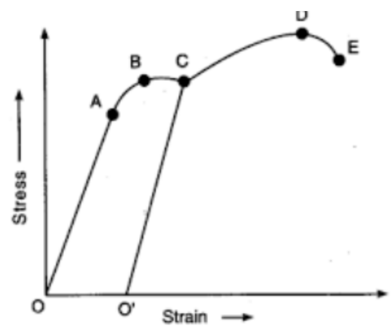
Short Answer Type Questions – I

Q.1. What are glass solids.

Ans. The solids in which atoms and molecules are not arranged in definite and regular manner are called glassy or amorphous solids, e.g. glass, rubber, sulphur etc.

Q.2. The stress-strain graph for a metal wire is given in figure. Upto 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.



(a) Upto which point of curve, is Hooke's law obeyed? This point is also called ' Proportion limit'.

(b) Which point on the curve corresponds to elastic limit and yield point of the wire?

(c) Indicate the elastic and plastic regions of the stress-strain curve.

(d) What change happens when the wire is loaded upto a stress corresponding to point C on curve, and then unloaded gradually?

Ans. (a) Upto point A, Hooke's law is obeyed because the graph is straight line from O to A.

(b) Point B, from the graph it is clear that the wire returns to its original position after being unloaded upto point A only, hence B is elastic limit.

(c) Elastic region – O to B,   Plastic region – B to E

(d) Strain varies as directly proportional to load upto point A and aster A, strain increases by greater amount as compared to first case (i.e., O to A) for a given increase in load. Beyond the elastic limit B, the curve does not retrace Backwards as the wire is unloaded but returns along dotted line CO'. Point O' corresponds to strain at zero load, which shows there is a permanent strain in the wire.

Q.3. A silica glass rod has a diameter of 1 cm and is 10 cm long. Estimate the largest mass that can be hung from it without breaking it.

Ans. Breaking strength of glass is 50×10^6 Nm^{-2}

Using Stress = $\frac{F}{A}$,

We get   F = stress × A

$= (50 \times 10^6) \times \pi \times \left(\frac{10^{-2}}{2}\right)$ N

Largest mass $= \frac{F}{g} = \frac{(50\times10^6)\left(\frac{\pi\times10^{-4}}{4}\right)}{10} kg$

$= 392.7$ kg

Q.4. What is Beam? What is its use? Give an expression for a depression of a beam.

Ans. Beam is ordinarily a bar supported at its ends.

It is used in the construction of a roof or a bridge.

$$\delta = \frac{\omega l^3}{4Y6d^3}$$

Q.5. Two rods of different material having coefficient of linear expansion α_1 and α_2 and Young's modulus Y_1 and Y_2 respectively are fixed between two rigid walls. The rods are heated to same high temperature. If $\alpha_1 : \alpha_2 :: 2 : 3$ the thermal stress in two rods is the furid same, then the rate Y_1/Y_2.

Ans. Stress = Y × strain

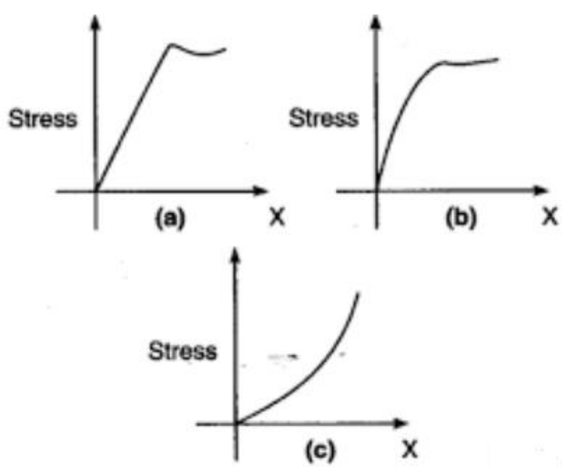
∴ $Y_1\alpha_1 t_1 = Y_2\alpha_2 t_2$

∴ $Y_1\alpha_1 = Y_2\alpha_2$

Or $\frac{Y_1}{Y_2} = \frac{\alpha_1}{\alpha_2}$

$= \frac{3}{2}$

Q.6. Following are the graphs of elastic materials. Which one corresponds to that of brittle material?



Ans. (b) is more brittle. A material is said to be brittle if there is small stress-strain variation beyond elastic point and fracture point of brittle material lies close to elastic point.

Q.7. A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force f, its length increases by l, Another wire of the same material of length 2L and radius 2r, is pulled by a force 2f. find the increase in length of this wire.

Ans. Young's Modulus = $\frac{f}{A} \times \frac{L}{l}$, where l is the increase in length of wire I

Or I wire, $Y = \frac{f}{\pi r^2} \times \frac{L}{l}$ (i)

For II wire, the increase in length be l'.

Then $Y = \frac{2f}{4\pi r^2} \times \frac{L}{l'}$

$Y = \frac{f}{\pi r^2} \times \frac{L}{l'}$ (ii)

From eq^n (s) (i) and (ii)

$$\frac{F}{\pi r^2} \times \frac{L}{l} = \frac{f}{\pi r^2} \times \frac{L}{l'}$$

$$\therefore l = l'$$

Q.8. A steel rod ($Y = 2.0 \times 10^{11}$ Nm^{-2}, and $\alpha = 10^{-5}$ $^oC^{-1}$) of length 1 m and area of cross-section 1 cm^2 is heated from 0^o C to 200^{o}C without being allowed to extend or bend. What is the tension produced in the rod?

Ans. Here, the equation of thermal expansion for linear expansion will be applied because of increase in temperature of the rod, length, increase.

$\Delta T = 200^oC - 0^oC = 200^oC$, $\alpha = 10^{-5}$ $^oC^{-1}$, $l = 1$ m

Area of cross – section, $A = 1\ cm^2 = 1 \times 10^{-4} m^2$

$\therefore \frac{\Delta l}{l} = \alpha \Delta T = 10^{-5} \times 200 = 2 \times 10^{-3}$

Tension produced in steel rod = $YA\alpha\Delta T$

$= 2.0 \times 10^{11} \times 1 \times 10^{-4} \times 2 \times 10^{-3} = 4 \times 10^4$ N.

Q.9. To what depth must a rubber ball be taken in deep sea so that its volume is decreased by 0.1%. (The bulk modulus of rubber is 9.8×10^8 Nm^{-2}, and the density of sea water is 10^3 kgm^{-3}.)

Ans. Bulk Modulus, $K = 9.8 \times 10^8$ N/m^2

Density of sea water (ρ) = 10^3Kg/m^3

Volume decrease (Percentage)

$$\left(\frac{\Delta V}{V} \times 100\right) = 0.1$$

$$\frac{\Delta V}{V} = \frac{0.1}{100}$$

$$= \frac{1}{100} = 1 \times 10^{-3}$$

Let rubber ball be taken up to depth h

∴ Change in pressure P = hpg

Bulk Modulus,

B = $\left|\frac{P}{\frac{\Delta V}{V}}\right| = \frac{hpg}{\frac{\Delta V}{V}}$

Or, $h = \frac{B \times \left(\frac{\Delta V}{V}\right)}{pg}$

$= \frac{9.8 \times 10^8 \times 1 \times 10^{-3}}{10^3 \times 9.8}$

$h = 100\ m$

Q.10. A truck is pulling a car out of a ditch by means of a steel cable that is 9.1 m long and has a radius of 5 mm. When the car just begins to move, the tension in the cable is 800 N. How much has the cable stretched? (Young's modulus for steel is 2 × 10^{11} Nm^{-2}.)

Ans. Given:

Steel cable's length, I = 9.1 m

Radius, r = 5mm = 5 × 10^{-3} m.

Tension in cable, F = 800 N

Young's modulus = 2 × 10^{11} N/m^2

Young's modulus,

Y = $\frac{F}{A} \times \frac{l}{\Delta l}$

Or $\Delta l = \frac{F}{\pi r^2} \times \frac{l}{Y}$

= $\frac{800 \times 9.1}{3.14 \times (5 \times 10^{-3})^2 \times 2 \times 10^{11}}$

= 4.64 × 10^{-4} m

Q.11. Two identical solid balls, one of ivory and the other of wet-clay, are dropped from the same height on the floor. Which one will rise to a greater height after striking the floor and why?

Ans. Since, the ivory ball is more elastic than the wet-clay ball, therefore, ivory ball will tend to retain its shape instantaneously after the collision. Hence, there will be a large energy and momentum transfer to the ivory ball as compared to the wet clay ball. Thus, the ivory ball will rise higher after striking the floor.