MER311 Spring 2016 Exam I ReWrite Cover Sheet

As a student at Union College, I am part of a community that values intellectual effort, curiosity, and discovery. I understand that in order to truly claim my educational and academic achievements, I am obligated to act with academic integrity. Therefore, I affirm that I carried out this assignment with full academic honesty, and I rely on my fellow students to do the same.

For this Exam ReWrite, I understand that:

1. I **must** work alone in writing out the solutions to the problems in this exam.
2. Once I start solving a problem in the ReWrite exam I **must** complete the problem without taking any breaks.
3. I **cannot** copy solutions, in part or whole, to the problem on this exam from any person or resource.
4. Prior to writing the exam problem as stipulated in 2 above, it is **completely acceptable** to use any resource (instructor, book, person, web, etc) to seek out help in formulating a solution to the problem.
5. I **cannot** use any electronic resources to assist me in the solution to the questions on this exam while I am writing the exam problem except a Matlab command window or Excel Spreadsheet that is blank, and my calculator. I cannot preprogram my calculator with any programs or varialbles.
6. Because I am being allowed to use my own computer to solve problems on this exam, I **can** only have the program stipulated in 5 running on my computer during the exam. I **cannot** have any other programs running while I am writing my solution as stipulated in 2 above, this is meant to include email, web browsers, etc.
7. I **can** use one page - single sided - of notes during the exam. This one page of notes **cannot** contain any solutions to problems. I must staple this page to the back of my exam at the end of the exam.
8. When I turn in my exam for grading,
    a. The ReWritten exam problems and all their parts must be in order.
9. I understand that I can solve as many problems on the exam as I wish and that one point credit will be added to my original test score for each section of the exam that is COMPLETELY CORRECT.

Signature: _____

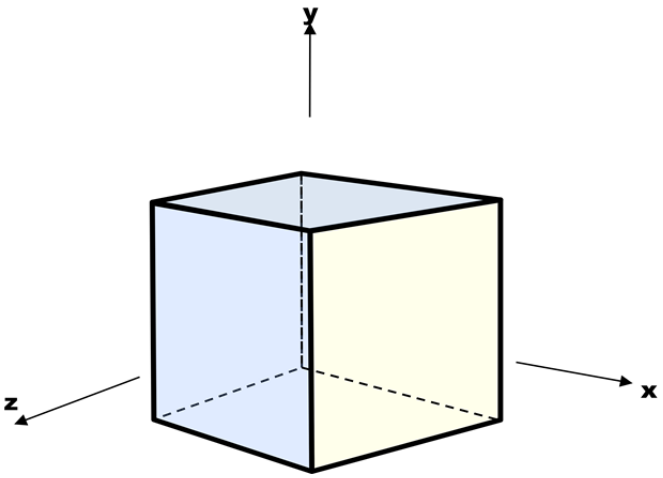
Print Name: _____

Due Date: _____

PROBLEM 1: At a point in a loaded member, the stresses relative to a x-y-z coordinate system are given by:

$$[\sigma]_{xyz} = \begin{bmatrix} 25 & 10 & 15 \\ 10 & 0 & 0 \\ 15 & 0 & -20 \end{bmatrix} MPa$$

1a. Draw the state of stress on the cube shown.



1b. Determine the principal stresses for this state of stress and their directions cosines. (If you use MATLAB or Excel to perform calculations, be sure to print out the Command Window or spreadsheet that contains the commands you used to perform the calculations AND ATTACH THE PRINT OUT DIRECTLY BEHIND THIS PAGE OF THE EXAM.)

1c. Write the transformation matrix that will transform the original state of stress to the principal state of stress.

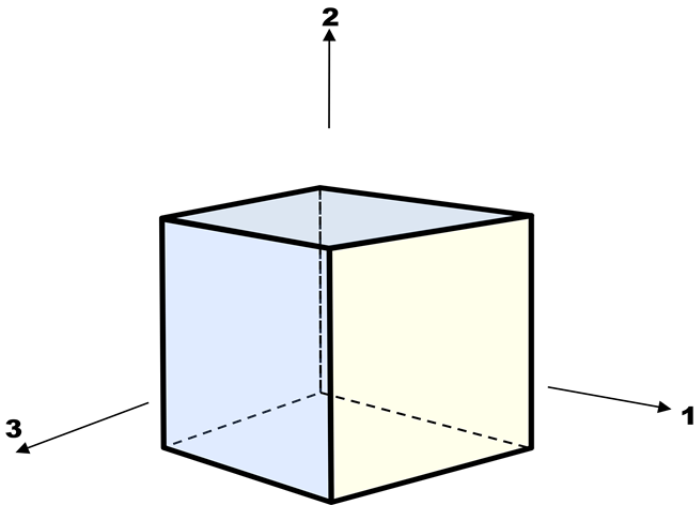
1d. What angles (in degrees) do each of the principal stresses make with the x, y, and z axes?

σ_1: θ_{1x}= θ_{1y}= θ_{1z}=

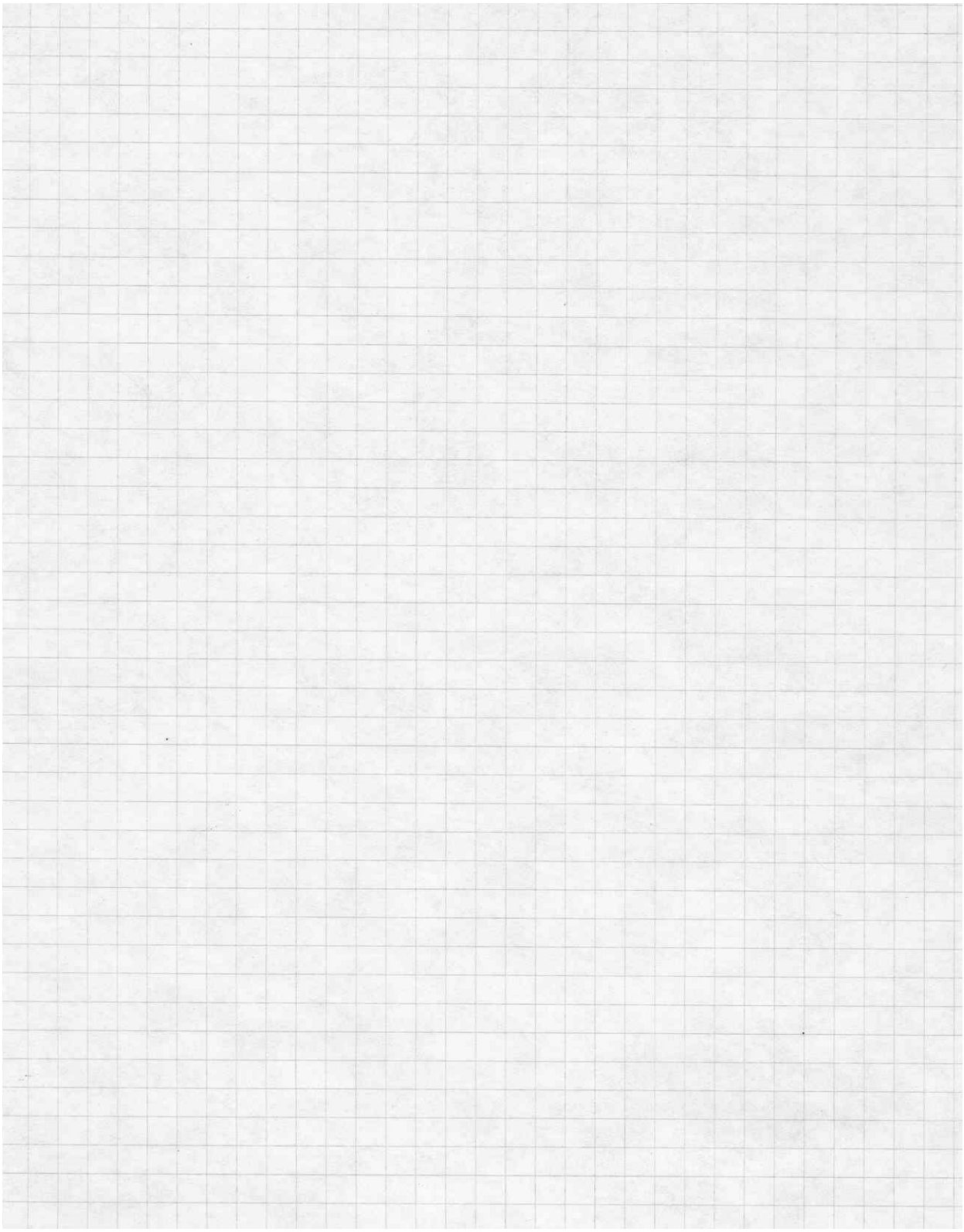
σ_2: θ_{2x}= θ_{2y}= θ_{2z}=

σ_3: θ_{3x}= θ_{3y}= θ_{3z}=

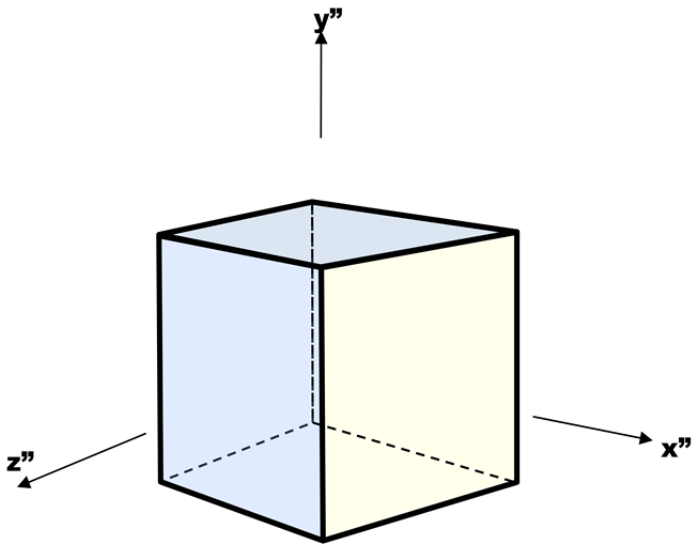
1e. Draw the principal state of stress on the stress cube provided. Make sure to use the engineering convention that $\sigma_1>\sigma_2>\sigma_3$.



1e. Draw Mohr's circle for the 3 dimensional state of stress at this point.



1f. What is the absolute maximum shear stress and the normal stresses that accompany it? Illustrate the state of stress where the shear stress is maximum on the cube below where the x"y"z" coordinate system is orientated such that it shows the maximum shear stress when one of the faces is in the principal state of stress.



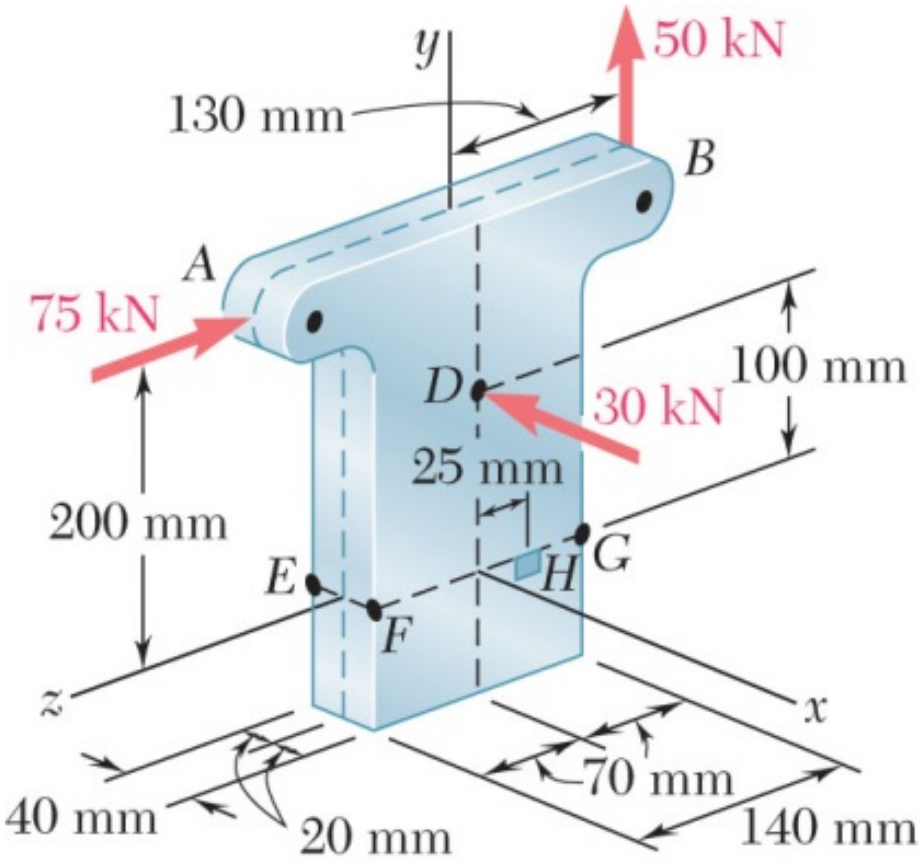
1g. What angles does the cube above make the original x, y, and z coordinates (if an algorithm is being used, attach it directly behind this page).

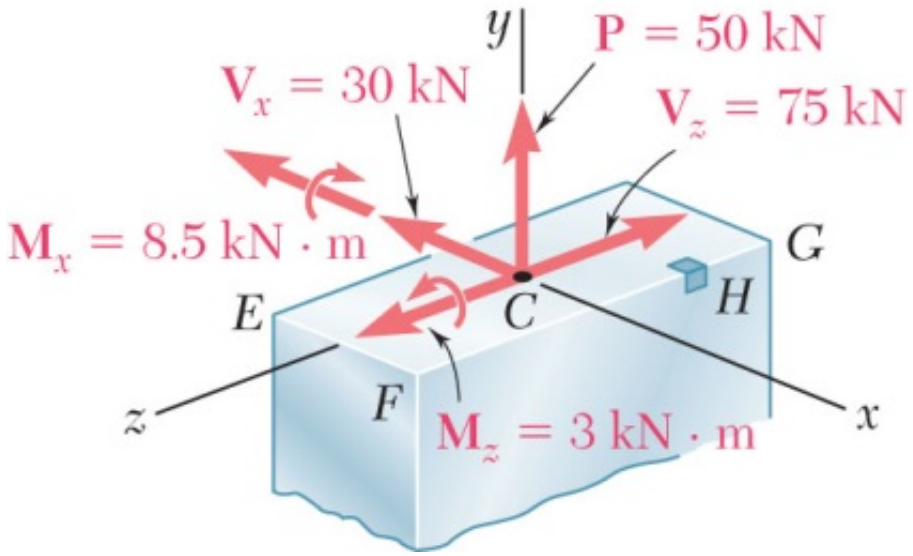
$\theta_{x"x}$= $\theta_{x"y}$= $\theta_{x"z}$=

$\theta_{y"x}$= $\theta_{y"y}$= $\theta_{y"z}$=

$\theta_{z"x}$= $\theta_{z"y}$= $\theta_{z"z}$=

PROBLEM 2: The structure below is loaded as shown. At the EFGHC cross-section the internal loads caused by this loading condition are shown in an expanded view below the figure.





2a. Determine the complete state of stress at point H in the structure (for a rectangle I=(1/12)* $b*h^3$).

2b. Draw the complete state of stress at H on the cube below.