Wednesday, March 21, 2012, 12 –1 PM.

Please write your name at the top of each page as indicated and write all answers in the space provided. If you need additional space, write on the backside of the sheet. Do not remove or add any pages. **Assume all problems are two-dimensional unless noted otherwise. For all answers, where appropriate, provide units.** *Good luck*!

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PROBLEM 1: 35 pts total

A) **5 pts** For this truss structure, determine the vertical and horizontal components of the reaction forces at both joints A and E.
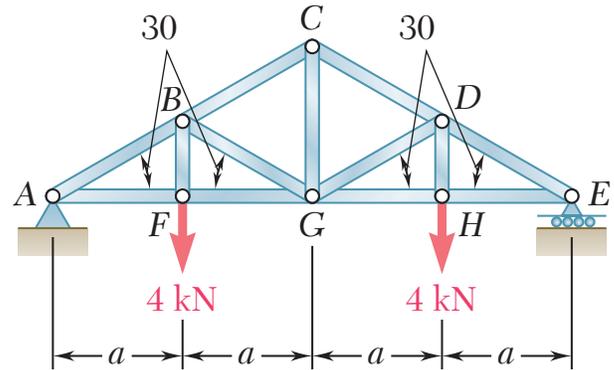

B) **15 pts** Determine the magnitude of the force in truss *EH* and also state whether it is in tension or compression.

c) **15 pts** Determine the magnitude of the force in truss *CD* and state whether it is in tension or compression.

PROBLEM 2: 35 pts total

Rod ABC has a circular cross section, with dimensions as shown. Rod portion AB is made of steel (E = 200 GPa) and portion BC is made of aluminum (E = 70 GPa). The magnitude of the upward-acting force P is 4 kN and downward-acting force Q is 2kN.

A) **10 pts** Plot a graph of the net axial force along the length of the bar. On your plot, let X=0 at point A, and denote all tensile forces with positive values.

P

A

0.4 m   20-mm diameter

B

0.25 m

60-mm diameter

0.25 m

Q

C
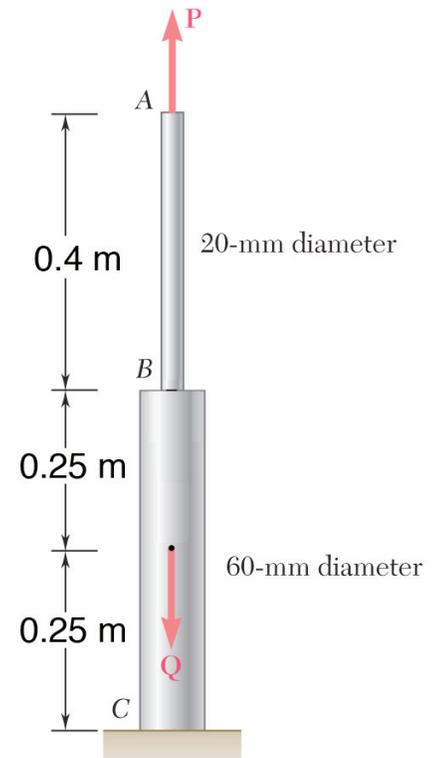
B) **5 pts** Determine the strain in rod portion AB. Be sure to specify if it is tensile or compressive.

C) **10 pts** Determine the total strain in rod portion BC. Be sure to specify if it is tensile or compressive.

D) **10 pts** Assume now that the force Q is unknown. Determine the magnitude of the force Q so the overall deflection at A is zero. Be sure to specify if Q is pointing upwards or downwards.

PROBLEM 3: 30 pts total

A state of plane stress is shown in the X-Y coordinate system, and a weld seam is shown at an angle of 75° to the X-axis. The plane of the weld extends in and out of the page and has a normal vector as shown. The shear stress τ_{xy} has not been specified. For this problem:

A) **10 pts** Determine the value of τ_{xy} for which the shear stress in the plane of the weld is zero.

2 MPa

τ_{xy}

75°

12 MPa

Y

X
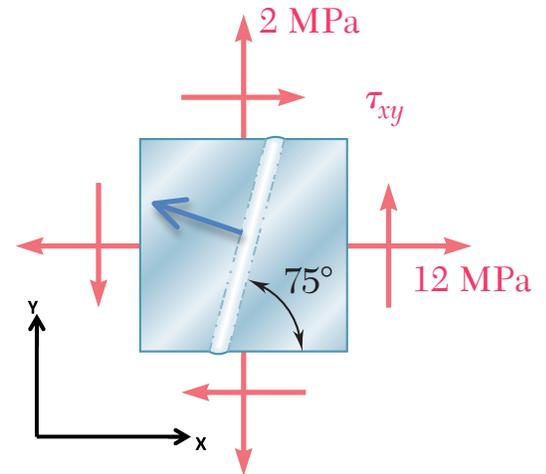
B) **10 pts** At this value of τ_{xy}, what is the value of the normal stress acting perpendicular to the plane of the weld, *i.e.* along the direction of the normal vector shown above? Be sure to denote whether that is a tensile or compressive stress.

C) **10 pts** For your given solution to this problem, plot the Mohr's Circle on the following chart. Be sure to clearly labeling the components of the stress state in the X-Y coordinate system and in the plane of the weld; and clearly label your scale.