Take Home Exam 05: Small Scale Fracture

Assigned: 09/28/2022

Due (as pdf by email) 10/02/2022 (Sunday) z

•you will receive a simple letter grade for your report

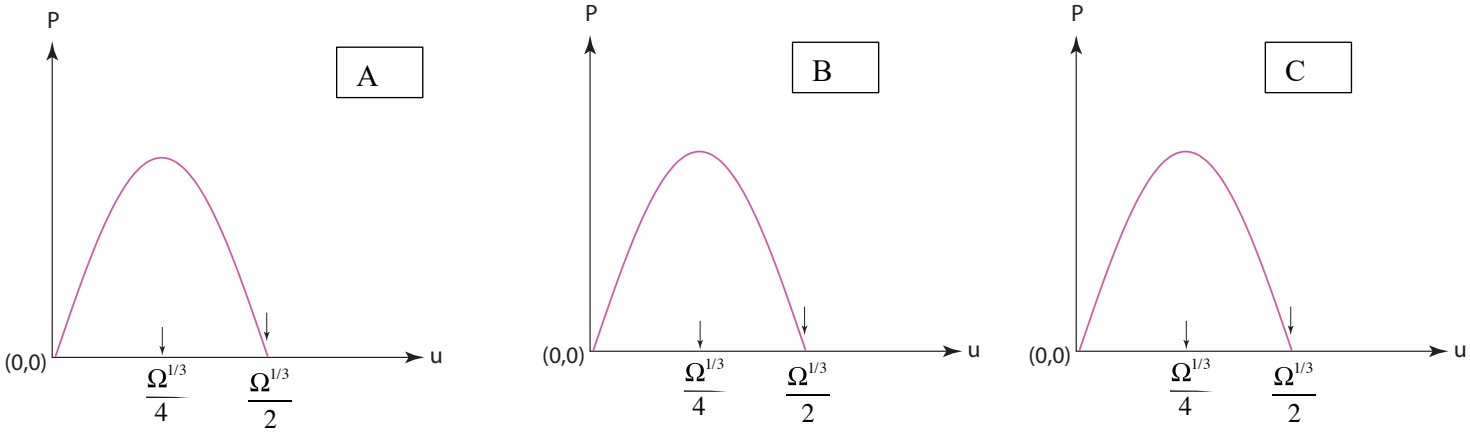
•You may submit your answers in one of two ways:

1) For typed answers: as a .docx file (as is) or converted into a pdf file. (DO NOT SEND GOOGLE DOC)

For handwritten answers: Please scan as images, and group together into one pdf file. Or you may hand them manually to my office (ECME-212)

HW 05.1

Consider three materials: A, B and C. The force displacement curve for A is shown below on the far left:



(i) Assume that material B has an elastic modulus that is 150% of A. Draw the curve for B superimposing it on the curve for A (the middle graph above).

(ii) Assume that material C has twice the work of fracture (enthalpy of formation) of material A. Draw the curve for C superimposing it on the curve for A (the graph on the right above).

HW 05.2

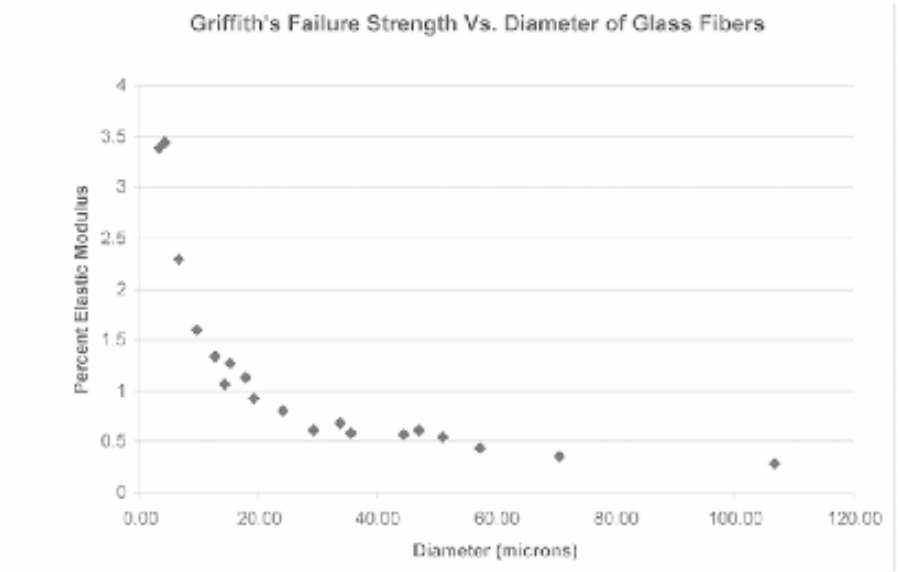
In class we discussed the possibility of finding a relationship between the fracture strength (stress to failure), σ_F and the flaw size, *c.* This relationship, as we shall derive in the next class, is given by:

$$K_{IC} = \sigma_F \sqrt{c} \qquad (1)$$

K_{IC} is called the fracture toughness; it has units of MPa $m^{1/2}$.

The fracture toughness of glass is approximately 1 MPa $m^{1/2}$

Draw a plot of the fracture stress (in MPa) against the flaw size (in μm), and compare the graph for the data for the fracture strength of glass fibers as a function of the fiber diameter as given below (and also discussed in class):



Compare the plot obtained from Eq. (1) and the experimental plot given above, converting the y-axis in the data into fracture stress expressed (assuming the elastic modulus of glass to be 80 GPa).

Discuss the similarity and the differences between these plots in a couple of lines.