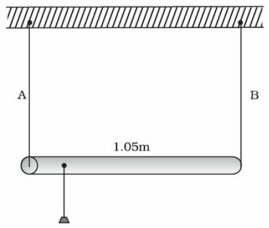
CBSE Test Paper 01

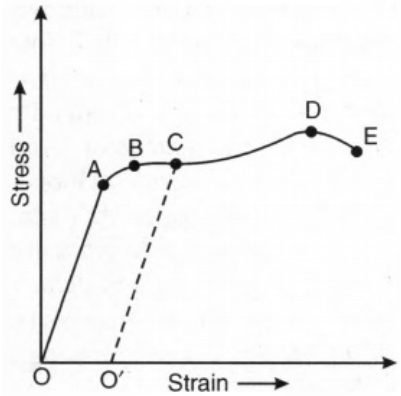
Chapter 9 Mechanical Properties of Solids

1. A solid brass sphere is initially surrounded by air, and the air pressure exerted on it is 1.0 $\times 10^{5}$ N/ m^{2} (normal atmospheric pressure). The sphere is lowered into the ocean to a depth at which the pressure is 2.0 $\times 10^{7}$ N/ m^{2} . The volume of the sphere in air is 0.50 m^{3}. By how much does this volume change once the sphere is submerged? modulus of brass as 61 GPa **1**
   a. -1.7 $\times 10^{-4}$ m^{3}
   b. -1.4 $\times 10^{-4}$ m^{3}
   c. -1.5 $\times 10^{-4}$ m^{3}
   d. -1.6 $\times 10^{-4}$ m^{3}
2. For a rope of yield strength S_{y} loaded in tension with weight Mg the minimum area A of the rope should be **1**
   a. A $\geq$ Mg S_{y}
   b. A $\geq$ Mg/ S_{y}
   c. A $\geq$ Mg/3 S_{y}
   d. A $\geq$ Mg/2 S_{y}
3. A rod of length 1.05 m having negligible mass is supported at its ends by two wires of steel (wire A) and aluminum (wire B) of equal lengths as shown in Figure. The cross-sectional areas of wires A and B are 1.0 mm^{2} and 2.0 mm^{2} , respectively. At what point along the rod should a mass m be suspended in order to produce equal strains in both steel and aluminum wires. Take Young's modulus of steel as 200 GPa, for aluminum 70 GPa **1**



   a. 0.42 m from steel wire
   b. 0.40 m from steel wire
   c. 0.43 m from steel wire
   d. 0.44 m from steel wire

4. Material is said to be brittle if **1**
   a. material cross section is significantly reduced at failure
   b. fracture occurs soon after the elastic limit is passed
   c. a large amount of plastic deformation takes place between the elastic limit and the fracture point
   d. material elongates a lot before finally breaking
5. A piece of copper having a rectangular cross-section of 15.2 mm $\times$ 19.1 mm is pulled in tension with 44,500 N force, producing only elastic deformation. Calculate the resulting strain? Take Young's modulus of copper as 11 $\times$ 10^{10} Pa **1**
   a. 0.06×10^{-2}
   b. 0.11×10^{-2}
   c. 0.04×10^{-2}
   d. 0.14×10^{-2}
6. Define Poisson's ratio? What is its unit? **1**
7. What are ductile and brittle materials? **1**
8. What is the Young's modulus for a perfect rigid body? **1**
9. Why do we prefer a spring made of steel and not of copper? **2**
10. When a load of a wire is increased from 3 kg wt to 5 kg wt, the length of that wire changes from 0.61 mm to 1.02 mm. calculate the change in the elastic potential energy of the wire. **2**
11. A wire elongates by l mm when a load W is hanged from it. If the wire goes over a pulley and two weights W each is hung at the two ends, then what will be the elongation of the wire in mm? **2**
12. The stress-strain graph for a metal wire is given in the figure. Up to the point B, the wire returns to its original state O along the curve BAO, when it is gradually unloaded. Point E corresponds to the fracture point of the wire. **3**



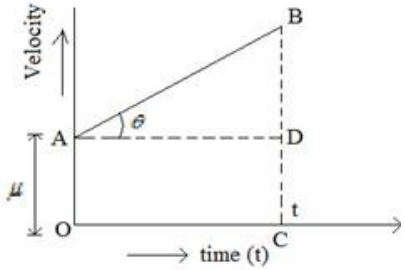
i. Up to which point of curve, is Hooke's law obeyed? This point is also called 'Proportionality limit'.

ii. Which point on the curve corresponds to elastic limit and yield point of the wire?

iii. Indicate the elastic and plastic regions of the stress-strain curve.

iv. What change happens when the wire is loaded up to a stress corresponding to point C on curve, and then unloaded gradually?

13. Establish $s = ut + \frac{1}{2}at^2$ from velocity-time graph for a uniform accelerated motion? **3**



14. A man carrying mass M = 125 kg makes a flying tackle at Vj = 4 m/s on a stationary quarterback of mass m = 85 kg and his helmet makes solid contact with quarterback's femur. **3**

i. What is the final speed of two athletes immediately after contact and also determine the average force exerted on the quarterback's femur, when the last collision occur at 0.100 s?

ii. If the area of cross-section of quarterback's femur is 5×10^4 m^2, then estimate the shear stress exerted on the femur in the collision.

15. Two wires of diameter 0.25 cm, one made of steel and the other made of brass are loaded as shown in Figure. The unloaded length of steel wire is 1.5 m and that of brass wire is 1.0 m. Compute the elongations of the steel and the brass wires. **5**