1-A hydrofracture test is used to measure the insitu stress in a vertical borehole. The breakdown pressure was 17 MPa and the shut-in pressure was 13 MPa. The estimated tensile strength of the rock is 1 MPa. An impression packer measures two vertical fractures on opposite sides of the borehole. These fractures have an orientation of 90°/100° S (dip/strike). Determine the magnitude and orientation of the horizontal principal stresses.

2. A hydrofracture test is performed in a horizontal borehole drilled at a trend of 060°. The breakdown pressure was 14 MPa and the shut-in pressure was 12 MPa. The estimated tensile strength of the rock is 2 MPa. An impression packer measures two horizontal fractures on opposite sides of the borehole. How deep was the borehole? What would be the in-situ horizontal stress that is perpendicular to the horizontal borehole?

3. A hydroelectric project plans to construct a 5 m diameter tunnel to carry water from a reservoir to the turbine gallery. It is desired to have some of this tunnel unlined. The rock consists of jointed andesite with a ucs = 90 MPa. Assume the insitu horizontal stresses are equal to the vertical stress. To be conservative on the design, the tensile strength of the rock mass is assumed to be zero. If the highest water pressure in the tunnel under surge conditions is expected to be 2 MPa, what is the minimum deep of cover in the rock needed to ensure that the tunnel is safe from fracking?