



First Exam
Part I – Closed Book

Name: _____
Student #: _____

Please Read Questions Carefully – Good Luck!

(20 points)

1. For the flowing statements circle the correct answer.

Ceramics are ductile and much stronger in compression than in tension.

T F

Thermoset polymers can not be melted and reformed.

T F

The main advantages of composite materials are the light weight and that they can stand high temperatures.

T F

The factor of safety is defined as the ratio of stress to strength.

T F

If 30 parts fail out of each 100 parts, this means that the reliability is 0.7.

T F

The Weibul distribution is a three parameter symmetrical bell-shaped distribution.

T F

Cold working decreases the ductility of the material.

T F

For a rotating ring, the maximum stress occurs at the outer surface.

T F

In a thick-walled pressure vessel the stress increases as we move away from the inner surface.

T F

Stress concentration factors should be used for both brittle and ductile materials.

T F

During quenching, a part will be cooled at a very fast rate using water or oil.

T F

Annealing is usually used for quenched parts in order to remove residual stresses and decrease the yield strength.

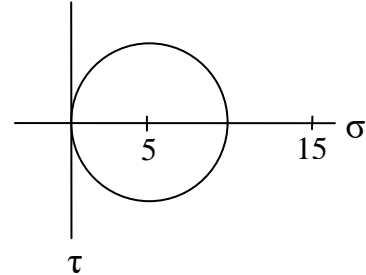
T F

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

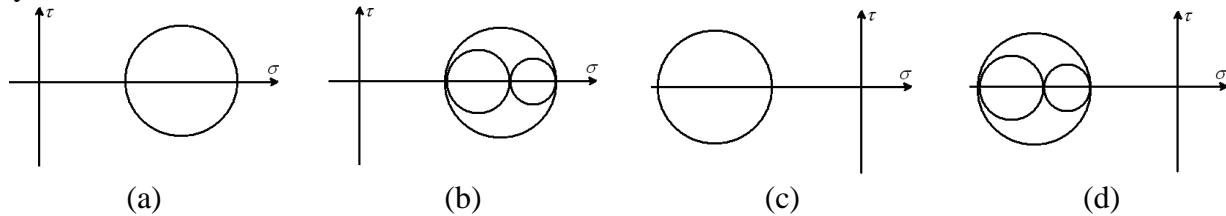
- a) In the principal orientation, both principal stresses are equal
- b) In the principal orientation, the shear stress is maxim
- c) In the maximum shear stress orientation, the normal stresses are equal
- d) None of the above

Which of the following states of stress can be represented by the Mohr's circle shown?

- a) $\sigma_x = 10, \sigma_y = 0, \tau_{xy} = 0$
- b) $\sigma_x = 10, \sigma_y = 0, \tau_{xy} = 5$
- c) $\sigma_x = 5, \sigma_y = 5, \tau_{xy} = 5$
- d) (a) and (c)
- e) all



Which of the following Mohr's circles represent the state of stress at the line of contact for cylindrical contact?

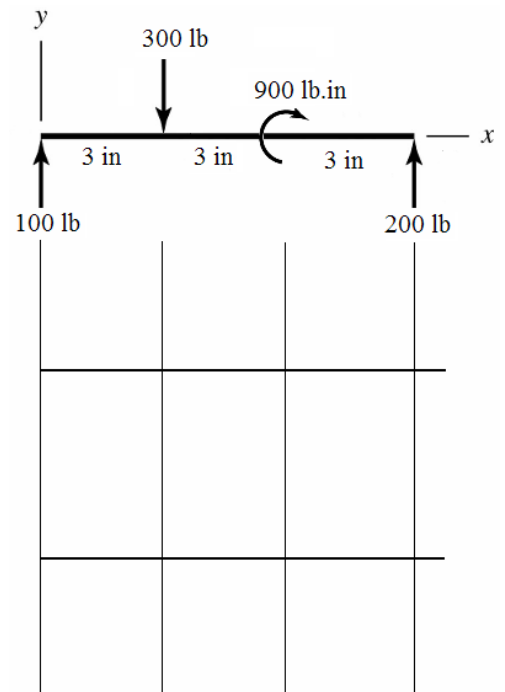


For a curved beam having rectangular cross section that is subjected to bending moment:

- 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 inner surface
- e) Non of the above

(5 points)

2. For the beam shown below, sketch the shear and moment diagrams and indicate the values of maximum shear force and maximum bending moment.

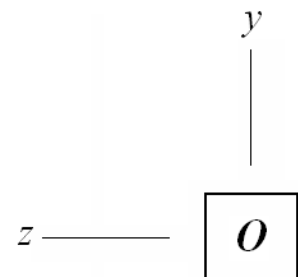
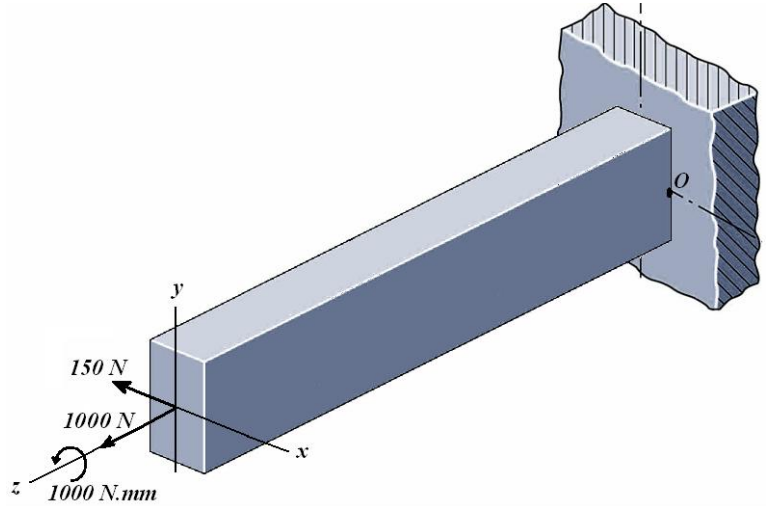


Part II – Open Book

Name: _____

(28 points)

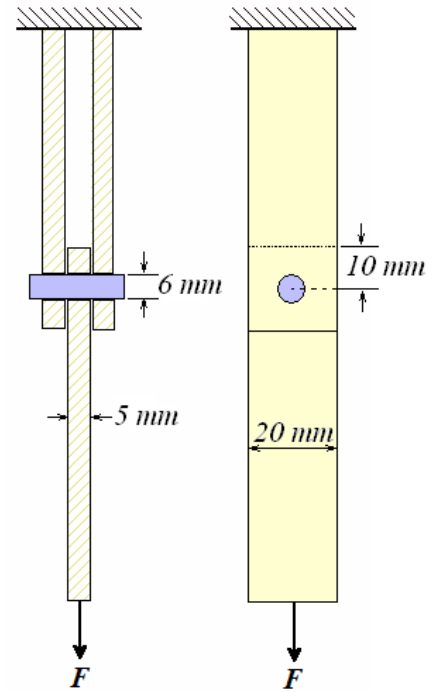
3. The 200 mm long cantilever beam is subjected to the loading show in the figure. The beam has a $(10\text{ mm} \times 20\text{ mm})$ rectangular cross-section. Determine the state of stress at point O (which is located at the middle of the side surface of the beam, as seen in the figure), and show the state of stress on the provided stress element.



(20 points)

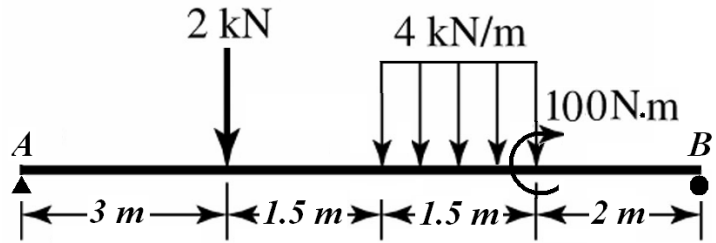
4. The double-splice joint shown is made of gray cast iron plates (*ASTM 40*) and the pin is made of heat treated steel (*AISI 1040 Q&T @ 650° C*). The joint is subjected to a force of $F = 3000\text{ N}$ as shown in the figure.

- Find the factor of safety for the plate.
- Find the factor of safety for the pin.



(12 points)

5. Using singularity functions write the loading expression for the beam shown.



(15 points)

6. The yield strength results obtained from tensile tests of AISI 1035 HR steel samples follow a weibull distribution with the following parameters $x_0 = 39.5 \text{ ksi}$, $\theta = 50.8 \text{ ksi}$ and the shape parameter $b = 2.88$. Find:

- The median yield strength
- Yield strength at a reliability of 0.95
- The reliability for a yield strength value of 45 ksi