Saitech Gurukulam

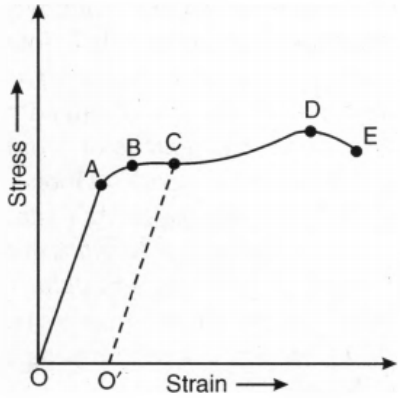
43, Haridoss Main Rd, CH-99. Ph:9444929163

MECHANICAL PROPERTIES OF SOLIDS

Class 11 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 45**

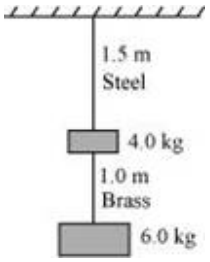
1. State the two factors on which the modulus of elasticity depends. **[1]**
2. Amorphous solids do not melt at a sharp temperature, rather these have softening range. Explain this observation. **[1]**
3. How does Young's modulus change with the rise of temperature? **[1]**
4. What is the meaning of the word amorphous? **[1]**
5. The spherical ball contracts in volume by 0.1% when subjected to a uniform normal pressure of 100 atmosphere. Calculate the bulk modulus of material of ball. **[1]**
6. The average depth of ocean is 2500 m. Calculate the fractional compression $\left(\frac{\Delta V}{V}\right)$ of Water at the bottom of ocean, given that the bulk modulus of water is 2.3×10^9 N/m^2. **[3]**
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 2*L* and radius 2*r*, is pulled by a force 2f. Find the increase in length of this wire. **[3]**
8. Briefly apply your knowledge of elasticity in the working of a crane used for lifting and moving heavy loads. Illustrate by some rough calculations. **[3]**
9. 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?

10. The Young's modulus of steel is 2.0×10^{11} N/m^2. If the interatomic spacing for the metal is 2.8×10^{-10} m, find the increase in the interatomic spacing for a force of 10^9 N m^{-2} and the force constant? **[3]**

11. Two wires of diameter 0.25 cm, one made of steel and the other made of brass are loaded as shown in the 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]**



12. A mild steel wire of length 1.0 m and cross-sectional area $0.50 \times 10^{-2} cm^2$ is stretched, well within its elastic limit, horizontally between two pillars. A mass of 100 g is suspended from the mid-point of the wire. Calculate the depression at the midpoint. **[5]**

13. A 14.5 kg mass, fastened to the end of a steel wire of unstretched length 1.0 m, is whirled in a vertical circle with an angular velocity of 2 rev/s at the bottom of the circle. The cross-sectional area of the wire is 0.065 cm^2. Calculate the elongation of the wire when the mass is at the lowest point of its path. **[5]**

14. **Assertion:** The strain produced in a stretched spring is shearing **[1]**
Reason: When spring is stretched, the length of wire of spring increases.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

15. **Assertion:** Lead is more elastic than rubber. **[1]**
Reason: If same load is loaded on the lead and rubber wire of same cross-sectional area, the strain of lead is very much less than that of rubber.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

16. **Assertion (A):** If the volume of a body remains unchanged, when subjected to tensile strain, the value of Poisson's ratio is $-\frac{1}{2}$. **[1]**
Reason (R): Phosphor bronze has low Young's modulus and higher rigidity modulus.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

17. **Assertion (A):** Identical springs of steel and copper are equally stretched. More work will be done on the steel spring. **[1]**
Reason (R): Steel is more elastic than copper.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

18. **Assertion (A):** Elastic restoring forces may be conservative. **[1]**

Reason (R): The value of strain for same stress are different while increasing the load and while decreasing the load.

a) Both A and R are true and R is the correct explanation of A.

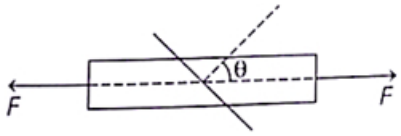
b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Question No. 19 to 23 are based on the given text. Read the text carefully and answer the questions: **5.0**

When a bar of cross-section A is subjected to equal and opposite tensile forces at its ends, then a restoring force equal to the applied force normal to its cross-section comes into existence. This restoring force per unit area of cross-section is known as tensile stress. While when the deforming force acts tangentially to the surface, then this tangential force applied per unit area of cross-section is known as tangential stress. consider a plane section of the bar whose normal makes an angle θ with the axis of the bar.



19. Which of the following property of the bar does not change due to this force?

a) Size

b) Shape

c) Area

d) Volume

20. What is the tensile stress on this plane?

a) (F/A) $\sec^2\theta$

b) (F/A) $\cos^2\theta$

c) (F/A) $\tan\theta$

d) (F/A)

21. What is the shearing stress on this plane?

a) $\frac{F}{4A^2}$

b) $\frac{F}{A}\cos 2\theta$

c) $\frac{F}{2A}\sin 2\theta$

d) $\frac{F}{2A}\cos^2\theta$

22. For what value of θ is the tensile stress maximum?

a) 30^o

b) 0^o

c) 45^o

d) 90^o

23. For what value of θ is the shearing stress maximum?

a) 90^o

b) 60^o

c) 45^o

d) 30^o

Scan for Key