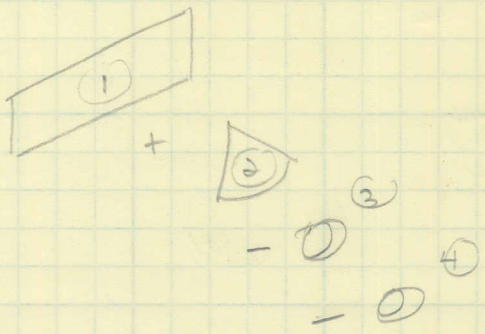
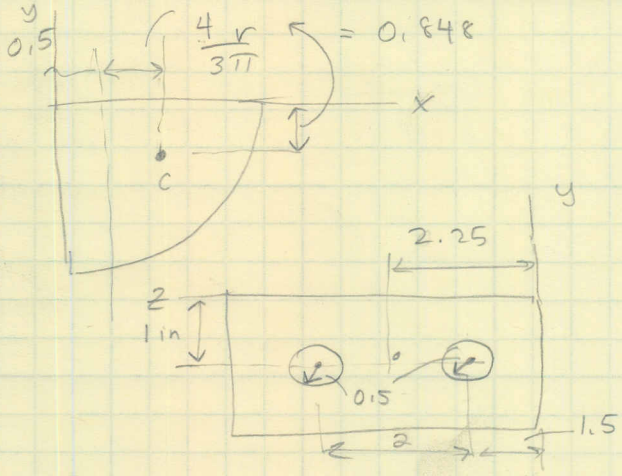
Statics | Practice Exam 3

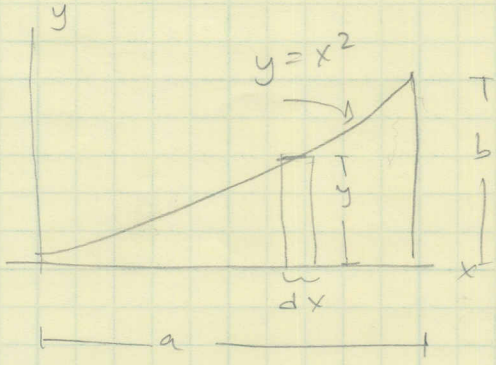
#1





Segment	volume	$\bar{x}$	$\bar{y}$	$\bar{z}$	$\bar{x}V$	$\bar{y}V$	$\bar{z}V$
1	$(4.5)(2)(0.5) = 4.5$	0.25	−1	2.25	1.125	−4.5	10.125
2	$\frac{1}{4}\pi(2)^2(0.5) = 1.571$	1.3488	−0.848	0.25	2.119	−1.333	0.393
3 ⊖	$\pi(0.5)^2(0.5) = -0.3927$	0.25	−1	3.5	−0.098	0.393	−1.374
4 ⊖	$\pi(0.5)^2(0.5) = -0.3927$	0.25	−1	1.5	−0.098	0.393	−0.589
	5.286				3.048	−5.047	8.55

#2



$$y = \frac{b}{a^2}x^2 \quad \text{or} \quad x = \frac{a}{\sqrt{b}}\sqrt{y}$$

$$dA = y\,dx = \frac{b}{a^2}x^2\,dx$$

$$\tilde{x} = x$$

$$\tilde{y} = \frac{1}{2}\frac{b}{a^2}x^2$$

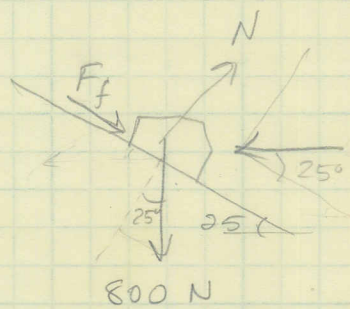
$$\bar{x} = \frac{\int x\,\frac{b}{a^2}x^2\,dx}{\int \frac{b}{a^2}x^2\,dx} = \frac{\int_0^a x^3\,\frac{b}{a^2}}{\int_0^a x^2\,\frac{b}{a^2}} = \frac{\frac{b}{a^2}\frac{x^4}{4}\Big|_0^a}{\frac{b}{a^2}\frac{x^3}{3}\Big|_0^a} = \frac{\frac{ba^4}{a^2 4}}{\frac{ba}{3}} = a^2\frac{b}{4}$$

$$\bar{x} = \frac{\frac{a^2 b}{4}}{\frac{ab}{3}} = \boxed{a\,\tfrac{3}{4}}$$

$$\bar{y} = \frac{\int\left(\frac{1}{2}\frac{b}{a^2}x^2\;\frac{b}{a^2}x^2\right)dx}{\int \frac{b}{a^2}x^2\,dx} = \frac{\frac{1}{2}\left(\frac{b}{a^2}x^2\right)^2 dx}{\frac{ab}{3}} = \frac{\frac{b^2}{2a^4}\frac{x^5}{5}\Big|_0^a}{\frac{ab}{3}} = \frac{\frac{ab^2}{10}}{\frac{ab}{3}}$$

$$\bar{y} = \frac{ab^2}{10}\left(\frac{3}{ab}\right) = \boxed{b\,\tfrac{3}{10}}$$

3



$\mu_s = 0.35$ $\mu_k = 0.25$

a) $\searrow \sum F_x = -P\cos 25° + 800 \sin 25° + F_f = 0$ ($F_f \nearrow \mu_s N$)

$\sum F_y = -P \sin 25° - 800 \cos 25 + N = 0$

$N = 800 \cos 25 + P \sin 25$

$N = 725 + 0.42P$

$800 \sin 25 + 0.35(725 + 0.42P) - 0.906P = 0$

$338.095 + 253.75 + 0.147P - 0.906P = 0$

$591.845 = 0.759P$

$\frac{591.845}{0.759} = P = 779.7 \sim 780\ N \nwarrow$

b)

x: $-P\cos 25° + 800 \sin 25° + \underbrace{\mu_k}_{0.25} N = 0$

y: $N - 800 \cos 25 - P \sin 25 = 0$

$N = P \sin 25 + 800 \cos 25$

$800 \frac{\sin 25°}{\cos 25} + 0.25\left(P \frac{\sin 25}{\cos 25} + 800 \frac{\cos 25}{\cos 25}\right) = P \cos 25$

$373.046 + 0.11658P + 200 = P$

$\frac{573.046}{(1 - 0.11658)} = P = 648.67 \sim 649\ N \nwarrow$

c) x: $800 \sin 25 - \mu_s N = P \cos 25$

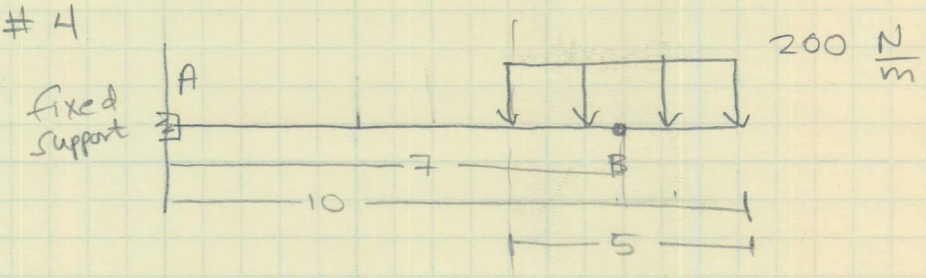
y: $N - 800 \cos 25 - P \sin 25 = 0$

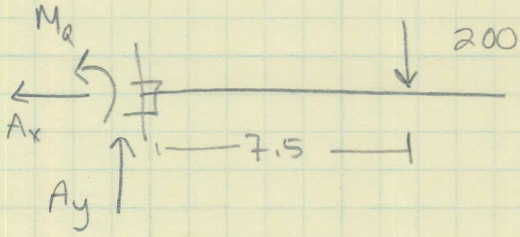
from a) $800 \sin 25 - 0.35(725 + 0.42P) - 0.906P = 0$

$338.095 - 253.75 = 0.147P + 0.906P$

$\frac{84.345}{1.053} = P = 80.09$

#4



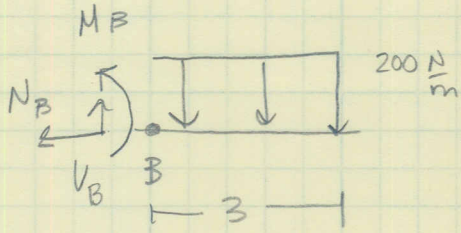


$$\Sigma M_a = M_a - 1000\ N\,(7.5m) = 0$$

$$M_a = 750\ N\cdot m \curvearrowleft$$

$$\Sigma F_y = A_y - 200\ \tfrac{N}{m}\,(5m) = 0$$

$$A_y = 1000\ N \uparrow \qquad A_x = 0$$



$$\Sigma M_B = M_B - 200\ \tfrac{N}{m}\,(3m)\,(1.5m) = 0$$

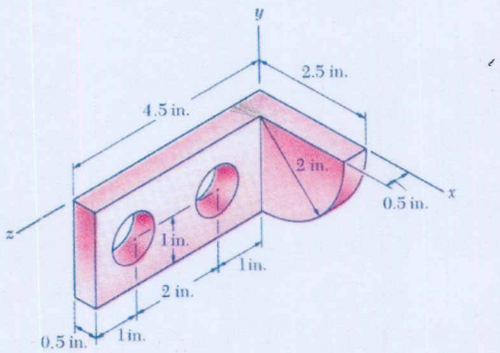
$$\boxed{M_B = 900\ N\cdot m \curvearrowright}$$

$$\Sigma F_y = V_B - 200\ \tfrac{N}{m}\,(3m) = 0$$

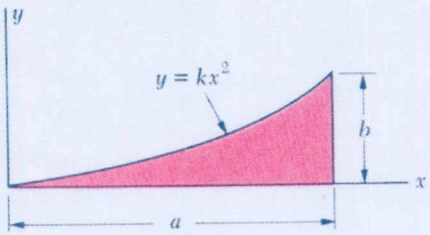
$$\boxed{V_B = 600\ N \uparrow}$$

Practice Exam 3
Statics

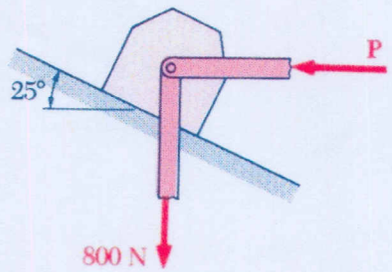
1. Locate the center of gravity of the steel machine element shown. Both holes are 1-in in diameter.



2. Determine by direct integration the centroid of a parabolic spandrel.
Hint: y = b; x = a; $b = ka^2$; $k = b/a^2$



3. A support block is acted upon by two forces as shown. Knowing that the coefficients of friction between the block and the incline are = 0.35 and = 0.25, determine the force P required to: a) start the block moving up the incline, b) to keep it moving up, and c) to prevent it from sliding down.



4. Determine the shear force and bending moment at point B.