



The University of Zambia  
School of Natural Sciences  
Department of Physics

## PHY2231: Properties of Matter and Thermodynamics

### Tutorial Sheet 1

2022-2023 Academic year-Part I

1. A  $2.0\text{ m}$  long steel rod with a cross-sectional area of  $0.30\text{ cm}^2$  is clamped up on one end while a  $550\text{ kg}$  milling machine is hung on the other end. Determine the stress, strain, and the elongation of the rod.
2. A  $3.1\text{ m}$  long wire with a diameter of  $1.2\text{ mm}$  is stretched by  $1.7\text{ mm}$  when a  $5.2\text{ kg}$  block is suspended from one end while the other end is attached to a rigid ceiling. What is Young's modulus for the material of the wire? Research on the values of the Young's modulus for different materials and identify which material the wire is made of.
3. A  $1.3\text{ m}$  long bronze bar with diameter of  $30.0\text{ mm}$  is subjected to a tensile stress of  $8.0 \times 10^7\text{ N/m}^2$ . Given that Young's modulus for the material of the bar is  $8.5 \times 10^7\text{ N/m}^2$ , calculate
  - (a) The extension produced in the bar.
  - (b) The deforming force.
  - (c) The work done during the process.
4. A hydraulic press contains  $0.25\text{ m}^3$  ( $250\text{ L}$ ) of oil. Find the decrease in volume of the oil when it is subjected to a pressure increase of  $\Delta P = 1.6 \times 10^7\text{ Pa}$ . The bulk modulus of oil is  $B = 5.0 \times 10^9\text{ Pa}$ .
5. Calculate the work done in stretching a uniform metal wire of cross section area  $10^{-6}\text{ m}^2$  and length  $1.5\text{ m}$  by  $4.0 \times 10^{-3}\text{ m}$  given  $Y = 2.0 \times 10^{11}\text{ N/m}^2$ .
6. A square brass plate of an outdoor sculpture experiences a shear force as a result of an earthquake. The plate is  $0.80\text{ m}$  square and  $0.50\text{ cm}$  thick, and one of its edges is displaced by  $0.16\text{ mm}$ . How large is the shear force?
7. Young's modulus of a metal is  $2 \times 10^{11}\text{ N/m}^2$  and its breaking stress is  $1.078 \times 10^9\text{ N/m}^2$ .

Calculate

- (a) The maximum amount of energy per unit volume which can be stored in the metal when it is stretched.
- (b) The largest length the wire can be stretched to if its original length is  $1\text{ m}$ .