HW06: Questions related to Principal Stresses and Principal Strains

1.

Decompose a uniaxial state of stress into principal stresses that represent (i) pure hydrostatic and (ii) pure shear stress state.

2.

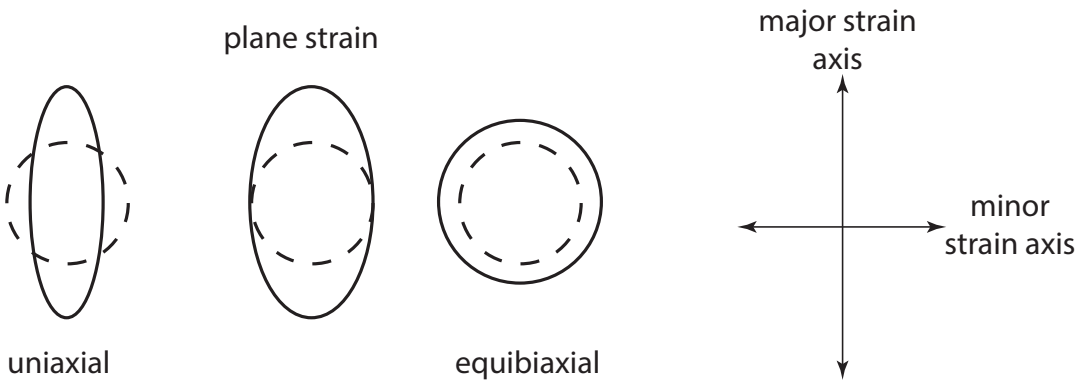
(a) Consider the pure shear stress state above. Consider a cube representing the stress state showing the two principal stresses.

(b) Orient the above cube to show shear stresses.

(c) Apply mechanical equilibrium to relate the magnitude of the stresses in (a) and (b).

3. The concept of principal strains can also be used to describe large scale deformation during plastic flow (the principal stresses are a different matter altogether, we shall deal with in the next topic). This problem is related to plastic deformation where the strains are large (requiring true strains to calculate their magnitude - do you understand this?). and where deformation occurs at constant volume, that is the Poisson's ratio = 0.5. Remember that in constant volume, $\varepsilon_1 + \varepsilon_2 + \varepsilon_3 = 0$.

Now consider the stretching of sheet metal in different ways. Here, two of the principal strain directions are in the plane of the sheet while the third is perpendicular to the sheet. The in-plane principal strains are measured by measuring the deformation of circles etched on the surface. These circles can deform in different ways as shown below:



Draw the strain path for each of the above three cases on the graph drawn with minor and major strain as the x and the y axis.