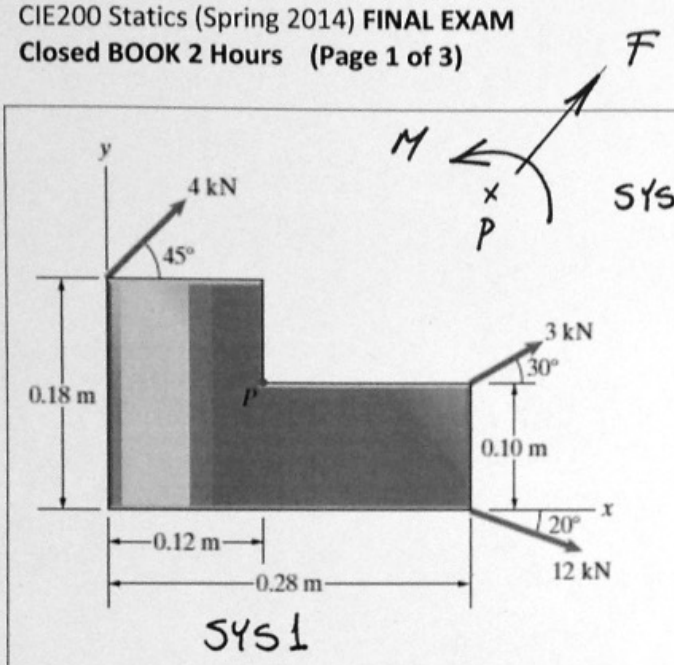
CIE200 Statics (Spring 2014) **FINAL EXAM**
Closed BOOK 2 Hours (Page 1 of 3)

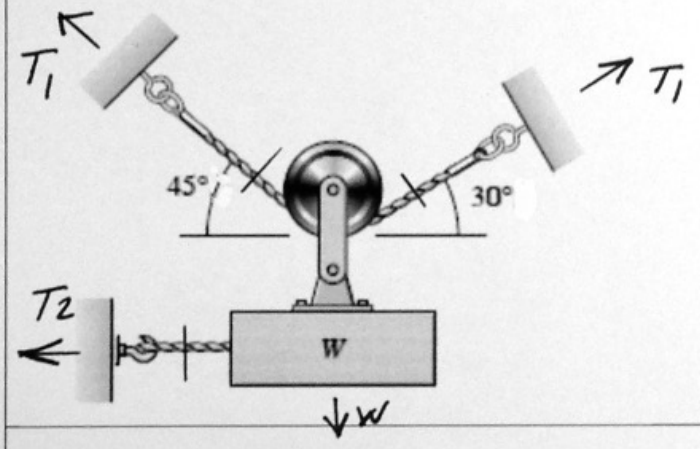


Problem 1 (10 points)
Replace the force system by a single force F and a couple M at point P. Determine F and M.

$\overset{+}{\rightarrow} F_x = 4\cos 45 + 3\cos 30 + 12\cos 20 = 16.7$

$\overset{+}{\uparrow} F_y = 4\sin 45 + 3\sin 30 - 12\sin 20 = 0.224$

$\overset{+}{\circlearrowleft} M = -4\cos 45(0.08) - 4\sin 45(0.12) + 3\sin 30(0.16) = 0.145$



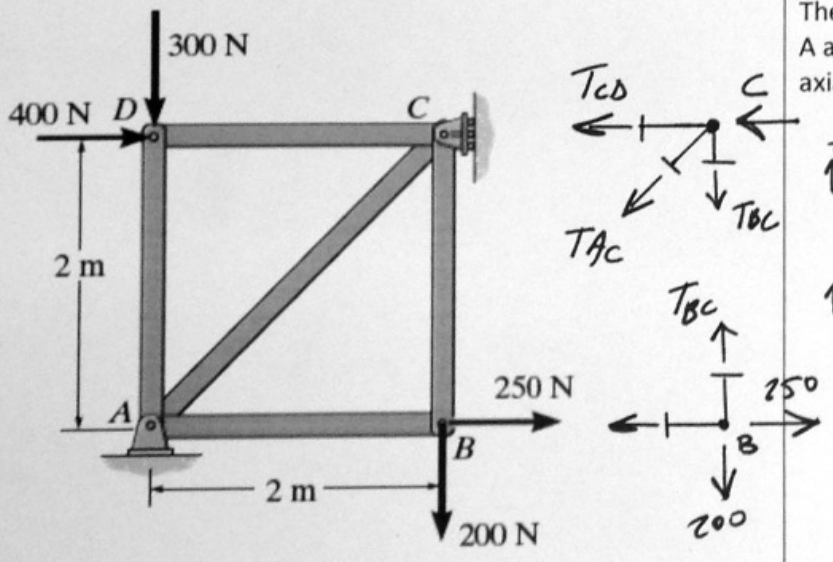
Problem 2 (10 points)
Determine the tension in all cables. Express your results in terms of W.

$+\uparrow T_1\sin 45 + T_1\sin 30 - W = 0$

$T_1 = 0.828\,W$

$\overset{+}{\rightarrow} -T_2 - T_1\cos 45 + T_1\cos 30 = 0$

$T_2 = 0.132\,W$



Problem 3 (10 points)
The truss is supported by a hinge at A and a roller at C. Determine the axial force in member AC.

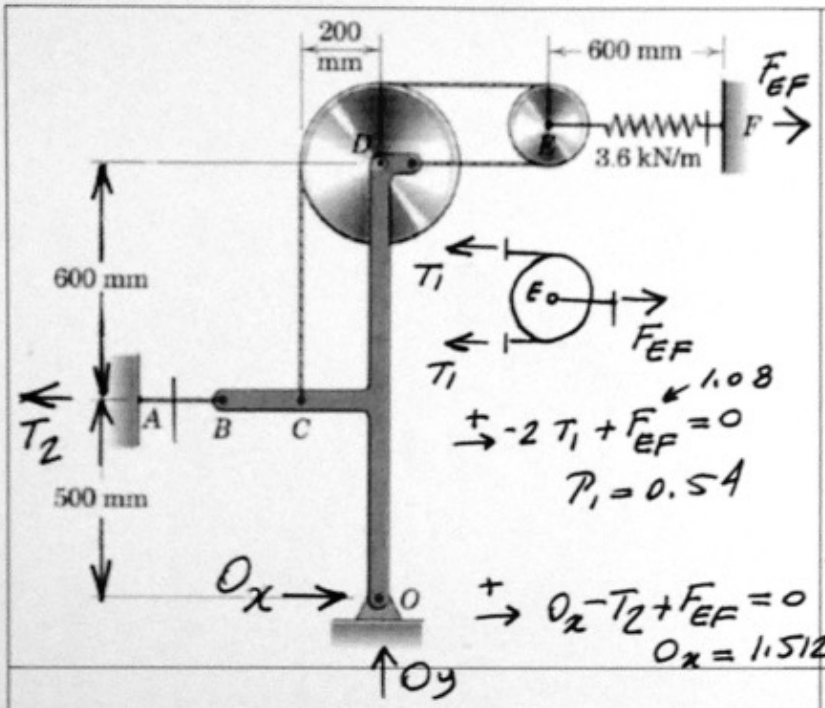
FBD @ B

$\overset{+}{\uparrow} T_{BC} - 200 = 0, \quad T_{BC} = 200$

FBD @ C

$\overset{+}{\uparrow} -T_{AC}\frac{1}{\sqrt{2}} - T_{BC} = 0,$

$T_{AC} = -200\sqrt{2}$



Problem 4 (15 points)
The un-stretched (original) length spring EF is 300 mm and the spring constant = 3.6 kN/m. A cable connects A to B and a cable connects C to D. Supports are hinges at A, F and O.
(1) Determine the tension in all cables.
(2) Determine the reactions at O.

$F_{EF} = 3.6(0.6-0.3) = 1.08$

BASIC FBD

$\stackrel{+}{\rightarrow} -2T_1 + F_{EF} = 0$ (1.08)

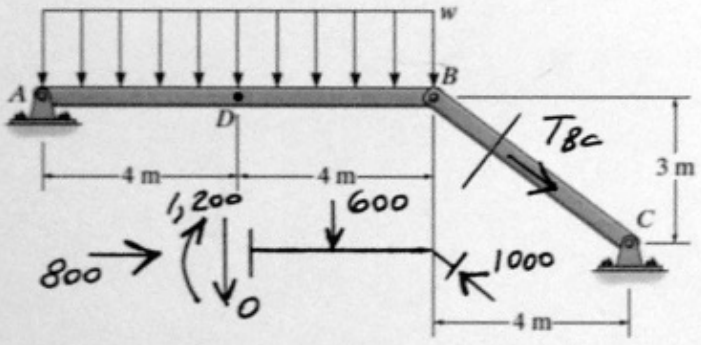
$T_1 = 0.54$

$\stackrel{+}{\rightarrow} O_x - T_2 + F_{EF} = 0$

$O_x = 1.512$

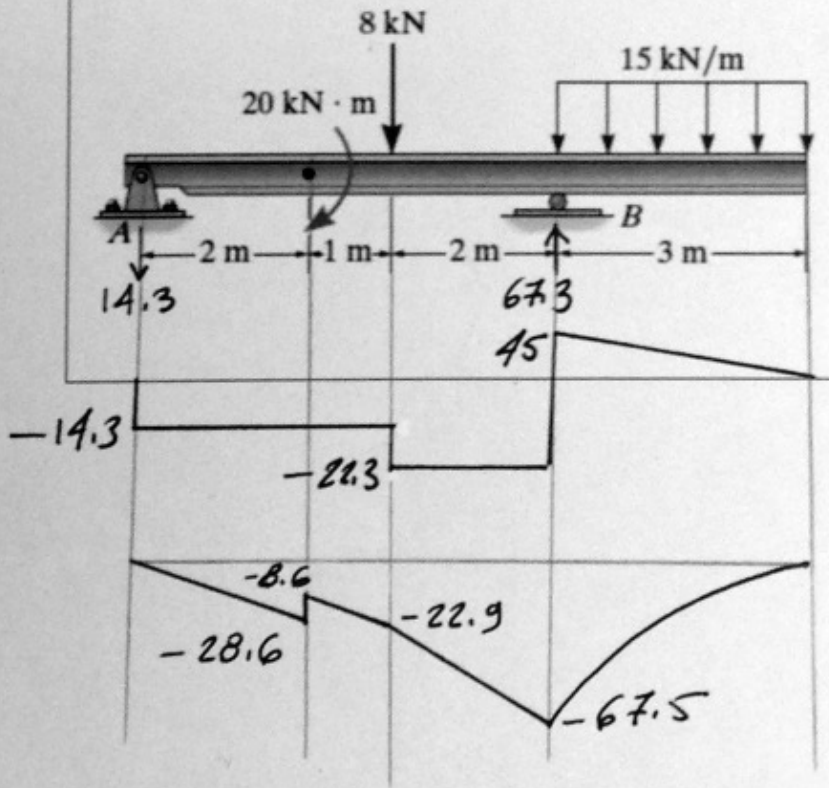
$+\circlearrowleft \Sigma M_O = 0: \; T_2(500) - F_{EF}(1200) = 0$

$T_2 = 2.592$

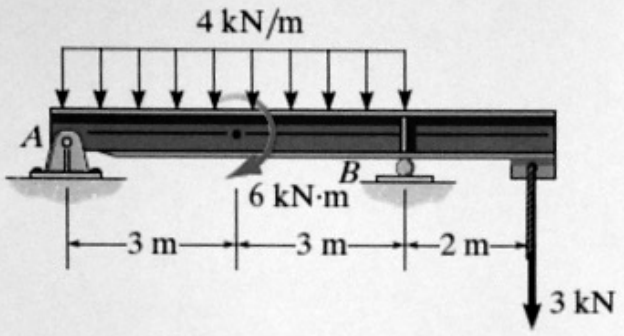


Problem 5 (15 points)
Two members AB and BC are connected by a pin at B. Supports are hinge at A and hinge at C. Determine the internal actions at D. Use w = 150 N/m.

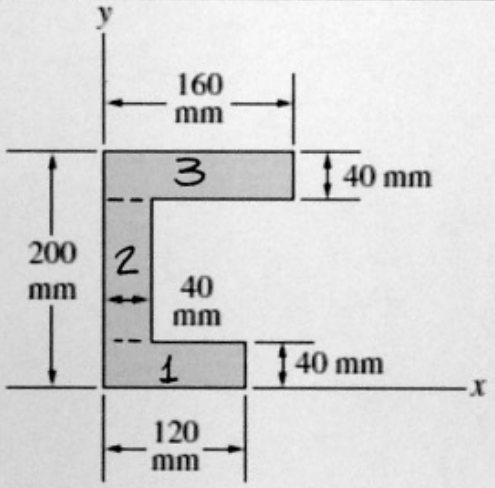
$+\circlearrowleft \Sigma M_A = 0: \; -T_{BC}\frac{3}{5}(8) - 1{,}200(4) = 0, \; T_{BC} = -1{,}000$



Problem 6 (15 points)
Draw the shear and moment diagrams using method B (the method of relations). Any other method will not count. Supports are hinge at A and roller at B.

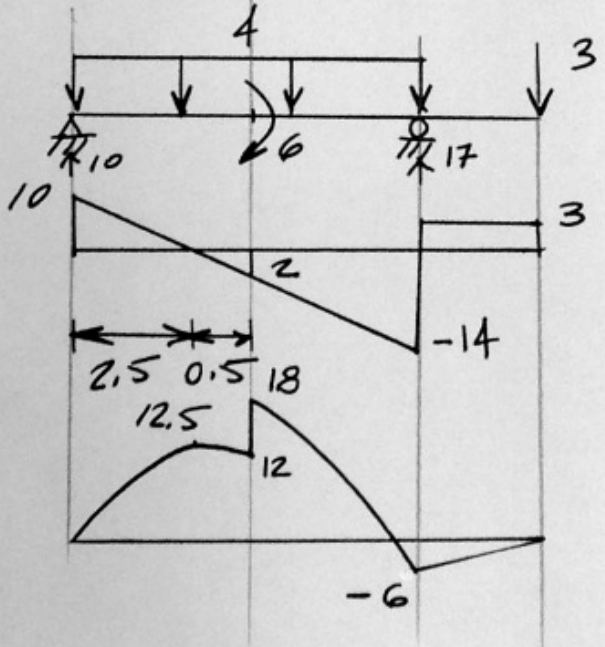


Problem 7 (15 points)
Draw the shear and moment diagrams using method B (the method of relations). Any other method will not count. Supports are hinge at A and roller at B.



Problem 8 (10 points)
(1) Determine the coordinates of the centroid of the composite area.
(2) Determine the moment of inertia of the composite area about the x-axis.

Moment of inertia of a rectangle about centroidal axis = 1/12 BH^3



$$I_2 = \frac{1}{3}\times 120\times 40^3 + \frac{1}{12}\times 40\times 120^3 + 40\times 120\times 100^2 + \frac{1}{12}\times 160\times 40^3 + 160\times 40\times 180^2$$

$$= 264\times 10^6 \text{ mm}$$

SECTION	A_i	x_i	y_i	$A_i x_i$	$A_i y_i$
120×40	4,800	60	20	288,000	96,000
120×40	4,800	20	100	96,000	480,000
160×40	6400	80	180	512,000	1,152,000
	16,000			896,000	1,728,000

$\bar{x} = 56$ mm

$\bar{y} = 108$ mm