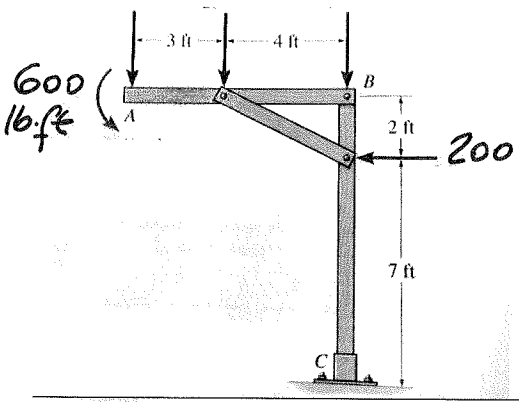
Section of Dr. Tabbara

CIE200 Statics	Fall/2014	FINAL EXAM	15-January-2015	3 HOURS	Closed Book	Page 1/2

Name M. TABBARA ID# SOLUTION

- ALL FBDs required for the solution should be clearly drawn
- ALL calculations required for the solution should be clearly shown

300 200 400 lb



600 lb-ft

Problem 1 (10 Points)

Replace System #1 shown in the figure by an equivalent System #2 that consists of a single force and specify where its line of action intersects line AB measured from A. Draw the updated diagram of System #2 showing all your results.

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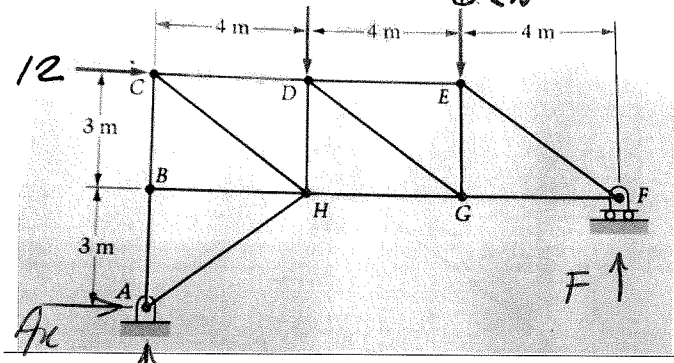
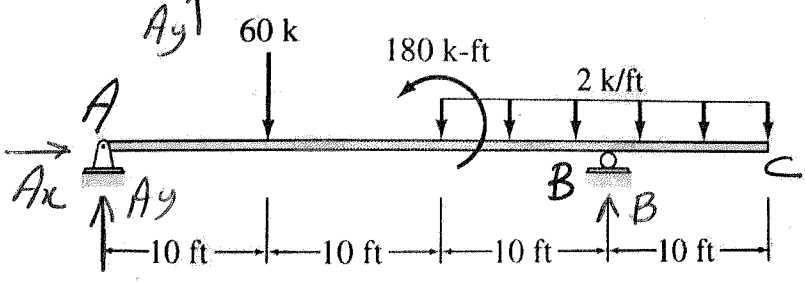
12 6 kN



Problem 2 (15 Points)

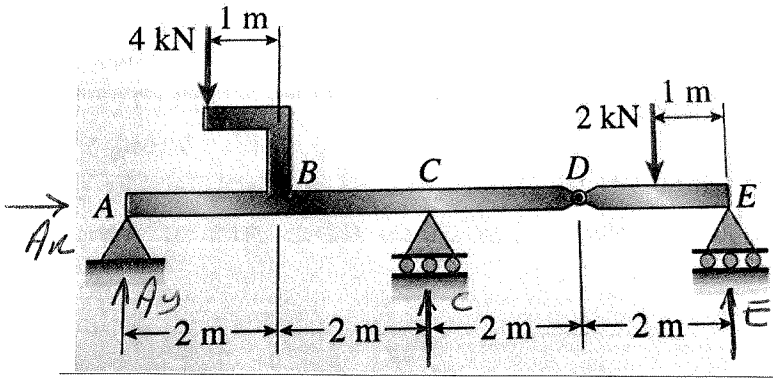
The truss is supported by a hinge at A and roller at F. Determine the axial force in:

(1) Member CH using the **Method of Joints**; no other method will count.
(2) Member DH using the **Method of Sections**; no other method will count.



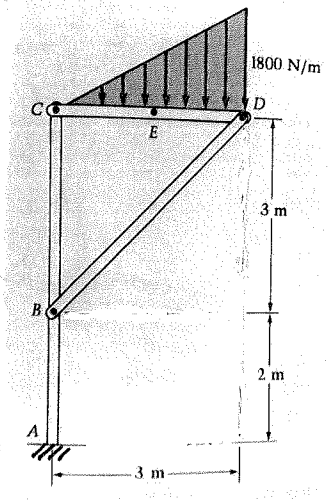
Problem 3 (15 Points)

Draw the moment diagram for AC. Supports are hinge at A and roller at B. Use **Method B** (method of relations), any other method will not count.

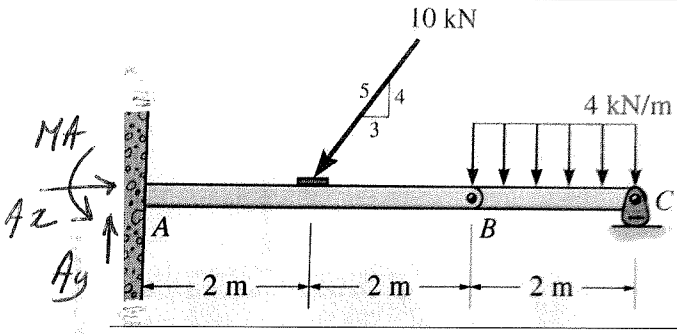


Problem 4 (10 Points)

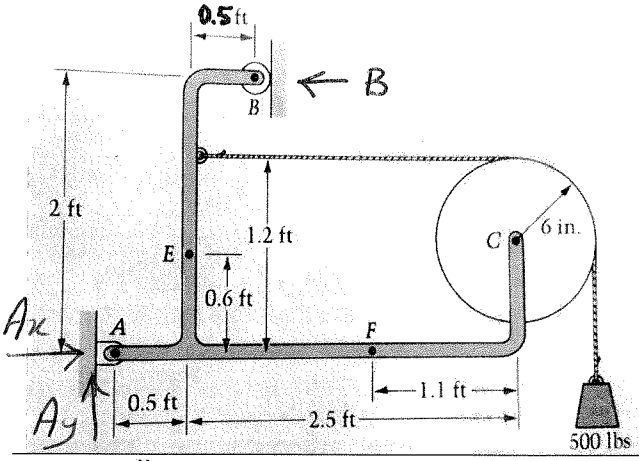
Two members AD and DE are connected by a pin at D. Supports are hinge at A, roller at C roller, and roller at E. Determine the equation of the moment between B and C using A as the origin. Use **method A** (method of cuts), any other method will not count.



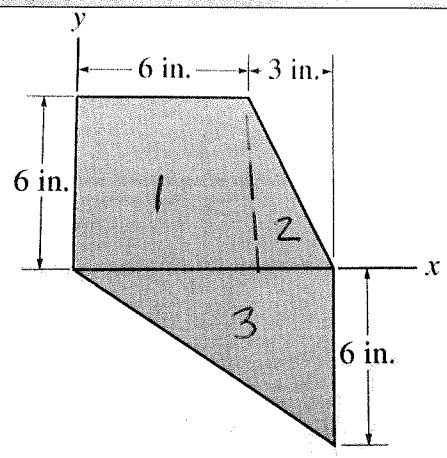
Problem 5 (10 Points)
Three members AC, CD and BD are connected by pins at B, C and D as shown in the figure. Support is a fixity at A. Determine the internal actions at E, the midpoint of CD.



Problem 6 (10 Points)
Two members AB and BC are connected by a pin at B. Supports are fixity at A and roller at C. Determine reactions at A.



Problem 7 (20 Points)
One member with a pulley at C. Supports are hinge at A and roller at B. Determine the internal actions:
(1) at point E
(2) at point F

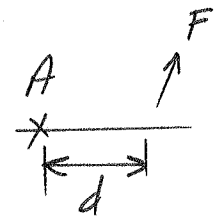


Problem 8 (10 points)
For the composite area shown in the figure, determine the:
(1) Coordinates of the centroid
(2) Moment of inertia about the y-axis

Moment of Inertia
Rectangle about centroidal axis = 1/12 BH^3
Triangle about centroidal axis = 1/36 BH^3

FINAL SOLUTION

(1)



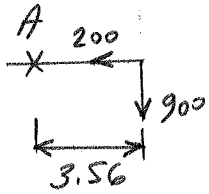
$\overset{+}{\rightarrow} \Sigma F_x : F_x = 200$

$+\uparrow \Sigma F_y : F_y = -300 - 200 - 900, \quad F_y = -900$

$\circlearrowleft^{+} \Sigma M_A : F_y(d) = 600 - 200(3) - 400(7) - 200(2), \quad d = 3.56$

$\uparrow -900$

SYS #2



UPDATED

(2) BASIC FBD

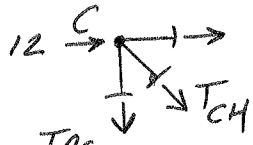
$\circlearrowleft^{+} \Sigma M_A = 0 : F(12) - 12(6) - 12(4) - 6(8) = 0, \quad F = 14$

$\uparrow^{+} \Sigma F_y = 0 : A_y + F - 12 - 6 = 0, \quad A_y = 4$

$\uparrow 14$

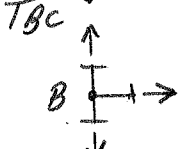
$\overset{+}{\rightarrow} \Sigma F_x = 0 : A_x + 12 = 0, \quad A_x = -12$

METHOD OF JOINTS



$\uparrow^{+} \Sigma F_y = 0 : -T_{BC} - T_{CH}\frac{3}{5} = 0, \quad T_{CH} = \frac{65}{3}$

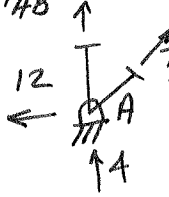
$\uparrow -13$



$\uparrow^{+} \Sigma F_y = 0 : -T_{AB} + T_{BC} = 0, \quad T_{BC} = -13$

$\uparrow -13$

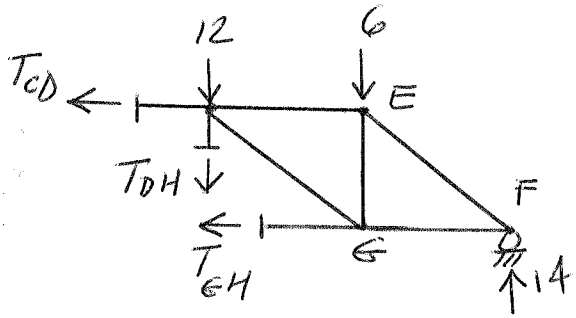
$\overset{+}{\rightarrow} \Sigma F_x = 0 \quad T_{AH}\frac{4}{5} - 12 = 0, \quad T_{AH} = 15$



$\uparrow^{+} \Sigma F_y = 0 : T_{AB} + T_{AH}\frac{3}{5} + 4 = 0, \quad T_{AB} = -13$

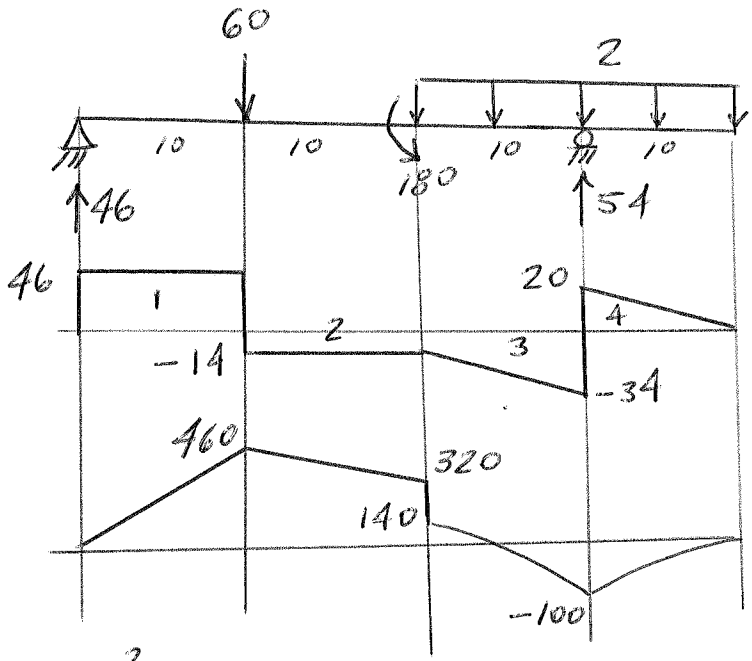
$\uparrow 15$

METHOD OF SECTIONS



$\uparrow^{+} \Sigma F_y = 0 : -T_{DH} - 12 - 6 + 14 = 0, \quad T_{DH} = -4$

(3)



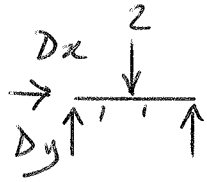
BASIC FBD

$\circlearrowleft^+ \Sigma M_B = 0: -A_y(30) + 60(20) + 180 = 0$, $A_y = 46$

$\uparrow^+ \Sigma F_y = 0: A_y - 60 - 40 + B = 0$, $B = 54$

	V-AREA
1	460
2	-140
3	-240
4	100

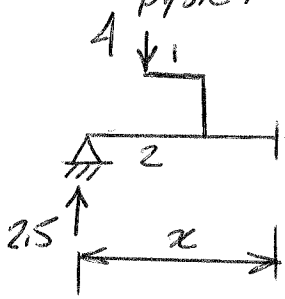
(4)



$\circlearrowleft^+ \Sigma M_D = 0: E(2) - 2(1) = 0$, $E = 1$

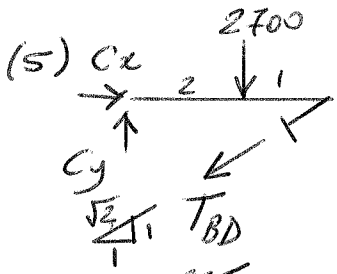
$\circlearrowleft^+ \Sigma M_C = 0: -A_y(4) + 1(3) - 2(3) + E(4) = 0$, $A_y = 2.5$

BASIC FBD



$\circlearrowleft^+ \Sigma M_x = 0: M - 2.5x + 1(x-1) = 0$, $M = -1.5x + 1$

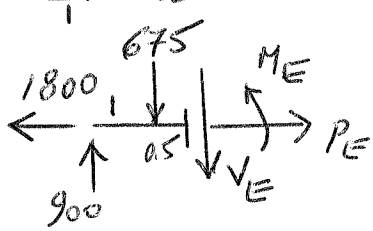
(5)



$\circlearrowleft^+ \Sigma M_C = 0: -2700(2) - T_{BD}\frac{1}{\sqrt{2}}(3) = 0$, $T_{BD} = -1800\sqrt{2}$

$\rightarrow^+ \Sigma F_x = 0: C_x - T_{BD}\frac{1}{\sqrt{2}} = 0$, $C_x = -1800$

$\uparrow \Sigma F_y = 0: C_y - 2700 - T_{BD}\frac{1}{\sqrt{2}} = 0$, $C_y = 900$

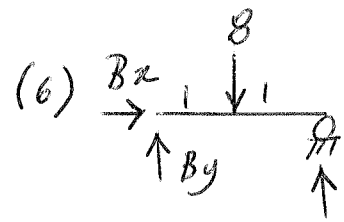


$\rightarrow^+ \Sigma F_x = 0: -1800 + P_E = 0$, $P_E = 1800$

$+\uparrow \Sigma F_y = 0: 900 - 675 - V_E = 0$, $V_E = 225$

$\circlearrowleft^+ \Sigma M_E = 0: -900(1.5) + 675(0.5) + M_E = 0$, $M_E = 1012.5$

(6)



$\circlearrowleft^+ \Sigma M_B = 0: -8(1) + C(2) = 0$, $C = 4$

BASIC FBD $\rightarrow^+ \Sigma F_x = 0: A_x - 10\frac{3}{5} = 0$, $A_x = 6$

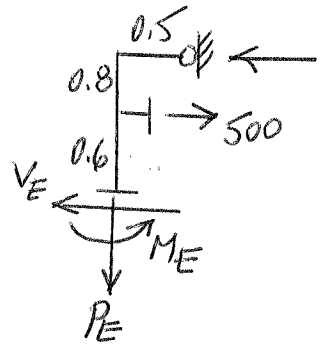
$+\uparrow \Sigma F_y = 0: A_y - 10\frac{4}{5} - 8 + C = 0$, $A_y = 12$

$\circlearrowleft^+ \Sigma M_A = 0: M_A - 10\frac{4}{5}(2) - 8(5) + C(6) = 0$, $M_A = 32$

$C = 4$

(7) BASIC FBD

$\curvearrowright^{+} \Sigma M_A = 0 : -500(3.5) + B(2) = 0 \;,\; B = 875$

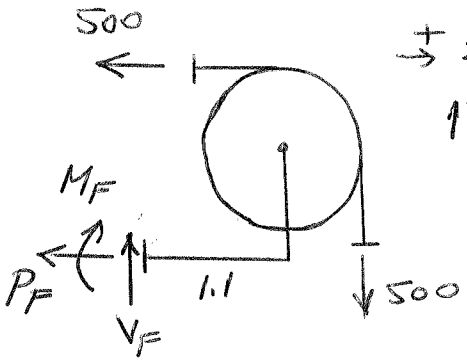


$\rightarrow \Sigma F_x = 0 : -V_E + 500 - 875 = 0 \;,\; V_E = -375$

$\uparrow^{+} \Sigma F_y = 0 : -P_E = 0 \;,\; P_E = 0$

$\curvearrowright^{+} \Sigma M_E = 0 : M_E - 500(0.6) + 875(1.4) = 0$

$M_E = -925$



$\rightarrow^{+} \Sigma F_x = 0 : -P_F - 500 = 0 \;,\; P_F = -500$

$\uparrow^{+} \Sigma F_y = 0 : V_F - 500 = 0 \;,\; V_F = 500$

$\curvearrowright^{+} \Sigma M_F = 0 : -M_F - 500(1.6) + 500(1.2) = 0$

$M_F = -200$

(8)

AREA	A_i	$\bar{x}_i$	$\bar{y}_i$	$\bar{x}_i A_i$	$\bar{y}_i A_i$
1	$6 \times 6 = 36$	3	3	108	108
2	$\frac{1}{2} 6 \times 3 = 9$	7	2	63	18
3	$\frac{1}{2} 6 \times 9 = 27$	6	-2	162	-54
	72			333	72

$\bar{x} = \frac{333}{72} \qquad \bar{y} = \frac{72}{72}$

$I = \frac{1}{3} 6 \times 6^3 + \frac{1}{36} 6 \times 3^3 + 9(7)^2 + \frac{1}{36} 6 \times 9^3 + 27(6)^2$

$= 1971$