The Hashemite University
Faculty of Engineering
Mechanical Engineering Department

Machine Design I
Fall 2008
Instructor: Dr. Ala Hijazi

First Exam   *Name:* _____
Part I – Closed Book   *Student #:* _____

Please Read Questions Carefully – Good Luck!
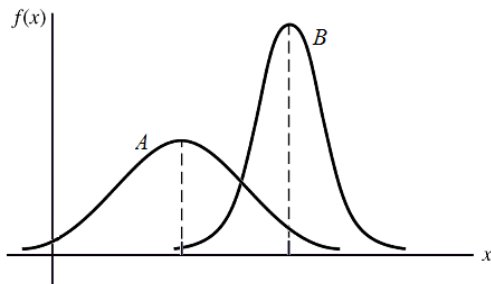
(22 points)
1. For the flowing statements circle the correct answer.

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

If 20 parts fail out of each 100 parts, this means that the reliability is
0.2.   T   F

The probability density functions for two normally distributed sets of
data are shown below:

The mean for data set A is larger than that of set B.   T   F

The standard deviation of data set A is larger than that of set B. T   F

The probability of the mean for data set A is smaller than that of set B.   T   F

A number of samples were picked randomly out of a truck load of
steel pieces and were tested for yield strength. If engineer "A" reported
the yield strength as being 400 MPa and engineer "B" reported the
yield strength as being 410 MPa, this means that engineer "B" reported
the yield strength at a lower reliability.   T   F

Brittle materials undergo large amounts of plastic deformation before
fracture.   T   F

Cold working decreases the yield strength of the material.   T   F

During quenching the part is allowed to cool-down in still-air.   T   F

Ceramics are brittle and much stronger in compression than in tension.   T   F

Thermoplastic polymers can not be melted and reformed.   T   F

One of the main disadvantages of fiber reinforced composite materials
is that they can not stand high temperatures.   T   F

For spherical contact, the maximum shear stress occurs at the surface.   T   F

Maximum stress in a thick walled pressure vessel occurs at the outer
surface.   T   F

For a beam subjected to pure bending moment, shear stress is
maximum at the neutral axis.   T   F

Stress concentration factors should be used only for brittle materials.   T   F

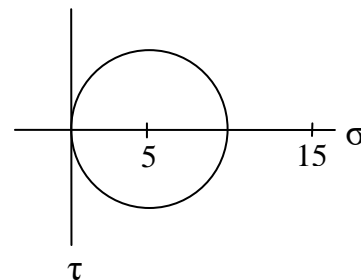For a point under plane stress condition, which of the following is true?
 a) In the principal orientation, both principal stresses are equal
 b) In the principal orientation, the shear stress is maxim
 c) In the maximum shear stress orientation, the normal stresses are equal to zero
 d) None of the above

In general, the stress in an element is independent of the material the element is made of where it depends only on the load and geometry except for the flowing:
 a) Contact stress
 b) Stress in rotating rings
 c) Stress resulting from press or shrink fits
 d) all
 e) Stress never depends on the material
 f) Stress always depends on the material

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) $\sigma_x = 0$, $\sigma_y = 10$, $\tau_{xy} = 0$
 c) $\sigma_x = 5$, $\sigma_y = 5$, $\tau_{xy} = 5$
 d) none
 e) all

(20 points)
2. A <u>close-ended</u> cylinder has an internal diameter of *80 mm* and a wall thickness of *1 mm* is. The pressure inside the cylinder is *4 MPa* and the cylinder is also subjected to torque of *T = 20 N.m* applied at both ends as shown in the figure.
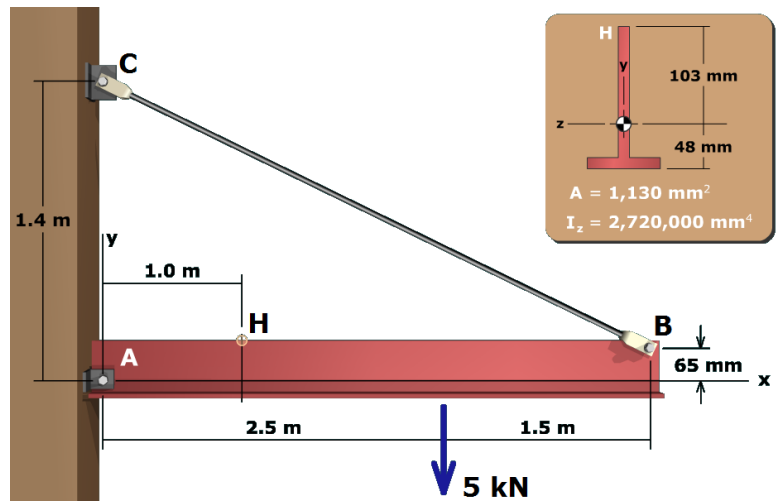
    a) Find the <u>state of stress</u> at point *B* on the surface of the cylinder and <u>show</u> it on a stress element.

    b) Find the principal stresses.
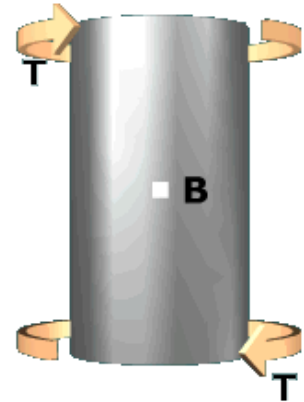
(30 points)
3. The inverted T-cross section beam is pinned to the wall at **A** and supported by the cable **BC**. The beam is subjected to a load of **5 kN** as shown in the figure.

 a) Find the stress at point **H**.
 b) Without considering the stress concentrations, where do you expect the maximum stress on the beam to be (<u>indicate the point on the figure</u>)?
 c) If the maximum stress in the beam is equal to **150 MPa** and the factor of safety must be ≥ **2**, what hot-rolled steel alloy should the beam be made of?

103 mm

48 mm

A = 1,130 mm²
I$_z$ = 2,720,000 mm⁴

1.4 m

1.0 m

H

A

2.5 m

1.5 m

B

65 mm

x

5 kN

(28 points)

4. The bracket is fixed at O and subjected to the loading shown.

a) Draw free body diagrams for links AB and BC.

b) Considering the stress concentration and knowing that the value of the load $F = 500 N$, determine the state of stress at point A (on the top surface and facing the positive y direction) and <u>show</u> it on the provided stress element.

38 mm dia.

3 mm R.

24 mm dia.

350 mm

400 mm

O

A

B

C

F

F

A ——— x

z