Name:

Exam 2

1. (30 pts.) Consider the problem of an infinite plante with a hole under biaxial tension as shown in Figure 1.

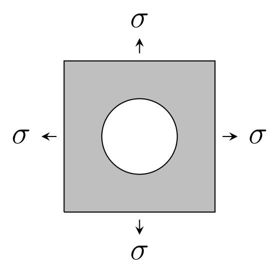

Figure 1: Infinite plate with a hole under biaxial tension

   (a) Formulate boundary conditions for the problem
   (b) Develop the Airy stress function in polar coordinates to satisfy the remote boundary conditions
   (c) How would you proceed to finish the problem?

2. (30 pts.) You are tasked with testing a material which is assumed to be monoclinic under a unique biaxial test ($\sigma_{11} = \sigma$, $\sigma_{22} = 2\sigma$, all other $\sigma_{ij} = 0$).

   (a) Find the strain in terms of the applied stress, σ

   (b) What, if anything, could you measure from this experiment to confirm whether or not the material is, in fact, monoclinic?

3. (40 pts.) You are attempting to characterize a large deformation material using a new potential function you found in a paper. This potential function is expressed in terms of the invariants of stretch, which are given below for an incompressible material.

$$I_1 = \lambda_1^2 + \lambda_2^2 + \lambda_3^2 \tag{1}$$
$$I_2 = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2} + \frac{1}{\lambda_3^2} \tag{2}$$
$$I_3 = J^2 = \lambda_1^2\lambda_2^2\lambda_3^2 \tag{3}$$

Recall that the Cauchy stress can be found in terms of W as

$$\sigma_i = \lambda_i \frac{\partial W}{\partial \lambda_i} \tag{4}$$

. The potential function to be implemented is given as

$$W = C_{11}(I_1 - 3)(I_2 - 3) + C_{22}(I_1 - 3)^2(I_2 - 3)^2 + D(J - 1)^2 \tag{5}$$

. Find σ_1 as a function of the applied stretch, λ, for the following loading conditions:

$$\text{uniaxial} \qquad \lambda_1 = \lambda \qquad \lambda_2 = \lambda_3 \tag{6}$$
$$\text{biaxial} \qquad \lambda_1 = \lambda \qquad \lambda_2 = \lambda \tag{7}$$
$$\text{plane strain shear} \qquad \lambda_1 = \lambda \qquad \lambda_2 = 1 \tag{8}$$