4.2 - Elasticity

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- (1999) Define "Young's Modulus" of a material and give its SI units.
- (1999) With the aid of a sketch graph, explain what happens when a steel wire is stretched gradually by an increasing load until it breaks.
- (1999) A force F is applied to a long steel wire of length L and cross-sectional area A.
  - Show that if the wire is considered to be a spring, the force constant k is given by: $k = AY/L$, where Y is Young's Modulus of the wire.
  - Show that the energy stored in the wire is $U = 1/2F\Delta L$ where ΔL is the extension of the wire
- (2000) Define the bulk modulus of a gas
- (2000) Find the ratio of the adiabatic bulk modulus of a gas to that of its isothermal bulk modulus in terms of the specific heat capacities of the gas.
- (2000) Explain Youngs Modulus of rigidity
- (2000) Find the work done in stretching a steel wire of 1.0 mm^2 cross-sectional area and 2.0 m in length through 0.1 mm.
- (2007) With the aid of a diagram describe a simple laboratory experiment to measure Youngs modulus of a wooden bar acting as a loaded cantilever from its period of vibration given that the depression s is given by $S = (WL^3)/(3IE)$.
- (2007) Differentiate between tensile and shear stress.
- (2007) A lift is designed to hold a maximum of 12 people. The lift cage has a mass of 500 kg and the distance from the top floor of the building to the ground floor is 50 m.
  - What minimum cross-sectional area should the cable have in order to support the lift and the people in it?
  - Why should the cable have to be thicker than the minimum cross-sectional area above in practice?
  - How much will the lift cable above stretch if 10 people get into the lift at the ground floor, assuming that the lift cable has a cross section of 1.36 cm?
  - Note: Mass of an average person = 70 kg . $E_{steel} = 2 \times 10^{11}$ N/m^2 , Tensile strength of steel = 4×10^{11} N/m^2 .

- (2009) Define the following terms:
  - Tensile stress
  - Tensile strain
  - Youngs modulus
- (2009) Derive the expression for the work done in stretching a wire of length L by a load W through an extension X .
- (2009) A vertical wire made of steel of length 2.0 m and 1.0 mm diameter has a load of 5.0 kg applied to its lower end. What is the energy stored in the wire?
- (2009) A copper wire 2.0 m long and 1.22×10^{-3} m diameter is fixed horizontally to two rigid supports 2.0 m apart. Find the mass in kg of the load, which when suspended at the mid point of the wire, produces a sag of 2.0×10^{-2} m at the point.
- (2013) The bulk modulus of elasticity for lead is 8×10^9 N/m^2 . Find the density of lead if the pressure applied is 2×10^8 N/m^2 .
- (2013) Define the terms: proportional limit, elastic limit, yield point and elasticity.
- (2013) Use a sketch graph to show how the extension of the wire varies with the applied force and mark the elastic limit and yield point on it. Explain how the magnitude of the Young's modulus is obtained from the graph.
  - A block of metal weighing 20 N with a volume of 8×10^{-4} m? is completely immersed
  - in oil of density 700 kg/m^3 then attached to one end of a vertical wire of length 4.0 m and diameter of 0.6 mm whose other end is fixed. If the length of the wire is increased by 1.0 mm. find the:
  - youngs modulus of the wire.
  - energy stored in the wire.
- (2015) Define the following materials as classified on the basis of elastic properties:
  - Ductile materials
  - Brittle materials
  - Elastomers
- (2015) Briefly explain why the stretching of a coil spring is determined by its shear modulus.
- (2015) A copper wire of negligible mass, 1 m long and cross-sectional area 10^{-5} m^2 is kept on a smooth horizontal table with one end fixed. A ball of 1 kg is attached to the other end. The wire and the ball are rotating with an angular velocity of 35 rad/s. If the elongation of the wire is 10^{-3} m, find Youngs modulus of wire. If on increasing the angular velocity to 100 rad/s, the wire breaks down, find the breaking stress.
- (2015) Differentiate bulk modulus from shear modulus.
- (2015) Two wires, one of steel and one of phosphor bronze each 1.5 m long and 2 mm diameter are joined end to end as a composite wire of length 3 cm. What tension in the composite wire will produce total extension of 0.064 cm?