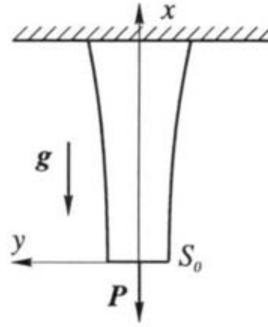


Hydrodynamics and Elasticity 2025/2026

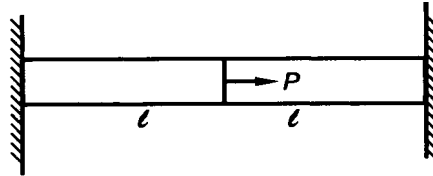
Sheet 3

One of the problems will be handed in and marked.

Problem 1 A rod, the cross section of which slightly varies along its length, is suspended in a vertical plane, under the action of gravity and a force P uniformly distributed over the lower cross section S_0 . What shape $S(x)$ should the rod be for the tensile stress T_{xx} to be identical in every cross section? Assume that T_{xx} is the only nonzero component of the stress tensor.



Problem 2 A composite rod, formed by welding two slender bars of equal length and diameter, is loaded by an axial force P as shown in the figure. If Young's moduli of the two portions are E_1 i E_2 find how the applied force is distributed between the two halves. The external walls are stiff and they do not deform.



Problem 3 Consider a cylindrical rod that is acted upon by an axial stress $T_{11} = -P$. What will be the state of stress in the rod if the lateral surface is constrained so that there is no contraction or expansion? Show that the effective Young's modulus $(E_Y)_{eff} = T_{11}/E_{11}$ is equal to

$$(E_Y)_{eff} = E_Y \frac{(1 - \nu)}{(1 - 2\nu)(1 + \nu)},$$

where ν is the Poisson ratio.

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