Quiz #2 (Total points: 100) COE 2001 Section H
November 9, 2011

Printed Name: ANSWER KEY

Please read and sign the Honor Pledge below

I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Georgia Tech community.

Signature:_____ **Date:**_____

1. The plane bent bar in Figure 1 is subjected to a vertical force. The bar is supported by a pin at *A* and a roller at *B*. Neglect the weight of the bar.

(a). Draw a free-body diagram of the bar. (25 points)

(b). Find the reactions at *A* and *B*. (25 points)

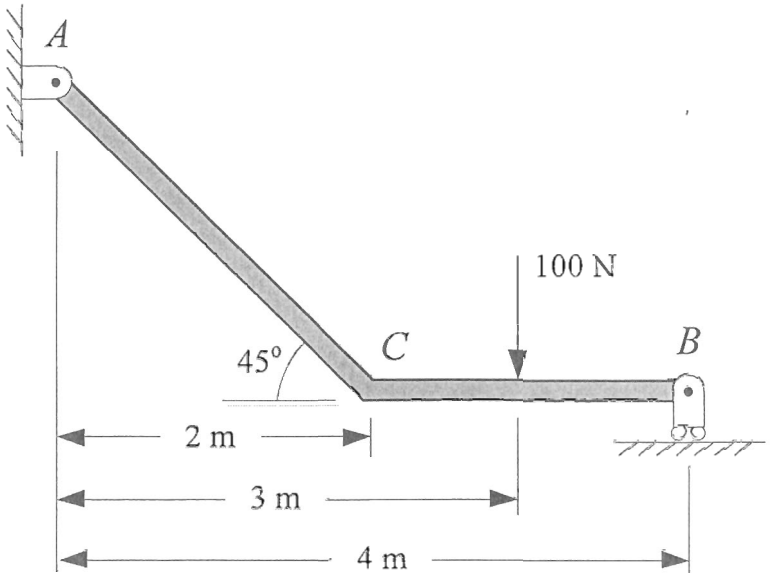
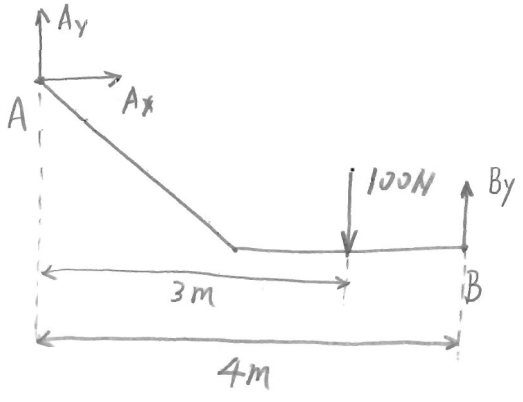


Figure 1

(a)



(b)

$\Sigma M_A = 0 \Rightarrow B_y \cdot 4 - 100 \cdot 3 = 0 \Rightarrow B_y = 75\,N$

$\Rightarrow \boxed{B_y = 75\,N \uparrow}$

$\Sigma F_x = 0 \Rightarrow \boxed{A_x = 0}$

$\Sigma F_y = 0 \Rightarrow 75 + A_y - 100 = 0 \Rightarrow A_y = 25\,N$

$\Rightarrow \boxed{A_y = 25\,N \uparrow}$

2. The triangle plate with a circular hole in Figure 2 weighs 100 N. The plate is subjected to a distributed load at its top, and is held in equilibrium by cable *BD* and a pin at *A*. The plate has a uniform density.

(a). Replace the distributed load by an equivalent concentrated load (give the magnitude, the direction and the point of application of the equivalent concentrated load). (15 points)

(b). Find the centroid of the plate (give the x and y coordinates of the centroid). (15 points)

(c). Draw a free-body diagram of the plate (in the diagram, replace the distributed load by the equivalent concentrated load that you obtained from part (a)). (10 points)

(d). Based on the free-body diagram that you drew in part (c), find the reaction at A and the cable tension in *BD*. (10 points)

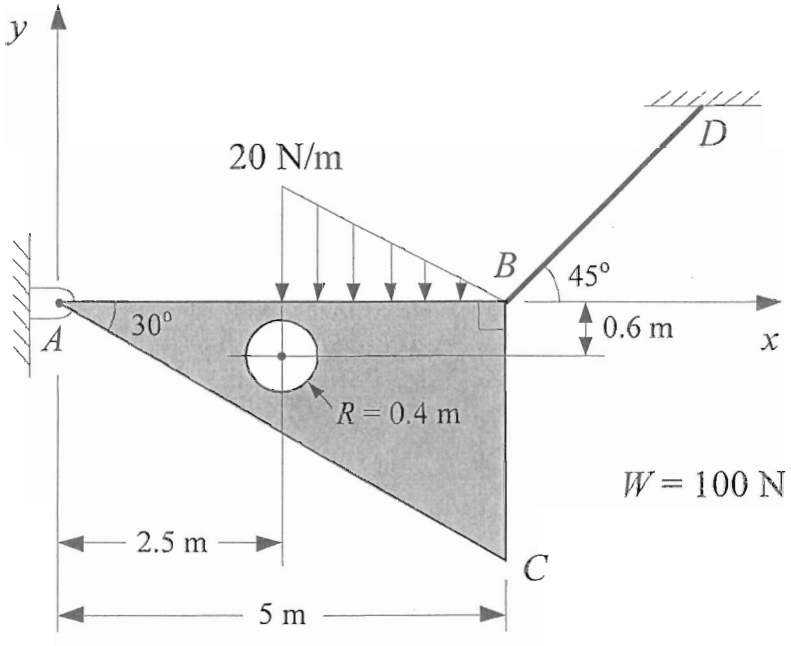


Figure 2

(a). Assume $f(x) = ax + b$

$x = 2.5,\ f(x=2.5) = 20\ N/m \Rightarrow 2.5a + b = 20$

$x = 5,\ f(x=5) = 0\ N/m \Rightarrow 5a + b = 0$

$\Rightarrow a = -8,\ b = 40$

$\Rightarrow f(x) = -8x + 40$

$$F = \int_{2.5}^{5} f(x)\,dx$$

$$= \int_{2.5}^{5} (-8x + 40)\,dx$$

$$= (-4x^2 + 40x)\Big|_{2.5}^{5}$$

$$= \boxed{25\ N\downarrow}$$

$$M_O = \int_{2.5}^{5} f(x)\,x\,dx$$

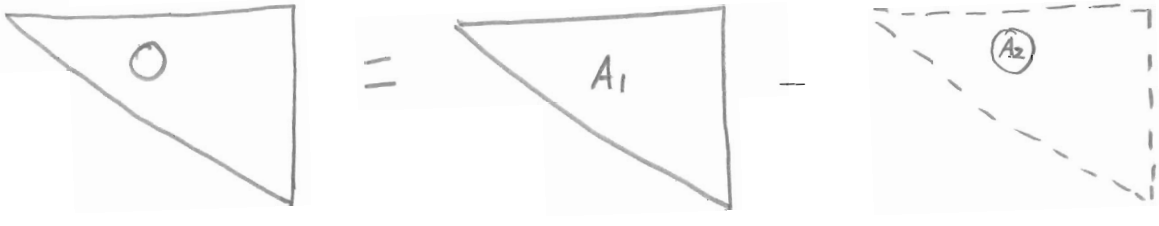
$$= \int_{2.5}^{5} (-8x^2 + 40x)\,dx$$

$$= \left(-\frac{8}{3}x^3 + 20x^2\right)\Big|_{2.5}^{5}$$

$$= \frac{250}{3}\ N.m$$

$$x_c = \frac{M_O}{F} = \frac{250}{3 \times 25} = \boxed{3.333\ m}$$

(b)



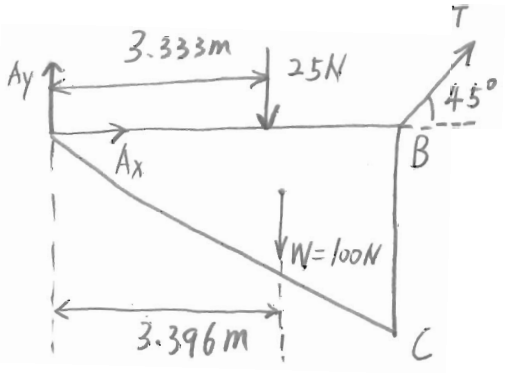
	Area	x_c	y_c
1	$5\times\frac{5}{\sqrt{3}}\times\frac{1}{2}=\frac{25\sqrt{3}}{6}$	$5\times\frac{2}{3}=\frac{10}{3}$	$-\frac{5}{\sqrt{3}}\times\frac{1}{3}=-\frac{5\sqrt{3}}{9}$
2	$-\pi(0.4)^2=-\frac{4\pi}{25}$	2.5	-0.6

$$A_{TOTAL}=A_1+A_2=\frac{25\sqrt{3}}{6}-\frac{4\pi}{25}=6.7142\ m^2$$

$$x_c=\frac{\frac{10}{3}\times\frac{25\sqrt{3}}{6}+2.5\times(-\frac{4\pi}{25})}{A_{TOTAL}}=\boxed{3.396\ m}$$

$$y_c=\frac{-\frac{5\sqrt{3}}{9}\times\frac{25\sqrt{3}}{6}+(-0.6)\times(-\frac{4\pi}{25})}{A_{TOTAL}}=\boxed{-0.989\ m}$$

(c)



(d)

$$\Sigma M_A=0\Rightarrow -25\times3.333-100\times3.396+T\times5\times\sin45^\circ=0$$

$$\Rightarrow \boxed{T=119.6\ N\ \angle 45^\circ}$$

$$\Sigma F_x=0\Rightarrow A_x+T\cdot\cos45^\circ=0\Rightarrow A_x=-84.6N\Rightarrow \boxed{A_x=84.6\ N\leftarrow}$$

$$\Sigma F_y=0\Rightarrow A_y-25-100+T\cdot\sin45^\circ=0$$

$$\Rightarrow \boxed{A_y=40.4\ N\uparrow}$$