Homework #5
Due: 10/27/16

1. (20) In class we drew the yield surfaces for both the Tresca (maximum shear stress) and von Mises (energy distortion) yield criteria. Recall that these surfaces assume isotropic plasticity (or yielding). On 2D plots, draw how you would expect both yield surfaces to change for a plastically *anisotropic* material where (a) $Y_1 > Y_2$. (b) How would the von Mises yield surface change for $Y_3 > Y_1 = Y_2$, and $Y_3 < Y_1 = Y_2$. Y is the yield stress in uniaxial tension.

2. (20) A rare number of materials undergo volume expansion during deformation. (a) Describe and show the yield surface you might expect for such a material and note how it differs from a material that is volume conservative. (b) Describe problems that might be encountered in the practical forming of such a material.

3. (20) Use numerical calculations to show whether the effective stress in plain strain compression is greater or less than that for uniaxial compression. Repeat for the effective strain. In each case, explain why one is greater than the other?

4. (40) An annealed copper sheet, originally 1 mm thick, is to be plastically formed into a hemispherical dome, with outer radius 10 mm, using a pressurized fluid (bulging). The metal's behavior is described by $\bar{\sigma} = 315 \cdot \left(\bar{\varepsilon}\right)^{0.54}$ MPa. The specific heat and density of copper is 385 J/Kg-K and 8970 Kg/m^3.

   (a) Using the von Mises yield criterion, find the maximum internal fluid pressure required to form the dome.
   (b) Calculate the total amount of work done on the material and the temperature rise, assuming the process is adiabatic and the temperature uniform throughout the copper specimen.