

Exercises on Elastic Behavior

1. A 2m long steel rod has a cross-sectional area of 0.3cm^2 . The rod is a part of a vertical support that holds a heavy 550kg platform that hangs attached to the rod's lower end. Ignoring the weight of the rod, what is the tensile stress in the rod and the elongation of the rod under the stress? Young's modulus for steel is $Y = 2.0 \times 10^{11} \text{Pa}$
2. By how much does a 65kg mountain climber stretch her 0.8cm diameter nylon rope when she hangs 35m below a rock outcropping? (For nylon, $Y = 1.35 \times 10^9 \text{Pa}$.)
3. A farmer making grape juice fills a glass bottle to the brim and caps it tightly. The juice expands more than the glass when it warms up, in such a way that the volume increases by 0.2%. Calculate the force exerted by the juice per square centimeter if its bulk modulus is $1.8 \times 10^9 \text{N/m}^2$, assuming the bottle does not break.
4. The bulk modulus of a material is $1 \times 10^{11} \text{N/m}^2$. What fractional change in volume does a piece of this material undergo when it is subjected to a bulk stress increase of 10^7N/m^2 ? Assume that the force is applied uniformly over the surface.
5. A cleaning person tries to move a heavy, old bookcase on a carpeted floor by pushing tangentially on the surface of the very top shelf. However, the only notice able effect of this effort is similar to that seen in Figure1, and it disappears when the person stops pushing. The book case is 180cm tall and 90cm wide with four 30cm deep shelves, all partially loaded with books. The total weight of the bookcase and books is 600N. If the person gives the top shelf a 50N push that displaces the top shelf horizontally by 15 cm relative to the motionless bottom shelf, find the shear modulus of the bookcase.

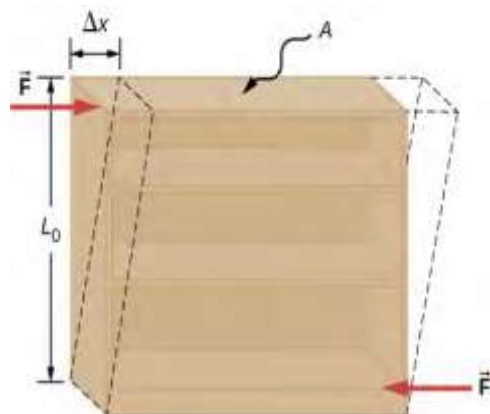


Figure 1