The Hashemite University
Faculty of Engineering
Mechanical Engineering Department

Machine Design I
Fall 2007
Instructor: Dr. Ala Hijazi

First Exam
Part I – Closed Book

Name:____________________
Student #:__________________

Please Read Questions Carefully – Good Luck!

(19 points)
1. For the flowing statements circle the correct answer.

Cold working decreases the yield strength of the material.	T	F
For a rotating ring, the maximum stress occurs at the inner surface.	T	F
In a thick-walled pressure vessel the stress increases as we move away from the inner surface.	T	F
The factor of safety can be either equal or larger than the design factor.	T	F
Stress concentration factors should be used for brittle materials but not for ductile materials.	T	F
Ductile materials undergo large amounts of plastic deformation before fracture.	T	F
During tempering, a part will be cooled at a very fast rate using water or oil.	T	F
Annealing is usually used on cold worked parts in order to remove residual stresses and decrease the yield strength.	T	F
Ceramics are ductile and much stronger in compression than in tension.	T	F
Thermoplastics can not be melted and reformed.	T	F

For a plane stress condition with $\sigma_x \neq 0$, $\varepsilon_y \neq -\nu\varepsilon_x$ if:

a) $\sigma_y = \sigma_x$ b) $\sigma_y \neq 0$
c) $\sigma_y < 0$ d) all of the above

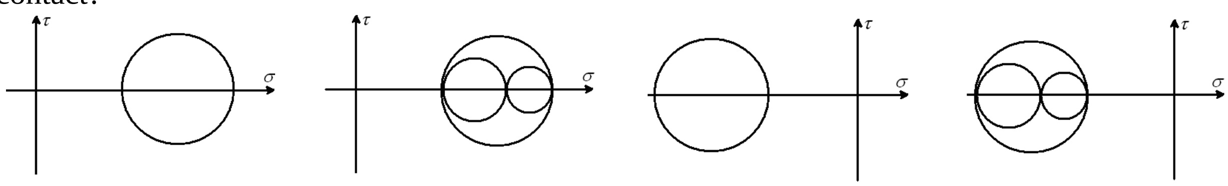
Two sets of data were found to have a normal distribution. Data set A has a mean of 40 and a standard deviation of 5, while dataset B has a mean of 42 and a standard deviation of 3. Which of the following is true?

a) All the data points of set A are bigger than those of set B
b) All the data points of set A are smaller than those of set B
c) The same percentage of data points in sets A and B are smaller than 45
d) Half of the data points in set A are smaller than 40
e) None of the above

For a point under plane stress condition, which of the following is true?

a) In the principal orientation, both principal stresses are equal
b) In the principal orientation, the shear stress is maxim
c) In the maximum shear stress orientation, the normal stresses are equal
d) None of the above

Which of the following Mohr's circles represent the state of stress at contact point for spherical contact?



(a) (b) (c) (d)

For a curved beam having rectangular cross section that is subjected to bending moment:

a) The maximum stress will occur at the outer surface
b) The stresses at the inner and outer surfaces will have the same magnitude
c) The stress will be zero at the centroid of the cross-section
d) The neutral axis will be closer to the outer surface
e) Non of the above

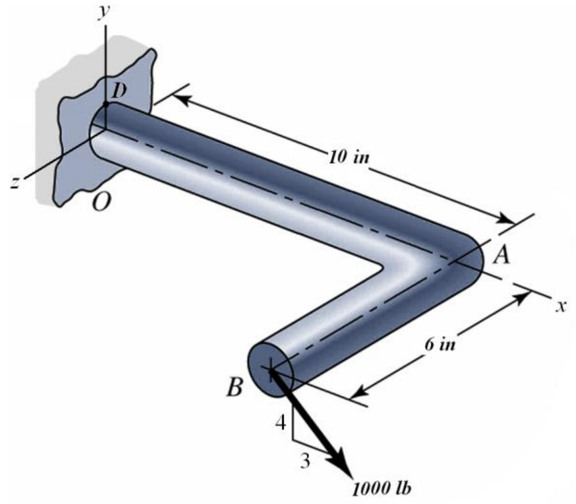
For a shaft of rectangular cross section subjected to torsion,

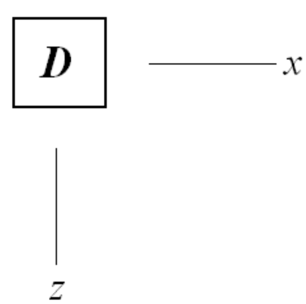
a) the maximum shear stress will occur at the corners
b) the maximum shear stress will occur at the middle of the longest side
c) the maximum shear stress will occur at the middle of the shortest side
d) the maximum shear stress will occur at the center
e) the shaft surface will be subjected to normal stress not to shear stress

Part II – Open Book ***Name:***______________________

(25 points)

2. The 2 inch diameter bar is subjected to a force of 1000 lb as shown. Determine the state of stress at point ***D*** on the top surface of the bar (along the *y* axis), and show the state of stress on the provided stress element.

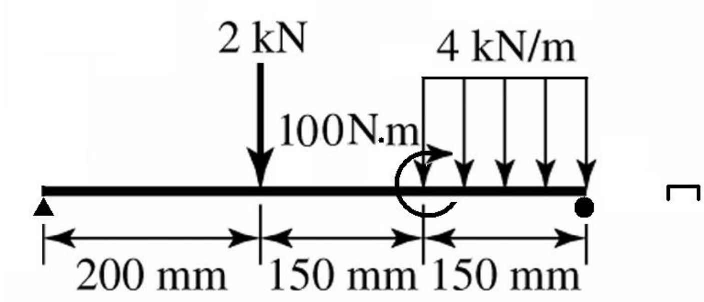




(25 points)

3. A simply supported beam is subjected to the loading shown. A standard size C-channel cross section made of 1040-HR steel is to be used to make the beam.

   a) Using a design factor of 3, choose a C-channel of appropriate size.
   b) Find the factor of safety for the beam.



(25 points)

4. A close-ended cylinder has an internal radius of r_i = 50 mm and a wall thickness of t = 1 mm. The pressure inside the cylinder is P_i = 1 MPa. The cylinder is also subjected to a torque of T = 50 N.m applied at both ends. Find the state of stress at a point on the surface of the cylinder and show it on a stress element.

(16 points)

5. A 20 mm thick 1050-CD steel plate is to be rolled to make a cylinder. Determine the minimum value of inner radius r_i at which the plate can be rolled such that it will not fracture during rolling. *Assume that the mid-plane of the plate does not experience any tension or compression (i.e., there is no elongation at the mid-plane).*