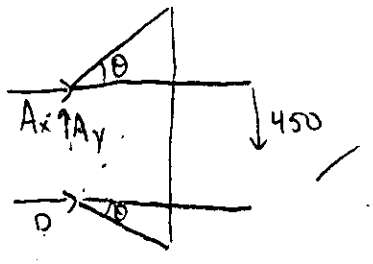
AA 210 Statics

Midterm #2 – Winter 2009

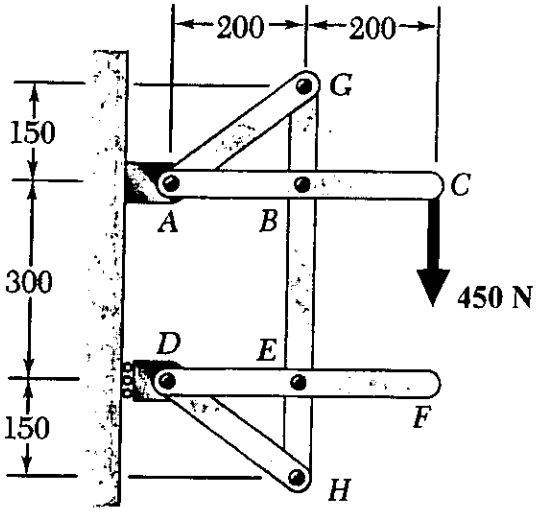
(60 min, Open Book & Open Notes; show all work and FBD's)

Version D

1. For the frame and loading shown, determine all forces acting on member ***GBEH***. (35 pts)



$\theta = \tan^{-1}\left(\frac{150}{200}\right) = 36.87°$



Dimensions in mm

$\Sigma F_x = A_x + D = 0$

$\Sigma F_y = A_y - 450 = 0$

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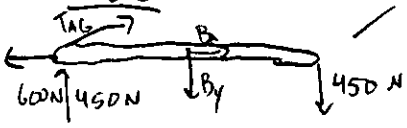
$\Sigma M_A = -(450)(400) + D(300) = 0$

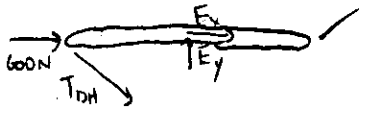
$D = 600\,N$, $A_x = -600\,N$

$A_y = 450\,N$

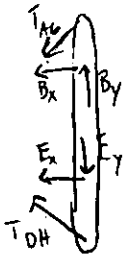
ABC



DEF



GBEH



ABC

$\Sigma F_x = -600N + B_x + T_{AG}(\cos 36.87°) = 0$

$\Sigma F_y = 450N - 450N + T_{AG}(\sin 36.87°) - B_y = 0$

$\Sigma M_A = (450N)(400m) + (B_y)(200m) = 0$

$B_y = -900\,N$ (upward)

$T_{AG} = -1500\,N$ (C), $B_x = 1800\,N$

DEF

$\Sigma F_x = 600N + E_x + T_{DH}\cos(36.87) = 0$

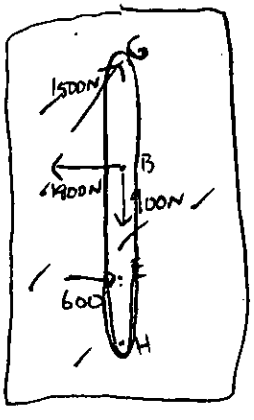
$\Sigma F_y = E_y - T_{DH}\sin(36.87) = 0$

$\therefore T_{DH} = 0 = E_y$

GBEH

$\Sigma M_H = (E_x)(150) + (1800\,N)(450) - 1500N\cos(36.87°)(600) = 0$

$E_x = -600\,N$ (to the right)



2. A homogeneous flat plate with a circular hole (r = 100 mm, as shown) is sitting on an inclined platform, $\theta = 20^\circ$. Knowing that A_y is 70 N, determine the reaction at B (which is B_y). (35 pts)

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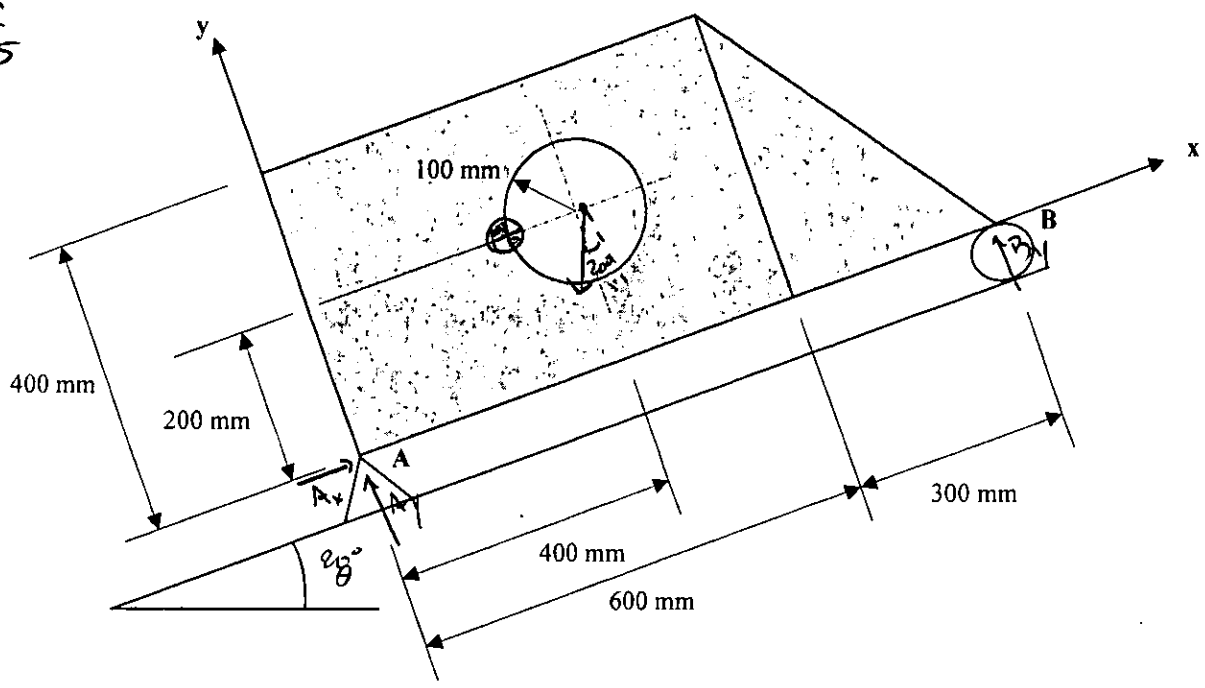


$$\bar{X} = \frac{(300mm)(2400\,mm^2) - (400mm)(\pi(100mm)^2) + (700mm)(\frac{1}{2}\,1200\,mm^2)}{(2400 - \pi 100^2 + 600\,mm^2)}$$

$$= 402.11\ mm\ X$$

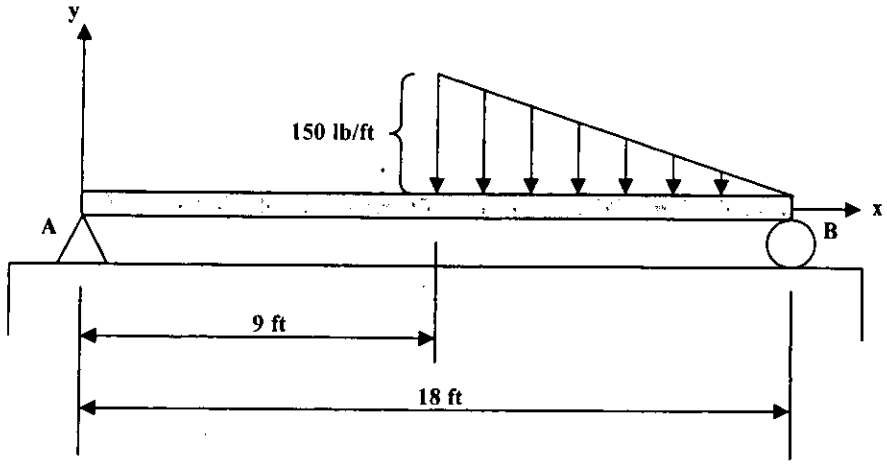
$$\Sigma F_y = 70N + B_y - W\cos 20^\circ = 0$$

$$\Sigma M_A = -(W\cos 20^\circ)(400mm) + (B_y)(900mm) = 0$$

$$\begin{bmatrix} -1 & \cos 20^\circ \\ 900 & -400\cos 20^\circ \end{bmatrix} \begin{bmatrix} B_y \\ W \end{bmatrix} = \begin{bmatrix} 70 \\ 0 \end{bmatrix}$$

$$\boxed{B_y = 56\ N}\ X$$

3. The weightless beam below is subjected to a distributed load as shown. Draw the shear force & bending moment diagrams for the entire beam and indicate those values of A, B, and middle of the beam on the diagrams. (30 pts)



$\Sigma F_y = A_y + B_y - \frac{1}{2}(150)(9) = 0$

$\Sigma M_A = (B_y)(18) - \frac{1}{2}(9)(150)\left[18 - \left(\frac{2}{3}9\right)\right] = 0$

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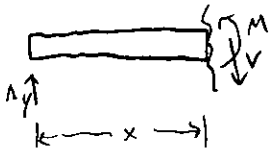
$B_y = 450\ N$ ✓

$A_y = 225\ N$

$0 < x < 9$



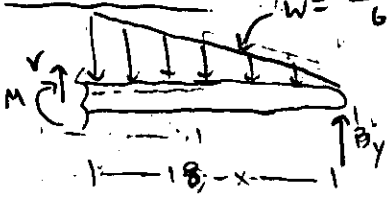
$\Sigma F_y = 225\ N - V = 0$

$V = 225N$

$\Sigma M_{cut} = -225x + M = 0$

$M = 225x$

$6 < x < 12$

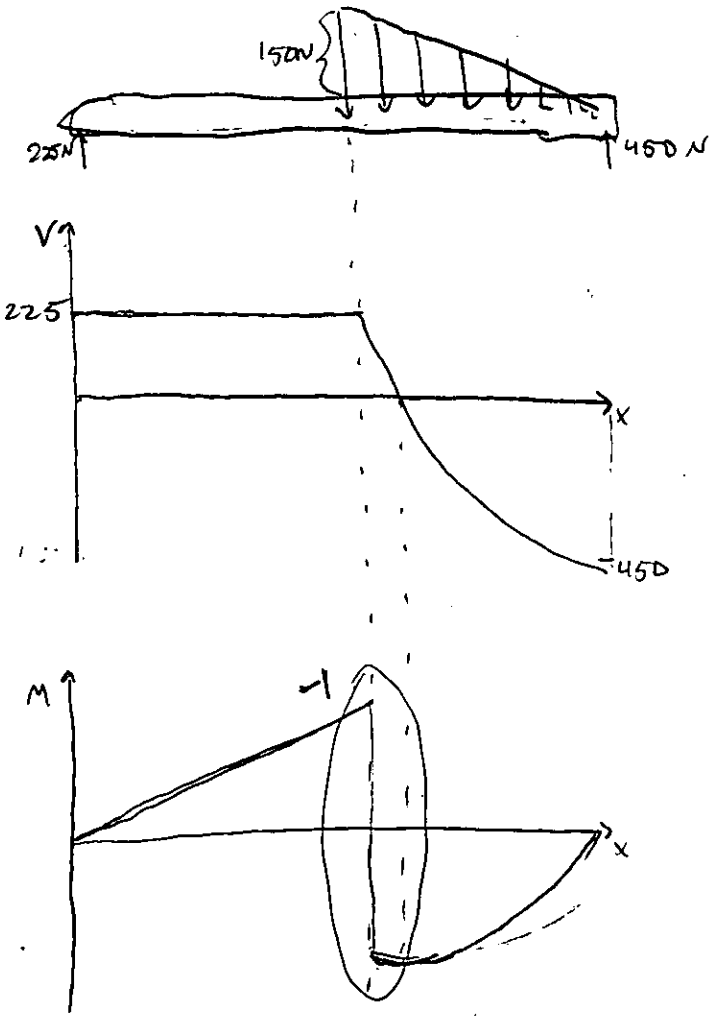


$\Sigma F_y = B_y + V - \left(\frac{1}{2}\right)(18-x)\left(\frac{150}{9}\right)(18-x) = 0$

$V = \frac{150}{18}(18-x)^2 - 450$

$\Sigma M_{cut} = 450(18-x) - M - \left[\frac{1}{2}(18-x)\left[\frac{150}{9}(18-x)\right]\frac{1}{3}(18-x)\right] = 0$

$M = \ominus 450(18-x) \oplus \frac{150}{54}(18-x)^3$



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