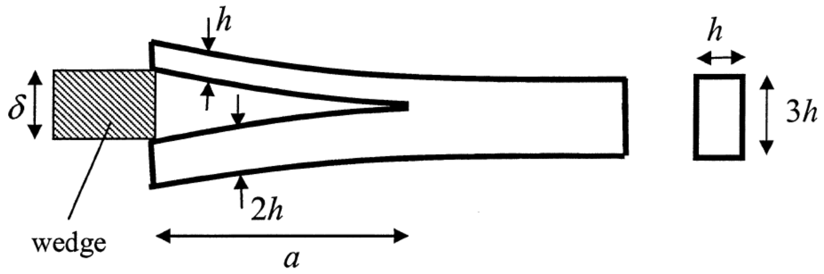
A? Problem 2.1 (4 pts)

Wooden chop-sticks have the geometry shown below, where the arms are opened by a wedge of height δ. The wood has a linear elastic behaviour with a Young's modulus E.

(a) Determine the compliance of each arm of the chop-sticks.

(b) Calculate the energy release rate G.

(c) Will crack growth be stable or unstable? Assume that the material has a flat R-curve.



A? Problem 2.2 (4 pts)

The R-curve for a steel alloy is given by:

$$R = \frac{K_{Ic}^2}{E} + \frac{1}{2}\sqrt{\Delta a}$$

where R is in MJ/m^2, the crack extension Δa is in meters, $K_{Ic} = 95\,\text{MPa}\sqrt{\text{m}}$ and $E = 210000\,\text{MPa}$. A large but thin plate is made from this material and contains a centre crack of length $2a_0 = 40\,\text{mm}$.

(a) Show that this plate allows a maximum stable crack growth of 6.3 mm at both tips.

(b) Calculate the critical stress σ_c at which unstable fracture will occur.

A? Problem 2.3 (2 pts)

The following data were obtained from a series of tests conducted on pre-cracked specimens with a thickness $B = 10\,\text{mm}$.

Crack length a (mm)	Compliance C (mm/kN)	Critical load P (kN)
50.0	0.100	10.00
66.7	0.143	8.75
84.2	0.202	7.80
102.7	0.279	7.00
119.5	0.359	6.55

Where P is the critical load at fracture. All load-displacement records were linearly elastic up to fracture. Determine the critical energy release rate G_c for this material.