Exam 2

Spring 2008-2009

Name: _____ CM: _____

Section:_____

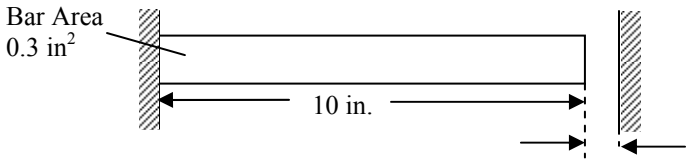
Problem 1 (31 pts)	_____
Problem 2 (37 pts)	_____
Problem 3 (32 pts)	_____
Total	_____

Be sure to show all work to receive full credit.

Problem 1 – *31 points*

a. (8 pts) A force, $\vec{F} = 300\,\vec{\imath} + 180\,\vec{\jmath} - 240\,\vec{k}$ lb acts at a point (2,0,0). An axis is described by the unit vector $\vec{e} = 0.6\,\vec{\imath} + 0.8\,\vec{k}$ and passes through the point (0,3,0). Distances are in inches. Calculate the moment of the force about the axis.

b. (6 pts) The figure below shows a bar which is 10.0 in long at a temperature of 40°F. The temperature rises to 100°F. Calculate (a) the strain in the bar at 100°F and (b) the stress in the bar at 100°F. (Hint: we suggest you check to see whether the gap closes.)

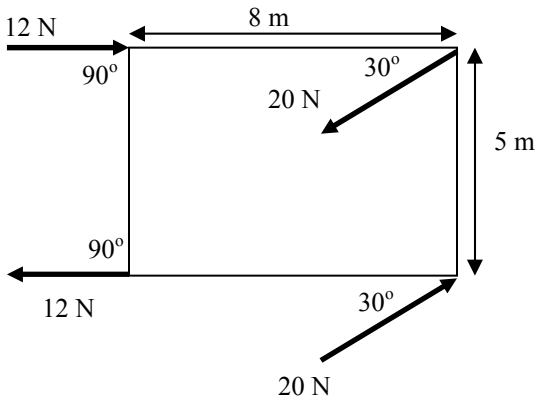


$E = 10 \times 10^6$ psi

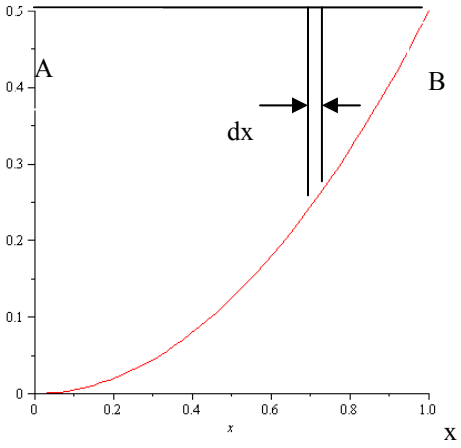
$\alpha = 20 \times 10^{-6}$ /°F

c. (8 pts) Four forces are applied to the corners of a rectangle. Replace these forces with a single couple.

$\vec{C}$ =_____



d. (9 pts) We need to calculate the centroid of the area bounded by the parabola $y = 0.5\ x^2$, the horizontal line AB, and the y-axis. We use integration. Use the differential area shown.



To calculate the centroidal y-coordinate we need the integral,

$$y = \frac{1}{A} \int_a^b \tilde{y}\, dA$$

The differential area, dA, may be written as

i. 0.5 dx
ii. 0.5 x^2 dx
iii. (0.5 – 0.5 x^2) dx
iv. 0.5 x^2 dy

$\tilde{y}$ is equal to

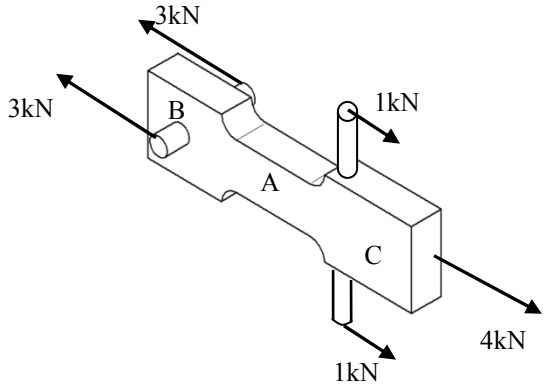
i. $0.5\ x^2$
ii. x
iii. $0.5 - 0.5\ x^2$
iv. $0.25 + 0.25\ x^2$

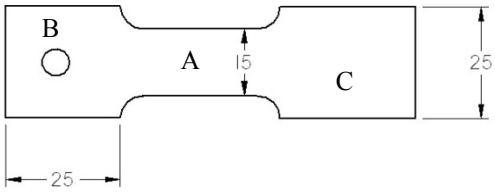
The limits of integration are

i. a=0, b=1.0
ii. a =0, b=0.5
iii. a = x b = 0.5
iv. a = 0, b = x

Problem 2 – *37 points*

A 5mm thick aluminum link is loaded by forces applied to two aluminum pins and one other force as shown. Relevant dimensions of the link are shown in the figure on the right. The pin is 6mm in diameter. The material property information for this aluminum is shown in the table below. Show clear Free Body Diagrams for all forces that are used in stress calculations.





2024-T3 Aluminum

Ultimate Tensile Strength	480 MPa
Yield Strength	340 MPa
Shear Strength	200 MPa
Elastic Modulus	70 GPa
Poisson's Ratio	0.33
Density	2.77 gm/cm^3

a. Determine the normal stress in the link at section A.

b. Determine the Factor of Safety, FOS, with respect to shear failure for the pin.

c. The average normal stress at cross section A is_____ the average normal stress at section B. (Circle one of the following choices.)

higher than lower than the same as

d. For a different loading configuration (a set of applied *forces* that are different than the set shown in the figure) a normal strain of 0.003 was measured at location C. The normal stress at that location is

i. 210 MPa
ii. 23.3 MPa
iii. 42.8 MPa
iv. It is not possible to determine the answer from the given information

Problem 3 – *32 points*

Locate the x and y centroids of the shaded region.

Hint: A table of the centroids of simple shapes is on the back of your equation sheet.