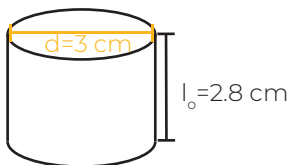


## Introduction to Material Elasticity AIC Lesson 1 Homework

The objective of this assignment is to help you familiarize yourself with the equations from Lesson 1. This homework will require some basic algebraic calculations and unit conversion. All equations and conversions needed will be provided on the last page of this homework assignment.

1. In the Lesson 1 video, we saw a tensile stress example using a piece of elastic. If the blue highlighted section of the elastic had some original length of 2 cm and stretched to a length of 3.69cm after a one-pound weight was applied, what was the (a) tensile stress, (b) strain, and (c) Young's Modulus of our piece of elastic? This elastic is 1mm thick and 12.7mm across.

2. In the Lesson 1 video, we saw a compressive stress example using a marshmallow. If the marshmallow had the initial dimensions shown here and was compressed with a one-pound weight to a height of 2.38 cm, what was the compressive Young's Modulus of our marshmallow?



3. Imagine we are trying to choose a material for a clothes line. We have three candidate materials: cotton fiber rope, hemp fiber rope, and nylon. Relevant material properties for the problem are given in the table below.

(a) If the clothes line must span a 3.5m gap and withstand around 18 pounds of wet clothes weight, which material has the lowest strain value if all ropes are 1cm in diameter?

(b) Which material would give me the cheapest line that meets my requirements?

Material	Young's Modulus (GPa)	Density (kg/m <sup>3</sup> )	Price (USD/kg)
Cotton fiber	9.17	1.54e3	3.06
Hemp fiber	62	1.49e3	1.15
Nylon	4.47	1.14e3	3.49

4. I need to make an Argon gas tank used for welding. My tank is 80 cubic feet and must withstand a pressure of 2640 psi. I want a maximum of 0.01% volumetric change when at full pressure. What Bulk modulus K is needed for my material to meet my conditions?

## Relevant Equations and Unit Conversions

$$\sigma = \frac{F}{A_o}$$

$$\varepsilon = \frac{l_f - l_o}{l_o}$$

$$\sigma = E\varepsilon$$

$$P = K\Delta$$

*Force = mass \* gravity*

*Area of a rectangle = thickness \* width*

*Area of a Circle =  $\pi r^2$*

*Newtons (N) =  $\frac{kg * m}{s^2}$*

*gravity (g) =  $9.81 \text{ m/s}^2$*

*1 pound = 0.454 kg*

*1 psi = 6894.76 Pa*

*1 cubic foot =  $0.028 \text{ m}^3$*