Name:

Exam 1

1. (20 pts) Formulate the boundary conditions for an infinite plate with a hole. The plate is fixed remotely and has a shear traction applied around the hole as shown.

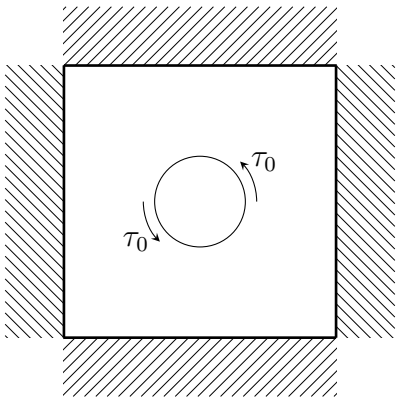

Figure 1: Figure for problem 1

2. (40 pts) One method of characterizing Mode II fracture toughness is End-Notched Flexure (ENF).

   (a) For the ENF specimen shown, show how to use beam theory to calculate the strain energy release rate (do NOT calculate).

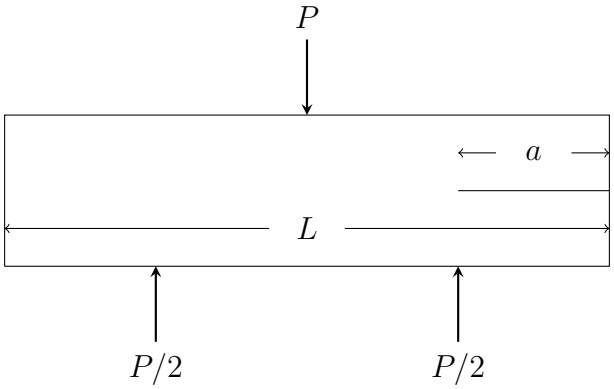

Figure 2: Figure for problem 2

   (b) How can the strain energy released as a function of crack length can be used to determine stable or unstable crack growth?

   (c) For the ENF specimen above, the strain energy can be found as

$$G = \frac{9P^2Ca^2}{2b(2L^3 + 3a^3)}$$

   where the beam compliance, C, is given as

$$C = \frac{2L^3 + 3a^3}{8Ebh^3}$$

   calculate under what conditions crack growth will be stable for both fixed displacement and fixed load boundary conditions.

3. (15 pts) The Westergaard function for a semi-infinite crack with concentrated splitting forces applied is

$$Z_I = \frac{P}{\pi(z+b)}\sqrt{\frac{b}{z}}$$

Calculate the stress intensity factor

4. (15 pts) What is the difference between the strain energy release rate (G) and the stress intensity factor (K). When will they predict the same failure stress? When won't they?