PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

ELASTICITY

Example

1. Calculate the value of stress on a wire of steel having radius of 2 mm, when 10 kN of

force is applied on it.

A. $7.76 \times 10^8 Nm^{-2}$

B. $7.96 \times 10^8 Nm^{-2}$

C. $6.96 \times 10^8 Nm^{-2}$

D. $5.56 \times 10^8 Nm^{-2}$

Answer:

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2. Consider a rod stell having radius of 8 mm and the length of 2 m. If a force of 150 kN stretches it along its length, then calculate the stress and strain in the rod, if the elongation in length is 7.46 mm.

A. $7.46 \times 10^{8} N,^{-2}$ and 3.73×10^{-3}

B. $7.43 \times 10^{6} Nm^{-2}$ and 2.73×10^{-5}

C. $7.28 \times 10^{10} Nm^{-2}$ and 2.83×10^{-4}

D. None of the above

Answer:

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3. If the angle of shear is 30° for a cubical body and the change in length is 250 cm, then what must be the volume of this cubical body.

A. $81.295m^3$

B. $71.309m^3$

C. $91.106m^3$

D. $83.266m^3$

Answer:

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4. If a wire of length 4 m and cross-sectional area of 2 m^2 is stretched by a force of 3 kN, then determine the change in length due to this force, Given, Young's modulus of material of wire is $110 \times 10^9 Nm^{-2}$

A. $60.2 \times 10^{-3} mm$

B. $54.5 \times 10^{-6} mm$

C. $56.4 \times 10^{-3} mm$

D. $62.5 \times 10^{-3} mm$

Answer:

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5. Find the change in volume of a lead block of volume 2 m^3 Which is subjected to pressure of 20 atm. (Take, 1 atm $= 1.013 \times 10^5 N/m^2$ and bulk modulus $= 8 \times 10^9 N/m^2$)

A. $5.065 \times 10^{-4} m^3$

B. $2.326 \times 10^{-5} m^3$

C. $8.325 \times 10^{-6} m^3$

D. $4.203 \times 10^{-3} m^3$

Answer:

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6. What will be the bulk modulus, if the compressibility of water is 4×10^{-5} per unit atmospheric pressure?

A. $2.533 \times 10^9 Nm^{-2}$

B. $3.354 \times 10^9 Nm^{-2}$

C. $2.233 \times 10^9 Nm^{-2}$

D. $4.562 \times 10^9 Nm^{-2}$

Answer:

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7. The ratio of shearing stress to a corresponding shearing strain is called the ... A...of the material. It is also called the ....B...

A. shear modulus, modulus of elasticisy

B. Young's modulus, modulus of elasticity

C. shear modulus, modulus of rigidity

D. shear, modulus, modulus of plasticity

Answer:

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8. A square steel plate has area $1m^2$ and thickness 5 cm. The lower surface is fixed. A tangential force applied to top surface

displace it through 0.005 cm. Find the modulus of rigidity of steel, if shearing stress of modulus of rigidity of steel. If shearing stress of $4.2 \times 10^3 N/m^2$ is being applied.

A. $5.2 \times 10^6 Nm^{-2}$

B. $4.2 \times 10^6 Nm^{-2}$

C. $3.6 \times 10^4 Nm^{-2}$

D. $4.6 \times 10^4 Nm^{-2}$

Answer:

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9. A steel wire having cross-sectional area 2 mm^(2)` is stretched by 20 N. Find the lateral strain produced in the wire

A. 0.1955×10^{-4}

B. 0.391×10^{-4}

C. 0.1455×10^{-4}

D. None of the above

Answer:

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10. A uniform rod of length (L) and area of cross-section (A) is subjected to tensil load (F). If σ be the Poisson's ratio and Y be the Young's modulus of the material of the rod, then find the volumetric strain produced in the rod.

A. $\frac{5}{AY}(L + 2\sigma)$

B. $\frac{F}{AY}(L - 2\sigma)$

C. zero

D. None of these

Answer:

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11. The stress-strain graphs for materials A and B are shown in Fig (i) and fig (ii)

The graphs are drawn to the same scale.

i. Which of the materials has greater Young's modulus?

ii. Which of the two is the stronger material?

A. A,B

B. B,A

C. A,A

D. B,C

Answer:

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12. Calculate the work done in stretching a steel wire of Young's modulus of $2 \times 10^{11} Nm^{-2}$, mass of 40 kg, length of 200

cm and area of cross-section is `0.06 cm^(2)~ slowly applied without the elastic limit being reached.

A. 2.502 j

B. 1.103 j

C. 0.9 j

D. 0.128 j

Answer:

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13. A steel wire 4.0 m in length is stretched through 2.0 mm. The cross-sectional area of the wire is $2.0mm^2$. If young's modulus of steel is $2.0 \times 10^{11} Nm^{-2}$, then find the energy density of wire.

A. $2.5 \times 10^4 Jm^{-3}$

B. $0.5 \times 10^4 Jm^{-3}$

C. $1.6 \times 10^4 Jm^{-3}$

D. $3.6 \times 10^4 Jm^{-3}$

Answer:

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Exercise 1

1. The following four wires of length L and radius r are made of the same material. Which of these will have the largest extension, when the same tension is applied?

A. L = 100 cm, r = 0.2 cm

B. L = 200 cm, r = 0.4 cm

C. L = 300 cm, r = 0.6 cm

D. L = 400 cm, r = 0.8 cm

Answer: a

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2. 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: b

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3. To break a wire of 1 m length, minimum 40 kg weight is required. Then, the wire of the same material of double radius and 6 m length will require breaking weight.

A. 80 kg weight

B. 240 kg weight

C. 200 kg weight

D. 160 kg weight

Answer: c

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4. 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: a

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5. A force of $6 \times 10^6 Nm^{-2}$ required for breaking a material. The denisty ρ of the material is $3 \times 10^3 kgm^{-3}$. If the wire is to break under its own weight, then the length of the wire made of that material should be (Given, g = 10 ms^{-2})

A. 20 m

B. 200 m

C. 100 m

D. 2000 m

Answer: b

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6. The length of the wire is increased by 2% by applying a load of 2.5 kg-wt. what is the linear strain produced in the wire?

A. 0.1

B. 0.01

C. 0.2

D. 0.02

Answer: d

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7. 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. 2F

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

D. 4F

Answer: d

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8. A copper wire and a steel wire of the same diameter and length are joined end and a force is applied which stretches their combined length by 1 cm. Then, the two wires will have

A. the same stress and strain

B. the same stress but different strains

C. the same strain but different stresses

D. different stresses and strains

Answer: b

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9. 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 m

D. 30.9 m

Answer: c

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10. The breaking stress of a wire depends on

A. material of wire

B. length of wire

C. radius of wire

D. shape of cross-section

Answer: a

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11. Two wires of equal cross-section but one made of steel and the other of copper are joined end to end. When the cobination is kept under tension, the elongations in the two

wires are found to be equal elongations in the two wire are found to be equal. What is the ratio of the lengths of the two wires?

(Given, Young's modulus of steel $= 2 \times 10^{11} Nm^{-2}$ and young's modulus of copper $= 1.1 \times 10^{11} Nm^{-2}$)

A. $2:11$

B. $11:2$

C. $20:11$

D. $11:20$

Answer: c

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12. The Young's modulus of brass and steel are respectively $1.0 \times 10^{11} Nm^{-2}$ and $2.0 \times 10^{11} Nm^{-2}$. A brass wire and a steel wire of the same length are extended by 1 mm each under the same force. If radii of bras and steel wires are R_B and R_s respectively, then

A. $R_s = \sqrt{2} R_B$

B. $R_s = \frac{R_B}{\sqrt{2}}$

C. $R_s = 4R_B$

D. $R_s = \frac{R_B}{2}$

Answer: b

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13. A tangential force of 0.25 N is applied to a 5 cm cube to displace its upper surface with respect to the bottom surface. The shearing stress is

A. $10Nm^{-2}$

B. $50Nm^{-2}$

C. $75Nm^{-2}$

D. $100Nm^{-2}$

Answer: d

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14. The adjacent graph shows the extension (ΔI) of a wire of lenth 1 m suspended from the top of a root at one end with a load w connected to the other end. It the cross-

sectional area of the wire is $10^{-6}m^2$, then calculate the Young's modulus of material of the wire

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

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

C. $3 \times 10^{-12} Nm^{-2}$

D. $2 \times 10^{-13} Nm^{-2}$

Answer: a

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15. A body subjected to strain a number of times does not obey Hook's law due to

A. Yield point

B. permanent state

C. elastic fatigue

D. breaking stress

Answer: a

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16. Which of the following statements is wrong?

A. Young's modulus for a perficetly rigid body is zero

B. Bulk modulus is relevant for solids, liquids and gases

C. Rubber is less elastic then steel

D. Young's modulus and shear modulus are relevant for solids

Answer: a

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17. A stress of $3.18 \times 10^8 Nm^{-2}$ is applied to a steel rod of length 1m along its length, its Young's modulus is $2 \times 10^{11} Nm^{-2}$. Then the elongation produced in the rod (in mm) is

A. 3.18

B. 6.36

C. 5.18

D. 1.59

Answer: d

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18. 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: b

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19. 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: c

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20. A particular force (F) applied on a wire increases its length by 2×10^{-3} m. To

increases the wire's length by 4×10^{-3} m, the applied force will be

A. 4F

B. 3F

C. 2F

D. F

Answer: c

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21. 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. $9.8 \times 10^{10} Nm^{-2}$

B. $10.2 \times 10^{10} Nm^{-2}$

C. $0.98 \times 10^{10} Nm^{-2}$

D. $8.4 \times 10^{10} Nm^{-2}$

Answer: a

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22. A copper bar of length L and area of cross-section A is placed in a chamber at atmospheric pressure. If the chamber is evacuated, then the percentage change in its volume will be (Given, compressibility of copper is $8 \times 10^{12} m^2 N^{-1}$ and 1 atm $= 10^5 Nm^{-2}$)

A. 8×10^{-7}

B. 8×10^{-5}

C. 1.25×10^{-4}

D. 1.25×10^{-5}

Answer: b

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23. A ball falling in a lake of depth $200m$ shows a decrease of 0.1% in its volume at the bottom. The bulk modulus of elasticity of the material of the ball is (take $g = 10ms^{-2}$)

A. $10^9 Nm^{-2}$

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

C. $3 \times 10^9 Nm^{-2}$

D. $4 \times 10^9 Nm^{-2}$

Answer: b

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24. When a rubber cord is stretched, the change in volume with respect to change in its

linear dimensions is negligible. The Poisson's ratio for rubber is

A. 1

B. 0.25

C. 0.5

D. 0.75

Answer: c

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25. A uniform cube is subjected to volume compression. If each side is decreased by 1 % then bulk strain is

A. 0.01

B. 0.02

C. 0.03

D. 0.06

Answer: c

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26. For most materials the Youngs modulus is n times the modulus of rigidity, where n is

A. 2

B. 3

C. 4

D. 6

Answer: b

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27. In the three states of matter, the elastic coefficient can be

A. young's modulus

B. Coefficient of volume elasticity

C. modulus of rigidity

D. Poisson's ratio

Answer: b

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28. For a wire of length L, maximum change in length under stress condition is 2 mm. What is the change in length under same conditions when length of wire is halved?

A. 1 mm

B. 2 mm

C. 4 mm

D. 8 mm

Answer: a

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29. To what depth below the surface of sea should a rubber ball be taken as to decreases its volume by 0.1% (Given denisty of sea water = 1000 kg m^{-3}, Bulk modulus of rubber $= 9 \times 10^8 Nm^{-2}$, acceleration due to gravity $= 10ms^{-2}$)

A. 9m

B. 18 m

C. 180 m

D. 90 m

Answer: d

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30. One end of a unifrom wire of length L and weigth W is attached rigidly to a point in the roof and a weight W_1 is suspended from its lower end. If S is the area of cross-section of the wire then the stress in the wire at a height $\frac{3L}{4}$ from its lower end is

A. $\frac{(W_1 + W)}{S}$

B. $\frac{W_1}{S}$

C. $\frac{\left(W_1 + \frac{3W}{4}\right)}{S}$

D. $\frac{\left(W_1 + \frac{W}{4}\right)}{S}$

Answer: c

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31. A 5 aluminium wire $\left(Y = 7 \times 10^{10} Nm^{-2}\right)$ of diameter 3 mm supports a 40 kg mass. In

order to have the same elongation in a copper wire $\left(Y = 12 \times 10^{10} Nm^{-2}\right)$ of the same length under the same weight, the diameter (in mm) should be

A. 1.75

B. 2.0

C. 2.3

D. 5.0

Answer: c

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32. Four identical rods are stretched by same force. Maximum extension is produced in

A. L = 10 cm, D = 1 mm

B. L = 100 cm, D = 2 mm

C. L = 200 cm, D = 3 mm

D. L = 300 cm, D = 4 mm

Answer: b

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33. Compressibility of water is $5 \times 10^{-10} m^2 N^{-1}$. The change in volume of 100 mL water subjected to 15×10^6 Pa pressure will be

A. increases by 0.75 mL

B. decreases by 1.50 mL

C. increases by 1.50 mL

D. decreases by 0.74 mL

Answer: d

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34. 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

B. 2l

C. zero

D. l/2

Answer: d

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35. An iron bar of length I and having a cross-section area A is heated from 0° to $100^\circ C$. If this bar is so held that it is not permitted to expand or bend, the force that is developed, is

A. inversely proportional to the cross-sectional area of the bar

B. independent of the length of the bar

C. inversely porportional to the length of the bar

D. directly proportional to the length of the bar

Answer: b

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36. The relation between Y (Young's modulus), K (bulk modulus) and η (shear modulus) is

A. $\frac{9}{Y} = \frac{1}{B} + \frac{3}{\eta}$

B. $\frac{1}{Y} = \frac{1}{3\eta} + \frac{1}{9B}$

C. $\frac{9}{Y} = \frac{1}{\eta} + \frac{3}{B}$

D. $\frac{1}{\eta} = \frac{1}{B} + \frac{1}{Y}$

Answer: b

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37. When the tension in a metal wire is T_1, its length is I_1. When the tension is T_2, its length is I_2. The natural length of wire is

A. $\frac{T_2}{T_1}(I_1 + I_2)$

B. $T_1 I_1 + T_2 I_2$

C. $\frac{I_1 T_2 - I_2 T_1}{T_2 - T_1}$

D. $\frac{I_1 T_2 + I_2 T_1}{T_2 + T_1}$

Answer: c

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38. A rubber rope of length 8 m is hung from the ceiling of a room. What is the increases in length of the rope due to its own weight?

(Given, Young's modulus of elasticity of rubber $= 5 \times 10^6 Nm^{-2}$ and density of rubber $= 1.5 \times 10^6 kgm^{-3}$ and $g = 10ms^{-2}$)

A. 1.5 mm

B. 6 mm

C. 24 mm

D. 96 mm

Answer: d

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39. A and B are two wire. The radius of A is twice that of B. If they are stretched by the same load, then the stress on B is

A. equal to that of A

B. two times that of A

C. four times that of A

D. half that of A

Answer: c

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40. Two wires, one made of copper and other of steel are joined end the end (as shown in figure). The area of cross-section of copper wire is twice that of steel wire.

They are placed under compressive force fo magnitudes F. The ratio for their lengths such that change in lengths of both wires are same is (Given, $Y_s = 2 \times 10^{11} Nm^{-2}$ and $Y_C = 1.1 \times 10^{11} Nm^{-2}$)

A. 2.1

B. 1.1

C. 1.2

D. 2

Answer: b

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41. If the Young's modulus of the material is 3 times its modulus of rigidity then its bulk modulus of elasticity will be

A. zero

B. infinity

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

D. $3 \times 10^{10} Nm^{-2}$

Answer: b

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42. If the compressibility of water is σ per unit atmospheric pressure, then the decrease in

volume V due to atmospheric pressure P will be

A. $\sigma p / V$

B. $\sigma p V$

C. $\sigma / p V$

D. $\sigma V / P$

Answer: b

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43. A cube is compressed at $0^\circ C$ equally from all sides by an external pressure p. By what amount should be temperature be raised to bring it back to the size it had before the external pressure was applied? Given, B is bulk modulus of elasticity of the material of the cube and α is the coefficient of linear expansion.

A. $\frac{p}{B\alpha}$

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

C. $\frac{3\pi\alpha}{P}$

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

Answer: b

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44. 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. $0.4cm^3$

B. $0.025m^3$

C. $4 \times 10^5 cm^3$

D. $0.04cm^3$

Answer: a

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45. A wire is suspended by one end. At the other end a weight equivalent to 20 N force is applied. If the increase in length is 1.0 mm, the increase in energy of the wire will be

A. 0.01 J

B. 0.02 J

C. 0.04 J

D. 1.00 J

Answer: a

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46. 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

A. $\frac{1}{2}Fx$

B. $\frac{1}{2}Yx$

C. $\frac{1}{2}Fx^2$

D. None of these

Answer: a

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47. A 1 m long steel wire of cross-sectional area $1mm^2$ is extended 1 mm. If $Y = 2 \times 10^{11} Nm^{-2}$, then the work done is

A. 0.1 J

B. 0.2 J

C. 0.3 J

D. 0.4 J

Answer: a

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48. Two wire of same material and same diameter have lengths in the ratio 2 : 5. They are stretched by same force. The ratio of work done in stretching them is

A. $5:2$

B. $2:5$

C. $1:3$

D. $3:1$

Answer: b

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

A. $0.5YX^2$

B. $0.5Y^2X$

C. $2YX^2$

D. YX^2

Answer: a

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50. 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: d

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51. A body of mass m = 10 kg is attached to a wire of length 0.3m. The maximum angular velocity with which it can be rotated in a horizontal circle is (Given, breaking stress of

wire $= 4.8 \times 10^7 Nm^{-2}$ and area of cross-section of a wire $= 10^{-2} m^2$)

A. $4 rads^{-1}$

B. $8 rads^{-1}$

C. $1 rads^{-1}$

D. 2 rad

Answer: a

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52. Two wires of equal lengths and cross-sections are suspended as shown in the figure. Their Young's moduli are y_1 and y_2 respectively. What is their equivalent Young's modulus?

A. $Y_1 + Y_2$

B. $\frac{Y_1 + _2}{2}$

C. $\sqrt{y_1 y_2}$

D. $\frac{Y_1 Y_2}{Y_1 + Y_2}$

Answer: b

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53. Two cylinders of same material and of same lengths are joined to end as shown in the figure. The upper end of A is rigidly fixed. Their radii are in ratio of 1 : 2. If the lower end of B is twisted by an angle θ, then the angle of twist of cylinder A is

A. $\frac{15}{16}\theta$

B. $\frac{16}{15}\theta$

C. $\frac{16}{17}\theta$

D. $\frac{17}{16}\theta$

Answer: c

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54. Wires A and B are made from the same material. A has twice the diameter and three times the length of B. If the elastic limits are

not reached, when each is stretched by the same tension, the ratio of energy stored in A to that in B is.

A. $2:3$

B. $3:4$

C. $3:2$

D. $6:1$

Answer: b

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55. Two wires of the same material and length but diameters in the ratio 1 : 2 are stretched by the same force. The potential energy per unit volume for the two wire when stretched will be in the ratio

A. $16:1$

B. $4:1$

C. $2:1$

D. $1:1$

Answer: a

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56. A metal rod of Young's modulus $2 \times 10^{10} Nm^{-2}$ undergoes elastic strain of 0.06%. The energy per unit volume stored (in Jm^{-3}) is

A. 3600

B. 7200

C. 10800

D. 14400

Answer: a

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57. A 45 kg boy whose leg bones are $5cm^2$ in area and 50 cm long falls through a height of 2m without breaking his leg bones. If the bones can stand a stress of $0.9 \times 10^8 Nm^{-2}$, then young's modulus for the material of the bone 18

A. $2.25 \times 10^7 Nm^{-2}$

B. $2.25 \times 10^9 Nm^{-2}$

C. $8.5 \times 10^7 Nm^{-2}$

D. $8.85 \times 10^9 Nm^{-2}$

Answer: c

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58. Two wires A and B of same length and of the same material have the respective radii r_1 and r_2. Their one end is fixed with a rigid support, and at other end equal twisting

couple is applied. Then the ratio of the angle of twist at the end of A and the angle of twist at the end of B will be

A. $\frac{r_2^4}{r_1^4}$

B. $\frac{r_1^4}{r_2^4}$

C. $\frac{r_2^2}{r_1^2}$

D. $\frac{R_1^2}{r_2^2}$

Answer: a

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59. If the work done in stretching a wire by 1 mm is 2J, then work necessary for stretching another wire of same material but with double radius of corss-section and half the length by 1 mm is

A. $\frac{1}{4}J$

B. 4J

C. 8 J

D. 16 J

Answer: d

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60. In above question, the work done in the two wire is

A. 0.5 J, 0.03 J

B. 0.25 J, 0 J

C. 0.03 J, 0.25 J

D. 0J, 0j

Answer: a

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61. A material has Poisson's ratio 0.50. If a uniform rod of it suffers a longitudinal strain of 2×10^{-3}, then the percentage change in volume is

A. 0.6

B. 0.4

C. 0.2

D. zero

Answer: d

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62. A rigid bar of mass M is supported symmetrically by three wires each of length I. Those at each end are of copper and the middle one is of iron. What is the ratio of their diameters $\frac{D_{\text{copper}}}{D_{\text{iron}}}$ if each wire is to have ratio same tension?

A. $\frac{Y_{\text{copper}}}{Y_{\text{iron}}}$

B. $\sqrt{\frac{Y_{\text{iron}}}{Y_{\text{copper}}}}$

C. $\frac{Y_{\text{iron}}^2}{Y_{\text{copper}}^2}$

D. $\frac{Y_{\text{iron}}}{Y_{\text{copper}}}$

Answer: b

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63. When a wire is subjected to a force along its length, its length increases by 0.4% andits radius decreaes by 0.2%. Then, the poisson's ratio of the material of the wire is

A. 0.8

B. 0.5

C. 0.2

D. 0.1

Answer: b

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64. Two rods of different materials with coefficients linear thermal expansion α_1, α_2, and Young's moduli Y_1 and Y_2, respectively are

fixed between two rigid walls. They are heated to have the same increase in temperature . If the rods do not bend and if $\alpha_1 : \alpha_2 = 2:3$, then thermal stresses developed in the two rods will be equal when $Y_1 : Y_2$ ie equal to

A. $2:3$

B. $2:5$

C. $3:2$

D. $5:2$

Answer: c

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65. 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: c

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66. The poisson's ratio cannot have the value

A. 0.7

B. 0.2

C. 0.1

D. 0.3

Answer: a

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Exercise 2

1. In the given figure, if the diamensions of the wires are the same and materials are different, Young's modulus is more for

A. A

B. B

C. Both

D. None of these

Answer: a

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2. An elastic material with Young's modulus Y is subjected to a tensile stress S, elastic energy stroed per unit volume of the material is

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

B. $\frac{s^2}{y}$

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

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

Answer: c

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3. The bulk modulus of water is $2.1 \times 10^9 Nm^{-2}$. The pressure required ot increase the density of water by 0.1% is

A. $2.1 \times 10^3 Nm^{-2}$

B. $2.1 \times 10^6 Nm^{-2}$

C. $2.1 \times 10^5 Nm^{-2}$

D. $2.1 \times 10^7 Nm^{-2}$

Answer: b

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4. 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. $96 \times 10^{-3} m$

B. $19.2 \times 10^{-5} m$

C. 9.4 cm

D. 9.6 m

Answer: c

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5. A brass rod of length 2 m and corss-sectinal area $2.0cm^2$ is attached to end to a steel rod of length L and corss-sectinal area $1.0cm^2$. The compound rod is subjected to equal and opposite pulls of magnitude $5 \times 10^4 N$ at its

ends.

If the elongations of the two rods are equal, then the length of the steel rod L is $(Y_{\text{brass}} = 1.0 \times 10^{11} Nm^{-2}$ and $y_{\text{steel}} = 2.0 \times 10^{11} Nm^{-2})$

A. 1.5 m

B. 1.8 m

C. 1 m

D. 2 m

Answer: d

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6. An elevator cable is to have a maximum stress of $7 \times 10^7 Nm^{-2}$ to allow for appropriate safety factors. Its maximum upward acceleration is $1.5ms^{-2}$. If the cable has to support the total weight of 2000 kg of a loaded elevator, the area cross-section of the cable should be

A. $3.22cm^2$

B. $2.38cm^2$

C. $0.32cm^2$

D. $8.23cm^2$

Answer: a

Watch Video Solution

7. A uniform steel bar of cross-sectional area A and length L is suspended, so that it hangs vertically. The stress at the middle point of the bar is (ρ is the density of stell)

A. $\frac{L}{2A}\rho g$

B. $\frac{L\rho g}{2}$

C. $\frac{LA}{\rho g}$

D. $L\rho g$

Answer: b

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8. Match the following column I and column II.

Column I	Column II
A. Stress $\times$ strain	1. j
B. YA/I	2. N/m
C. Yl^3	3. J/m^3
D. Fl/AY	4. m

A. 3,2,1,4

B. 2,1,4,3

C. 3,4,1,2

D. 1,2,4,3

Answer: a

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9. A solid block of silver with density $10.5 \times 10^3 kgm^{-3}$ is subjected to an external pressure of $10^7 Nm^{-2}$. If the bulk modulus of silver is $17 \times 10^{10} Nm^{-2}$. Then the change in density of silver (in kgm^{-3}) is

A. 0.61

B. 1.7

C. 6.1

D. 17×10^3

Answer: a

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10. A stress of $1kg/mm^2$ is applied on a wire. If the modulus of elasticity of the wire is $10^{10}\text{dyne}/cm^2$, then the percentage increase in the length of the wire will be

A. 0.0098%

B. 0.0098

C. 0.098

D. 0.98

Answer: b

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11. A rectangular bar 2 cm in breadth, 1cm in depth and 100 cm in length is supported at its ends and a load of 2kg is applied at its middle. If young's modulus of the material of the bar is 20×10^{11} cyn cm^{-2}, the depression in the bar is

A. 0.2450 cm

B. 0.3675

C. 0.1225 cm

D. 0.98

Answer: A

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12. A steel wire of length 20 cm and uniform cross-sectional $1mm^2$ is tied rigidly at both the ends. The temperature of the wire is

altered from $40^\circ C$ to $20^\circ C$. Coefficient of linear expansion of steel is $\alpha = 1.1 \times 10^{-5}.^\circ C^{-1}$ and Y for steel is $2.0 \times 10^{11} Nm^2$, the tension in the wire is

A. $2.2 \times 10^8 N$

B. 16 N

C. 8 N

D. 44N

Answer: d

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13. A copper wire $\left(Y = 10^{11} Nm^{-2}\right)$ of length 8 m and a steel wire $\left(Y = 2 \times 10^{11} Nm^{-2}\right)$ of length 4 m, each of $0.5cm^2$ cross-section are fastened end to end and stretched with a tension of 500 N. choose the correct option.

A. Elongation in copper wire is 0.8 mm

B. Elongation in steel is $\frac{1}{4}$ th the elongation in copper wire

C. Total elongation is 1.0 mm

D. All of the above

Answer: d

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14. A stress of $10^6 Nm^{-2}$ is required for breaking a material. If the density of the material is $3 \times 10^3 kgm^{-3}$., then what should be the length of the wire made of this material, so that it breakes under its own weight?

A. 10 m

B. 33.3 m

C. 5 m

D. 66.6 m

Answer: b

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15. The temperature of a wire length 1 m and area of cross-section $1cm^2$ is increased from $0^\circ C$ to $100^\circ C$. If the rod is not allowed to

increase in length, then the force, required will be $\left(\alpha = 10^{-5}.^{\circ} C^{-1} \text{ and } Y = 10^{11} Nm^{-2}\right)$

A. $10^3 N$

B. $10^4 N$

C. $10^5 N$

D. $10^9 N$

Answer: b

Watch Video Solution

16. Two wires of copper having the length in the ratio $4:1$ and their radii ratio as $1:4$ are stretched by the same force. The ratio of longitudinal strain in the two will be

A. $1:16$

B. $16:1$

C. $1:64$

D. $64:1$

Answer: b

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Watch Video Solution

17. A steel wire of length 20 cm and uniform cross-sectional area of $1mm^2$ is tied rigidly at both the ends at $45^\circ C$. If the temperature of the wire is decreased to $20^\circ C$, then the change in the tension of the wire will be

[Y for steel $= 2 \times 10^{11Nm^{-2}}$, the coefficient of linear expansion for steel $= 1.1 \times 10^{-5}/.^\circ \mathbb{C}^{-1}$]

A. 22 N

B. 32 N

C. 55 N

D. 60 N

Answer: c

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18. A force of 20 N is applied at one end of a wire of length 2 m having area of cross-section $10^{-2}cm^2$. The other end of the wire is rigidly fixed. If coefficient of linear ezpanison of the wire $\alpha = 8 \times 10^{-6}.^{\circ} C^{-1}$ and Young's

modulus $Y = 22 \times 10^{11} Nm^{-2}$ and its temperature is increased by $5^{\circ}C$, then the increase in the tension of the wire will be

A. 4.2 N

B. 4.4 N

C. 2.4 N

D. 8.8 N

Answer: d

Watch Video Solution

19. Two wires of same diameter of the same material having the length l and $2l$ If the force F is applied on each, the ratio of the work done in two wires will be

A. $1:2$

B. $1:4$

C. $2:1$

D. $1:1$

Answer: a

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20. A 5 metre long wire is fixed to the ceiling. A weight of 10 kg is hung at the lower end at is 1 metre above the floor. The wire was alongated by 1 mm. The energy stored in the wire due to stretching is

A. 0.01 J

B. 0.05 J

C. 0,02 J

D. 0,04 J

Answer: b

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21. The stress versus strain graphs for wires of two materials A and B are as shown in the figure. If Y_A and Y_B are the young's modulii of the materials, then

A. $Y_B = 2Y_A$

B. $Y_A = Y_B$

C. $Y_B - 3Y_A$

D. $Y_A = 3Y_B$

Answer: d

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22. The load versus elongation graph for four wire of the same material is shown in the figure. The thickest wire is represented by the line

A. OD

B. OC

C. OB

D. OA

Answer: a

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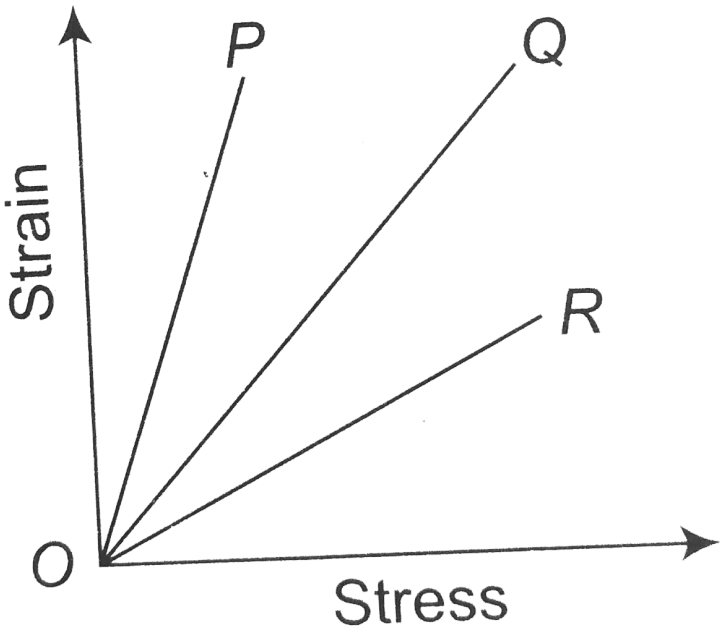

23.

The strain stress curves of three wires of different materials are shown in the figure. P, Q and R are the elastic limits of the wires. The figure shown that

A. elasticity of wire P is maximum

B. elasticity of wire Q is maximum

C. tensile strength of wire R is maximum

D. None of the above

Answer: c

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24. The density of a metal at normal pressure is ρ. Its density when it is subjected to an excess pressure p is ρ'. If B is the bluk

modulus of the metal, then find the ratio ρ' / ρ.

A. $\frac{1}{1 - \frac{p}{B}}$

B. $1 + \frac{B}{P}$

C. $\frac{1}{1 - \frac{B}{P}}$

D. $1 + \frac{P}{B}$

Answer: a

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25. The poisson's ratio of a material is 0.1. If the longitudinal strain of a rod of this material is 10^{-3}, then the percentage change in the volume of the rod will be

A. 0.008%

B. 0.08%

C. 0.8%

D. 8%

Answer: b

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Watch video solution

26. The poisson's ratio of a material is 0.4. if a force is applied to a wire of this material, there is a decrease of cross-sectional are a by 2%. The percentage increases in its length is

A. 0.03

B. 0.025

C. 0.01

D. 0.005

Answer: b

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27. The symbols, Y,K and η represent the Young's modulus, bulk modulus and rigidty modulus of the material of a body. If $\eta = 3K$, then

A. Y = 2.5 K

B. Y = 3.5 K

C. Y = 4.5 K

D. $Y = \frac{9}{5}K$

Answer: c

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28. 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. Ba/mg

B. Ba/3mg

C. mg/3Ba

D. mg/Ba

Answer: c

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29. The bulk modulus of a metal is $8 \times 10^9 Nm^{-2}$ and its density is 11 g cm^{-2}. The density of this metal under a pressure of 20000 N cm^{-2} will be (in g cm^{-3})

A. $\frac{440}{39}$

B. $\frac{431}{39}$

C. $\frac{451}{39}$

D. $\frac{40}{39}$

Answer: a

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30. When a force is applied on a wire of uniform cross-sectional are $3 \times 10^{-6} m^2$ and length 4 m, the increase in length is 1 mm. Energy stored in it will be (Given, $Y = 2 \times 10^{11} Nm^{-2}$)

A. 6250 J

B. 0.177 J

C. 0.075 J

D. 0.150 J

Answer: c

Watch Video Solution

31. A wire of cross section A is stretched horizontally between two clamps located $2lm$ apart. A weight Wkg is suspended from the mid-point of the wire. If the mid-point sags vertically through a distance $x < l$, the strain produced is

A. x^2 / I^2

B. $2x^2 / I^2$

C. $x^2 / 2I^2$

D. $x / 2I$

Answer: c

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32. An elastic spring of unstretched length L and spring constant K is stretched by a small length x. It is further stretched by another

small length y. the work done in second stretcing is

A. $\frac{1}{2}ky^2$

B. $\frac{1}{2}K\left(x^2+y^2\right)$

C. $\frac{1}{2Ky(2x+y)}$

D. $\frac{1}{2}Ky(2x+y)$

Answer: d

Watch Video Solution

33. What is the increase in elastic potential energy when ghe stretching force in increased by 200 kN?

A. 238.5 J

B. 636.0 J

C. 115.5 J

D. 79.5 J

Answer: b

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34. The work done in increasing the length of a one metre long wire of cross-sectional area $1mm^2$ through 1 mm will be $\left(Y = 2 \times 10^{11} Nm^{-2}\right)$

A. 0.1 J

B. 5 J

C. 10 J

D. 250 J

Answer: a

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35. A load of 4.0 kg is suspended from a celling through a streel wire of length 2.0 m and radius 2.0 mm. It is found that the length of the wire increases by 0.031 mm as equilibrium is achieved. Taking $g = 3.1\pi ms^{-2}$ the Young's modulus of steel is

A. $2.010^{8} Nm^{-2}$

B. $2.0 \times 10^{9} Nm^{-2}$

C. $2.0 \times 10^{11} Nm^{-2}$

D. $2.0 \times 10^{13} Nm^{-2}$

Answer: c

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36. Identify the incorrect statement.

A. Youngs modulus and shear modulus are relevant only for solids

B. Bulk modulus is relevant for solids, liquids and gases

C. Alloys have larger values of Young's modulus than metals

D. Metals have larger values of Young's modulus than elastomers

Answer: c

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37. A 5m aluminium wire $(Y = 7 \times 10^{10} Nm^{-2})$ of diameter 3 mm supports a 40 kg mass. In order to have the

same elongation in a copper wire $(Y = 12 \times 10^{10} Nm^{-2})$ of the same length under the same weight, the diameter (in mm) should be

A. 1.75

B. 1.5

C. 2.3

D. 5

Answer: c

Watch Video Solution

38. A wire of length L and radius a rigidlyl fixed at one end. On stretching the other end of the wire with a force F, the increase in its length is L, if another wire of same material but of length 2 L and radius 2 a is stretched with a force 2 F, the increase in its length will be

A. I/4

B. I

C. I/2

D. 2I

Answer: b

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39. A load o f 1 kg weight is a attached to one end of a steel wire o f area of cross-section $3mm^2$ and Young's modulus $10^{11}N/m^2$. The other end is suspended vertically from a hook on a wall , then the load is pulled horizontally and released .When the load passes through its lowest position the fraction al change in lenght is $\left(Takeg = 10m/s^2\right)$

A. 0.3×10^{-4}

B. 0.3×10^{-3}

C. 0.3×10^{3}

D. 0.3×10^{4}

Answer: a

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40. If the volume of a block os aluminium is decreased be 1% the pressure (stress) on is

surface is increased by (Bulk moduals) of $Al = 7.5 \times 10^{10} Nm^{-2}$)

A. $7.5 \times 10^{10} Nm^{-2}$

B. $7.5 \times 10^{8} Nm^{-2}$

C. $7.5 \times 10^{6} Nm^{-2}$

D. $7.5 \times 10^{4} Nm^{-2}$

Answer: b

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41. 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. ΔI versus $\frac{1}{I}$

B. ΔI versus I^2

C. ΔI versus $\frac{1}{I^2}$

D. ΔI versus I

Answer: b

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42. 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 $g = 10ms^{-2}$)

A. 0,82%

B. 0.0091

C. 0.0136

D. 0.0124

Answer: c

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43. A $0.1kg$ mass is suspended from a wire of negligible mass. The length of the wire is 1m and its crosssectional are is $4.9 \times 10^{-7}m^2$. If the mass is pulled a little in the vertically downward direction and released, it performs simple harmonic motion of angular frequency

$140 rads^{-1}$. If the Young's modulus of the material of the wire is $n \times 10^9 Nm^{-2}$, the value of n is

A. 4

B. 2

C. 5

D. 5

Answer: a

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44. A rope 1 cm in diameter breaks, if the tension in it exceeds 500 N. The maximum tension that may be given to similar rope of diameter 3 cm is

A. 500 N

B. 3000 N

C. 4500 N

D. 2000 N

Answer: c

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45. A steal wire of cross-section area $3 \times 10^{-6} m^2$ can withstand a maximum strain of 10^{-3} .Young's modulus of steel is $2 \times 10^{11} Nm^{-2}$ .The maximum mass this wire can hold is

A. 40 kg

B. 60 kg

C. 80 kg

D. 100 kg

Answer: b

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46. The bulk modulus for an incompresssible liquid is

A. zero

B. unity

C. infinity

D. between 0 and 1

Answer: c

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47. Young's modulus of steel is Y and its rigidity modulus is η. A piece of steel of cross-sectional area A, is stretched into a wire of length L and area of cross-section $\frac{A}{4}$, In wire case

A. Y increases and η decreases

B. Y deceases and η increases

C. Both Y and η do not change

D. Both Y and η are increased

Answer: c

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48. A wire of length L and radius r is loaded with a weigth Mg. If y and σ denote the Youngs modulus and Poisson's ratio of the material of the wire respectively. Then the decreases in the radius of the wire is given by

A. $\Delta r = \frac{\sigma \pi r}{MgY}$

B. $r = \frac{Mgr}{\sigma \pi Y}$

C. $\Delta r = \frac{Mg\sigma}{\pi r Y}$

D. $\Delta r = \frac{MgY}{\pi r \sigma}$

Answer: c

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Mht Cet Corner

1. Two wires having same length and material are stretched by same force. Their diameters are in the ratio 1:3. The ratio of strain energy per unit volume for these two wires (smaller to larger diameter) when stretched is

A. $3:1$

B. $9:1$

C. $27:1$

D. $81:1$

Answer: b

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2. Let a steel bar of length l, breadth b and depth d be laoded at the centre by a load W. Then the sag of bending of beam is (Y = young's modulus of material of steel)

A. $\frac{Wl^2}{2bd^3Y}$

B. $\frac{Wl^3}{4bd^3Y}$

C. $\frac{Wl^2}{2bd^3Y}$

D. $\frac{Wl^3}{4bd^2Y}$

Answer: b

Watch Video Solution

3. A string of length L and force constant k is stretched to obtain extension l. It is further stretched to obtain extension l_1. The work done in second streching is

A. $\frac{1}{2}KI_1(2I + I_1)$

B. $\frac{1}{2}KI_1^2$

C. $\frac{1}{2}K\left(I^2 + I_1^2\right)$

D. $\frac{1}{2}\left(I_1^2 - I^2\right)$

Answer: d

Watch Video Solution

4. The load V elongation graph for four wires of the same materials shown in the figure. The thinnest wire is represented by the line

A. OC

B. OD

C. OA

D. OB

Answer: c

View Text Solution

5. Which of the following relation is true ?

A. $Y = 2\eta(1 - 2\sigma)$

B. $Y = 2\eta(1 + 2\sigma)$

C. $Y = 2\eta(1 - \sigma)$

D. $(1 + \sigma)2\eta = Y$

Answer: d

View Text Solution

6. Four wires of the same material are stretched by the same load. Which one of them will elongate most if their dimensions are as follows

A. L = 100 cm, r = 1 mm

B. L = 200 cm, r = 3 mm

C. L = 300 cm, r = 3 mm

D. L = 400 cm, r = 4 mm

Answer: a

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7. The length of an elastic string is a metre when the longitudinal tension is 4 N and b metre when the longitudinal tension is 5 N.

The length of the string in metre when the longitudinal tension is 9 N is

A. a - b

B. 5b - 4a

C. $2b - \frac{1}{4}a$

D. 4a - 3b

Answer: b

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8. A long elastic spring is stretched by $2cm$ and its potential energy is U. If the spring is stretched by $10cm$, the PE will be

A. U/5

B. U/25

C. 5 U

D. 25 U

Answer: d

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

A. becomes zero

B. remains constant

C. decreases

D. increases

Answer: b

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10. The increase in pressure required to decrease the 200 L volume of a liquid by 0.008 % in kPa is (Bulk modulus of the liquid = 2100 M Pa is)

A. 8.4

B. 84

C. 92.4

D. 168

Answer: b

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11. The force constant of a wire is k and that of another wire is . 2k When both the wires are stretched through same distance, then the work done

A. $W_2 = 2W_1^2$

B. $W_2 = 2W_1$

C. $W_2 = W_1$

D. $W_2 = 0.5W_1$

Answer: b

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12. There is no change in the volume of a wire due to change in its length on stretching. The poisson's ratio of the material of the wire is

A. 0.5

B. -0.50

C. 0.25

D. -0.25

Answer: b

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13. If a wire having initial diameter of 2 mm produced the longitudinal strain of 0.1%, then the final diameter of wire is $(\sigma = 0.5)$

A. 2.002 mm

B. 1.999 mm

C. 1.988 mm

D. 2.001 mm

Answer: b

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14. The energy stored per unit volume in copper wire, which produces longitudinal strain of 0.1% is

$\left(Y = 1.1 \times 10^{11} N/m^2\right)$

A. $11 \times 10^3 Jm^{-3}$

B. $5.5 \times 10^3 Jm^{-3}$

C. $5.5 \times 10^4 Jm^{-3}$

D. $11 \times 10^4 Jm^{-3}$

Answer: c

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15. Under elastic limit the stess is

A. indirectly proportional to strain

B. directly proportional to strain

C. independent to strain

D. None of the above

Answer: b

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16. A metal rod of length 'L', cross-sectional area 'A', Young's modulus 'Y' and coefficient of linear expansion $'\alpha'$ is heated to $'t'^{\circ} C$. The work that can be perfomred by the rod when heated is

A. $\frac{YA\alpha Lt^2}{2}$

B. $\frac{YA\alpha^2 Lt^2}{2}$

C. $\frac{YA\alpha^2 L^2 t^2}{2}$

D. $\frac{YA\alpha LT}{2}$

Answer: b

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