -50 \text{ kN} \\ \dots \end{cases}$$



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Year. \_\_\_\_\_ Month. \_\_\_\_\_ Date. ( )

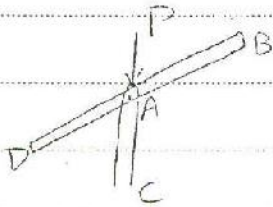
# Class Note:



$$F_{AB} = F_{AD}$$

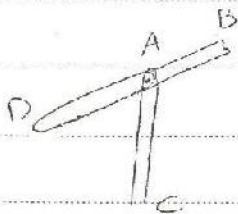
$$F_{AE} = F_{AC}$$

Que: \_\_\_\_\_



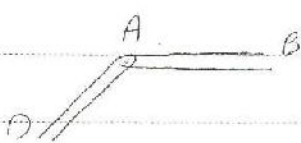
$$F_{AB} = F_{AD}$$

$$F_{AC} = P$$



$$F_{AC} = 0$$

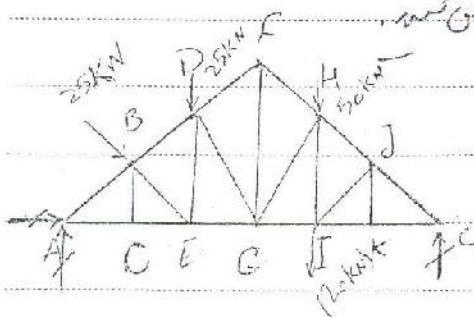
$$F_{AB} = F_{AD}$$



$$F_{AB} = 0$$

$$F_{AD} = 0$$

in general in truss structure we use the following rule:



$$C = \begin{cases} F_{BC} = 0 \\ F_{AC} = F_{CE} \end{cases}$$

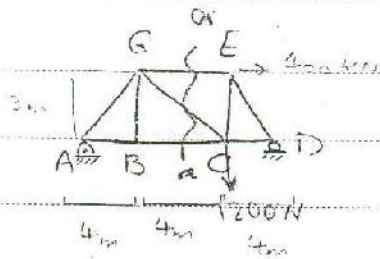
$$K = \begin{cases} F_{JK} = 0 \\ F_{TK} = F_{KL} \end{cases}$$

KANDOO

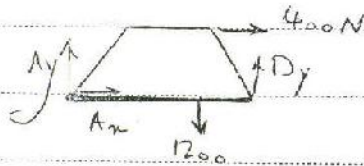
Fd

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$$F_{CE} = F_{BC}, F_{CG} = 9$$



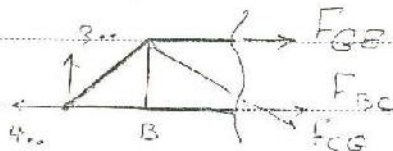
$$\sum M_A = 0$$

$$-D_y \times 12 + 8(200) + 3 \times 400 = 0$$

$$D_y = 900 \text{ N}$$

$$\sum F_y = 0 \Rightarrow A_y = 300 \text{ N}$$

$$\sum F_x = 0 \Rightarrow A_x = -400 \text{ N}$$



$$\sum M_G = 0 \Rightarrow 3F_{BC} = 3 \times 400 + 4 \times 300$$

$$\Rightarrow F_{BC} = 800 \text{ N}$$

$$\sum M_C = 0 \Rightarrow 3 \times F_{CG} + 8 \times 300 = 0$$

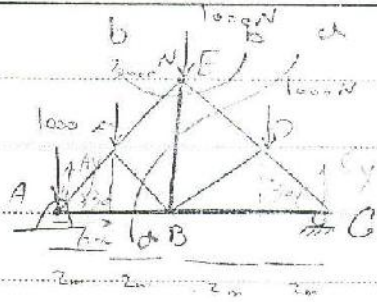
$$F_{CG} = -800 \text{ N (C)}$$



$$\sum F_y = 0 \Rightarrow 300 - \frac{3}{5} F_{CG} = 0 \Rightarrow F_{CG} = 500 \text{ N}$$

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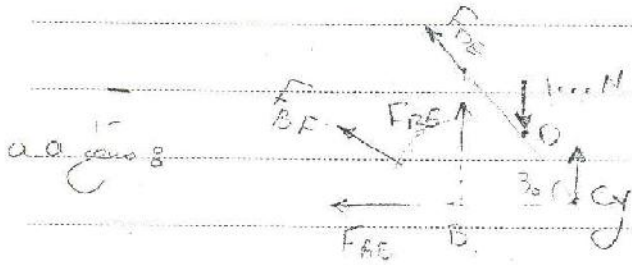
Find  $F_{DE}$  = ?

Find  $F_{DE}$  = ?

$$\sum F_x = 0 \Rightarrow A_x = 0$$

$$\sum M_A = 0 \Rightarrow C_y = 2 \text{ kN}$$

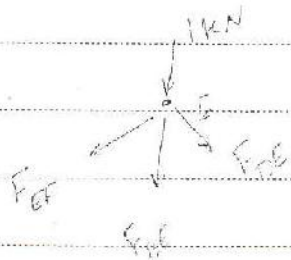
$$\sum F_y = 0 \Rightarrow A_y = 4 \text{ kN}$$



$$\sum M_B = 0 \Rightarrow 4 \times 2 - 2 \times 1 + F_{DE}$$

$$(4 \times 2 - 2 \times 1) = 0$$

$$F_{DE} = -3 \text{ kN}$$



$$\sum F_y = 0$$

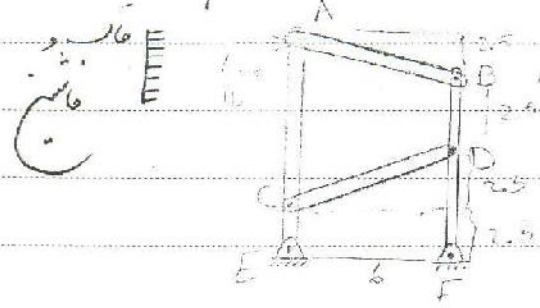
$$\sum F_x = 0$$



Force  $F_{in}$  applied at point C

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### Examples

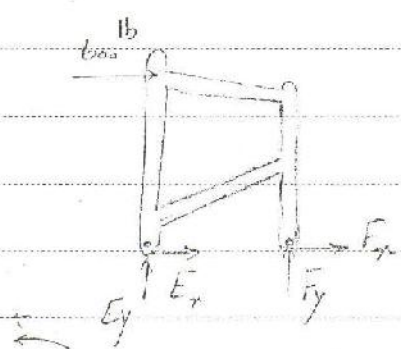


معموداً بر روی شیب  $BDF$   $ACE$  است  
 محورها  $BDF$   $ACE$  است

در صورت نیاز به  $P_{in}$  (مثلاً)  $P_{out}$  ←

اینکه اگر  $P_{in}$  را در نظر بگیریم  $P_{out}$  را هم در نظر بگیریم

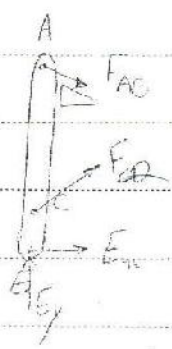
معموداً بر روی شیب  $BDF$   $ACE$  است  
 محورها  $BDF$   $ACE$  است



$$\sum M_E = 0 \Rightarrow -600 \times 6 + F_y(6) = 0 \Rightarrow F_y = 600$$

$$\sum F_x = 0 \Rightarrow E_x - 600 + F_x = 0$$

$$\sum F_y = 0 \Rightarrow F_y + E_y = 0 \Rightarrow E_y = -600$$



$$\sum M_B = 0 \Rightarrow \frac{12}{13} F_{CB} \times 5 + \frac{12}{13} F_{AB} \times 10 + 10 \times 600 = 0$$

$$\sum F_y = 0 \Rightarrow \frac{5}{13} (F_{CB} - F_{AB}) + E_y = 0$$

$$\Rightarrow F_{AB} = 1560$$

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( )

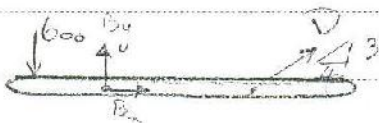
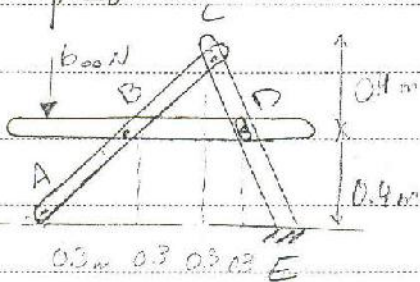
$$\sum F_{x=0} \rightarrow F_{x=1000} \text{ N}$$

$$F_x = 400 \text{ N}$$

~~Check the calculation of the reaction forces~~

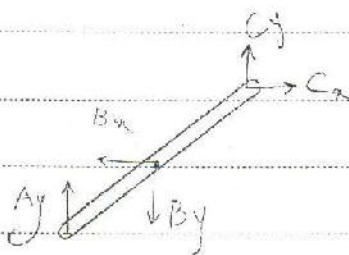
1. Find the reaction forces

### Example 8



$$\sum M_B = 0 \Rightarrow -3 \times 600 + 6 \times \frac{3}{5} D = 0$$

$$D = -500 \text{ N}$$



$$\sum M_C = 0$$

$$\therefore 6 A_y - 3 B_y + 4 B_x = 0$$

$$A_y = 183.3 \text{ N}$$

$$\sum F_x = 0 \Rightarrow B_x = -\frac{4}{5} D = 400 \text{ N}$$

$$\sum F_y = 0 \Rightarrow B_y + \frac{3}{5} D - 600 = 0$$

$$B_y = 900 \text{ N}$$

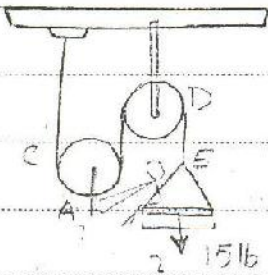
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$$\sum F_x = 0 \Rightarrow 11E - 6 = 0 \Rightarrow E = 0.54 \text{ kN}$$

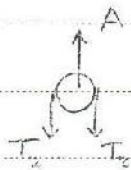
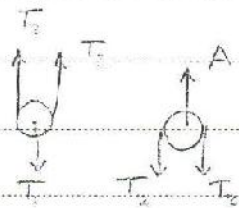
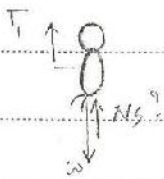
$$\sum M_A = 0 \Rightarrow 11E - 1.2 \cdot 6 = 0 \Rightarrow 11E = 7.2 \text{ kNm}$$

$$\frac{E}{11} = 0.6545$$



دری با وزن 15 lb یک این سیستم  
 در A یک کابل 1-  
 در E یک کابل 2-  
 در C یک کابل 3-  
 در D یک کابل 4-

P. وین



$$N_s + T_1 \cdot 2 = 15$$

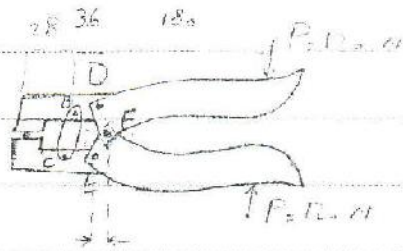
$$N_s + 15 = T_2$$

$$165 - 2T_2 = T_1 \Rightarrow T_2 = 55 \text{ lb} \quad T_1 = 2T_2 \Rightarrow T_1 = 110 \text{ lb}$$

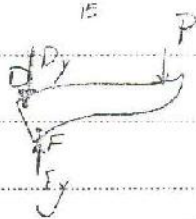


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سین!



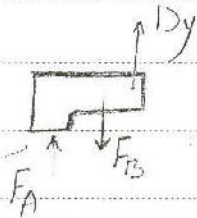
$$\sum M_D = 0$$

$$-P \times 18 + F_y(15) = 0$$

$$F_y = \frac{P(18)}{15} = 1.2P$$

$$D_y - P + 1.2P = 0$$

$$D_y = 11P = 1320 \text{ N}$$

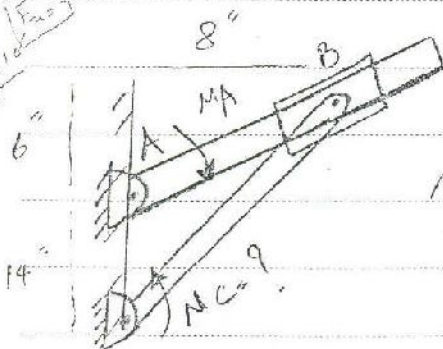


$$\sum M_B = 0$$

$$D_y(36) - 28 F_A = 0$$

$$F_A = \frac{D_y(36)}{28} = \frac{1320 \times 36}{28} = 1700 \text{ N}$$

در صورت  
که  
در  
محل  
A  
و  
B  
فرد  
فرد  
فرد



$$M_A = 500 \text{ lb-in}$$

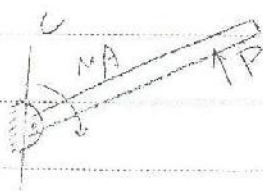
! در صورت  $M_C$  مشخص

!  $C$  در صورت  $M_C$  مشخص

$$\sum M_A = 0$$

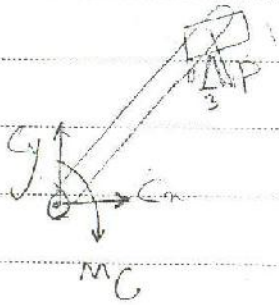
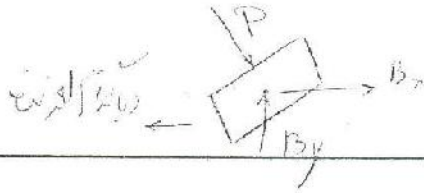
$$-M_A + P(16) = 0$$

$$P = 50 \text{ lb}$$



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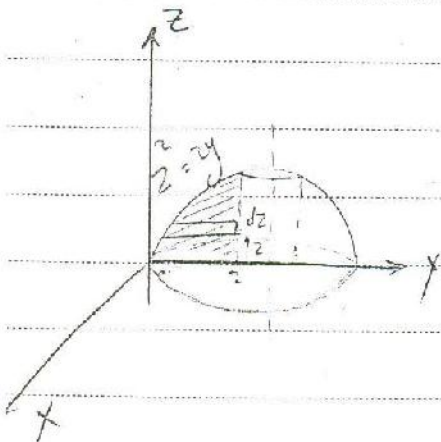
$$\sum M_C = 0$$

$$M_C - 5 \left( \frac{3}{5} \right) \times 20 - \frac{4}{5} \times 5 \times 8 = 0$$

$$\Rightarrow M_C = 92 \text{ lb}\cdot\text{in}$$

$$\sum F_x = 0 \quad C_x + \frac{3}{5}P = 0 \quad C_x = -300 \text{ lb}$$

(Machines / Finished)



$$dv = \pi \left[ \left( 3 - \frac{z^2}{2} \right)^2 - 1^2 \right] dz$$

$$Z_G = \frac{\int z dv}{\int dv} = \frac{\int_0^2 z \left( \left( 3 - \frac{z^2}{2} \right)^2 - 1^2 \right) dz}{\int_0^2 \left( \left( 3 - \frac{z^2}{2} \right)^2 - 1^2 \right) dz}$$

$$Z_G = 0.624 \text{ m}$$

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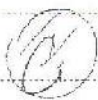
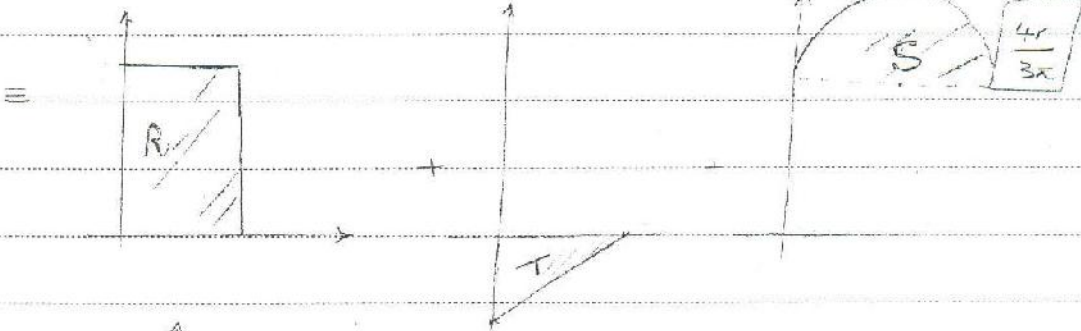
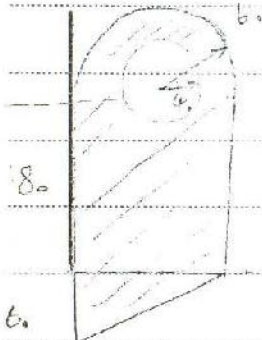
22/05/2020

Handwritten notes

12

حل اول سطح مقطع و مرکز ثقل آن را بیابید

ابن اولی مرتبه سطح را بیابید



Handwritten notes and formulas related to the centroid calculation.

	A	$\bar{X}$	$\bar{Y}$	$A\bar{y} = A\bar{Y}$	$A\bar{x} = A\bar{X}$
R	$8 \cdot (12)$	$6$	$4$	$576 E3$	$384 E3$
T	$\frac{1}{2} (12) (6)$	$4$	$-20$	$144 E3$	$-92 E3$
S	$\frac{\pi}{2} (6)^2$	$6$	$105,5$		$596 E3$
C	$\pi (6)^2$	$6$	$8$	$-321,6 E3$	$-982 E3$

$\Sigma = \Sigma$

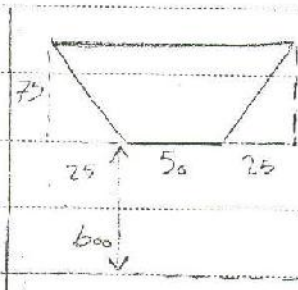


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$$\bar{x}_C = \frac{\sum Q_y}{\sum A} = 54.8 \text{ mm}$$

$$\bar{y}_C = \frac{\sum Q_x}{\sum A} = 36.6 \text{ mm}$$



پہلے CP کو معلوم کرنا ہے

(وہ)



پہلے دونوں کے CP معلوم کرنا ہے



	A	$\bar{y}$	$A\bar{y}$
R			
T			

$$\sum A\bar{y} = 3.610 E6 \text{ mm}^2$$

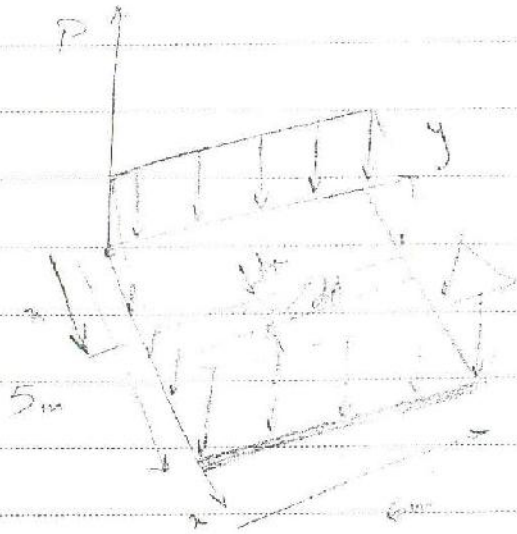
$$V = 2\pi(3.610) E6 =$$

$$0.023 \text{ m}^3$$

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2.1 (part 2) ... 100 (10)  
... .. 7



Pressure  
distribution

$$P = \left( \frac{-24}{n+1} + 34 \right) \text{ kPa}$$

$$dF = p \cdot dA$$

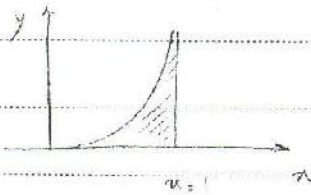
$$F = \int dF = \int p \cdot dA \quad dF = \left( \frac{-24}{n+1} + 34 \right) 6 \, dn$$

$$F = \int \dots = 762 \, \text{N}$$

$$\bar{x} = 3 \, \text{m} \quad \bar{x} = \frac{\int n \, dF}{\int dF} = \frac{6 \int \left( \frac{-24 \cdot n}{n+1} + 34 \cdot n \right) dn}{762} = \boxed{2.71 \, \text{m}}$$

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مركز

$$\frac{\int x \, dA}{\int dA}$$

$$\frac{\int y \, dA}{\int dA}$$

مركز



$$\bar{x} = \frac{\int xy \, dx}{\int y \, dx}$$

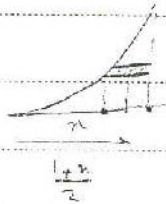
$$\bar{y} = \frac{\int \frac{y}{2} \, dx}{\int y \, dx}$$

$$y = x^2$$

$$\bar{x} = \frac{\int_0^1 x^3 \, dx}{\int_0^1 x^2 \, dx} = \frac{\frac{1}{4} x^4 \Big|_0^1}{\frac{1}{3} x^3 \Big|_0^1} = \frac{\frac{1}{4}}{\frac{1}{3}} = \frac{3}{4} = .75$$

$$\bar{y} = \frac{\frac{1}{2} \int_0^1 x^4 \, dx}{\int_0^1 x^2 \, dx} = \frac{\frac{1}{2} \left( \frac{1}{5} \right)}{\frac{1}{3}} = \frac{3}{10}$$

مركز



$$\bar{x} = \frac{\int x \, dA}{\int dA}$$

$$\frac{\int \left( \frac{1+y}{2} \right)^2 dy}{\int \left( \frac{1+y}{2} \right) dy}$$

$$dy = 2x \, dx$$

$$= \frac{\int \left( \frac{1+y}{2} \right)^2 (2x) \, dx}{\int x(1+x) \, dx}$$

→ 75 }  
→ 3 } check at





Subject:

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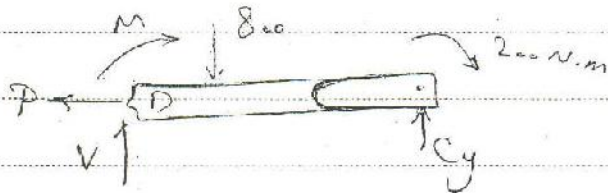
( )



$$\sum M = 0 \Rightarrow M - 2 \times C_y + 200 = 0$$
$$M = -100 \text{ N.m}$$

$$\sum F_y = 0 \Rightarrow V + 50 = 0 \Rightarrow V = -50 \text{ N}$$

$$\sum F_x = 0 \Rightarrow P = 0 \text{ N}$$



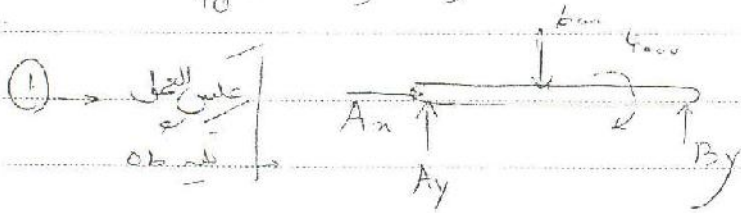
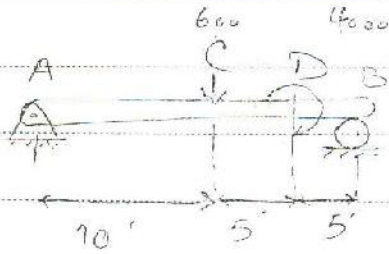
$$\sum M_D = 0 \Rightarrow M = 1300 \text{ N.m}$$

$$\sum F_x = 0 \Rightarrow P = 0$$

$$\sum F_y = 0 \Rightarrow V = 75 \text{ N}$$

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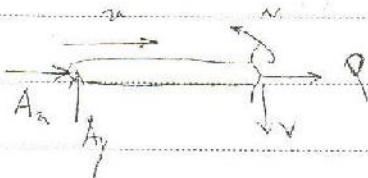
$$\sum F_x = 0 \rightarrow Ax = 0$$

$$\sum M_A = 0 \rightarrow -600(10) - 4000 + By(20) = 0$$

$$By = \frac{10000}{20} = 500 \text{ N}$$

$$\sum F_y = 0 \rightarrow Ay - 600 + 500 = 0$$

$$Ay = 100 \text{ N}$$

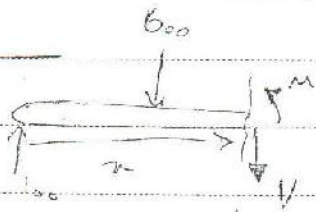


$$\sum M = 0 \rightarrow M - 100x = 0$$

$$M = 100x$$

$$\sum F_y = 0 \rightarrow V - 100 = 0$$

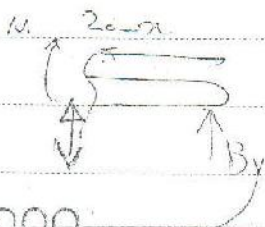
$$V = 100$$



$$\sum M = 0 \rightarrow -100x + M + 600(x - 10) = 0$$

$$M = 400x + 6000$$

$$\sum F_y = 0 \rightarrow V = -500$$



$$\sum M = 0 \rightarrow M = 500(20 - x)$$

$$\sum F_y = 0 \rightarrow V = -500$$

KANDOO

dr



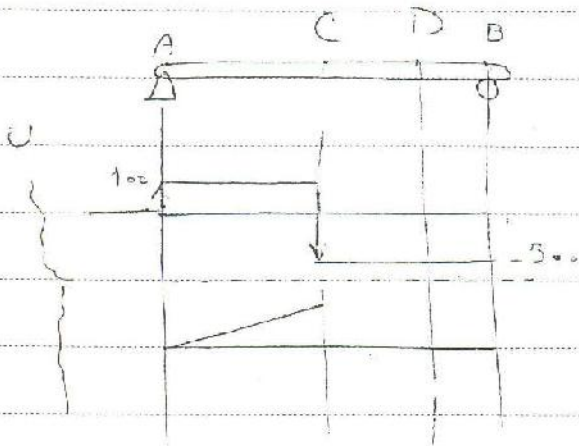
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( )



نکات: از هر دو طرف سیم‌ها را برای بریب آوردن محمولات استوار کرد

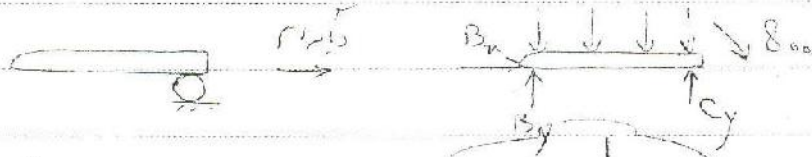
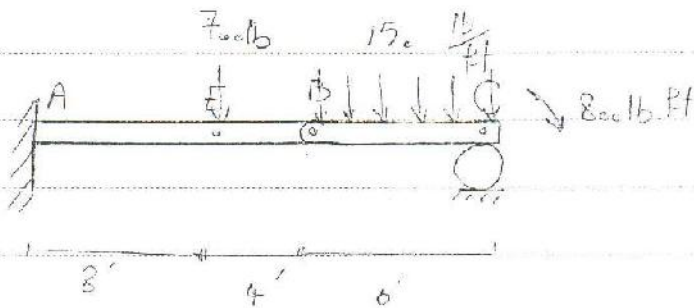
گاره! در تیرهای طول

دیگرم حال جسمی که در فاصله  $\frac{1}{2}$  تا  $\frac{1}{3}$  است که حال جسمی عمود

به تیر و در سیم

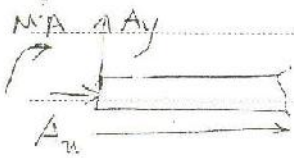
دیگرم تیرهای که در فاصله  $\frac{1}{2}$  تا  $\frac{1}{3}$  است که در سیم جانف در آورد

دیگرم حال از کل تیرهای در فاصله  $\frac{1}{2}$  تا  $\frac{1}{3}$  عمود جانف دیگرم تیرهای



$C_y = 583 \text{ lb}$   
 $M_A = -9400 \text{ lb}\cdot\text{ft}$   
 $A_y = 1016.7 \text{ lb} \approx 1017 \text{ lb}$   
 $A_x = 0$

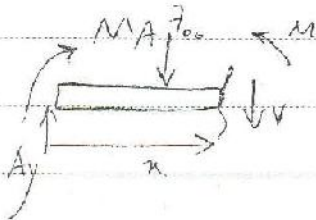
*تساوی*  
*سخت کردن*  
*تیرهای غیر صاف است!*



$w(x) = 0$   
 $\Rightarrow V(x) = -\int w(x) dx = C_1$   
 $x \rightarrow 0 \Rightarrow V(0) = A_y = 1017$

$M = \int V(x) dx = 1017x + C_2$   
 $x \rightarrow 0 \Rightarrow M(0) = -9400$

$C_2 = -9400 \Rightarrow M(x) = 1017x - 9400$



$w(x) = 0 \Rightarrow V(x) = C$   
 @ E;  $x = 8 \quad V = 1017 - 700$   
 $V(x) = 317 \text{ lb}$

Subject:

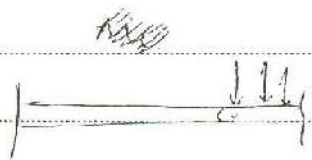
Year. Month. Date. ( )

$$M(x) = \int V(x) dx = 317x + C$$

↓

$$\textcircled{\text{a}} X = 12 \quad M(12) = C = -3800$$

$$M(x) = 317x - 3800$$



$$W(x) = 150$$

$$V(x) = -150x + C$$

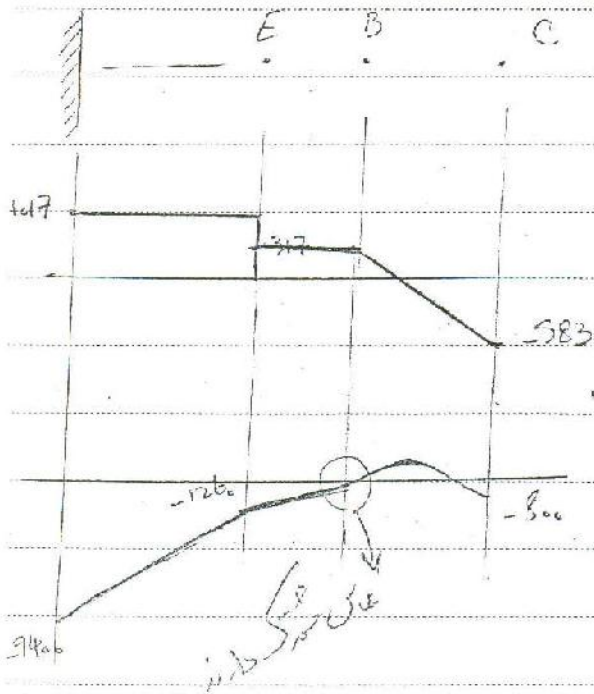
$$\textcircled{\text{a}} X = 12 \quad V_0 = 317$$

$$V(x) = -150x + 2117$$

$$M(x) = \int V(x) dx = -75x^2 + 2117x + C$$

$$M(12) = 0$$

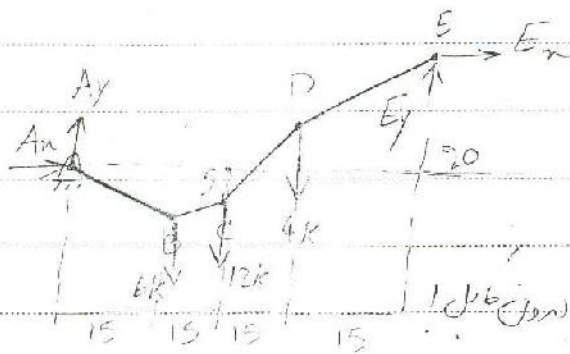
$$M(x) = -75x^2 + 2117x - 14600 \quad \text{Oops!!}$$





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← Slope is least at D.

D, B is least value

$$\Rightarrow \sum M_E = 0 \rightarrow 6 \times A_y - 2 \times A_x = 15 \times 4 + 30 \times 12 + 40 \times 6 \quad \text{(I)}$$

$$\sum M_C \rightarrow 5 \times A_x - 3 \times A_y = 1 \times 6 \quad \text{(II)}$$

$$\Rightarrow A_x = -18k$$

$$A_y = 3k$$

$$\rightarrow \sum M_B = 0 \rightarrow \frac{1}{2} \times A_x + 20 \times A_y = 0$$

$$\frac{1}{2} \times A_x = -20 \times A_y$$

$$\frac{1}{2} \times A_x = -20 \times 3k$$

$$\frac{1}{2} \times A_x = -60k$$

$$A_x = -120k$$

$$\sum M_D = 0 \rightarrow \frac{1}{2} \times A_x + 5.83 \times A_y = 0$$

$$\frac{1}{2} \times A_x = -5.83 \times A_y$$

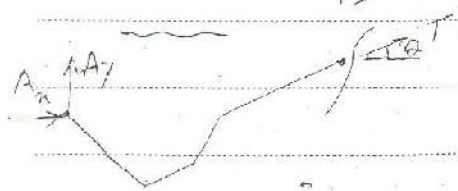
$$\frac{1}{2} \times A_x = -5.83 \times 3k$$

$$\frac{1}{2} \times A_x = -17.49k$$

$$A_x = -34.98k$$

Max Slope @ DE

$$\theta = \frac{20 - 5.83}{15} \rightarrow \theta = 43.4$$

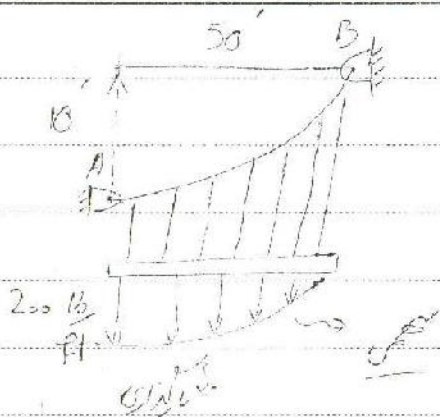


$$T_{\text{at } B} = A_x = -18k$$

$$T = \frac{18k}{\cos 43.4} = 24.8k$$

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$$w = 20 \left( 1 - \left( \frac{x}{50} \right)^2 \right)$$

$$y_{max} = 9$$

$$\max \left( \frac{d^2y}{dx^2} \right)$$

$$\frac{d^2y}{dx^2} = 0$$

A ( )

$$T_0 \frac{d^2y}{dx^2} = w(x)$$

$$T_0 \frac{d^2y}{dx^2} = 20 \left( 1 - \left( \frac{x}{50} \right)^2 \right)$$

$$T_0 \frac{dy}{dx} = \int \left( 20 - 20 \left( \frac{x}{50} \right)^2 \right) dx + C$$

$$T_0 \frac{dy}{dx} = 20x - \frac{20}{750} \times \frac{1}{3} x^3 + C \quad | \quad x=0 \rightarrow \frac{dy}{dx} = 0 \rightarrow C = 0$$

$$T_0 \frac{dy}{dx} = 20x - \frac{2}{75} x^3$$

$$T_0 y = \frac{20x^2}{2} - \frac{2}{75} \times \frac{1}{4} x^4 + k \quad \rightarrow \quad x=0 \rightarrow y=0$$

$$T_0 y = 10x^2 - \frac{1}{150} x^4 = 20 \left( \frac{x^2}{2} - \frac{1}{12 \times 50^2} x^4 \right)$$

$$T_0 \left| \rightarrow \frac{y}{10} \rightarrow \frac{10x^2}{10} - \frac{1}{150} x^4 \right| \quad \left| \frac{T_0 = 20 \times 83}{10 \times 5} \right|$$

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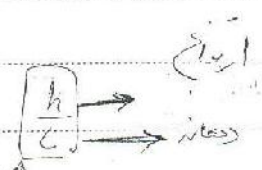
$$\frac{dV}{dx} = \frac{T}{L} \left( 2ax - \frac{700}{2500} \times \frac{1}{3} x^3 \right)$$

$$\textcircled{a} B \rightarrow \frac{dV}{dx} = 0 \Rightarrow \theta_B = 17.7^\circ$$

$$T_{max} \cos \theta_B = T_0 \Rightarrow T_{max} = 21.8 \text{ k}$$

$$S_{AB} = \int \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx = \int \sqrt{1 + \left(\frac{2ax - \frac{700}{2500} \times \frac{1}{3} x^2}{L}\right)^2} dx$$

مساحت سطح کابل



$$S_{AB} = 50 \left[ 1 + \frac{2}{3} \left(\frac{1}{5}\right)^2 - \frac{2}{5} \left(\frac{1}{5}\right)^3 \right]$$

$$\Rightarrow S_{AB} = 54.30$$

$$|AB| = 50.92$$

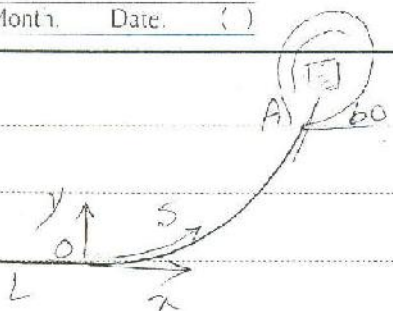
$$T = T_0 + Hy$$

$$= T_0 \cosh \frac{Hy}{T_0}$$



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$$\mu = \frac{0.8 \text{ lb}}{\text{ft}} = \text{weight per unit length}$$

$$T_A = 150 \text{ lb}$$

Force at A

Find  $L, h$ ?

$$y(x) = \frac{T_0}{\mu} \left( \cosh \frac{\mu x}{T_0} - 1 \right)$$

$$\rightarrow \text{At } T_A = 150 \text{ lb} \rightarrow T_0 = T \cos 60 = 75 \text{ lb}$$

$$y(x) = \frac{75}{0.8} \left[ \cosh \frac{0.8x}{75} - 1 \right]$$

$$\frac{dy}{dx} = \sinh \frac{\mu x}{T_0}$$

$$\text{@ } A \rightarrow \frac{dy}{dx} = \tan \tau \rightarrow \frac{\sinh \frac{0.8x}{75}}{\frac{75}{0.8}} = \sqrt{3} \rightarrow \frac{\mu x}{T_0} = 1.3168$$

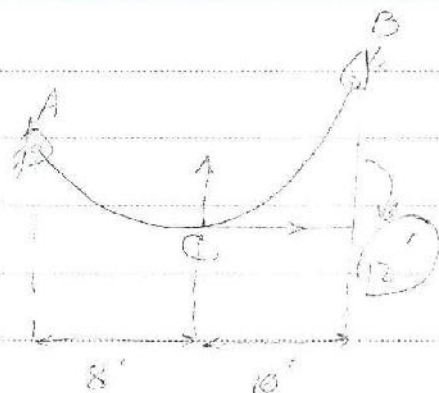
$$\rightarrow h = (y(x_A)) = \frac{75}{0.8} \left[ \cosh(1.3168) - 1 \right] \quad h = 93.73'$$

$$S_{OP} = \frac{T_0}{\mu} \sinh \frac{\mu x_A}{T_0}$$

$$S_{OA} = 102.4$$

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$$y(x) = \frac{T_0}{\mu} \left[ \cosh \frac{\mu x}{T_0} - 1 \right]$$

$$y(B) = 12 = \frac{T_0}{\mu} \left[ \cosh \frac{\mu x_B}{T_0} - 1 \right]$$

$$X = \frac{\mu}{T_0} \rightarrow 12 = \frac{1}{2} \left[ \cosh 10x - 1 \right]$$

$$\Rightarrow X = 5.466 \Rightarrow T_0 = 16.398 \text{ lb}$$

$$T_C = T_0$$

$$T_B = T_0 + \mu y_B = 52.4 \text{ lb}$$

$$T_A = T_0 + \mu y_A = 37.3 \text{ lb}$$

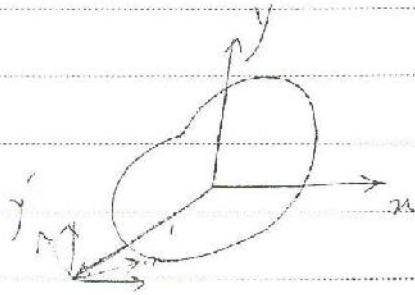
$$T = T_0 \cosh \frac{\mu x}{T_0}$$

$$T_0 = T_0 + \mu y$$

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$I_{xy}$  (Le abt)



$I_{xy}$  (Le abt)

$$I = \begin{bmatrix} I_{xx} & -I_{xy} \\ \text{sym} & I_{yy} \end{bmatrix} \quad \text{Dist!}$$

$$= \begin{bmatrix} \phantom{I_{xx}} & \phantom{-I_{xy}} \\ \phantom{\text{sym}} & \phantom{I_{yy}} \end{bmatrix} \quad \text{Dist!}$$

!(Le abt)

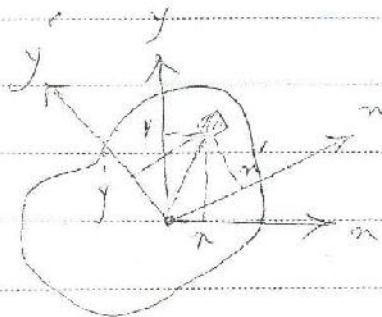
(Dist!) (Le abt) (Dist!) (Le abt)

$$\begin{bmatrix} I_{xx} \\ I_{yy} \end{bmatrix} \rightarrow \text{ab! Dist! (Le abt)}$$

$$\rightarrow \text{Min. Max}$$

=

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$





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$$I_{x'x'} = \int y'^2 dA = \int (-\sin\theta x + \cos\theta y)^2 dA$$

$$= \sin^2\theta \int x^2 dA + \cos^2\theta \int y^2 dA - 2\sin\theta\cos\theta \int xy dA$$

$I_{yy}$

$I_{xx}$

$I_{xy}$

مطلوب  $I_{xx'}$  و  $I_{xy'}$

$$I_{x'y'} = \int x'y' dA = \int (-x\sin\theta + y\cos\theta)(x\cos\theta + y\sin\theta) dA =$$

$$(I_{xx} - I_{yy})\sin\theta\cos\theta + I_{xy}(\cos^2\theta - \sin^2\theta)$$

! ←  $I_{x'x'}$  و  $I_{x'y'}$  مع  $2\theta$

$$I_{xx'} = \frac{I_{xx} - I_{yy}}{2} + \frac{I_{xx} + I_{yy}}{2} \cos 2\theta - I_{xy} \sin 2\theta$$

$$I_{x'y'} = \frac{I_{xx} - I_{yy}}{2} \sin 2\theta + I_{xy} \cos 2\theta$$

~~مطلوب~~  $(\cos 2\theta)$   
مطلوب  $(\sin 2\theta)$

$$\frac{dI_{x'y'}}{d\theta} = 0 \rightarrow \tan 2\theta = \frac{-2I_{xy}}{I_{xx} - I_{yy}}$$

$I_{x'y'} = 0$

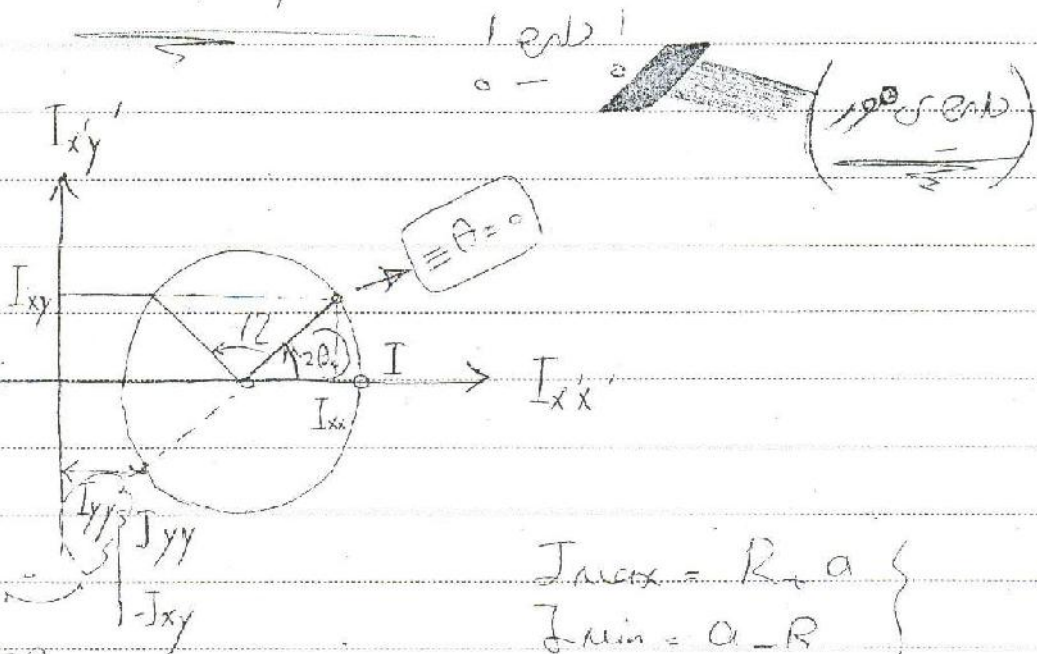
مطلوب  $(\cos 2\theta)$  و  $(\sin 2\theta)$

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$$\left[ I_{xx}' - \frac{I_{xx} - I_{yy}}{2} \right]^2 + I_{xy}'^2 = \left( \frac{I_{xx} - I_{yy}}{2} \right)^2 + I_{xy}^2$$

$$(X-a)^2 + y^2 = R^2$$



$$\left. \begin{aligned} I_{max} &= R + a \\ I_{min} &= a - R \end{aligned} \right\}$$

described

radius of circle

$I_{yy} = I_{xx}$

$$\tan 2\theta = \frac{-I_{xy}}{\frac{I_{xx} - I_{yy}}{2}}$$

$$\frac{R^4 \sin \alpha}{2}$$

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$$\begin{bmatrix} 5 & 1 \\ 1 & 2 \end{bmatrix} \begin{matrix} R_1 \rightarrow \\ R_2 \rightarrow \end{matrix} \begin{matrix} \times \\ - \\ = \\ 0 \end{matrix} \quad \left| \begin{bmatrix} 5-\lambda & 1 \\ 1 & 2-\lambda \end{bmatrix} \right| = 0$$

$$(5-\lambda)(2-\lambda) - 1 = 0$$

$$\rightarrow \lambda_1, \lambda_2 = \frac{3.5 \pm \sqrt{13}}{2}$$

دالة مميزة حقيقية (Real Eigenvalue)

دالة مميزة حقيقية (Real Eigenvalue)

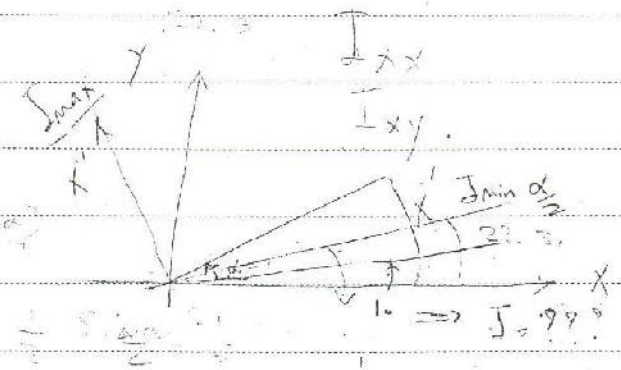
$$I_{x'x'} + I_{y'y'} = 2a \quad \text{ثابت}$$



در مسائل مابین چهار وجهی در این صورت است!

در مسائل مابین چهار وجهی

جواب



$$I_{xx} = \frac{R^4}{4} \left[ \frac{\alpha}{2} \frac{\sin 2\alpha}{2} \right]$$

$$I_{yy} = \frac{R^4}{4} \left[ \frac{\alpha}{2} \frac{\sin 2\alpha}{2} \right]$$

$$a = \frac{I_{xx} + I_{yy}}{2} = \frac{R^4 \alpha}{8}$$

$$I_{xy} = \int xy dA = \frac{R^4}{4} \left[ \frac{\sin 2\alpha}{2} \right]$$

$$R = \sqrt{\left( \frac{-R^4}{4} \cdot \frac{\sin 2\alpha}{2} \right)^2 + \left( \frac{R^4}{4} \cdot \frac{\sin 2\alpha}{2} \right)^2} = R^4 \sqrt{\frac{\sin^2 2\alpha}{4} + \frac{\sin^2 2\alpha}{4}} = R^4 \sqrt{\frac{2 \sin^2 2\alpha}{4}} = R^4 \sqrt{\frac{\sin^2 2\alpha}{2}}$$

KANDOO



Subject:

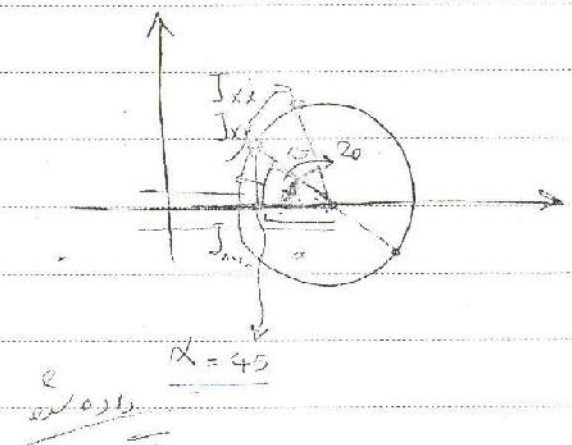
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$$\tan 2\alpha = \frac{\sin 2\alpha}{\cos 2\alpha} = \frac{2 \sin \alpha \cos \alpha}{\cos^2 \alpha - \sin^2 \alpha} = \frac{2 \tan \alpha}{1 - \tan^2 \alpha}$$

میدان مرکز ثقل E

I<sub>xx</sub> I<sub>yy</sub> I<sub>xy</sub>  
محور

محورهای اصلی I<sub>xx</sub> و I<sub>yy</sub> را پیدا کنید!



محور اصلی!

$$I_{xx} = \int y^2 dA = \sum I_{xx_i}$$

$$I_{xx} = \sum I_{xx_i} + \sum y_i^2 A_i = \sum I_{xx_i} + \sum y_i^2 A_i$$

محور اصلی

Subject:

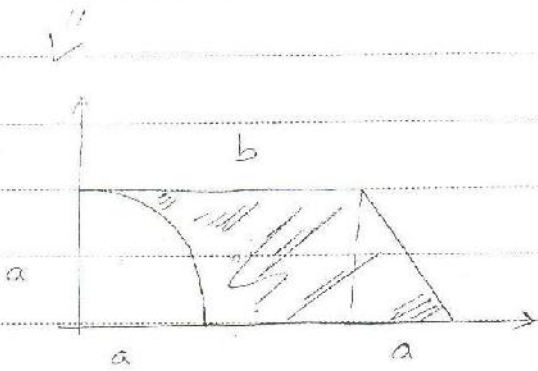
Year

Month

Date

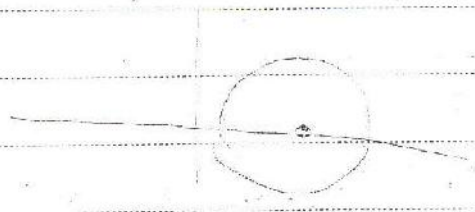
( )

	$\bar{I}_{xx}$	$\bar{I}_{yy}$	$\bar{I}_{xy}$	$\bar{x}_c$	$\bar{y}_c$	A	$\bar{x}_c^2 A$	$\bar{y}_c^2 A$	$\bar{x}_c \bar{y}_c A$
1/2 Circle	$\frac{ba^3}{12}$	$\frac{ab^3}{12}$	0	$-\frac{b}{2}$	$-\frac{a}{2}$	ab	$\frac{b^2 ab}{4}$	$\frac{a^2 ab}{4}$	$\frac{ab^2 ab}{4}$
2/3 Triangle	$\frac{a^3}{36}$	$\frac{4}{36}$	0	$-(\frac{b+a}{3})$	$-\frac{a}{3}$	$\frac{a^2}{2}$	—	—	$(b+\frac{a}{3})(\frac{a}{3})(\frac{a^2}{2})$
end of	9	9	9	$\frac{4a}{3\pi}$	$\frac{4a}{3\pi}$	$\frac{\pi a^2}{4}$			



$$I_{xx} = \frac{\pi R^4}{16} + \left( \frac{4a}{3\pi} \right)^2 \left( \frac{1}{2} a^2 \right) \Rightarrow I = \left( \frac{\pi}{16} - \frac{4}{9\pi} \right) a^4$$

$I_{yy} =$



Subject:

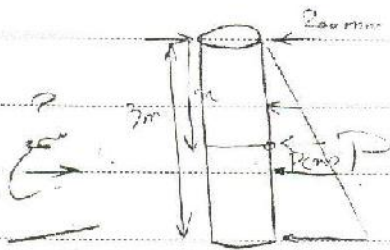
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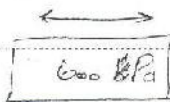


# Friction

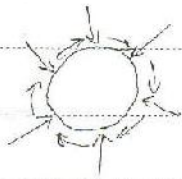


$$\mu_s = 0.3$$

جواب سوال  
فریسی



$$P = 200 \times (0.3)$$



$$dN = P \cos(\alpha) \, d\alpha$$

$$dF_s = \mu \, dN = \mu P \cos(\alpha) \, d\alpha$$

$$dM = r \, dF_s = \mu P r \cos(\alpha) \, d\alpha$$

$$M = \int dM = \mu P r \int_0^{\pi/2} \cos(\alpha) \, d\alpha = 17 \, \text{N}\cdot\text{m}$$

پس جواب سوال 17 نیوتن متر





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( )

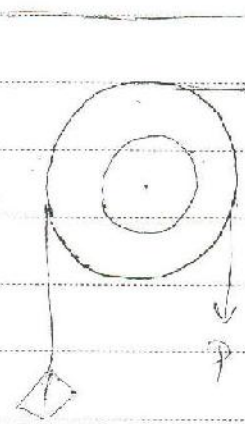
$$P = \rho$$

$$P = \int dN \sin \theta = 2\pi \rho \int_{R_1}^{R_2} r dr$$

$$P = \pi \rho (R_2^2 - R_1^2)$$

$$P = \frac{2}{3} \frac{\pi \rho}{\sin \theta} \times \frac{R_2^3 - R_1^3}{R_2^2 - R_1^2}$$

بیشتر



$\omega = 500 \text{ lb}$

$P$  (in  $z$ )  $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$

$\omega = 500 \text{ lb}$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$

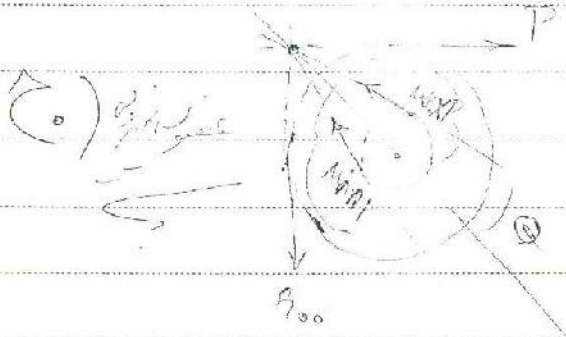
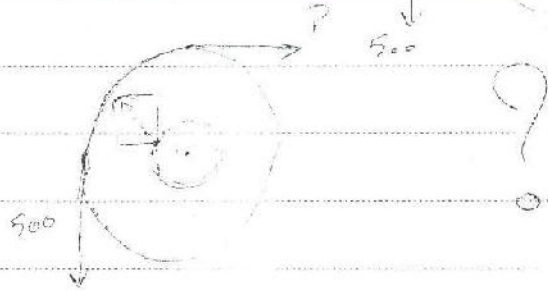
$\omega = 500 \text{ lb}$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$

$\omega = 500 \text{ lb}$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$

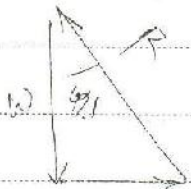
$\omega = 500 \text{ lb}$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$   $P$   $\rightarrow$

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$$\tan \theta = \frac{rP}{\sqrt{2} \cdot 500} \Rightarrow \theta = 49.1^\circ$$



$$P_{min} = 500 \tan 49.1$$

$$P = 577.13$$

3. A block of mass 120 kg is pushed up a rough inclined plane by a force P acting parallel to the plane. The block is pushed up the plane at a constant speed. The coefficient of friction is 0.15. Find the magnitude of P.

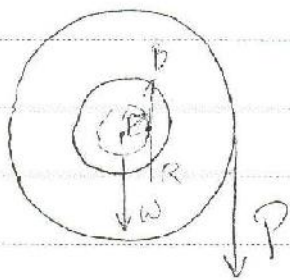
Given:  $m = 120 \text{ kg}$ ,  $\mu = 0.15$ ,  $v = \text{constant}$

Find:  $P$



Subject: \_\_\_\_\_

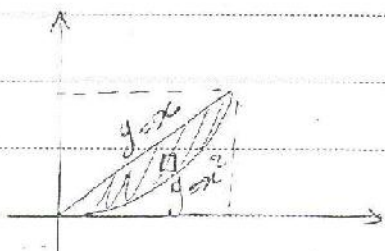
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$$\sum M_B = 0 \Rightarrow P(60 - r_f) = W \times (r_f)$$

$$r_f = 15 \text{ m} = 4.5$$

$$P = 40 \text{ N}$$



1.  $x = \frac{y}{m}$  (from  $y = mx$ )

$$I_{xx} = ? \quad \int y^2 dA = \int_0^m \int_{x^2}^m y^2 (dy dx)$$

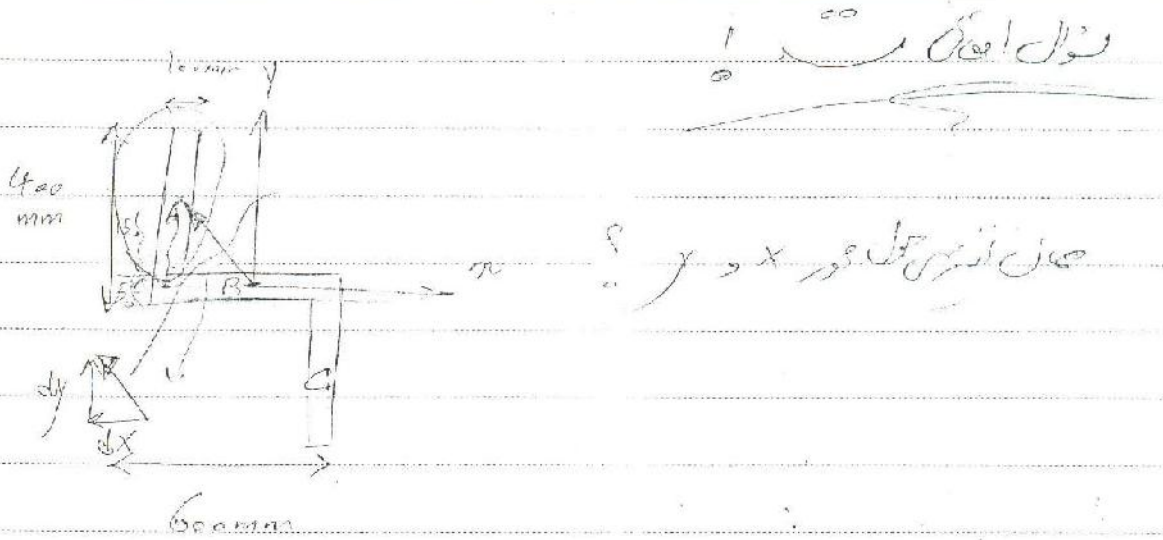
$$I_{xy} = ? \quad = \int_0^m \left. \frac{1}{3} y^3 \right|_{x^2}^m dx = \frac{1}{3} \int_0^m (m^3 - m^3 x^2) dx$$

$$I_{xy} = \int xy dA = \int_0^m \int_{x^2}^m xy dy dx = \int_0^m \left. \frac{xy^2}{2} \right|_{x^2}^m dx =$$

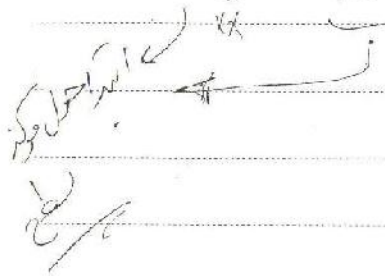
$$\frac{1}{2} \int_0^m (m^3 x - x^5) dx$$

Subject: \_\_\_\_\_

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(A) 
$$I_x = \frac{1}{12} \times 100 \times 300^3 + 100 \times 300 \times (200)^2 = 1.425 \times 10^8 \text{ mm}^4$$



$$I_y = \frac{1}{12} \times 300 \times 100^3 + 100 \times 300 \times (250)^2 = 1.9 \times 10^8 \text{ mm}^4$$



$$I_{xy} = 0 + A d_x d_y = 100 \times 300 \times (250) \times (-200) = -1.5 \times 10^8 \text{ mm}^4$$

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$$\textcircled{A} \quad I_x = 1.425 \times 10^9$$

$$I_y = 1.9 \times 10^9$$

$$I_{xy} = -1.5 \times 10^9$$

$$\textcircled{B} \quad I_x = \frac{1}{12} (600)(400)^3 = 0.05 \times 10^9$$

$$I_y = \frac{1}{12} \times 1000 \times (600)^3 = 1.8 \times 10^9$$

$$I_{xy} = 0$$

$$I_{xx} = \sum I_{xx} =$$

$$I_{yy} = \sum I_{yy} =$$

$$I_{xy} = \sum I_{xy} =$$



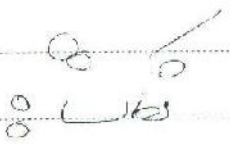
Subject:

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مجموعه (  $I_{xy}$   $I_{yy}$   $I_{xx}$  )



مجموعه  $I_{xy}$   $I_{yy}$   $I_{xx}$  را می توان به روش زیر محاسبه کرد.



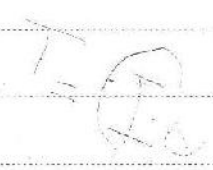
مجموعه  $I_{xy}$   $I_{yy}$   $I_{xx}$  را می توان به روش زیر محاسبه کرد.

مجموعه  $I_{xy}$   $I_{yy}$   $I_{xx}$  را می توان به روش زیر محاسبه کرد.

مجموعه  $I_{xy}$   $I_{yy}$   $I_{xx}$  را می توان به روش زیر محاسبه کرد.

$$O \left( \frac{I_{xx} + I_{yy}}{2}, 0 \right)$$

مجموعه  $(I_{xx}, I_{yy})$  A



مجموعه  $(I_{xx}, I_{yy})$  A

Subject:

Year. Month. Date. ( )

دانشگاه تهران - محوطه واقع در میدان خاور -  $I_{min}$  و  $I_{max}$  را در  $\theta = 0^\circ$  و  $90^\circ$  محاسبه کنید

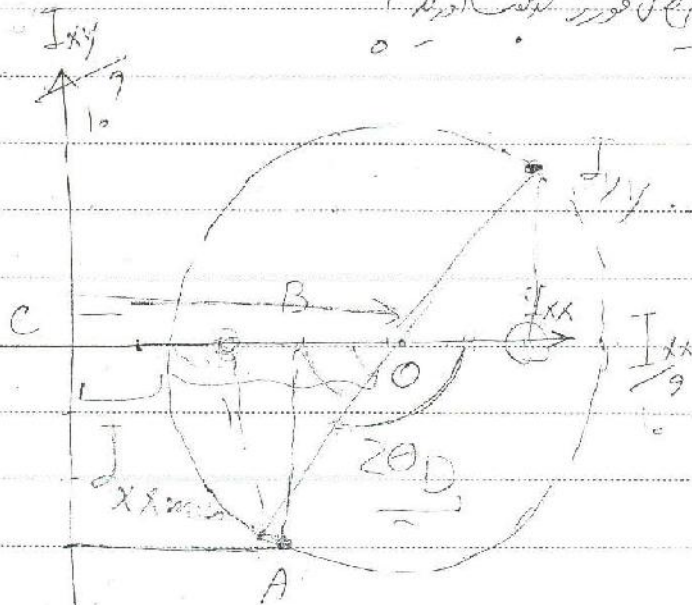
دانشگاه تهران - محوطه واقع در میدان خاور -  $I_{xy}$  را در  $\theta = 45^\circ$  محاسبه کنید

دانشگاه تهران - محوطه واقع در میدان خاور -  $I_{xx}$  و  $I_{yy}$  را در  $\theta = 0^\circ$  و  $90^\circ$  محاسبه کنید

دانشگاه تهران - محوطه واقع در میدان خاور -  $I_{xy}$  را در  $\theta = 45^\circ$  محاسبه کنید

در همان حالت

دانشگاه تهران - محوطه واقع در میدان خاور -  $I_{xx}$  و  $I_{yy}$  را در  $\theta = 45^\circ$  محاسبه کنید



$$O (4.55, 0) \times 10^6$$

$$OA = \sqrt{(4.55 - 2.9)^2 + 3^2} = 3.29$$

$$A (2.9, -3) \times 10^6$$

Year: \_\_\_\_\_ Month: \_\_\_\_\_ Date: \_\_\_\_\_



$$I_{MO} = (4.25 + 3.22) \times 10^{-9} \text{ m}^4$$

$$I_{min} = CO \cdot OA = (4.25 - 3.22) \times 10^{-9} \text{ m}^4$$

$$I_{xy} = 1.339 \times 10^{-9} \text{ m}^4$$

$$2\theta_{D_1} = 180 - \sin^{-1} \frac{BA}{GA} = 114.2^\circ$$

$$\theta_{D_1} = 57.1^\circ \text{ CCW} \Rightarrow \theta_{D_2} = 9^\circ + \theta_{D_1}$$