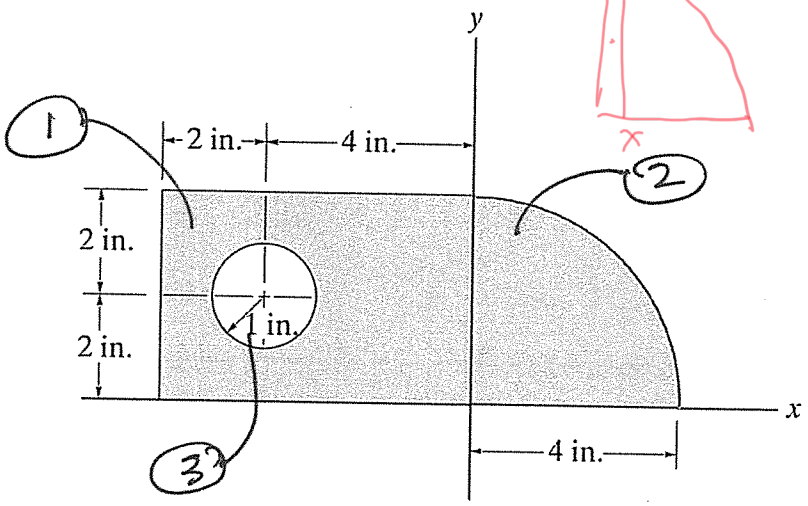
Name: _____ CWID #: _____ Section Number: _____

ENSC 2113 - FALL 2017 - EXAM #2

EACH PROBLEM IS WORTH 25 POINTS. BOX YOUR ANSWERS AND PROVIDE PROPER UNITS, WHERE APPLICABLE. CALCULATIONS AND FREE BODY DIAGRAMS MUST BE SHOWN THAT SUPPORT THE ANSWER TO RECEIVE CREDIT.

1) Using the tabular method of composite bodies, calculate the centroidal distance measured from the y-axis, x bar.



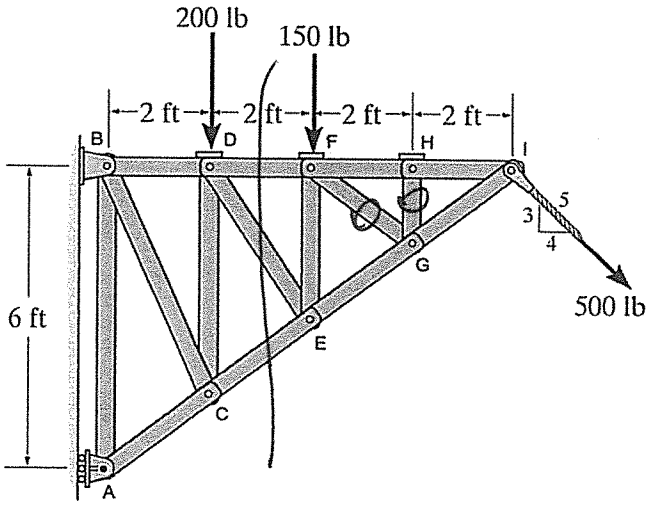
$$\frac{\int \frac{1}{2}x\cdot\sqrt{16-x^2}\,dx}{\frac{1}{4}\cdot 4^2\pi} = \frac{\frac{1}{3}(16-x^2)^{\frac{3}{2}}\Big|_0^4}{4\pi} = -\frac{1}{24\pi}(0-64) = \frac{8}{3\pi}$$

$$\bar{x} = \frac{\Sigma A\tilde{x}}{\Sigma A}$$

SHAPE	AREA	$\tilde{x}$	$A\tilde{x}$
1	bh $6(4) = 24$	$-\frac{b}{2}$ $-\frac{6}{2} = -3$	-72
2	$\frac{\pi r^2}{4}$ $\frac{\pi(4)^2}{4} = 12.57$	$\frac{4r}{3\pi}$ $\frac{4(4)}{3\pi} = 1.7$	21.33
3 VOID	$-\pi r^2$ $-\pi(1)^2 = -3.14$	-4	12.57
Σ	33.43		-38.1

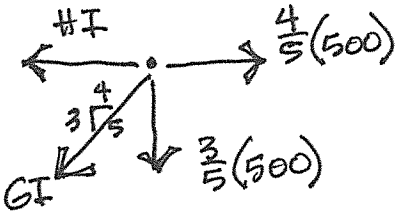
$$\bar{x} = \frac{-38.1}{33.43} = \boxed{-1.14 \text{ in}}$$

2) The truss below is supported by a pin at B and a roller at A. Determine the force in members DF, DE, and CE by method of sections and GI by method of joints. Indicate if the member is in tension or compression. List all zero force members and draw all pertinent free-body diagrams.



ΣM's : HG, FG

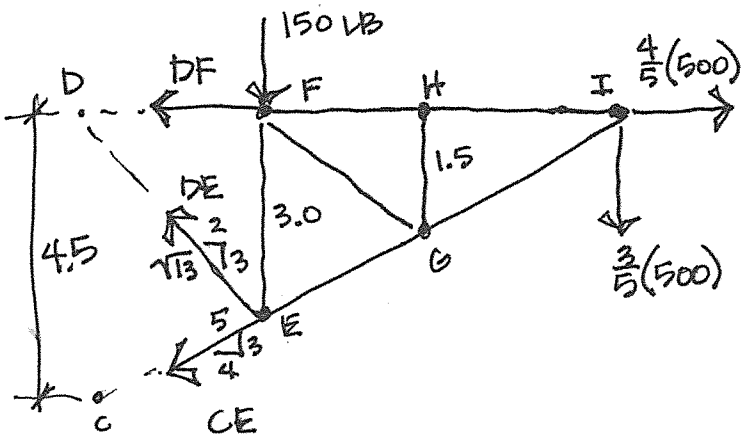
JOINT I:



$+\uparrow \Sigma F_y = 0 = -\frac{3}{5}GI - \frac{3}{5}(500)$

$GI = 500$ LB (C)

RIGHT CUT:



$+\circlearrowleft \Sigma M_E = 0 = DF(3) - \frac{3}{5}(500)(4) - \frac{4}{5}(500)(3)$

$DF = 800$ LB (T)

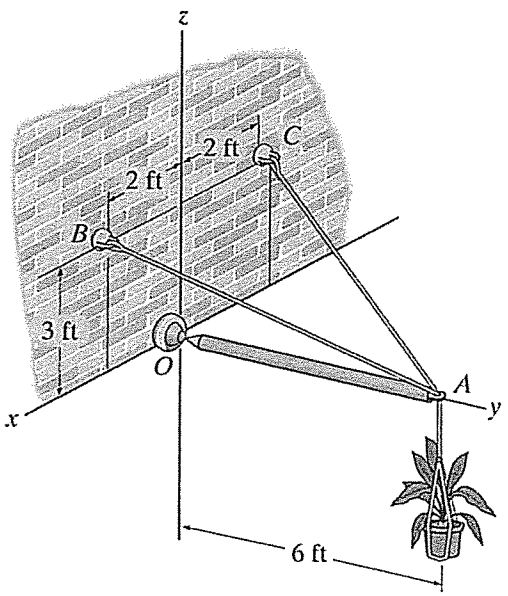
$+\circlearrowleft \Sigma M_D = 0 = -150(2) - \frac{3}{5}(500)(6) - \frac{4}{5}CE(3) - \frac{3}{5}CE(2)$

$CE = 583.3$ LB (C)

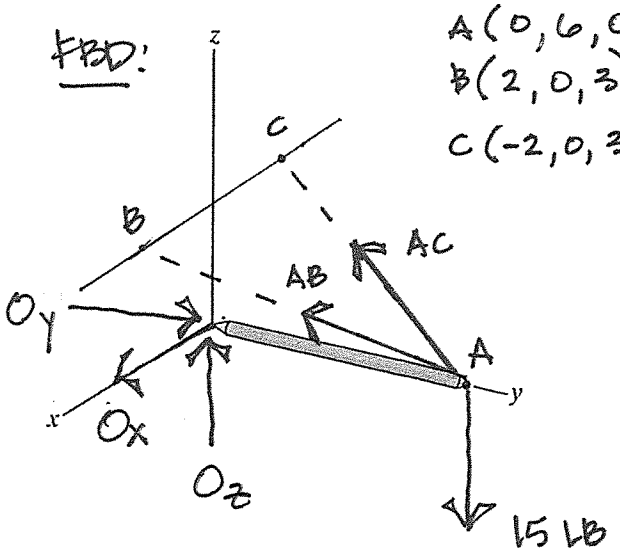
$+\uparrow \Sigma F_y = 0 = -\frac{3}{5}(500) - 150 + \frac{3}{\sqrt{13}}DE - \frac{3}{5}(-583.3)$

$DE = 120.2$ LB (T)

3) A 15 lb flower pot hangs from rod OA which is supported by a ball and socket at O and cables AB and AC. Draw the free-body diagram (on the axes provided). Assume all support reactions positive in your FBD using right hand rule sign convention. Calculate the support reactions utilizing equilibrium equations.



FBD:



A(0,6,0)
B(2,0,3)
C(-2,0,3)

CARTESIAN FORM:

$$\overline{AC} = \frac{-2\hat{i}-6\hat{j}+3\hat{k}}{\sqrt{(-2)^2+(-6)^2+(3)^2}}\,AC$$

$$= \left\{-\tfrac{2}{7}AC\,\hat{i} - \tfrac{6}{7}AC\,\hat{j} + \tfrac{3}{7}AC\,\hat{k}\right\}$$

$$\overline{AB} = \frac{2\hat{i}-6\hat{j}+3\hat{k}}{\sqrt{(2)^2+(-6)^2+(3)^2}}\,AB$$

$$= \left\{\tfrac{2}{7}AB - \tfrac{6}{7}AB + \tfrac{3}{7}AB\right\}$$

EQUILIBRIUM:

① $\Sigma F_x = 0 = -\frac{2}{7}AC + \frac{2}{7}AB + O_x$

② $\Sigma F_y = 0 = -\frac{6}{7}AC - \frac{6}{7}AB + O_y$

③ $\Sigma F_z = 0 = \frac{3}{7}AC + \frac{3}{7}AB - 15 + O_z$

EQUILIBRIUM CON'T:

④ $\Sigma M_x = 0 = -15(6) + \frac{3}{7}AC(6) + \frac{3}{7}AB(6)$

⑤ $\Sigma M_y = 0 = 0$

⑥ $\Sigma M_z = 0 = -\frac{2}{7}AC(6) + \frac{2}{7}AB(6)$

$AC = AB$

FROM ④: AC = 17.5 LB, AB = 17.5 LB

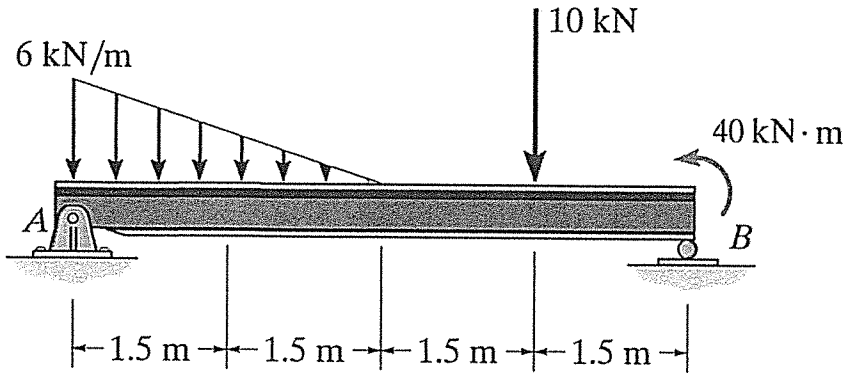
FROM ①, ②, ③:

$O_x = 0$

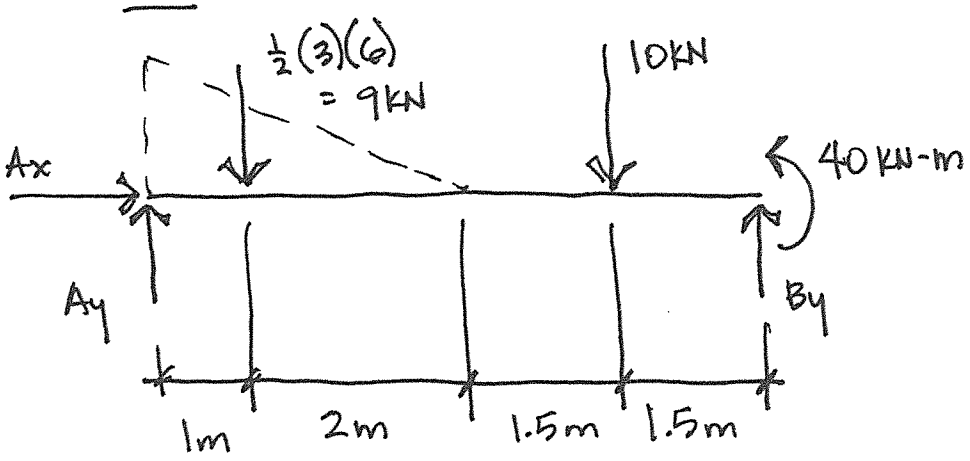
$O_y = 30$ LB

$O_z = 0$

4) Calculate the support reactions the pin at A and the roller at B given the loading shown. Indicate direction in the answer with directional arrows and draw all pertinent free-body diagrams.



FBD:



$+\circlearrowleft \Sigma M_A = 0 = -9(1) - 10(4.5) + B_y(6) + 40$

$B_y = 2.33\ \text{KN} \uparrow$

$+\uparrow \Sigma F_y = 0 = A_y - 9 - 10 + 2.33$

$A_y = 16.67\ \text{KN} \uparrow$

$+\rightarrow \Sigma F_x = 0 = A_x$

$A_x = 0$