PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

Mechanical Properties of Solids

Exercise

1. Define the terms deforming force, elasticity and plasticity. What are perfectly elastic and perfectly plastic bodies ? Give Examples.

2. Give an explanation of the elastic properties of materials in terms of inteatomic/intermolecular forces.

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3. Explain elastic behaviour of solids on the basis of mechanical spring-ball model of a solid.

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4. Define the term stress. Give its units and dimensions. Describe the different types of stress.

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5. Define the term strain. Why it has no units and dimensions ? What are different types of strain ?

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6. ELASTIC LIMIT

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7. State Hooke's law. How can it be verified experimentally ?

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8. Define modulus of elasticity. Give its units and dimensions.

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9. Define Young's modulus of elasticity. Give its units and dimensions

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10. Explain what happens when the load on a metal wire suspended from a rigid support is gradually increased. Illustrate your answer with a suitable stress-strain graph.

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11. Explain an experiment for the determination of Young's modulus of the material of a wire

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12. Distinguish between ductile and brittle materials on the basis of stress-strain curve

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13. What are elastomers ?

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14. A wire increases by 10^{-3} of its length when a stress of $1 \times 10^{8} Nm^{-2}$ is applied to it. What is the Young's modulus of the material of the wire?

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15. Find the stress to be applied to a steel wire to stretch it by 0.025% of its original length. Y for steel is $9 \times 10^{10} Nm^{-2}$

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16. A steel wire of length 4 m and diameter 5 mm is stretched by 5kg-wt. Find the increase in its length if the Young's modulus of steel wire is $2.4 \times 10^{12} dynecm^{-2}$

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17. Two wires made of the same material are subjected to forces in the ratio of $1:4$. Their lengths are in the ratio $8:1$ and diameter in the ration 2:1. Find the ratio of their extensions.

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18. A wire elongates by 9 mm when a load of 10 kg is suspended from it. What is the elongation when its radius is doubled, if all other quantities are same as before?

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19. The breaking stress of aluminium is $7.5 \times 10^7 Nm^{-2}$ Find the greatest length of aluminum wire that can hang vertically without breaking Density of aluminium is $2.7 \times 10^3 kgm^{-3}$

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20. A steel wire of length 5.0 m and cross-section $3.0 \times 10^{-5} m^2$ stretches by the same amount as a copper wire of length 3.0 m and cross -section $4.0 \times 10^{-5} m^2$ under a given load. What is the ratio of Young's modulus of steel to that of copper?

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21. Two exactly similar wires of steel and copper are stretched by equal forces. If the total elogation is 1cm. Find by how much is each wire elongated ? Given Y for steel $= 20 \times 10^{11} dyne / cm^2$ and $Y f$ or $copper = 12 \times 10^{11} dyne / cm^2$

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22. Two parallel wires A and B of same material are fixed to rigid support at the upper ends and subjected to same load at the lower ends. The lengths of the wire are in the ration 4 : 5 and their radii are in the ratio 4 : 3 the increase in the length of wire A is 1 mm. Calculate the increase in the length of the wire B.

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23. Two wires of equal cross section but one made of steel and the other of copper, are joined end to end. When the combination is kept under tension, the elongations in the two wires are found to be equal. Find the ratio of the lengths of the two wires. Young modulus of steel $= 2.0 \times 10^{11} Nm^{-2}$ and that of copper $= 1.1 \times 10^{1} Nm^{-2}$

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24. A lift is tied with thick iron wire and its mass is $1000 kg$. If the maximum acceleration of the lift is $1.2 ms^{2}$ and the maximum stress of the wire is $1.4 \times 10^8 Nm^2$ what should be the minimum diameter of the wire?

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25. The length of a metal wire is l_1 when the tension in it is T_1 and is l_2 when the tension is T_2. Then natural length of the wire is

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26. A metal bar of length L and area of cross-section A is rigidly clamped between two walls. The Young's modulus of its material is Y and the coefficient of linear expansion is α. The bar is heated so that its temperature is increased by $\theta^\circ C$. Find the force exerted at the ends of the bar.

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27. A metallic cube whose each side is 10 cm is subjected to a shearing force of 100 kgf. The top face is displaced through 0.25 cm with respect to the bottom ? Calculate the shearing stress, strain and shear modulus.

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28. An Indian rubber cube of side 7 cm has one side fixed, while a tengential force equal to the weight of 200 kilogram is applied to the opposite face. Find the shearing strain produced and distance through which th strained side moves. Modulus of rigidity for rubber is 2×10^7 dyne cm^{-2}

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29. A metal cube of side $10cm$ is subjected to a shearing stress of $10^6 N/m^2$. Calculate the modulus of rigidity if the edge of the cube is displaced by $0.05cm$ with respect to its bottom.

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30. Two parallel and opposite forces, each of magnitude $4000N$, are applied tangentially to the upper and lower faces of a cubical metal block $25cm$ on a side. Find the angle of shear and the displacement of the upper surface relative to the lower surface. The shear modulus for the metal is $80GPa$.

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31. The elastic after effect show that the

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32. Describe elastic hysteresis.

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33. Why is any metallic part of a machinery never subjected to a stress beyond the elastic limit ?

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34. How is the knowledge of elasticity useful in selecting metal ropes used in cranes for lifting heavy loads ?

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35. Explain why should the beams used in the construction of bridge and small breadth.

(ii) Why are girders given I shape?

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36. Explain why should the beams used in the construction of bridge and small breadth.

(ii) Why are girders given I shape?

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37. what is meant by elastic potential energy? Deerive an expression for the elastic potential energy of streched wire. Prove that its elasic energy density is equal to $\frac{1}{2}$ x stress x strain

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38. A steel wire of length 2.0 m/s is stretched through 2.0 mm. The cross sectional area of the wire is 4.0 mm^2. Calculate the elastic potential energy stored in the wire in the stretched condition. Young modulus of steel $= 2.0x10^{11}Nm^{-2}$

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39. If the Young's modulus of steel is $2 \times 10^{11}Nm^{-2}$, calculate the work done in stretching a steel wire 100 cm in length and of cross-sectional area $0.03cm^3$ when a load of 20 kg is slowly applied without the elastic limit being reached.

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40. The limiting stress for a typical human bone is 0.9 $\times\ 10^8$ N m^{-2} while Young's modulus is 1.4 $\times\ 10^{10}$ Nm^{-2}. How much energy can be absorbed by two legs (without breaking) if each has a typical length of 50 cm and an average cross-sectional area of 5 cm^2 ?

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41. Calculate the Poisson's ratio for silver. Given its Young's modulus = 7.25 $\times\ 10^{10}$ Nm^{-2} and bulk modulus = 11 $\times\ 10^{10}$ N m^{-2}

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42. In solids interatomic forces are

A. totally repulsive

B. totally attractive

C. both (a) and (b)

D. none of these

Answer:

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43. According to C.E van der Waal, the interatomic potential varies with the average interatomic distance (R) as

A. R^{-1}

B. R^{-2}

C. R^{-4}

D. R^{-6}

Answer:

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44. The term liquid crystal refers to a state that is intermediate between

A. crystalline solid and amorphous liquid

B. crystalline solid and vapour

C. amorphous liquid and its vapour

D. a crystal immersed in a liquid

Answer:

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45. Which of the following has no dimensions?

A. strain

B. angular velocity

C. momentum

D. angular momentum

Answer:

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46. Which one the following is not a unit of Young's modulus ?

A. Nm^{-1}

B. Nm^{-2}

C. $dy \neq cm^{-2}$

D. mega pascal

Answer:

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47. A steel wire 10 m long and $10^{-5}m^2$ in crosssectional area elongates by 0.01 m under a tension of 2500 N. Young's modulus for steel from this data is computed as

A. $2.5 \times 10^7 Nm^{-2}$

B. $2.5 \times 10^9 Nm^{-2}$

C. $2.5 \times 10^{11} Nm^{-2}$

D. none of these

Answer:

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48. An iron rod of length 2 m and cross-sectional area of $50mm^2$ is stretched by 0.5 mm, when a mass of 250 Kg is hung from its lower end. Young's modulus of iron rod is

A. $19.6 \times 10^{20} Nm^{-2}$

B. $19.6 \times 10^{18} Nm^{-2}$

C. $19.6 \times 10^{10} Nm^{-2}$

D. $19.6 \times 10^{15} Nm^{-2}$

Answer:

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49. A $4m$ long copper wire of cross sectional are a$1.2cm^2$ is stretched by a force of $4.8 \times 10^3 N$.

if Young's modulus for copper is $Y = 1.2 \times 10^{11} M / m^2$, the increases in length of wire and strain energy per unit volume are

A. 1.32 mm

B. 0.8 mm

C. 0.48 mm

D. 5.36 mm

Answer:

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50. A steel rod has a radius 10 mm and a length of 1.0 m. A force stretches it along its length and produces a strain of 0.32%.

Young's modulus of the steel is $2.0 \times 10^{11 Nm^{-2}}$. What is the magnitude of the force stretching the rod?

A. 100 KN

B. 314 KN

C. 31.4 KN

D. 200 KN

Answer:

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51. The diameter of a brass rod is 4 mm and Young's modulus of brass is $9 \times 10^{10} N/m^2$. The force required to stretch by 0.1 % of its length is

A. $360\pi N$

B. 36 N

C. 36 pi times 10^5 N`

D. $144\pi \times 10^3 N$

Answer:

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52. A wire whose cross-sectional area is $2mm^2$ is stretched by 0.1 mm by a certain load, and if a similar wire of triple the area of cross-section is stretched by the same load, then the elongation of the second wire would be

A. 3.3 mm

B. 0.033 mm

C. 0.33 mm

D. 0.0033 mm

Answer:

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53. A wire of cross section 4 mm is stretched by 0.1 mm by a certain weight. How far (length) will be wire of same material and length but of area $8mm$ stretch under the action of same force.

A. 0.5 mm

B. 1.0 mm

C. 0.05 mm

D. 0.06 mm

Answer:

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54. when a weight of 10 kg is suspended from a copper wire of length 3m and diameter 0.4 mm. Its length increases by 2.4 cm. If the diameter of the wire is doubled then the extension in its length will be

A. 7.6 cm

B. 4.8 cm

C. 1.2 cm

D. 0.6 cm

Answer:

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55. Two wires A and B are of same material. Their lengths are in the ratio 1:2 and diameters are in the ratio 2:1 when stretched by force F_A and F_B respectively they get equal increase in their lengths. Then the ratio $\frac{F_A}{F_B}$ should be

A. $1:2$

B. $1:1$

C. $2:1$

D. $8:1$

Answer:

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56. There are two wires of same material and same length while the diameter of second wire is 2 times the diameter of first wire, then ratio of extension produced in the wires by applying same load will be

A. $1:1$

B. $2:1$

C. $1:2$

D. $4:1$

Answer:

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57. A wire of length L and radius r is fixed at one end. When a stretching force F is applied at free end, the elongation in the wire is l. When another wire of same material but of length $2L$ and radius $2r$, also fixed at one end is stretched by a force $2F$ applied at free end, then elongation in the second wire will be

A. $\frac{l}{2}$

B. l

C. 2 l

D. $\frac{l}{4}$

Answer:

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58. The breaking force for a wire of diameter D of a material is F. The breaking force for a wire of the same material of radius D is

A. F

B. 2 F

C. $\frac{F}{4}$

D. 4 F

Answer:

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59. A wire of diameter 1 mm breaks under a tension of 1000 N. Another wire of same materials as that of the first one but of diameter 2 mm breaks under a tension of

A. 500 N

B. 100 N

C. 1000 N

D. 4000 N

Answer:

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60. A substance breaks down by a stress of $10^6 Nm^{-2}$. If the density of the material of the wire is $3 \times 10^3 kgm^{-3}$, then the length of the wire of the substance which will break under its own weight when suspended vertically is

A. 66.6 m

B. 60.0 m

C. 33.3 mm

D. 30.3 mm

Answer:

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61. A uniform heavy rod of weight W, cross sectional area a and length L is hanging from fixed support. Young modulus of the material of the rod is Y. Neglect the lateral contraction. Find the elongation of the rod.

A. $\frac{\omega l}{2a\gamma}$

B. $\frac{2\omega l}{a\gamma}$

C. $\frac{3\omega l}{2a\gamma}$

D. $\frac{2\omega l}{3a\gamma}$

Answer:

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62. With what minimum acceleration can monkey slide down a rope whose breaking strength is two third of his weight?

A. $\frac{g}{3}$

B. $\frac{2}{3}g$

C. $\frac{3}{2}g$

D. $\frac{g}{2}$

Answer:

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63. A body of mass m = 0 kg is attached to a wire of length 0.3 m. Calculate the maximum angular velcoity with wicch it can be rotated in a horizontal circle (Breaking stress of wire $= 4.8x10^7 N/m^2$ and area of cross-section of wire = $10^{-6} m^2$)

A. $4rad/s$

B. $8rad/s$

C. $1rad/s$

D. $2rad/s$

Answer:

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64. When a body of mass M is hung from a spring, the spring extends by 1 em. If the body of mass 2M be hung from the same spring, the extension of spring will be

A. 1 cm

B. 2 cm

C. 0.5 cm

D. 4 cm

Answer:

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65. The dimensional formula for the modulus of rigidity is

A. $[ML^{-2}T^{-2}]$

B. $[ML^{-3}T^{-2}]$

C. $[ML^{2}T^{-2}]$

D. $[ML^{-1}T^{-2}]$

Answer:

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66. The relationship between Young's modulus Y, Bulk modulus K and modulus of rigidity η is

A. $\frac{1}{\gamma} = \frac{1}{\kappa} = \frac{3}{\eta}$

B. $\frac{3}{\gamma} = \frac{1}{\eta} = \frac{3}{\kappa}$

C. $\frac{1}{\gamma} = \frac{3}{\eta} = \frac{1}{3\kappa}$

D. $\frac{1}{\kappa} = \frac{3}{\gamma} = \frac{1}{3\kappa}$

Answer:

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67. When a sphere is taken to bottom of sea 1 km deep, it contracts by 0.01%. The bulk modulus of elasticity of the material of sphere is

(Given density of water = 1 g cm^{-3})

A. $9.8 \times 10^{10} N / m^2$

B. $10.10 \times 10^{10} N / m^2$

C. $0.98 \times 10^{10} N / m^2$

D. $8.4 \times 10^{10} N / m^2$

Answer:

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68. A sphere or radius 3 cm is subjected to a pressure of 100 atm. Its volume decreases by 0.3 cc. What will be its bulk modulus?

A. $4\pi \times 10^5 atm$

B. $4\pi \times 3 \times 10^3 atm$

C. $4\pi \times 10^6 atm$

D. $4\pi \times 10^8 atm$

Answer:

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69. A uniform cube is subjected to volume compression. If each side is decreased by 2% , then bulk strain is

A. 0.02

B. 0.03

C. 0.04

D. 0.06

Answer:

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70. A solid sphere of radius R made of a material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless pistion of area A floats on the surface of the liquid. When a mass

M is placed on the piston to compress the liquid the fractional change in the radius of the sphere, $\delta R / R$, is ....

A. $\frac{mg}{3AR}$

B. $\frac{mg}{A}$

C. $\frac{mg}{3A\kappa}$

D. $\frac{mg}{A\kappa}$

Answer:

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71. A metallic rod of length l and cross - sectional area A is made of a material of Young's modulus Y. If the rod is elongated by an amount y, then the work done is proportional to

A. y

B. $\frac{1}{y}$

C. y^2

D. 1/y^2

Answer:

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72. A wire of length L and cross sectional area A is made of a material of Young's modulus Y. If the wire is streched by an amount x, the work done is..................

A. $\frac{Yax^2}{2L}$

B. $\frac{Yax^2}{L}$

C. Yax^2L

D. $\frac{YAx}{2L}$

Answer:

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73. The work done per unit volume in stretching the wire is equal to

A. stress times strain

B. 1/2 (stress times strain)

C. stress/strain

D. strain/stress

Answer:

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74. The work done in stretching an elastic wire per unit volume is or strain energy in a stretched string is

A. $\frac{1}{2} \times stress \times stra \in$

B. $stress \times stra \in$

C. gamma (Strain)^2

D. $\frac{1}{2}\gamma(stress)^2$

Answer:

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75. A body of weight mg is hanging on a string which extends in length by l. The work done in extending the string is

A. mgl

B. mgl/2

C. 2 mgl

D. none of these

Answer:

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76. If the work done in stretching a wire by 1 mm is 2 J, the work necessary for stretching another wire of same material but with double radius of cross-section and half the length by 1 mm (in joule) is

A. 16 J

B. 8 J

C. $\frac{1}{16}J$

D. $\frac{1}{8}J$

Answer:

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77. The length of a rod is $20cm$ and area of cross-section $2cm^2$. The Young's modulus of the material of wire is $1.4 \times 10^{11} N/m^2$. If the rod is compressed by 5 kg-wt along its length, then increase in the energy of the rod in joules will be

A. 8.57×10^{-6}

B. 22.5×10^{-4}

C. 9.8×10^{-5}

D. 45.0×10^{-5}

Answer:

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78. Minimum and maximum values of Poisson's ratio for a metal lies between

A. $-\infty \rightarrow +\infty$

B. 0 to 1

C. $\infty \rightarrow +1$

D. 0 to 0.5

Answer:

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79. A long piece of rubber is wider than it is thick. When it is stretched in length by some amount,

A. its thickness decreases but its width increases

B. its thickness decreases but its width remains constant

C. its thickness increases but its width decreases

D. both its thickness and width decrease.

Answer:

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80. If longitudinal strain for a wire is 0.03 and its Poisson's ratio is 0.5, then its lateral strain is

A. 0.003

B. 0.0075

C. 0.015

D. 0.4

Answer:

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81. The forces which produces deformation in a body is called

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82. COMPLETION TYPE QUESTIONS Restoring force and deforming force act in _______ directions

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83. The internal restoring force acting per unit area of cross-section of the deformed body is called

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84. COMPLETION TYPE QUESTIONS Stress is a ______ quantity and its CGS unit is _______

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85. The property of matter by virtue of which it does not regain its original shape and size after the removal of deforming force is called

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86. COMPLETION TYPE QUESTIONS The nearest approach to a perfectly elastic body is _______

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87. The property of matter by virtue of which it does not regain its original shape and size after the removal of deforming force is called

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88. On applying external force beyond the elastic limit,

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89. COMPLETION TYPE QUESTIONS The value of Young's modulus for a perfectly rigid body is ______.

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90. The bulk modulus for an incompresssible liquid is

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91. COMPLETION TYPE QUESTIONS The value of modulus of rigidity for an incompressible liquid is _______.

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92. COMPLETION TYPE QUESTIONS The reciprocal of bulk modulus of a material is called its ________.

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93. The dimensional formula for compressibility is

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94. COMPLETION TYPE QUESTIONS Modulus of rigidity is the ratio of ______ stress to the ______strain within the elastic limit.

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95. COMPLETION TYPE QUESTIONS Young's modulus and shear modulus are relevant only for _____.

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96. COMPLETION TYPE QUESTIONS ______ modulus is relevant for all three states of matter.

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97. COMPLETION TYPE QUESTIONS The stress required to double the length of a wire of Young's modulus Y is equal to _______.

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98. COMPLETION TYPE QUESTIONS The Young's modulus of the material of a wire having a cross-sectional area of $.5cm^2$ is 2×10^{12} dyne cm^{-2}. If the length of the wire is to be doubled, the force required is _______.

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99. COMPLETION TYPE QUESTIONS A tensile force of 2×10^5 dyne doubles the length of an elastic cord whose area of cross-section is 2 cm^2. The Young's modulus of the material of the cord is ______.

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100. A wire of length L and cross sectional area A is made of a material of Young's modulus Y. If the wire is streched by an amount x, the work done is..................

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101. A force of 400 kg. weight can break a wire. The force required to break a wire of double the area of cross-section will be

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102. COMPLETION TYPE QUESTIONS The Young's modulus of a wire of length L and radius r is Y. If the length is reduced to L/ 4 and radius r/4, then its Young's modulus will be______.

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103. If 'S' is stress and 'Y' is young's modulus of material of a wire, the energy stored in the wire per unit volume is

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104. A wire fixed at the upper end stretches by length l by applying a force F. The work done in stretching is

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105. COMPLETION TYPE QUESTIONS The delay on the part of the body in regaining its original configuration on removal of the deforming force is called the ________.

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106. COMPLETION TYPE QUESTIONS _______is the loss in the strength of a material caused due to repeated alternating strains to which the material is subjected.

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107. The ratio of lateral strain to the longitudinal strain of a wire is called

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108. Determine the Poisson's ratio of the material of a wire whose volume remains constant under an external normal stress.

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109. A hollow shaft is found to be stronger than a solid shaft made of same equal material.

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110. TRUE/FALSE TYPE QUESTIONS No material is perfect elastic.

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111. A metal wire of length L is suspended vertically from a rigid support. When a bob of mass M is attached to the lower end of wire, the elongation of the wire is l:

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112. TRUE/FALSE TYPE QUESTIONS Any metallic part of a machinery is never subjected to a stress beyond the elastic limit of the material.

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113. TRUE/FALSE TYPE QUESTIONS Modulus of elasticity of most of the materials decreases with the increase of temperature.

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114. A wire of length L and cross-sectional area A is made of material of Young's modulus Y. The work done in stretching the wire by an amount x is

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115. TRUE/FALSE TYPE QUESTIONS Rubber is more elastic than steel.

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116. State whether the following statements are true or false with reasons.

a. Elastic forces are always conservative.

b. Elastic forces are strictly conservative only when Hooke's law is obeyed.

c. When a wire is loaded beyond the elastic limit and then reloaded, the work done disappears completely as heat.

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117. Why a spring balance does not give correct measurements when it has been used for a long time?

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118. Among the interatomic and intermolecular forces, which are the stronger ones ? How much ?

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119. Give another name for amorphous solids.

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120. What is an isotropic medium ?

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121. What is an anisotropic solid ?

Watch Video Solution

122. Why are crystalline solids anisotropic ?

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123. Give one example each of isotropic and anisotropic substance?

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124. Write two points of distinction between crystalline and amorphous solids.

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125. What is a deforming force ?

Watch Video Solution

126. What is restoring force ?

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127. Give three examples of forces which are conservative in nature.

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128. Elasticity: Longitudinal Stress & strain | Shear stress & shear strain | Volumetric stress and strain

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129. ELASTIC LIMIT

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130. Define yield point.

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131. Young's modulus is

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132. The dimensional formula for young's modulus is

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133. What is the value of Young's modulus for a perfectly rigid body?

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134. What is the limitation of Hooke's law?

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135. COMPRESSIBILITY

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136. The bulk modulus for an incompresssible liquid is

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137. What is the value of modulus of rigidity for an incompressible liquid ?

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138. The Poisson's ratio is defined as

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139. Young's modulus of the material of a wire is Y. ON pulling the wire by a force F, the increase in its length is x. The potential energy of the stretched wire is

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140. Modulus of rigidity .

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141. The breaking stress for a wire of unit cross-section is called

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142. The material which practically does not exhibit elastic after effect is

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143. What is elastic fatigue?

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144. What is meant by hysteresis? Discuss briefly the dissipation of energy due to hysteresis. Draw hysteresis curves to soft iron and steel.

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145. The length of wire increase by 1 mm under 1 kgf. What will be increase in length under

(i) 2 kgf? (ii) under 100 kgf?

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146. What will happen to the potential energy of the atoms of a solid when

(i) compressed ? (ii) on stretching a wire?

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147. A spring is stretched by applying a load to its free end. The strain produced in the spring is

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148. State Hooke's law.

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149. Which of the two forces-deforming or restoring force is responsible for elastic behaviour of substance.

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150. Which one is more elastic rubber or steel? Explain.

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151. The young's modulus for steel is much more then that for rubber. For the same longitudinal strain, which one will have greater tensil stress ?

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152. Distinguish between elasticity and plasticity of materials.

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153. Hooke's Law

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154. Which one is more elastic rubber or steel? Explain.

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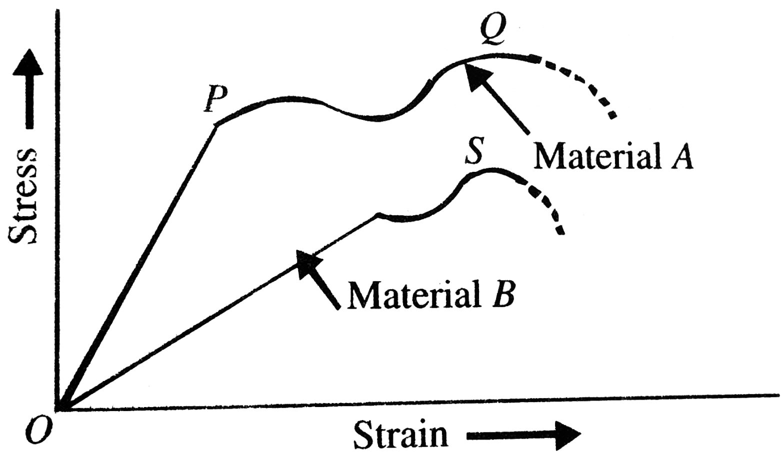
155. Figure shows the stress-strain graphs for materials .A and B

. From the graph it follows that



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156. Hooke's Law

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157. ELASTIC LIMIT

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158. If a metal wire is stretched a little beyond its elastic limit (or yield point), and released, it will

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159. Breaking point.

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160. What are elastomers ?

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161. The elastic after effect show that the

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162. Explain why should the beams used in the construction of bridge and small breadth.

(ii) Why are girders given I shape?

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163. For finding the maximum height of a mountain on the earth, we have to consider

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164. Define stress and strain and derive their units. What is Hooke's law? Write its one limitation.

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165. Define the terms stress and strain and also state their SI units. Draw the stress versus strain graph for a metallic wire, when stretched upto the breaking point.

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166. The Young's modulus, bulk modulus and the modulus of rigidity have

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167. Define elastic limit and elastic fatigue. What are ductile and brittle substances ?

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168. Explain how is the knowledge of elasticity useful in selecting metal ropes used in cranes for lifting heavy loads.

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169. The elastic potential energy of a stretched wire is given by

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170. Define Poisson's ratio. Write an expression for it. What is the significance of negative sign in this expression ?

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171. What is interatomic force ? .

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172. Define the term elasticity. Give an explanation of the elastic properties of materia!~ in terms of interatomic forces.

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173. State Hooke's law.

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174. To determine Young's modulus of the material of a wire,

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175. Define Young's modulus, bulk modulus and modulus of rigidity. Write mathematical expressions for these moduli.

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176. Discuss stress vs. strain graph, explaining clearly the terms elastic limit and permanent set.

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177. Derive an expression for the elastic potential energy stored in a stretched wire under stress.

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178. One end of a horizontal thick copper wire of length 2L and radius 2R is welded to an end fo another horizontal thin copper wire of lenth L and radius R. When the arrangement is stretched by applying forces at two ends, the ratio of the elongation in the thin wire to that in the thick wire is

A. 0.25

B. 0.5

C. 2

D. 4

Answer:

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179. A wire of length L and cross sectional area A is made of a material of Young's modulus Y. If the wire is streched by an amount x, the work done is..................

A. $YAx^2/2L$

B. YAx^2/L

C. $YAx/2L$

D. YAx^2L

Answer:

Watch Video Solution

180. The presssure of a medium is changed from $1.01 \times 10^5 Pa$ to $1.165 \times 10^5 Pa$ and change in volume is 10% keeping temperature constant . The bulk modulus of the medium is

(a) $204.8 \times 10^5 Pa$ (b) $102.4 \times 10^5 Pa$ (c) $5.12 \times 10^5 Pa$

(d) $1.55 \times 10^5 Pa$

A. 204.8 $\times$ 10^5 pa

B. 102.4 $\times$ 10^5 Pa

C. 51.2 $\times$ 10^5 Pa

D. 1.55 $\times$ 10^5 Pa

Answer:

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181. A given quantity of a ideal gas is at pressure P and absolute temperature T. The isothermal bulk modulus of the gas is

A. $2P/3$

B. P

C. $3P/2$

D. 2P

Answer:

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182. A steel wire of diameter 0.5 and Young's modulus 210 carries a load of mass . The length of the wire with the load is 1.0. A vernier scale with 10 divisions is attached to the end of this wire. Next to the steel wire is a reference wire to which a main scale, of least count 1.0 , is attached. The 10 divisions of the vernier scale correspond to 9 divisions of the main scale. Initially, the zero of vernier scale coincides with the zero of main scale. If the load on the steel wire is increased by 1.2 kg, the vernier scale division which coincides with a main scale division is ________.

Take g $=10ms^{-2}$ and $\pi = 3.2$.

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183. 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 are hung at the two ends, the elongation of the wire will be (in mm)

A. $l/2$

B. l

C. 2l

D. zero

Answer:

Watch Video Solution

184. A wire fixed at the upper end stretches by length l by applying a force F. The work done in stretching is

A. F/2l

B. Fl

C. 2Fl

D. Fl/2

Answer:

Watch Video Solution

185. A wire suspended vertically from one of the its ends is stretched by attaching a weight of 200 N to the lower end. The weight stretches the wire by 1 mm. then the elastic energy stored in the wire is

A. 0.2 J

B. 10 J

C. 20 J

D. 0.1 J

Answer:

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186. If 'S' is stress and 'Y' is young's modulus of material of a wire, the energy stored in the wire per unit volume is

A. 2Y/ S

B. S/ 2Y

C. 2 S^2Y

D. $\frac{S^2}{2Y}$

Answer:

Watch Video Solution

187. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area 3A. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

A. F

B. 4F

C. 6F

D. 9F

Answer:

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188. A pendulumd made of a uniform wire of cross sectional area (A) has time T.When an additionl mass (M) is added to its bob, the time period changes to T_M. $IftheYoung's \bmod \underline{u}softhematerialofthewireis(Y)then$ 1/Y` is equal to:

A. $\left[\left(\frac{^TM}{T}\right)^2-1\right]\frac{A}{Mg}$

B. $\left[\left(\frac{^TM}{T}\right)^2-1\right]\frac{Mg}{A}$

C. $\left[1-\left(\frac{{}^{T}M}{T}\right)^{2}\right]\frac{A}{Mg}$

D. $\left[1-\left(\frac{T}{{}^{T}M}\right)^{2}\right]\frac{A}{Mg}$

Answer:

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189. The potential energy function for the force between two atoms in a diatomic molecule is approximate given by $U(r)=\frac{a}{r^{12}}-\frac{b}{r^{6}}$, where a and b are constants and r is the distance between the atoms. If the dissociation energy of the molecule is $D=\left[U(r=\infty)-U_{\text{at equilibrium}}\right]$, D is

A. $\frac{b^2}{6a}$

B. $\frac{b^2}{2a}$

C. $\frac{b^2}{12a}$

D. $\frac{b^2}{4a}$

Answer:

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190. A man grows into a giant such that his linear dimension increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by a factor of

A. 9

B. $\frac{1}{9}$

C. 81

D. $\frac{1}{81}$

Answer:

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191. A uniformly tapering conical wire is made from a material of young's modulus Y and has a normal unextended length L the radii at the upper and lower ends of this conical wire, have values R and 3R, respectively the upper end of the wire is fixed to a rigid support and a mass M is suspended from its lower end. the equilibrium extended length of this wire would equal to:

A. $L\left(1+\frac{1}{3}\frac{Mg}{3\pi YR^2}\right)$

B. $L\left(1+\frac{2}{3}\frac{Mg}{3\pi YR^2}\right)$

C. $L\left(1+\frac{1}{9}\frac{Mg}{3\pi YR^2}\right)$

D. $L\left(1+\frac{2}{9}\frac{Mg}{3\pi YR^2}\right)$

Answer:

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192. A solid sphere of radius R made of a material of bulk modulus B is surrounded by a liquid in a cylindrical container. A massless piston of area A (the area of container is also A) floats on the surface of the liquid. When a mass M is placed on the piston to compress the liquid , fractional change in radius of the sphere is $\frac{Mg}{\alpha AB}$. Find the value of α.

A. $\frac{ka}{mg}$

B. $\frac{ka}{3mg}$

C. $\frac{mg}{3ka}$

D. $\frac{mg}{ka}$

Answer:

Watch Video Solution

193. According to Hooke's law of elasticity, if stress is increaed, the ratio of stress to strain

A. increases

B. decreases

C. becomes zero

D. remains constant

Answer:

Watch Video Solution

194. A thick rope of rubber of density $1.5 \times 10^3 kgm^{-3}$ and Young's modulus $5 \times 10^6 Nm^{-2}$, 8 m in length, when hung from ceiling of a room, the increases in length due to its own weight is

A. 9.6 $\times$ 10^{-5} m

B. 19.2 $\times$ 10^-7` m

C. 9.6 $\times$ 10^-2` m

D. 9.6 m

Answer:

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195. If in a wire of Young's modulus Y, longitudinal strain X is produced, then the value of potential energy stored in its unit volume will be

A. YX^2

B. 2YX^2

C. 0.5Y^2X

D. 0.5YX^2

Answer:

Watch Video Solution

196. A metal ring of initial radius r and cross-sectional area A is fitted onto a wooden disc of radius R > r. If Youngs modules of metal is Y then tension in the ring is

A. $\frac{AYR}{r}$

B. $\frac{Yr}{AR}$

C. $\frac{AY(R-r)}{r}$

D. $\frac{Y(R-r)}{Ar}$

Answer:

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197. For a constant hydraulic stress on an object, the fractional change in the object's volume $\left(\frac{\triangle V}{V}\right)$ and its bulk modulus (b) are related as

A. $\frac{\Delta V}{V} \alpha$ B

B. $\frac{\Delta V}{V} \alpha \frac{1}{B}$

C. $\frac{\Delta V}{V} \alpha B^2$

D. $\frac{\Delta V}{V} \alpha \frac{1}{B^2}$

Answer:

198. The compressibility of water is 4×10^{-5} per unit atmospheric pressure. The decrease in volume of 100 cubic centimetre of water under a pressure of 100 atmosphere will be

A. 0.4 cm^3

B. 4 $\times$ 10^-5cm^3`

C. 0.025 cm^3

D. 0.004 cm^3

Answer:

Watch Video Solution

199. A stretched rubber has

A. increased kinetic energy

B. increased potential energy

C. decreased kinetic energy

D. decreased kinetic energy

Answer:

Watch Video Solution

200. The breaking stress of a wire depends on

A. length of the wire

B. radius of the wire

C. material of the wire

D. shape of the cross-section

Answer:

Watch Video Solution

201. Which of the following affects the elasticity of a substance

A. hammering and annealing

B. change in temperature

C. impurity in substance

D. all of these

Answer:

Watch Video Solution

202. The young's modulus of a wire of length (L) and radius (r) is Y. If the length is reduced to $\frac{L}{2}$ and radius $\frac{r}{2}$, then its young's modulus will be

A. Y/2

B. Y

C. 2Y

D. 4Y

Answer:

Watch Video Solution

203. In designing, a beam for its use to support a load. The depression at centre is proportional to (where , Y is Young's modulus).

A. Y^2

B. Y

C. 1/Y

D. $\frac{1}{Y^2}$

Answer:

Watch Video Solution

204. The length of a metal wire is l_1 when the tension in it is T_1 and is l_2 when the tension is T_2. The natural length of the wire is:

A. $\frac{l_1 + l_2}{2}$

B. $\sqrt{l_1 l_2}$

C. $\frac{l_1 T_2 - l_2 T_2}{T_2 - T_1}$

D. $\frac{l_1 T_2 + l_2 T_2}{T_2 + T_1}$

Answer:

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205. A steel wire with cross-section 3 cm^2 has elastic limit 2.4 $\times 10^8$ Nm^{-2}. The maximum upward acceleration that can be given to a 1200 kg elevator supported by this cable if the stress is not to exceed one-third of the elastic limit (take g =10m/ s^2) is

A. 12 ms^{-2}

B. 10 ms^{-2}

C. 8 ms^{-2}

D. 7 ms^{-2}

Answer:

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206. Young's modulus for a steel wire is 2 $\times$ 10^{11} Pa and its elastic limit is 2.5 $\times$ 10^{8}Pa. By how much can a steel wire 3 m long and 2 mm in diameter be stretched before the elastic limit is exceeded ?

A. 3.75 mm

B. 7.50 mm

C. 4.75 mm

D. 4.00 mm

Answer:

Watch Video Solution

207. For a constant hydraulic stress on an object, the fractional change in the object's volume $\left(\frac{\triangle V}{V}\right)$ and its bulk modulus

(b) are related as

A. $\frac{P}{B}$

B. $\frac{B}{P}$

C. $\frac{\sqrt{P}}{B}$

D. $\left(\frac{B}{P}\right)^2$

Answer:

Watch Video Solution

208. The Young's modulus of a rope of 10 m length and having diameter of 2 cm is 20×10^{11} dyne cm^{-2} . If the elongation produced in the rope is 1 cm, the force applied on the rope is

A. 6.28 $\times$ 10^5` N

B. 6.28 $\times$ 10^4 N

C. 6.28 $\times$ 10^4 dyne

D. 6.28 $\times$ 10^5 dyne

Answer:

Watch Video Solution

209. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied

A. Length = 50 cm, diameter = 0.5 mm

B. Length = 100 cm, diameter =1 mm

C. Length = 200 cm, diameter =2 mm

D. Length = 300 cm, diameter = 3 mm

Answer:

Watch Video Solution

210. The Young's modulus of steel is twice that of brass. Two wires of the same length and of the same area of cross section, one of steel and another of brass are suspended from the same roof. If we want the lower ends of the wires to be at the same level, then the weight added to the steel and brass wires must be in the ratio of

A. $1:1$

B. $1:2$

C. $2:1$

D. $4:1$

Answer:

Watch Video Solution

211. Copper of fixed volume V is drawn into wire of length l. When this wire is subjected to a constant force F, the extension produced in the wire is $\triangle l$. Which of the following graphs is a straight line?

A. Δl versus $\frac{1}{l}$

B. Δ versus $\frac{1}{l^2}$

C. Δ versus l^2

D. Δlversus l

Answer:

Watch Video Solution

212. The approximate depth of an ocean is 2700 m. The compressibility of water is $45.4 \times 10^{-11} Pa^{-1}$ and density of water is $10^3 kg/m^3$. What fractional compression of water will be obtained at the bottom of the ocean ?

A. 1.0 $\times$ 10^{-2}

B. 1.2 $\times$ 10^-2`

C. 1.4 $\times$ 10^{-2}

D. 0.8 $\times$ 10^-2`

Answer:

Watch Video Solution

213. The bulk modulus of a spherical object is B if it is subjected to uniform pressure p, the fractional decrease in radius is:

A. $\frac{\rho}{B}$

B. $\frac{\rho}{3}P$

C. $3\frac{\rho}{B}$

D. $\frac{\rho}{3}B$

Answer:

Watch Video Solution

214. Two wires are made of the same material and have the same volume. The first wire cross sectional area A and the second wire has cross sectional area 3A. If the length of the first wire is increased by Δl on applying a force F, how much force is needed to stretch the second wire by the same amount?

A. 9F

B. F

C. 4F

D. 6F

Answer:

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Example

1. The length of a suspended loire increases by 10^{-4} of its original length when a stress of $10^{7} Nm^{-2}$ is applied on it.

Calculate the Young's modulus of the material of the wire.

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2. A uniform wire of steel of length 2.5m and density $8.0gcm^{-3}$ weighs 50g. When stretched by a force of $10kgf$, the length increases by 2mm. Calculate Young's modulus of steel.

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3. A structural steel rod has a radius of 10 mm and a length of 1.0 m. A 100 kN force stretches it along its length. Calculate (a) stress, (b) elongation, and (c) strain on the rod. Young's modulus, of structural steel is 2.0 $\times$ 10^{11} N m^{-2}.

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4. A structural steel rod has a radius of 10 mm and a length of 1.0 m. A 100 kN force stretches it along its length. Calculate (a) stress, (b) elongation, and (c) strain on the rod. Young's modulus, of structural steel is 2.0 $\times\ 10^{11}$ N m^{-2}.

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5. A structural steel rod has a radius of 10 mm and a length of 1.0 m. A 100 kN force stretches it along its length. Calculate (a) stress, (b) elongation, and (c) strain on the rod. Young's modulus, of structural steel is 2.0 $\times\ 10^{11}$ N m^{-2}.

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6. What is the percentage increase in length of a wire of diameter 2.5 mm, stretched by a force of 100 kg wt ? Young's modulus of elasticity of wire $= 12.5 \times 10^{11} dyne / cm^2$.

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7. The breaking stress for a metal is $7.8 \times 10^9 Nm^{-2}$. Calculate the maximum length of the wire of this metal which may be suspended breaking. The density of the metal =$7.8 \times 10^3 kgm^{-3}$. Take g =$10Nkg^{-1}$

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8. A rubber string 10m long is suspended from a rigid support at its one end. Calculate the extension in the string due to its own weight. The density of rubber is 1.5×10^3 and Young's modulus for the rubber is $5 \times 10^6 Nm^{-2}$ Take $g = 10Nkg^{-1}$.

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9. A silica glass rod has a diameter of1cmand is 10 cmlong. The ultimate strength of glass is $50x10^6 Nm^{-2}$. Estimate the largest mass that can be hung from it without breaking it. Take $g = 10Nkg^{-1}$.

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10. A composite wire of uniform diameter 3.0 mm consisting of a copper wire of length 2.2m and a steel wire of length 1.6m stretches under a load by 0.7 mm. Calculate the load, given that the Young's modulus for copper is $1.1 \times 10^{11} Pa$ and for steel is $2.0 \times 10^{11} Pa$.

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11. The maximum stress that can be applied to the material of a wire used to suspend an elevator is $\frac{3}{\pi} \times 10^8 N/m^2$ if the mass of elevator is 900 kg and it move up with an acceleration $2.2m/s^2$ than calculate the minimum radius of the wire.

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12. A mass of 100 grams is attached to the end of a rubber string 49 cm. long and having an area of cross section 20 sq. mm. The string is whirled round, horizontally at a constant speed of 40 r.p.s in a circle of radius 51 cm. Find Young's modulus of rubber.

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13. A uniform heavy rod of weight W, cross sectional area a and length L is hanging from fixed support. Young modulus of the material of the rod is Y. Neglect the lateral contraction. Find the elongation of the rod.

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14. A steel wire of uniform cross-section $1mm^2$ is heated to $70^\circ C$ and stretched by tying it two ends rigidly. Calculate the change in tension on the wire when temperature falls form $70^\circ C$ to $35^\circ C$

Watch Video Solution

15. The presssure of a medium is changed from $1.01 \times 10^5 Pa$ to $1.165 \times 10^5 Pa$ and change in volume is 10% keeping temperature constant . The bulk modulus of the medium is

(a) $204.8 \times 10^5 Pa$ (b) $102.4 \times 10^5 Pa$ (c) $5.12 \times 10^5 Pa$

(d) $1.55 \times 10^5 Pa$

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16. The average depth of indian Ocean is about 3000 m. The fractional compression, $\frac{\triangle V}{V}$ of water at the bottom of the ocean is (Given Bulk modulus of the water $= 2.2 \times 10^9 Nm^{-2}$ and $g = 10ms^{-2}$)

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17. A sphere contracts in volume by 0.01% when taken to the bottom of sea $1km$ keep. The bulk modulus of the material of the sphere is (Given density of sea water may be taken as $1.0 \times 10^3 kgm^{-3}$).

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18. If the normal density of sea water is $1.00g/cm^3$, what will be its density at a depth of 4km? Given compressibility of water = 0.00005 per atmosphere. 1 atmospheric pressure $=10^6 dyne/cm^2, g=980cm/s^2$.

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19. A cube is subjected to pressure of $5\times10^5 N/m^2$. Each side of the cube is shortened by 1%. Find volumetric strain and bulk modulus of elasticity of cube.

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20. Calculate the presure required to stop the increases in volume of a copper block when it is heated from 50° to $70^\circ C$. Coefficient of linear expansion of copper $= 8.0 \times 10^{-6} . ^\circ C^{-1}$ and bulk modulus of elasticity $3.6 \times 10^{11} Nm^{-2}$

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21. A cube of aluminimum of each side 4 cn is subjected to a tangential (shearing) force. The top face of the cube is sheared through 0.012 cm with respect to the bottom face. Find (i)shearing strain (ii) shearing stress and shearing force. Given $\eta = 2.08 \times 10^{11}$ dyne cm^2

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22. A cube of aluminimum of each side 4 cn is subjected to a tangential (shearing) force. The top face of the cube is sheared through 0.012 cm with respect to the bottom face. Find (i)shearing strain (ii) shearing stress and shearing force. Given $\eta = 2.08 \times 10^{11}$ dyne cm^2

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23. A square lead slab of side 50 cm and thickness 10.0 cm is subjected to a shearing force (on its narrow face) of magnitude $9.0 \times 10^4 N$. The lower edge is riveted to the floor. How much is the upper edge displaced, if the shear modulus of lead is 5.6×10^9 Pa?

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24. A rubber block $1cm \times 3cm10cm$ is clamped at one end with its 10cm side vertical. A horizontal force of 30 N is applied to the free surface. What is the horizontal displacement of the top face ? Modulus of rigidity of rubber $1.4 \times 10^5 Nm^{-2}$

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25. A 60 kg motor rests on four cylinderical rubber blocks. Each cylinder has a height of 3cm and a cross-sectional area of $15cm^2$. The shear modulus for this rubber is $2 \times 10^6 Nm^{-2}$. If a sideways force of 300N is applied to the motor, how far will it move sideways?

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26. A steel wire of 4.0 m is stretched through 2.0 mm. The cross - sectional area of the wire is $2.0mm^2$. If young's modulus of steel is $2.0 \times 10^{11} Nm^{-2}$ find (i) the energy density of the wire, (ii) the elastic potential energy stored in the wire.

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27. A steel wire of 4.0 m is stretched through 2.0 mm. The cross - sectional area of the wire is $2.0mm^2$. If young's modulus of steel is $2.0 \times 10^{11} Nm^{-2}$ find (i) the energy density of the wire, (ii) the elastic potential energy stored in the wire.

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28. Calculate the increase in energy of a brass bar of length 0.4 m and cross-sectional area $1cm^2$,when compressed with a load of 4kg wt along its length.Given Young's Modulus of Elasticity is $Y = 1.0 \times 10^{11} Nm^{-2}$

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29. When the load on a wire is slowly increased from $3kgwt$ to $5kgwt$, the elongation increases from 0.61 to $1.02mm$. The work done during the extension of wire is

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30. A 40 kg boy whose leg are $4cm^2$ in area and $50cm$ long falls through a height of $2m$ without breaking his leg bones. If the bones can stand a stress of $1.0 \times 10^8 \frac{N}{m^2}$, calculate the Young's modulus for the material of the bone.

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31. Define Poisson's ratio.Write an expression for it. What is the significance of negative sign in this expression ?

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32. Determine the Poisson's ratio of the material of a wire whose volume remains constant under an external normal stress.

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33. One end of a nylon rope of length 4.5 m and diameter 6 mmis fixed to a tree limb. A monkey weighing 100 N jumps to catch the free end and stays there. Find the elongation of the rope and the corresponding change in the diameter. Young modulus of nylon =0.2.

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34. A material has Poisson's ratio 0.5, If a uniform rod of it suffers a longtiudinal strain of 2×10^{-3} then the percentage increases in its volume is

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35. A material has Poisson's ratio 0.2. If a uniform rod of it suffers longitudinal strain 4.0 $\times$ 10^{-3} calculate the percentage change in its volume

A. .

B.

C.

D.

Answer:

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36. Intermolecular Forces

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37. In solids interatomic forces are

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38. Intermolecular Forces

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39. State the factors due to which three states of matter differ from each other.

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40. Crystalline solids are called true solids.Why ?

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41. What is a perfectly elastic body ? Give an example.

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42. Statement I: Young's modulus for a perfectly plastic body is zero.

Statement II: For a perfectly plastic body, restoring force is zero.

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43. No material is perfectly elastic. Why ?

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44. Can one distinguish between the internal energy of a body acquired by het transfer and that acquired by the performance of work on it by an etenal agent ?

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45. What are the factors on which the modulus of elesticity depends?

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46. A constant voltage is applied between the two ends of a metallic wire. If both the length and the radius of the wire are doubled, the rate of heat developed in the wire

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47. Stress and pressure are both force per unit area. How do you differentiate between them?

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48. Out of solids , liquids and gases, which one has all the three types of modulus ofelasticity and why gases have only bulk modulus of elasticity.

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49. Which type of elasticity is involved in the following cases ? Compressing of gas

Watch Video Solution

50. Which type of elasticity is involved in the following cases ? Compressing a liquid

Watch Video Solution

51. Which type of elasticity is involved in the following cases ?

Stretching a wire

Watch Video Solution

52. Which type of elasticity is involved in the following cases ?

Tangential push on the upper face of a block

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53. What does the slope of stress vs strain graph indicate?

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54. How does Young's modulus change with rise in temperature?

Watch Video Solution

Watch Video Solution

55. Glass, rubber, steel copper is order of increasing the property of elasticity

Watch Video Solution

56. What is more elastic : water or air, why?

Watch Video Solution

57. Why is a spring made of steel, not of copper?

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58. When we stretch a wire, we have to perform work. Why? What happens to the energy given to the wire in this process?

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59. What happens to the work done instreching a wire?

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60. Identical spring of steel and copper are equally stretched. On which, more work will have to be done ?

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61. There are two idential springs of copper and steel. They are stretched by equal forces. For which spring more work will have to be done?

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62. A wire gets heated when it is bent back and forth. Why?

Watch Video Solution

63. A hard wire is broken by bending repeatedly in alternating directions. Why ?

Watch Video Solution

64. Explain why should the beams used in the construction of bridge and small breadth.

(ii) Why are girders given I shape?

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65. The ratio stress/strain remains constant for small deformation. What will be the effect on this ratio when the deformation made is very large?

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66. The young's modulus of a wire of length (L) and radius (r) is Y. If the length is reduced to $\frac{L}{2}$ and radius $\frac{r}{2}$, then its young's modulus will be

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Watch Video Solution

67. A wire fixed at the upper end stretches by length l by applying a force F. The work done in stretching is

Watch Video Solution

68. A wire suspended vertically from one of the its ends is stretched by attaching a weight of 200 N to the lower end. The weight stretches the wire by 1 mm. then the elastic energy stored in the wire is

Watch Video Solution

69. If 'S' is stress and 'Y' is young's modulus of material of a wire, the energy stored in the wire per unit volume is

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70. A wire stretches by a certain amount under a load. If the load and radius are increased to four times, find the stretch caused in the wire.

Watch Video Solution

71. Which one is more elastic rubber or steel? Explain.

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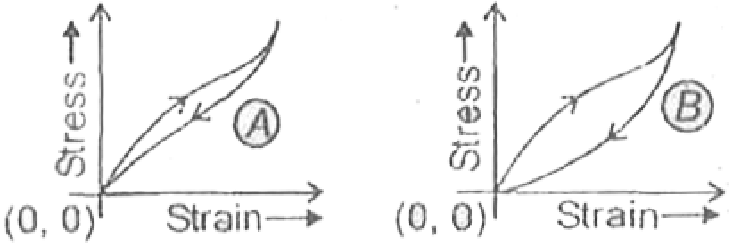
72. Two different types of rubber are found to have the stress-strain curves as shown. Thenbr>



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73. Read each of the statement below carefully and state, with reasons, if it is true or false.

(a) The modulus of elasticity of rubber is greater than that of steel.

(b) the stretching of a coil is determined by its shear modulus.

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74. Two wires of the same length and material but different radii r_1 and r_2 are suspended from a rigid support both carry the same load at the lower end. The ratio of the stress devedoped in the second wire to that developed in the first wire is

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75. Will the stress and strain in all wires be the same?

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76. A cable is replaced by another cable of the same length and material but of double the diameter.

(i) Under a given load which cable will show greater extension?

(ii) How many times the second cable can support the maximum load without exceeding the elastic limit?

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77. Two wires of same length and material but of different radii are suspended from a rigid support. Both carry the same load. Will the stress, strain and extension in them be same or different ?

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78. A uniform plant of Young's modulus Y is moved over a smooth horizontal surface by a constant horizontal force F. The area of cross section of the plank is A. The compressive strain on the plank in the direction of the force is

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79. What are the factors which affect the elasticity of a material ?

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80. What is the role of physics in your daily life?

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81. Why a spring balance does not give correct measurements when it has been used for a long time?

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82. Why are the bridge declared unsafe after long use?

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83. Two idential solid balls, one of ivory and the other of wet caly, are dropped from the same height on the floor. Which one will rise to a greater height after striking the floor and why ?

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84. If F is the breaking force of a wire, what will be the breaking force for (a) two parallel wires of the same size (b) for a single wire of double the thickness?

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85. Graphite consists of planes of carbon atoms. Between atoms in the planes there are only weak forces. What kind of elastic properties do you expect from graphite ?

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86. Why does modulus of elasticity of most of the materials decrease with the increase of temperature?

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87. 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 are hung at the two ends, the elongation of the wire will be (in mm)

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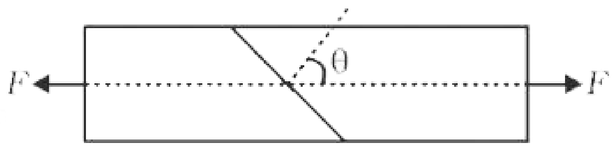
88. A bar of cross-section A is subjected to equal and opposite tensile forces at its ends. Consider a plane section of the bar whose normal makes an angle θ with the axis of the bar .

(i) What is the tensile stress on this plane?

(ii) What is the shearing stress on this plane?

(iii) For what value of θ is the tensile stress maximum

(iv) For what value of θ is the shearing stress maximum?



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89. A bar of cross-section A is subjected to equal and opposite tensile forces at its ends. Consider a plane section of the bar whose normal makes an angle θ with the axis of the bar .

(i) What is the tensile stress on this plane?

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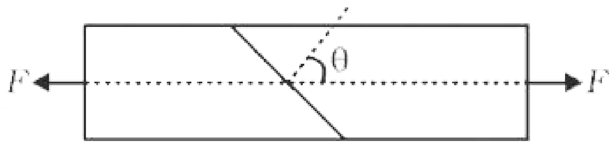

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90. A bar of cross section A is subjected to equal and opposite tensile force at its ends. Consider a plane section of the bar whose normal makes an angle θ with the axis of the bar.

a. What is the tensile stress on the plane?

b. What is the shearing stress on the this plane?

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

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

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91. A bar of cross section A is subjected to equal and opposite tensile force at its ends. Consider a plane section of the bar whose normal makes an angle θ with the axis of the bar.

a. What is the tensile stress on the plane?

b. What is the shearing stress on the this plane?

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

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

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92. A metallic wire is stretched by suspending weight to it. If α is the longitudinal strain and Y its Young's modulus of elasticity, shown that the elastic potential energy per unit volume is given by $Y\alpha^2/2$

93. A copper wire of negligible mass, $1m$ length and cross-sectional area $10^{-6}m^2$ is kept on a smooth horizontal table with one end fixed. A ball of mass $1kg$ is attached to the other end. The wire and the ball are rotating with an angular velocity of $20rad/s$. If the elongation in the wire is $10^{-3}m$.

a. Find the Young's modulus of the wire (in terms of $\times 10^{11}N/m^2$).

b. If for the same wire as stated above, the angular velocity is increased to $100rad/s$ and the wire breaks down, find the breaking stress (in terms of $\times 10^{10}N/m^2$).

94. A load of 31.4 kg is suspended from a wire of radius 10^{-3} m and density $9 \times 10^3 kg / m^3$ Calculate the change is temperature of the wire if 75% of the work done is converted into heat. The Young's modulus and the specific heat capactiy of the meterial of the wire are $9.8 \times 10^{10} N / m^2$ and $490 J / kg / K$ respectively.

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95. Alight rod of length 2 m is suspended horizontlly from the ceiling bty means of two vertical wirs of equal length tied to its ends One wire is mode of steel and is of cross - section 0.1 sq cm and the other is of brass of cross -section 0.2 sq cm Find the postion along the rod at which a wight may be hung to produce (i) equal stress in both wirs (ii) equal strain in both wires (Y for brass $= 10 \times 10^{10} Nm^{-2}$ and Y for steel $= 20 \times 10^{10} Nm^{-2}$)

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96. A thin rod of negligible mass and area of cross-section $4 \times 10^{-6} m^2$, suspended vertically from one end has a length of $0.5m$ at $10^\circ C$. The rod is cooled art $0^\circ C$, but prevented from contracting by attaching a mass at the loose end. Find

(i) This mass and

(ii) The energy stored in the rod.

Given for this rod, $Y = 10^{11} Nm^{-2}$, coefficient of linear expansion $= 10^{-5} K^{-1}$ and $g = 10ms^{-2}$.

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97. A stone of 0.5 kg mass is attached to one end of a 0.8 m long aluminium wire of 0.7 mm diameter and suspended vertically . The stone is now rotated in a horizontal plane at a rate such that the wire makes an angle of 85° with the vertical . find the

increase in the length of the wire . The Young's modulus of aluminium = $7 \times 10^{10} Nm^{-2}$, $\sin 85^\circ = 0.9962$, $\cos 85^\circ = 0.0872$

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98. A steel wire of length 4.87 mm and cross-section $3.0 \times 10^{-5} m^2$ stretches by the same amout as a copper wire of length 3.5 m and cross -section $4.0 \times 10^{-5} m^2$ under a given load . White is the ratio of the Young's modulus of steel so that of copper ?

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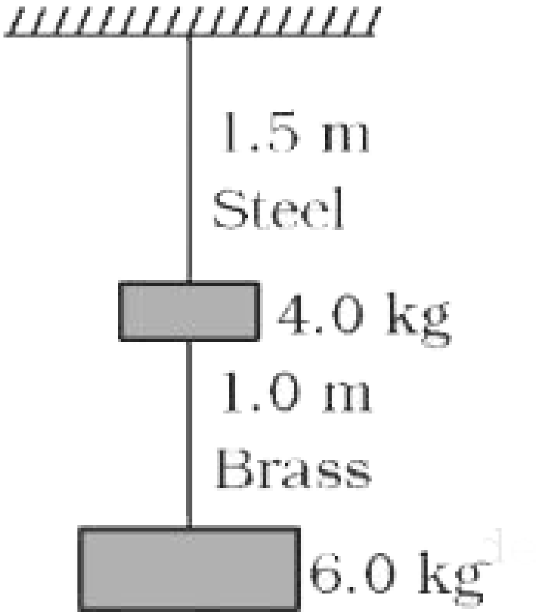
99. Two wires of diameter 0.25 cm, one made of steel and the other made of brass are loaded as shown in figure. The unloaded

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 .Young's modulus of steel is 2.0×10^{11} Pa and that of brass is 9.1×10^{11} Pa.



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100. The edges of an aluminum cube are $10 cm$ long. One face of the cube is firmly fixed to a vertical wall. A mass of $100 kg$ is then attached to the opposite face of the cube. Shear modulus of aluminum is $25 \times 10^9 Pa$, the vertical deflection in the face to which mass is attached is

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101. Four identical hollow cylindrical cloumns of steel support a big structure of mass 50.000 kg. the inner and outer radii of each column are 30 cm and 60 cm respectively. Assume the load distribution to be uniform , calculate the compressional strain of each column. the Young's modulus of steel is $2.0 \times 10^{11} Pa$.

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102. A piece of copper having a rectangular cross section of $15.2 \times 19.1mm$ is pulled in tension with 45,500N, force producing only elastic deformation. Calculate the resulting strain. Shear modulus of elasticity of copper is $42 \times 10^9 Nm^{-2}$.

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103. A steel cable with a radius of 1.5 cm support a chairlift at a ski area.if the maximum stress is not to exceed $10^8 Nm^{-2}$, what is the maximum load the cable can support?

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104. A rigid bar of mass 15 kg is supported symmetrically by three wires each 2 m long. Those at each end are of copper and middle one is of iron. Determine the ratio of their diameters if each is to have the same tension. Young's modulus of elasticity for copper and steel are $110 \times 10^{9} Nm^{-2}$ and $190 \times 10^{9} Nm^{-2}$ respectively.

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105. A 14.5 kg mass, fastened to the end of a steel wire of unstretched length 1m, is whirled in a vertical circle with an angular velocity of $2rev. / s$ at the bottom of the circle. The cross-sectional area of the wire is $0.065cm^{2}$. Calculate the elongaton of the wire when the mass is at the lowest point of its path $Y_{steel} = 2 \times 10^{11} Nm^{-2}$.

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106. Compute the bulk modulus of water from the following data : initial volume = 100.0 litre, pressure increase = 100.0 atmosphere. Final volume - 100.5 litre . (1 atmosphere = $1.013 \times 10^5 Pa$). Compare the bulk modulus of water that of air (at constant temperature). explain in simple terms why the ratio is so large.

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107. What is the density of ocean water at a depth, where the pressure is 80.0 atm, given that its density at the surface is $1.03 \times 10^3 kgm^{-3}$? Compressibilty of water $= 45.8 \times 10^{-11} Pa^{-1}$. Given 1 atm. =$1.013 \times 10^5 Pa$.

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

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109. The volume change of a solid copper cube 20 cm on an edge, when subjected to a pressure of 14 MPa is

(Bulk modulus of copper 140 GPa)

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110. How much should the pressure on a litre of water be changed to compress it by 0.10%? Bulk modulus of elasticity of water = $2.2 \times 10^9 Nm^{-2}$.

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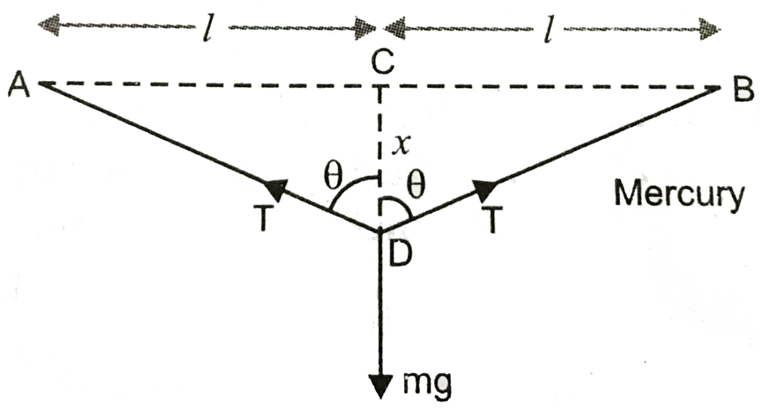
111. A mild steel wire of length 1.0 m and cross-sectional are $0.5 \times 10^{-20} cm^2$ is streached, well within its elastic limit, horizontally between two pillars. A mass of 100 g is suspended from the mid point of the wire, calculate the depression at the mid point.

$g = 10 ms^{-2}, Y = 2 \times 10^{11} Nm^{-2}$.



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112. Two strips of metal are riveted together at their ends by four rivets, each of diameter 6.0 mm. What is the maximum tension that can be exerted by the riveted strip if the shearing stress on the rivet is not to exceed $2.3 \times 10^9 Pa$? Assume that each rivet is to carry one quarter of the load.

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113. The marina Trench is located in the pacific ocean, and at one place it is nearly eleven km beneath the surface of water. The water pressure at the bottom of the Trench is about $1.1 \times 10^8 Pa$. A steel ball of initial volume $0.32 m^3$ is dropped into the ocean and falls to the bottom of the Trench. what is the change in the volume of the ball when it reaches to the bottom? Bulk modulus for steel =$1.6 \times 10^{11} Nm^{-2}$.

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