Phy 2053 Announcements

- Good luck on Exam 2!
- Exam 2 grades – grades should be available by Monday, April 6 on UF e-Learning web site.
- Exam 2 solutions will be posted early next week
- HW Assignment 9 next Wednesday, April 8

Elastic Properties of Solids

- Stress - force per unit area causing the deformation
- Strain - measure of the amount of deformation
- The elastic modulus is the constant of proportionality between stress and strain
- Three types of moduli:
  - Young’s modulus, shear modulus, bulk modulus

Young’s Modulus:

\[
\frac{F}{A} = \frac{Y}{L_0} \Delta L
\]

**Stress** = **Y** x **Strain** or \( \frac{\text{Stress}}{\text{Strain}} = Y \)

Stress \( F/A \) has units of N/m² 
1 N/m² = 1 Pascal (Pa)

Young’s Modulus: Elasticity in Length, Hooke’s Law redux

\[
\frac{F}{A} = \frac{Y}{L_0} \Delta L \Rightarrow F = \frac{AY}{L_0} \Delta L
\]

**Stress** = \( F/A \)

**Strain** = \( \Delta L/L_0 \)

**Example #9-11**

Determine the elongation of the rod shown below if it is under a tension of \( 5.8 \times 10^3 \) N.

- \( Y_{Al} = 7 \times 10^{10} \) Pa
- \( Y_{Cu} = 11 \times 10^{10} \) Pa

Shear Modulus

- **shear stress** = \( \frac{F}{A} \)
- **shear strain** = \( \frac{\Delta x}{h} \)

\[
\frac{F}{A} = \frac{S \Delta x}{h}
\]

- \( S \) is the shear modulus
- A material having a large shear modulus is difficult to bend
**Bulk Modulus**

\[ \Delta P = -B \frac{\Delta V}{V} \]

- A material with a large bulk modulus is difficult to compress.
- The negative sign is included since an increase in pressure will produce a decrease in volume.
- \( B \) is always positive.
- The **compressibility** is the reciprocal of the bulk modulus.

**Notes on Moduli**

- Solids have Young's, Bulk, and Shear moduli.
- Liquids and gases have only bulk moduli, they will not undergo a shearing or tensile stress.
- The liquid or gas would flow instead.

**Pressure**

- The force exerted by a fluid on a submerged object at any point if perpendicular to the surface of the object.

\[ P = \frac{F}{A} \text{ in } \text{Pa} = \frac{N}{m^2} \]

**Density**

- The density of a substance of uniform composition is defined as its mass per unit volume:

\[ \rho \equiv \frac{m}{V} \]

- Units are kg/m\(^3\) (SI) or g/cm\(^3\) (cgs).
- 1 g/cm\(^3\) = 1000 kg/m\(^3\).
Pressure and Depth

- Examine the darker region, assumed to be a fluid
  - It has a cross-sectional area $A$
  - Extends to a depth $h$ below the surface
- Three external forces act on the region

Pressure and Depth equation

- $P = P_0 + \rho gh$
- $P_0$ is normal atmospheric pressure
  - $1.013 \times 10^5 \text{ Pa}$

The pressure does not depend upon the shape of the container.