



# PHYSICS

## BOOKS - MAXIMUM PUBLICATION

### MECHANICAL PROPERTIES OF SOLIDS

#### Exercise

1. Solids are least compressible but gases are most compressible. Why?



**Watch Video Solution**

2. Find the radius of the rope that used to lift  $10 \rightarrow ns(10000kg)$ . Elastic limit (maximum stress) of steel is  $30 \times 10^7 \frac{N}{m^2}$ .



[Watch Video Solution](#)

3. What is meant by buckling?



[Watch Video Solution](#)

4. Why the beams used in construction of bridges have a cross-section of the type I?



[Watch Video Solution](#)

5. Find the height of mountain from the data given below. Maximum shearing stress =  $30 \times 10^7 \frac{N}{m^2}$ , Density of material of mountain =  $3 \times 10^3 kg \cdot m^{-3}$



[Watch Video Solution](#)

6. If longitudinal strain for a wire is  $0.03$  and its poisson's ratio is  $0.5$ , then its lateral strain is



[Watch Video Solution](#)

7. Between steel and diamond, which is more elastic?



[Watch Video Solution](#)

**8.** What is the value of  $Y$  for a perfectly elastic body?



**Watch Video Solution**

**9.** Young's modulus of the wire depends on



**Watch Video Solution**

**10.** For most materials the Young's modulus is  $n$  times the rigidity modulus, where  $n$  is



[Watch Video Solution](#)

**11.** The stress required to double the length of a wire of Young's modulus  $Y$  is



[Watch Video Solution](#)

**12.** What is the bulk modulus of a perfectly rigid body?



[Watch Video Solution](#)

**13.** What is shear modulus of liquid?



**Watch Video Solution**

**14.** What is the rigidity modulus of liquid?



**Watch Video Solution**

**15.** Identify the type of modulus in twisting of cylinder.



**Watch Video Solution**

**16.** Why work is required to be done to stretch a wire?



**Watch Video Solution**

**17.** Name the material which is famous for a large elastic after-effect.



**Watch Video Solution**



**18.** Find stress required to double the length of a wire of Young's modulus  $Y$ .



**Watch Video Solution**

**19.** When wire is bent back and forth, it becomes hot. Why?



**Watch Video Solution**

**20.** Hook's law is said to be that fundamental law in elasticity. State Hook's law of Elasticity.



**Watch Video Solution**

**21.** Hook's law is said to be the fundamental law in elasticity. Name the different types of modulus of elasticity with their equations.



**Watch Video Solution**

**22.** When an external force deforms a solid, internal restoring forces are developed in the body giving rise to stress and strain. Define stress and strain.



**Watch Video Solution**

**23.** When an external force deforms a solid, internal restoring forces are developed in the body giving rise to stress and strain. Draw the stress-strain diagram and mark the positions

of elastic limit and the regions of elastic and plastic behaviors.



[Watch Video Solution](#)

**24.** Distinguish between perfectly plastic and perfectly elastic materials.



[Watch Video Solution](#)

**25.** What is the quantity obtained from the slope of a stress-strain graph and what is the

area under the curve?



[Watch Video Solution](#)

**26.** Two wires have their lengths in the ratio 1:3 and radius in the ratio 2:1. What will be the ratio of elongations for the same linear stress?



[Watch Video Solution](#)

**27.** The modulus of elasticity of rubber is higher than that steel. Do you agree with this statement? Why?



**Watch Video Solution**

**28.** The modulus of elasticity of rubber is higher than that steel. Do you agree with this statement? Why?



**Watch Video Solution**

**29.** Prove that the elastic potential energy density of a stretched wire is half the product of stress and strain.



**Watch Video Solution**

**30.** We have common experience that a thin thread breaks if pulled at its ends. Also a thin metallic wire, when pulled at the ends elongates and then contracts, when released. What do you mean by elasticity?



**Watch Video Solution**

**31.** When an external force deforms a solid, internal restoring forces are developed in the body giving rise to stress and strain. Draw the stress-strain diagram and mark the positions of elastic limit and the regions of elastic and plastic behaviors.



**Watch Video Solution**



32. We have common experience that a thin thread breaks if pulled at its ends. Also a thin metallic wire, when pulled at the ends elongates and then contracts, when released.

A lift is tied with thick iron wires and its mass is  $1000\text{kg}$ . What should be the minimum diameter of the wire if the maximum acceleration of the lift is  $1.2\frac{\text{m}}{\text{s}^2}$  and maximum safe stress of the wire is  $1.4 \times 10^8 \frac{\text{N}}{\text{m}^2}$  ( $g = 9.8\frac{\text{m}}{\text{s}^2}$ )



[Watch Video Solution](#)

**33.** The property of material bodies to regain its original size on the removal of deforming force is called elasticity. What is the value of Young's modulus for a perfectly rigid body?



**Watch Video Solution**

**34.** What is the rigidity modulus of liquid?



**Watch Video Solution**

**35.** The property of material bodies to regain its original size on the removal of deforming force is called elasticity. Why do we prefer steel to copper in the manufacture of spring?



**Watch Video Solution**

**36.** The property of material bodies to regain its original size on the removal of deforming force is called elasticity. How much should the

pressure on a liter of water be changed to compress it by 0.10 % ? ( $B=2.2 \times 10^9 \frac{N}{m^2}$ )



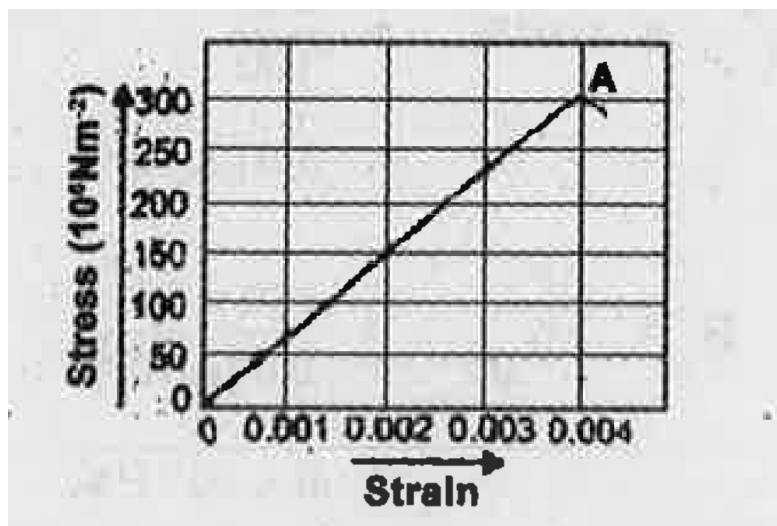
[Watch Video Solution](#)

**37.** A steel wire of length  $4.7m$  and cross sectional area  $2 \times 10^{-5}m^2$  stretches by the same amount as a copper wire of length  $3.5m$  and cross sectional area of  $4 \times 10^{-5}m^2$  under a given load. What is the ratio of the Young's modulus of steel to that of copper?



[Watch Video Solution](#)

38. Following figure shows the strain-stress curve for a given material. What is Young's modulus for this material?



Watch Video Solution

**39.** The edge of an aluminium cube is  $10\text{cm}$  long. One face of the cube is firmly fixed to a vertical wall. A mass of  $100\text{kg}$  is then attached to the opposite face of the cube. The shear modulus of aluminium is  $15\text{GPa}$ . What is the vertical deflection of this face?



**Watch Video Solution**

**40.** A steel cable with a radius  $1.5\text{cm}$  supports a chair lift. If the maximum stress is not to

exceed  $10^8 Nm^{-2}$ , what is the maximum load the cable can support?



[Watch Video Solution](#)

**41.** Compute the fractional change in volume of a glass slab when subjected to a hydraulic pressure of  $10 atm$ . Given: Bulk modulus of elasticity of glass =  $37 \times 10^9 Nm^{-2}$  and  $1 atm = 1.013 \times 10^5 Pa$ .



[Watch Video Solution](#)

**42.** Determine the volume contraction of a solid copper cube  $10\text{cm}$  on an edge, when subjected to a hydraulic pressure of  $7 \times 10^6 \text{Pa}$ . Bulk modulus of copper =  $140 \times 10^9 \text{Pa}$ .



**Watch Video Solution**

**43.** Elasticity is an internal property of matter. Fluids possess volume elasticity. Which is more elastic, air or water? Why?



**Watch Video Solution**



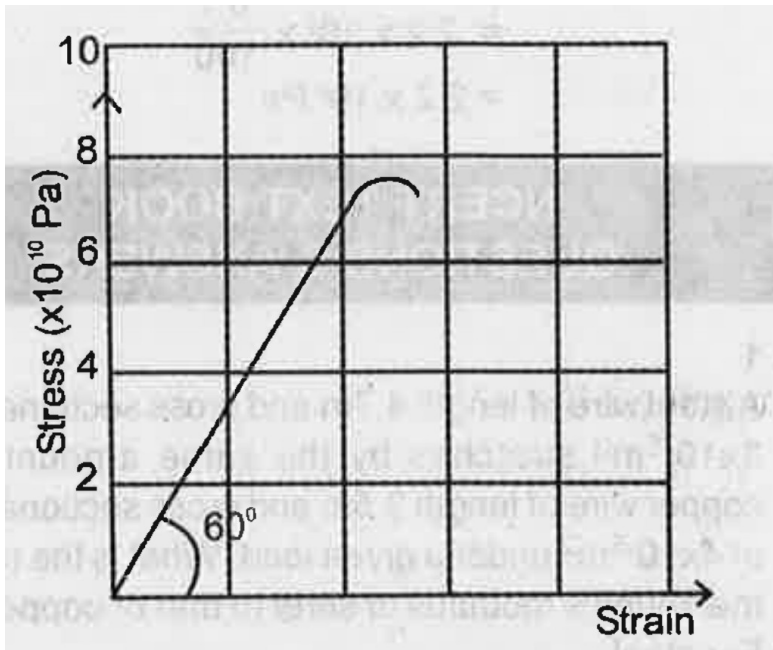
**44.** Elasticity is the property of a body by which it regains its original state on the removal of the deforming force. Why Steel is more elastic than Rubber?



**Watch Video Solution**

**45.** Elasticity is the property of a body by which it regains its original state on the removal of the deforming force. The figure

given below shows the stress-strain curve for a given material. What are the Young's modulus and approximate yield strength for this material?



[Watch Video Solution](#)

**46.** When the pressure on a sphere is increased by 80 atmospheres, its volume decreases by 0.01%. Find the bulk modulus of elasticity of the material of the sphere.



**Watch Video Solution**

**47.** When a mass is suspended on a metallic wire, the length of the wire increases slightly. Name and state the law that relates to the

restoring force developed in the wire and its deformation.



[Watch Video Solution](#)

**48.** Draw the stress-strain graph of a loading wire. Mark the following points : i) Elastic limit  
ii) Fracture point iii) Plastic region iv) Elastic region



[Watch Video Solution](#)

**49.** When a mass is suspended on a metallic wire, the length of the wire increases slightly. If the Young's moduli of iron and glass are  $190 \times 10^9 Nm^{-2}$  and  $65 \times 10^9 Nm^{-2}$  respectively, which is more elastic? Justify your answer.



**Watch Video Solution**

**50.** When a wire is stretched with a very large force it breaks. Represent the variation of

extension with load on a graph.



[Watch Video Solution](#)

**51.** When a wire is stretched with a very large force it breaks. Discuss the behaviour of the wire at various stages.



[Watch Video Solution](#)

**52.** When a wire is stretched with a very large force it breaks. State Hooke's law. For which

part of the the extension of a wire with a load graph, is Hooke's law applicable?



[Watch Video Solution](#)

**53.** Elasticity is the property of a body by which it regains its original state on the removal of the deforming force. Why Steel is more elastic than Rubber?



[Watch Video Solution](#)

**54.** Hooke's law states that stress  $\propto$  strain.

What is the necessary condition for the above law to be valid?



**Watch Video Solution**

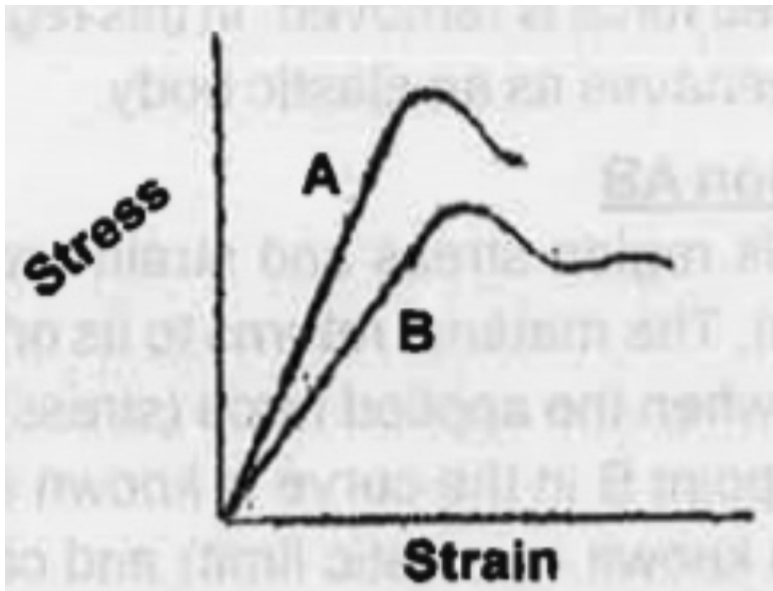
**55.** Stress - Strain graph of two materials is shown below: State the law which relates



stress

with

strain.



[Watch Video Solution](#)

56. Match the following

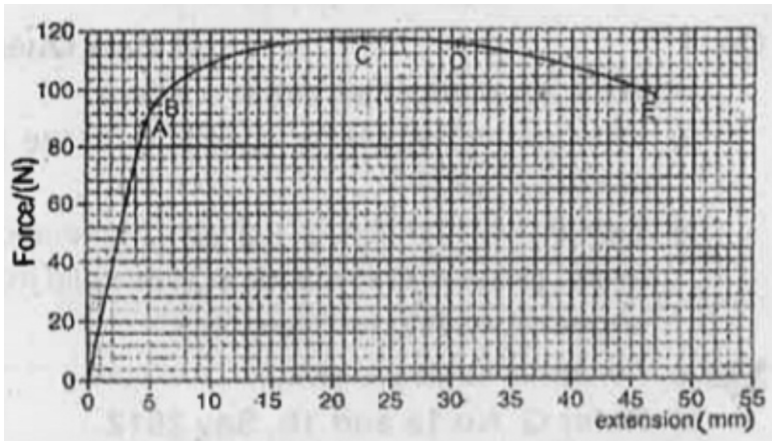
A	B
$\sin x \cos y - \cos x \sin y$	1
$\tan \frac{\pi}{4}$	$2 \cos^2 x$
$2 \sin x \cos x$	$\sin(x - y)$
$1 + \cos 2x$	$\sin 2x$



Watch Video Solution

57. The graph below shows how the force applied to a metal wire is related to the extension of the wire. The wire has an

unstretched length of  $2.30\text{m}$  and an area of cross section of  $3.90 \times 10^{-7}\text{m}^2$ . Determine the Young's modulus  $Y$  of the material.



[Watch Video Solution](#)

**58.** Name the law relating stress and strain.



[Watch Video Solution](#)

**59.** Calculate the stress developed in a metal wire when it is strained by 30%. Given Young's modulus of material is  $200\text{GPa}$



[Watch Video Solution](#)

**60.** Elasticity is the property of a body by which it regains its original state on the removal of the deforming force. Why Steel is more elastic than Rubber?



[Watch Video Solution](#)

61. A rigid body is a body with a perfectly unchanging shape under the influence of an external force. A rigid beam of length  $L$ , breadth  $b$  and depth  $d$  is supported near its ends. A load  $W$  is suspended at its center of mass. Write the expression for the amount of sagging.



[Watch Video Solution](#)

62. Young's moduli of three materials are given in the above table. Select the material from the table, which shows more elasticity.

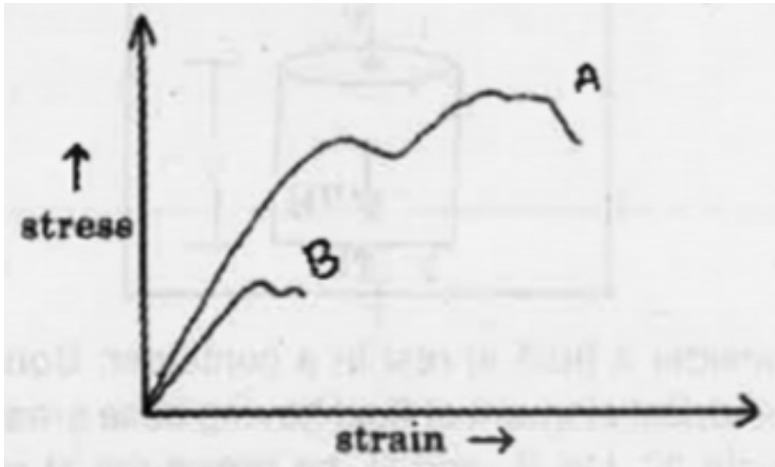
Substance	Young's modulus (N/m <sup>2</sup> )
X	$70 \times 10^9$
Y	$120 \times 10^9$
Z	$200 \times 10^9$



[Watch Video Solution](#)

63. The stress-strain graph for wires of two materials A and B are given below. When spring balances are continuously used for

long time, it shows wrong reading. Explain



why.



[Watch Video Solution](#)

64. The ratio of shear stress to shear strain is

...



[Watch Video Solution](#)

**65.** When a wire is stretched with a very large force it breaks. State Hooke's law. For which part of the the extension of a wire with a load graph, is Hooke's law applicable?



**Watch Video Solution**

**66.** A steel rod has a radius of  $10\text{mm}$  and a length of  $1.0\text{m}$ . A  $100\text{kN}$  force stretches it along its length. Calculate the elongation of



the steel rod. [Young's modulus of steel is  $2.0 \times 10^{11} \frac{N}{m^2}$ ]



[Watch Video Solution](#)

**67.** A metal cube of side  $10\text{cm}$  is subjected to a shear stress  $10^4 \frac{N}{m^2}$ . Calculate the rigidity modulus, if the top of the cube is displaced by  $0.05\text{cm}$  with respect to its bottom.



[Watch Video Solution](#)