**Due in class, Thursday, 22 April 2010**

**37. A spherical cavity in a power-law material**

In ES 240, we solved the following boundary-value problem in linear elastic theory (http://imechanica.org/node/205). A small spherical cavity is inside a block of a linearly elastic material, subject to a hydrostatic tension remote from the cavity. Now solve this boundary-value problem when the block is of an incompressible power-law material. In particular, determine the stress concentration factor:

$$\frac{\sigma_{\max}}{\sigma_{appl}} = C(n).$$

Also determine the field of deformation.

**38. The *J* integral over a contour around a bridged crack**

A crack is bridged over a zone behind its tip. The traction-separation curve is

$$\sigma = \sigma(\delta).$$

A contour starts on one face of the crack and ends on the other. If both the starting and the end points are on traction-free faces behind the bridging zone, show that the *J* integral over the contour is equal to

$$J = \int_0^{\delta_{tail}} \sigma(\delta) d\delta ,$$

where $\delta_{tail}$ is the separation at the tail of the bridging zone.

**39. Large-scale bridging**

- Read Z. Suo, S. Ho and X. Gong, Notch ductile-to-brittle transition due to localized inelastic band, ASME *J. Engng. Mater. Tech.* 115, 319-326 (1993). http://www.seas.harvard.edu/suo/papers/031.pdf
- Explain the physical content of Figure 5.
- Explain the mathematical procedure to construct this figure. List all the relevant equations.

**40. Adhesive toughness**

- Read M.D. Thouless, J.L. Adams, M.S. Kafkalidis, S.M. Ward, R.A. Dickie, G.L. Westerbeek, Determining the toughness of plastically deforming joints. *Journal of Materials Science* **33**, 189-197 (1998).
- Describe the experimental procedure.
- Derive Equation (9) from first principles.