AA210.M2

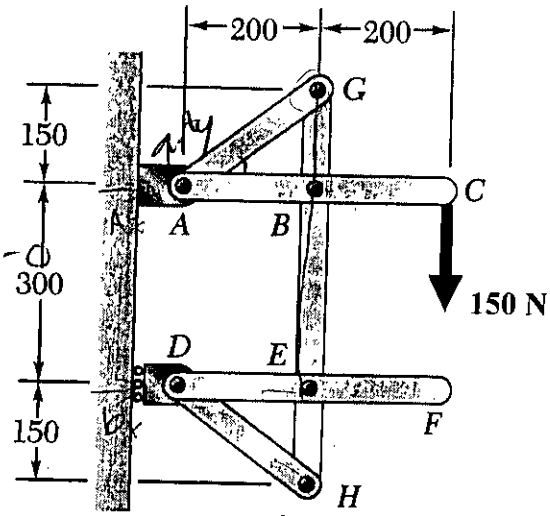
AA 210 Statics

Midterm #2 – Winter 2009

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

Version B

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



Rxn Forces

$\Sigma F_y = A_y - 150 = 0$

$A_y = 150\text{N}$ ✓

$\Sigma F_x = A_x + B_x = 0$

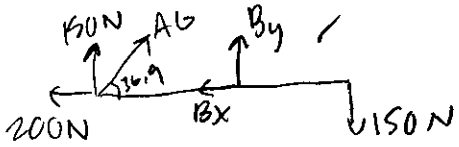
$\Sigma M_A = (300\text{mm})(D_x) - (400)(150) = 0$

$300\text{mm}\,D_x = 60\,000\ \text{N·mm}$

$D_x = 200\text{N}$ ✓

$A_x = -200\text{N}$ ✓

ABC



$\Sigma F_y = 150 - 150 + AB\sin 36.9 + B_y = 0$

$\Sigma F_x = -200 - B_x + AB\cos 36.9 = 0$

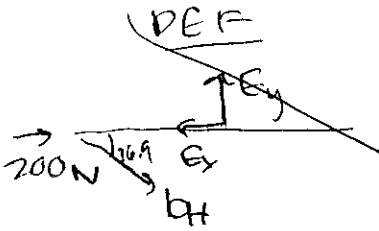
$\Sigma M_A = +(200)B_y - (400)(150) = 0$

$B_x = -200 + AB\cos 36.9$ $B_y = 300\text{N}$

$AB = -500\text{N}$

$B_x = -600\text{N}$

DEF



$\Sigma F_y = E_y - DH\sin 36.9 = 0$

$\Sigma F_x = 200 - E_x + DH\cos 36.9 = 0$

$\Sigma M_D = 200E_y$

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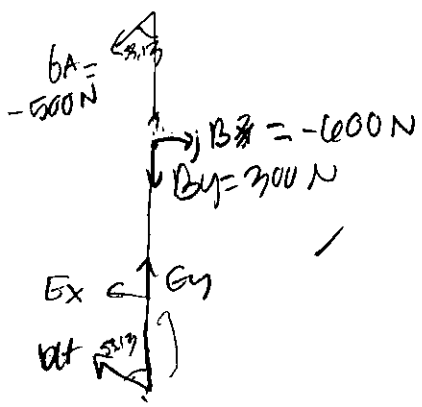
GBEH



$\Sigma F_x = -600 - (-500)(\sin 53.13) - E_x - DH\sin 53.13 = 0$

$\Sigma F_y = -(-500)(\sin 53.13) - 300 + E_y + DH\cos 53.13 = 0$

$\Sigma M_H = (150)(E_x) - (-600)(450) + (600)(-500)(\cos 53.13) = 0$

$G_A = -500\text{N}$ ✓	$E_x = -600\text{N}$ X	-2
$B_x = -600\text{N}$ ✓	$DH = 500\text{N}$ X	-2
$B_y = 300\text{N}$ ✓	$E_y = 400\text{N}$ X	-2

2. A homogeneous flat plate with a circular hole (r = 100 mm, as shown) is sitting on an inclined platform, $\theta = 28^\circ$. Knowing that A_y is 40 N, determine the reaction at B (which is B_y). (35 pts)

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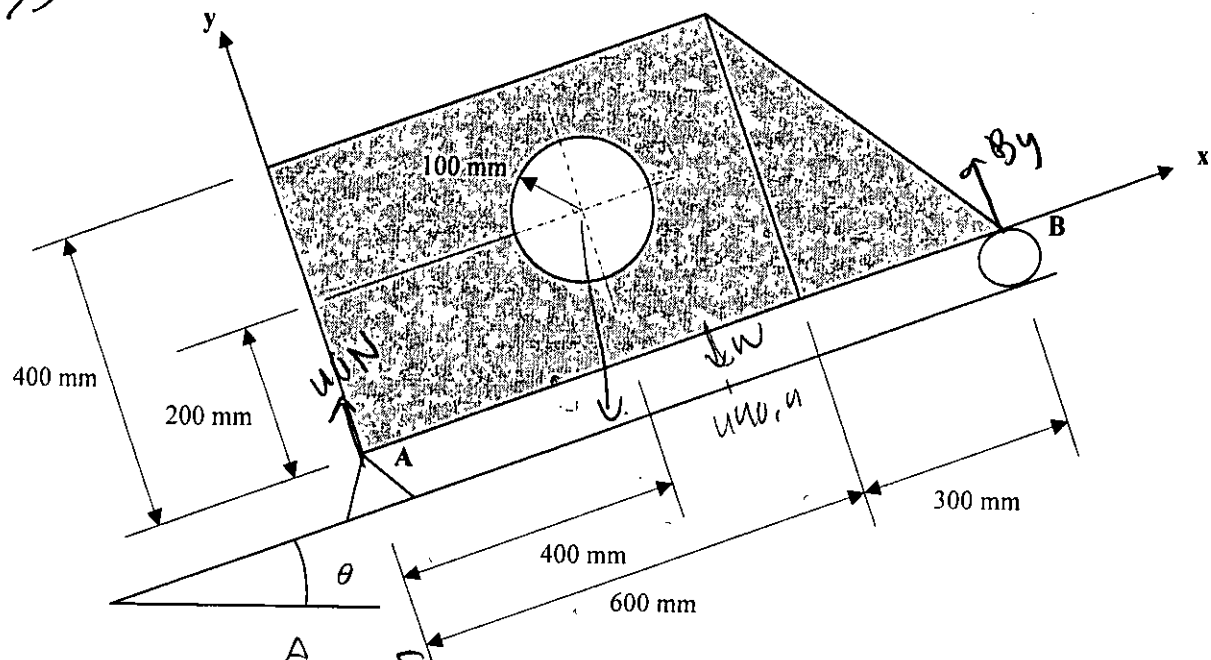


	A	$\bar{x}$
rectangle	240,000	300
triangle	60,000	600 + ⅓(300) = 700
circle	−31,416	400

$$\bar{x} = \frac{(240{,}000)(300) + (60{,}000)(700) - (31{,}416)(400)}{240{,}000 + 60{,}000 - 31{,}416}$$

$\bar{x} = 377.66$ mm

$\Sigma F_y = 40N + B_y - W \quad \therefore W = 40 + B_y$

$\Sigma M_A = -(377.66)(W) + (900)(B_y)$

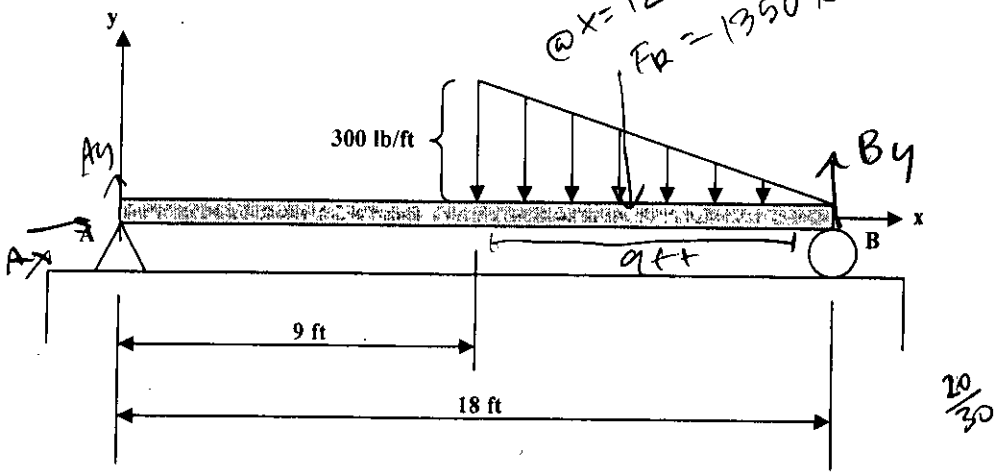
$= -(377.66)(40 + B_y) + 900B_y = 0$

$= -15106.4 - 377.66B_y + 900B_y = 0$

$522.34B_y = 15106.4$

$B_y = 28.92$ N ✗

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)



@x=12 $F_R = 1350$ N

9 ft

18 ft

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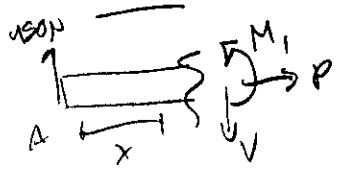
$\Sigma F_x = A_x = 0$ $\Sigma F_y = A_y - 1350 + B_y = 0$

$\Sigma M_A = -(12)(1350) + (18)B_y = 0$

$B_y = 900$ N

$A_y = 450$ N ✓

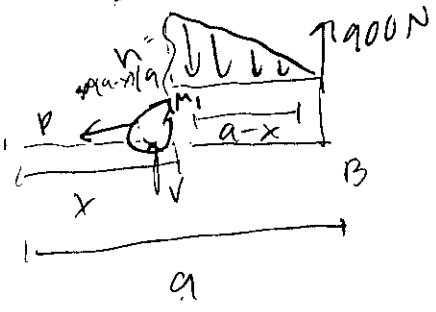
$x < 9$



$\Sigma F_y = -V + 450$ $\boxed{V = 450}$ ✓

$\Sigma M_c = M_1 - (450)(x)$ $\boxed{M_1 = 450x}$

$9 < x < 18$



$\frac{300}{9} \quad \frac{h}{9-x}$ $h = \frac{(9-x)300}{9}$

$\Sigma F_y = V - \left(\frac{300(9-x)}{9}\right)(9-x)\left(\frac{1}{2}\right) + 900\,N$

$V = \frac{300}{18}(9-x)^2 - 900$ ✓

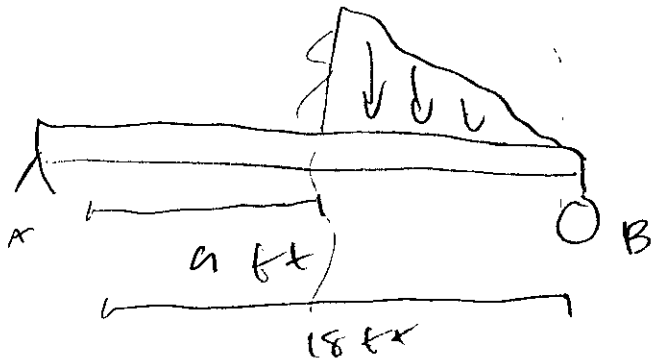
$\Sigma M_c = -M - \left(\frac{300}{18}(9-x)^2\right)\left(\frac{(9-x)}{3}\right) + (9-x)(900)$

force location

$M = -\frac{300}{54}(18-x)^3 - 900x + 8100$ (18-x)

diagrams over next pg

Diagrams



$x < 9$

$V = 450$

$M_1 = 450x$

$9 < x < 18$

$V = \frac{300}{18}(9-x)^2 - 900$

$M = -\frac{300}{6}(9-x)^3 - 900x + 8100$