

ROSE-HULMAN INSTITUTE OF TECHNOLOGY  
*Department of Mechanical Engineering*

EM121

Statics and Mechanics of Materials I

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**Exam 2**

Spring 2009-2010

Name: \_\_\_\_\_

CM: \_\_\_\_\_

Problem 1 (27 pts) \_\_\_\_\_

Problem 2 (23 pts) \_\_\_\_\_

Problem 3 (27 pts) \_\_\_\_\_

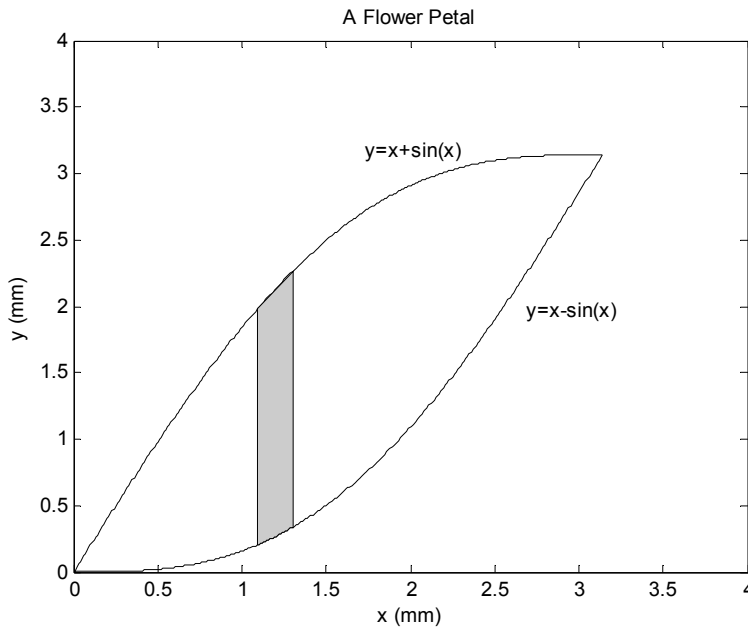
Problem 4 (23 pts) \_\_\_\_\_

Total \_\_\_\_\_

Be sure to show all work to receive full credit. However, "given" and "find" are not necessary.

**Problem 1 – Short Answer -- 27 points**

(a) Consider the mathematical model of a flower petal shown in the figure below.



The equation for the y-centroid of the shape may be written (using a vertical strip) as

$$y_c = \frac{\int_A \tilde{y} dA}{\int_A dA} = \frac{\int_a^b \tilde{y} w dx}{\int_a^b w dx}$$

For the limits of integration we should choose

- i.  $a=0, b=\pi$
- ii.  $a=0, b=x + \sin(x)$
- iii.  $a=0, b= x - \sin(x)$
- iv.  $a= x - \sin(x), b= x + \sin(x)$
- v. other (specify \_\_\_\_\_)

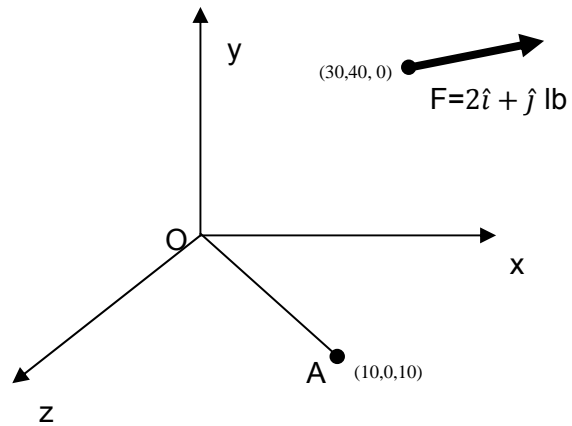
For  $dA$  we should choose

- i.  $dA = (x + \sin(x))dx$
- ii.  $dA = (x - \sin(x))dx$
- iii.  $dA = (2x)dx$
- iv.  $dA = (2 \sin(x))dx$
- v. other (specify \_\_\_\_\_)

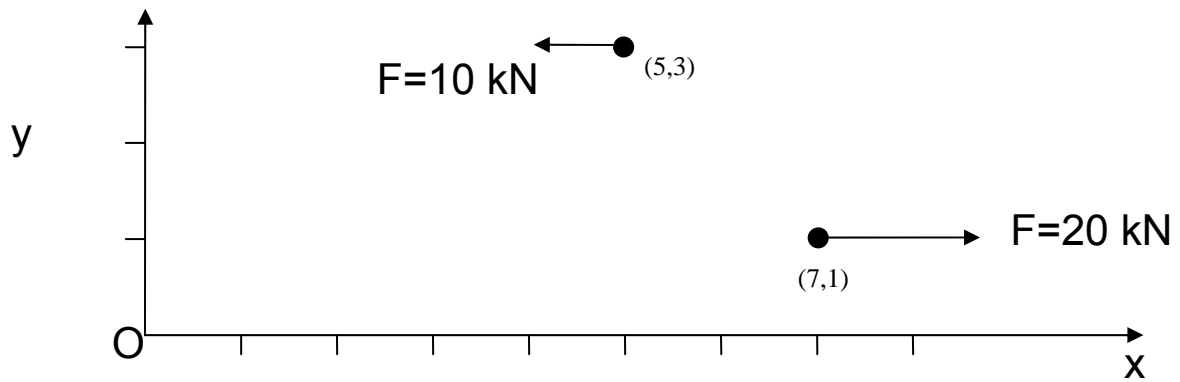
For the centroid of the strip we should choose

- i.  $\tilde{y}= y$
- ii.  $\tilde{y}= x$
- iii.  $\tilde{y}= x + \sin(x)$
- iv.  $\tilde{y}= x - \sin(x)$
- v.  $\tilde{y}= \sin(x)$
- vi. other (specify \_\_\_\_\_)

(b) Consider the diagram shown below. Find the moment about the line OA due to the force vector. All coordinates are in inches.

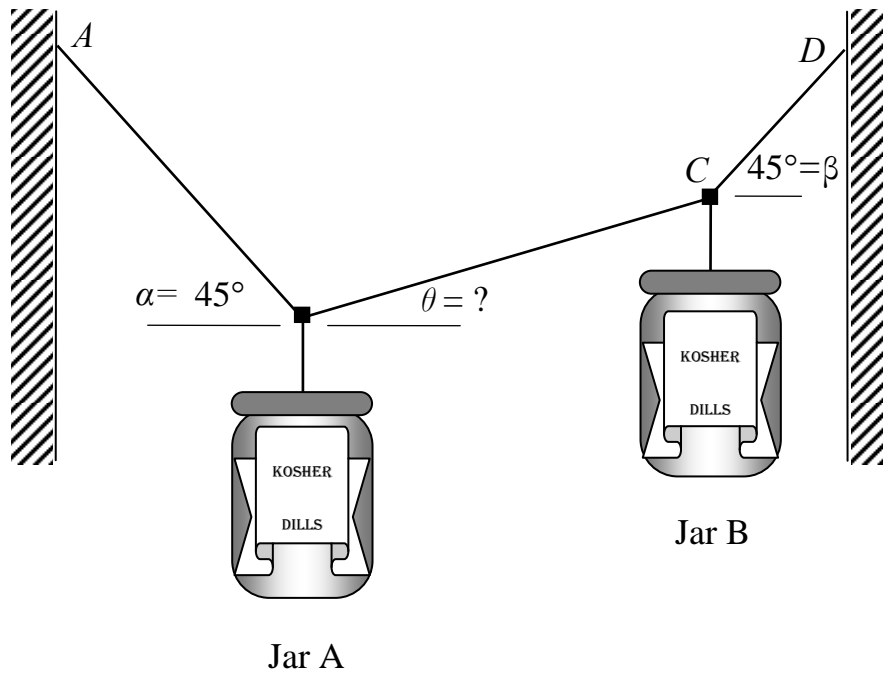


(c) Find the net moment due to these forces about point O (the origin). All coordinates are in meters.



**Problem 2 – 23 points**

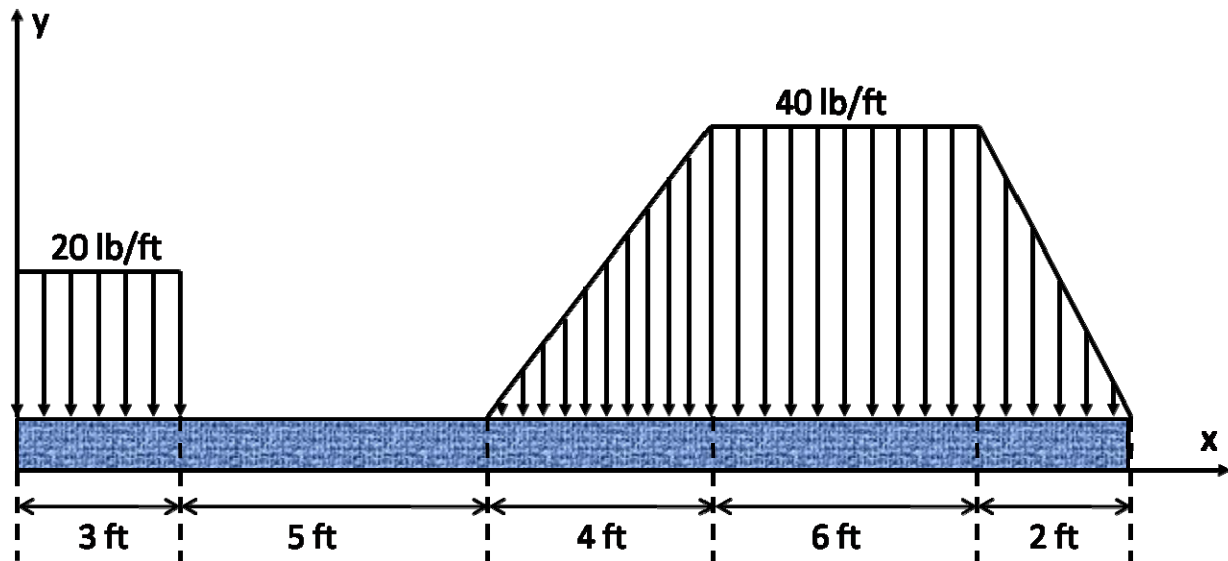
Please set up the following problem, but do not solve. Clearly list your unknowns and number your equations. Two economy-sized jars of kosher dill pickles are suspended from cables as shown in the figure. Jar A weighs  $W_A=10$  lbs and jar B weighs  $W_B=8$  pounds. The tension in each cable ( $AB$ ,  $BC$ , and  $CD$ ) and the angle  $\theta$  are all unknown.



**Problem 3 – 27 points**

The distributed load shown below acts on a solid beam and has an equivalent resultant force. Find:

- The magnitude of the equivalent resultant force
- The line of action of the equivalent resultant force



## Problem 4 – 23 points

Find the y coordinate of the centroid of the USB key below.

