

HW5

due March 5, 2026

Show all your work and indicate your reasoning in order to receive the full credit.

Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together, in class, in person)

Question:	1	2	Total
Points:	40	30	70
Score:			

Instructor/grader comments:

Thin-wall container

1. (40 points) A sealed cylindrical container has length L , radius R , and wall thickness d , where $L \gg R \gg d$. The container is subjected to an internal pressure p and situated in an environment with negligible external pressure. Find the relative change in volume of the container due to the internal pressure. Assume the material's Young's modulus (E) and Poisson's ratio (ν) are known.

Estimate the relative change in volume for a container with the following parameters: $L = 1.0$ m, $R = 0.1$ m, $d = 0.001$ m, $\nu = 0.5$, $p = 10^{-4}E$.

Hints:

Consider the equilibrium of the container sections by taking a plane (a) through the longitudinal axis of the cylinder and (b) perpendicular to the axis of the cylinder.

Since the cylinder is very long, you may disregard the stress variations at the ends and assume the stress distribution is uniform along the length the cylinder.

Buckling threshold

2. (30 points) Determine the buckling threshold for a uniform rod with one end clamped and another pinned.

Hints:

- For the *clamped* end of a rod, the lateral displacement and the slope of the rod are zero.
- For the *pinned* end of a rod, the lateral displacement and the moment are zero.
- Derive the transcendental equation that determine the buckling threshold. (With the accuracy better than 5%, the smallest positive root of the correct equation is $\frac{3\pi}{2}$.)