Name: _____ Student ID: _____

Worksheet activity: introduction to Mohr's Circle for Stress

Learning Goals

- Reinforce concepts discussed in lecture on the topics of stress and strain
- Develop an understanding of the relationships between the principal stresses, normal and shear stresses and the interaction of these on planes of varying orientation

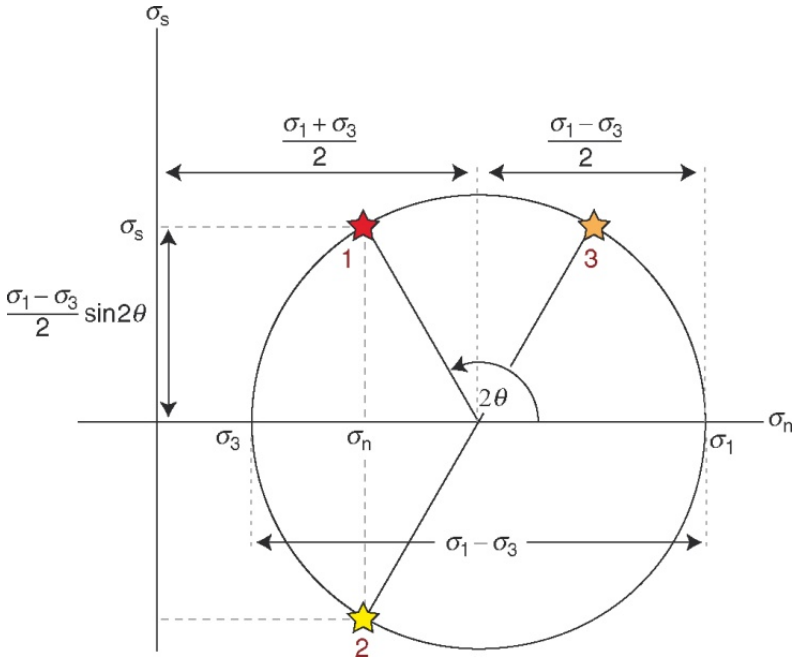
You will need, pencils, pens, pair of compasses for drawing circles, ruler, graph paper (provided)

We will use the Mohr circle to determine a variety of stress values for different initial known conditions. The Mohr circle can be used for:
- stress; plotting normal stress σn vs. shear stress σs and
- for strain; plotting a stretching function such as λ' vs. a measure of shear strain such as λ/γ with respect to a chosen marker feature such as the long axis of a fossil.

We will plot some new stress data, and we will take a look at our strain data from the Measuring Strain Homework.

First some details on the Mohr circle:

- Remember Θ is the angle between σ1 and the normal to the plane of interest.
- Note we use 2Θ on a Mohr circle to ensure our principal axes which are in reality perpendicular to each other, plot on the x-axis where shear stress = 0.



- σn is +ve in compression and –ve in tension.
- σs is +ve for anticlockwise (sinistral) and –ve for clockwise (dextral).
- *(Sometimes σn & σs are called σ and τ respectively.)*
- σ1 and σ3 are our max and min principal stresses.

- **Diameter** (σ1 – σ3) = differential stress. The larger the differential stress the greater potential for distortion

- **Centre** (σ1+σ3)/2 = mean stress. This is the lithostatic component of the stress field (produces dilation)

- **Radius** = (σ1-σ3)/2 = deviatoric stress, this produces distortion or change in shape. This is the non lithostatic component of stress.

Part 1 - Stress

1) On the graph paper provided draw the axes of the graph so that 2 cm = 100 MPa. Ensure that your origin goes through 0,0 and that you have room for -300 to +500 MPA on the horizontal and -300 to +300 on the vertical axis.
   Label your axes with shear stress and normal stress
2) Given that the principle stresses at a point are σ1 = 450 MPa and σ3 = 120 MPa construct a Mohrs circle on your graph and use it to determine the
   i) mean stress _____
   ii) differential stress _____
   iii) deviatoric stress _____

3) Using the same Mohr circle, and drawing and labelling your planes on the diagram, determine the values of the normal and shear stress acting on planes whose normals are inclined at:
   i) 0 degrees to the σ1 direction

   What quantity does this point represent?
   Based on your calculations, do these results make sense with the orientation of the plane with respect to σ1?
   Draw a simple sketch of the plane and σ1 to illustrate this:

   ii) 45 degrees to the σ1 direction

   What quantity does σn at this point represent?

   iii) 60 degrees to the σ1 direction

   iv) 90 degrees to the σ1 direction

   What quantity does this point represent? Based on your calculations do these results make sense with the orientation of the plane relative to σ1?
   Draw a simple sketch of the plane and σ1 to illustrate this: