Exam 2

Spring 2010-2011

Name: _____ CM: _____

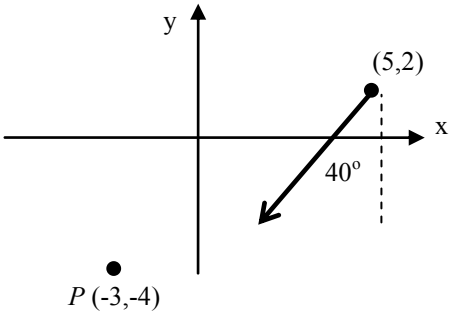
Section: _____

Problem 1 (34 pts)	_____
Problem 2 (9 pts)	_____
Problem 3 (24 pts)	_____
Problem 4 (33 pts)	_____
Total	_____

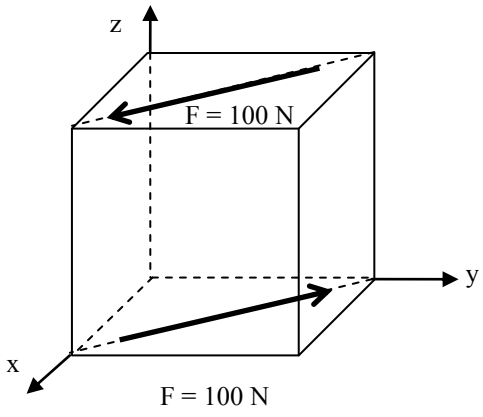
Be sure to show all work to receive full credit. However, "given" and "find" are not necessary.

Problem 1 – Short Answer – 40 pts

(a) 6 pts: Find the magnitude and direction of the moment of the 120 lb force about the point *P* (-3,-4). Distance units are inches.

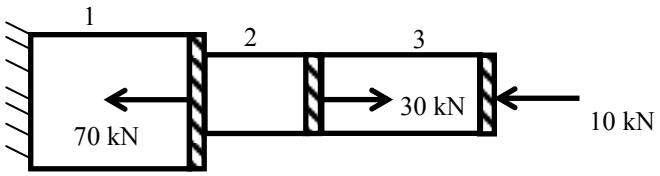


(b) 10 pts: Two equal and opposite forces of magnitude 100 N act on the sides of the cube as shown. If the cube has an edge that is 1.2 m long, calculate the moment due to the couple. Report your answer in Cartesian vector form



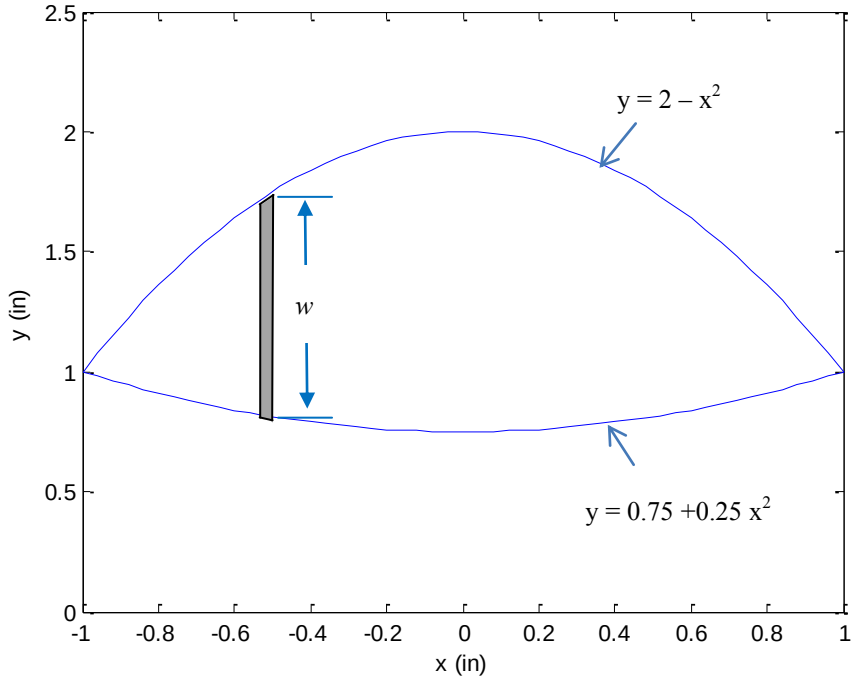
(c) 8 pts: A bar with a circular cross-section is made of 1040 steel with a yield strength of 55,000 psi and an ultimate tensile strength of 80,000 psi. The failure mode concerning the designers is yielding. The factor of safety is to be 3.0. If the maximum axial load to be carried is 12,500 lb, what should we choose for the diameter of the bar?

(d) 10 pts: You are given an axially loaded composite bar with the loading shown. It is supported by a rigid wall on the left. Draw a free body diagram that would be appropriate for calculating the stress in Section 2.



Problem 2 – *9 points*

Consider the shape below, which is defined at the top by the equation $y = 2 - x^2$ and at the bottom by the equation $y = 0.75 + 0.25x^2$.



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=-1, b=0
ii. a=1, b=2
iii. a=0.75, b=2
iv. a=-1, b= 1
v. other (specify_____)

For dA we should choose

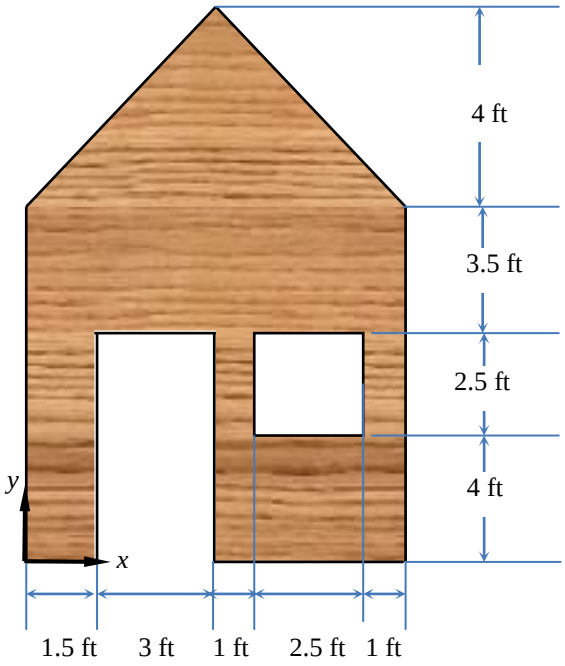
i. $dA = (2 - x^2)dx$
ii. $dA = (0.75x^2)dx$
iii. $dA = (1.25 - 1.25x^2)dx$
iv. $dA = (2.75 - 0.75x^2)dx$
v. other (specify_____)

For the centroid of the strip we should choose

i. $\tilde{y} = y$
ii. $\tilde{y} = (2 - x^2)/2$
iii. $\tilde{y} = 1.375 - 0.375x^2$
iv. $\tilde{y} = 0.675 - 0.675x^2$
v. other (specify_____)

Problem 3 – *24 points*

A set maker has constructed the plywood "house" below for use in the play *The World According to Dr. Grummypants*. The house has a rectangular cut out portion for the door and a square cut-out for the window. Find the location of y centroid of the house.



Problem 4 – *33 points*

We are supporting a rigid plate with blocks of metal, as shown in the figure below. Blocks 1 and 4 are steel, and they are the same size. Block 3 is also steel, but it wasn't tall enough so we cut an aluminum block (Block 2) to fit under the plate. The elastic modulus of steel is $E_S = 30 \times 10^6$ psi and the elastic modulus of aluminum is $E_A = 10 \times 10^6$ psi. All of the blocks have the same cross-sectional area. What are the internal forces in each of the four blocks? You may assume that both the internal forces and the deflections of Blocks 1 and 4 are the same.