Elasticity Assignment

1. The ratio of radius of two wire of same material is 2 : 1. Stretched by same force, then the ratio of stress is

(a) 2 : 1 (b) 1 : 2 (c) 1 : 4 (d) 4 : 1

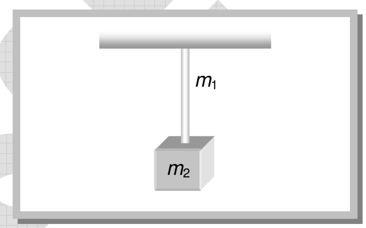
2. If equal and opposite forces applied to a body tend to elongate it, the stress so produced is called

(a) Tensile stress (b) Compressive stress (c) Tangential stress (d) Working stress

3. A vertical hanging bar of length *l* and mass *m* per unit length carries a load of mass *M* at the lower end, its upper end is clamped to a rigid support. The tensile force at a distance *x* from support is

(a) $Mg + mg(l - x)$ (b) Mg (c) $Mg + mgl$ (d) $(M+m)g\frac{x}{l}$

4. One end of a uniform rod of mass m_1 and cross-sectional area *A* is hung from a ceiling. The other end of the bar is supporting mass m_2. The stress at the midpoint is



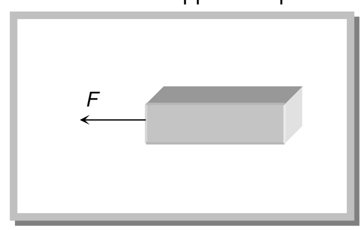
(a) $\frac{g(m_2 + 2m_1)}{2A}$

(b) $\frac{g(m_2 + m_1)}{2A}$

(c) $\frac{g(2m_2 + m_1)}{2A}$

(d) $\frac{g(m_2 + m_1)}{A}$

5. A uniform bar of square cross-section is lying along a frictionless horizontal surface. A horizontal force is applied to pull it from one of its ends then



(a) The bar is under same stress throughout its length

(b) The bar is not under any stress because force has been applied only at one end

(c) The bar simply moves without any stress in it

(d) The stress developed reduces to zero at the end of the bar where no force is applied

6. The reason for the change in shape of a regular body is

(a) Volume stress (b) Shearing strain (c) Longitudinal strain (d) Metallic strain

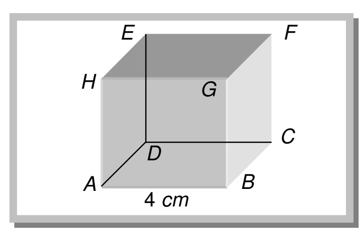
7. When a spiral spring is stretched by suspending a load on it, the strain produced is called

(a) Shearing (b) Longitudinal (c) Volume (d) Transverse

8. The longitudinal strain is only possible in

(a) Gases (b) Fluids (c) Solids (d) Liquids

9. The face *EFGH* of the cube shown in the figure is displaced 2 *mm* parallel to itself when forces of $5 \times 10^5\ N$ each are applied on the lower and upper faces. The lower face is fixed. The strain produced in the cube is



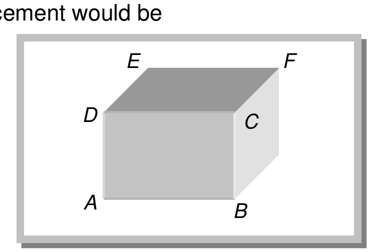
(a) 2

(b) 0.5

(c) 0.05

(d) 1.2×10^8

10. Forces of $10^5\ N$ each are applied in opposite direction on the upper and lower faces of a cube of side 10 *cm*, shifting the upper face parallel to itself by 0.5 *cm*. If the side of the cube were 20 *cm*, the displacement would be



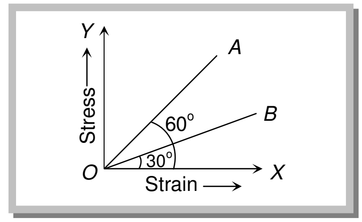
(a) 1 *cm*

(b) 0.5 *cm*

(c) 0.25 *cm*

(d) 0.125 *cm*

11. 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



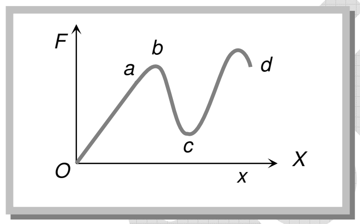
(a) $Y_B = 2Y_A$

(b) $Y_A = Y_B$

(c) $Y_B = 3Y_A$

(d) $Y_A = 3Y_B$

12. The graph is drawn between the applied force *F* and the strain (*x*) for a thin uniform wire. The wire behaves as a liquid in the part



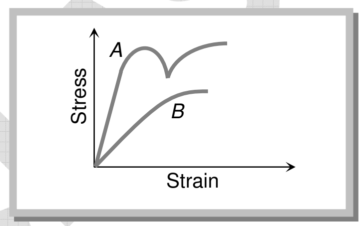
(a) *ab*

(b) *bc*

(c) *cd*

(d) *oa*

13. The diagram shows stress *v/s* strain curve for the materials *A* and *B*. From the curves we infer that



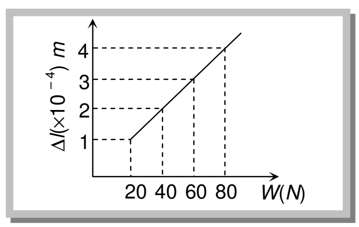
(a) *A* is brittle but *B* is ductile

(b) *A* is ductile and *B* is brittle

(c) Both *A* and *B* are ductile

(d) Both *A* and *B* are brittle

14. The adjacent graph shows the extension (Δl) of a wire of length 1 *m* suspended from the top of a roof at one end with a load *W* connected to the other end. If the cross sectional area of the wire is $10^{-6} m^2$, calculate the young's modulus of the material of the wire



(a) $2\times10^{11}\ N/m^2$

(b) $2\times10^{-11}\ N/m^2$

(c) $3\times10^{-12}\ N/m^2$

(d) $2\times10^{-13}\ N/m^2$

15. In the Young's experiment, if length of wire and radius both are doubled then the value of *Y* will become

(a) 2 times (b) 4 times (c) Remains same (d) Half

16. A rubber cord catapult has cross-sectional area 25mm^2 and initial length of rubber cord is 10*cm*. It is stretched to 5*cm*. and then released to project a missile of mass 5*gm*. Taking $Y_{rubber} = 5\times10^8\ N/m^2$ velocity of projected missile is

(a) 20 ms^{-1} (b) 100 ms^{-1} (c) 250 ms^{-1} (d) 200 ms^{-1}

17. The longitudinal extension of any elastic material is very small. In order to have an appreciable change, the material must be in the form of

(a) Thin block of any cross section (b) Thick block of any cross section

(c) Long thin wire (d) Short thin wire

18. In suspended type moving coil galvanometer, quartz suspension is used because

(a) It is good conductor of electricity (b) Elastic after effects are negligible

(c) Young's modulus is greater (d) There is no elastic limit

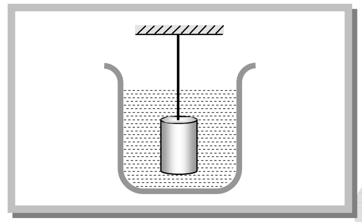
19. You are given three wires *A*, *B* and *C* of the same length and cross section. They are each stretched by applying the same force to the ends. The wire *A* is stretched least and comes back to its original length when the stretching force is removed. The wire *B* is stretched more than *A* and also comes back to its original length when the stretching force is removed. The wire *C* is stretched most and remains stretched even when stretching force is removed. The greatest Young's modulus of elasticity is possessed by the material of wire

(a) *A* (b) *B* (c) *C* (d) All have the same elasticity

20. The ratio of diameters of two wires of same material is *n* : 1. The length of wires are 4 *m* each. On applying the same load, the increase in length of thin wire will be

(a) n^2 times (b) n times (c) $2n$ times (d) None of the above

21. A wire of radius r, Young's modulus Y and length l is hung from a fixed point and supports a heavy metal cylinder of volume V at its lower end. The change in length of wire when cylinder is immersed in a liquid of density ρ is in fact



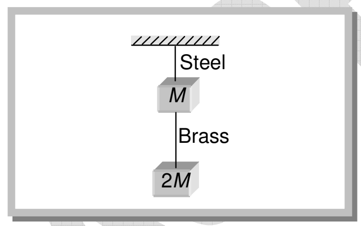
(a) Decrease by $\frac{Vl\rho g}{Y\pi r^2}$

(b) Increase by $\frac{Vr\rho g}{Y\pi l^2}$

(c) Decrease by $\frac{V\rho g}{Y\pi r}$

(d) $\frac{V\rho g}{Y\pi}$

22. If the ratio of lengths, radii and Young's modulii of steel and brass wires in the figure are a, b and c respectively. Then the corresponding ratio of increase in their lengths would be



(a) $\frac{2a^2c}{b}$

(b) $\frac{3a}{2b^2c}$

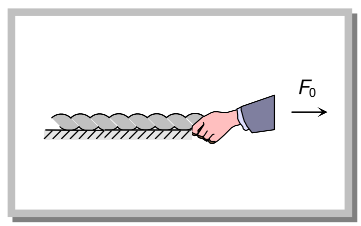
(c) $\frac{2ac}{b^2}$

(d) $\frac{3c}{2ab^2}$

23. A uniform heavy rod of weight W, cross sectional area A and length L is hung from a fixed support. Young's modulus of the material of the rod is Y. If lateral contraction is neglected, the elongation of the rod under its own weight is

(a) $\frac{2WL}{AY}$ (b) $\frac{WL}{AY}$ (c) $\frac{WL}{2AY}$ (d) Zero

24. A constant force F_0 is applied on a uniform elastic string placed over a smooth horizontal surface as shown in figure. Young's modulus of string is Y and area of cross-section is S. The strain produced in the string in the direction of force is



(a) $\frac{F_0Y}{S}$

(b) $\frac{F_0}{SY}$

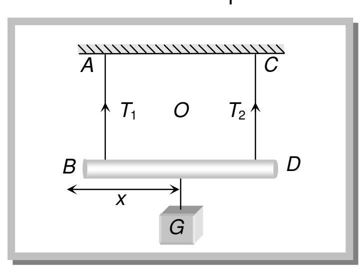
(c) $\frac{F_0}{2SY}$

(d) $\frac{F_0Y}{2S}$

25. A uniform rod of length L has a mass per unit length λ and area of cross section A. The elongation in the rod is l due to its own weight if it is suspended from the ceiling of a room. The Young's modulus of the rod is

(a) $\frac{2\lambda gL^2}{Al}$ (b) $\frac{\lambda gL^2}{2Al}$ (c) $\frac{2\lambda gL}{Al}$ (d) $\frac{\lambda gl^2}{AL}$

26. AB is an iron wire and CD is a copper wire of same length and same cross-section. BD is a rod of length 0.8 m. A load G = 2kg-wt is suspended from the rod. At what distance x from point B should the load be suspended for the rod to remain in a horizontal position $(Y_{Cu} = 11.8\times 10^{10}\, N/m^2, Y_{Fe} = 19.6\times 10^{10}\, N/m^2)$



(a) 0.1 m

(b) 0.3 m

(c) 0.5 m

(d) 0.7 m

27. A wire of length L and cross-sectional area A is made of a material of Young's modulus Y. It is stretched by an amount x. The work done is

(a) $\frac{YxA}{2L}$ (b) $\frac{Yx^2A}{L}$ (c) $\frac{Yx^2A}{2L}$ (d) $\frac{2Yx^2A}{L}$

28. 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 the two wires will be

(a) 1 : 2 (b) 1 : 4 (c) 2 : 1 (d) 1 : 1

29. If the potential energy of a spring is *V* on stretching it by 2 *cm*, then its potential energy when it is stretched by 10 *cm* will be

(a) *V*/25 (b) 5*V* (c) *V*/5 (d) 25*V*

30. The strain energy stored in a body of volume *V* due to shear *S* and shear modulus η is

(a) $\frac{S^2V}{2\eta}$ (b) $\frac{SV^2}{2\eta}$ (c) $\frac{S^2V}{\eta}$ (d) $\frac{1}{2}\eta S^2V$

31. *K* is the force constant of a spring. The work done in increasing its extension from l_1 to l_2 will be

(a) $K(l_2 - l_1)$ (b) $\frac{K}{2}(l_2 + l_1)$ (c) $K(l_2^2 - l_1^2)$ (d) $\frac{K}{2}(l_2^2 - l_1^2)$

32. The breaking stress of a wire depends upon

(a) Length of the wire (b) Radius of the wire (c) Material of the wire (d) Shape of the cross section

33. An aluminium rod has a breaking strain of 0.2%. The minimum cross sectional area of the rod, in m^2, in order to support a load of 10^4 *N* is $(Y = 7\times10^9\ N/m^2)$

(a) 1.4×10^{-4} (b) 7.1×10^{-4} (c) 1.4×10^{-3} (d) 7.1×10^{-5}

34. A cable is replaced by another one of the same length and material but of twice the diameter. The maximum load that the new wire can support without exceeding the elastic limit, as compared to the load that the original wire could support, is

(a) Half (b) Double (c) Four times (d) One-fourth

35. A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break

(a) When the mass is at the highest point (b) When the mass is at the lowest point
(c) When the wire is horizontal (d) At an angle of $\cos^{-1}$ (1/3) from the upward vertical

36. A heavy uniform rod is hanging vertically from a fixed support. It is stretched by its own weight. The diameter of the rod is

(a) Smallest at the top and gradually increases down the rod
(b) Largest at the top and gradually decreases down the rod
(c) Uniform everywhere
(d) Maximum in the middle

37. The specific heat at constant pressure and at constant volume for an ideal gas are C_p and C_v and its adiabatic and isothermal elasticities are E_ϕ and E_θ respectively. The ratio of E_ϕ to E_θ is

(a) C_v / C_p (b) C_p / C_v (c) C_pC_v (d) $1/C_pC_v$

38. If a rubber ball is taken at the depth of 200 *m* in a pool. Its volume decreases by 0.1%. If the density of the water is $1\times10^3\ kg/m^3$ and *g* = 10 *m*/s^2, then the volume elasticity in *N*/m^2 will be

(a) 10^8 (b) 2×10^8 (c) 10^9 (d) 2×10^9

39. 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 *cc* (b) $4\times10^{-5}\ cc$ (c) 0.025 *cc* (d) 0.004 *cc*

40. An ideal gas of mass *m*, volume *V*, pressure *p* and temperature *T* undergoes a small change in state at constant temperature. Its adiabatic exponent *i.e.*, $\frac{C_p}{C_v}$ is γ. The bulk modulus of the gas at the constant temperature process called isothermal process is

(a) *p* (b) γp (c) $\frac{m\gamma p}{T}$ (d) $\frac{\gamma pV}{T}$

41. An ideal gas of mass *m*, volume *V*, pressure *p* and temperature *T* undergoes a small change under a condition that heat can neither enter into it from outside nor can it leave the system. Such a process is called adiabatic process. The bulk modulus of the gas $\left(\gamma = \frac{C_p}{C_v}\right)$ is

(a) *p* (b) γp (c) $\frac{m\gamma p}{T}$ (d) $\frac{\gamma pV}{T}$

42. An ideal gas whose adiabatic exponent is γ is expanded according to the law $p = \alpha V$ where α is a constant. For this process the bulk modulus of the gas is

(a) *p* (b) $\frac{p}{\alpha}$ (c) αp (d) $(I - \alpha)p$

43. 1 *c.c.* of water is taken from the top to the bottom of a 200 *m* deep lake. What will be the change in its volume if *K* of water is $2.2\times10^9\ N/m^2$

(a) 8.8×10^{-6} *c.c.* (b) 8.8×10^{-2} *c.c.* (c) 8.8×10^{-4} *c.c.* (d) 8.8×10^{-1} *c.c*

44. Modulus of rigidity of a liquid

(a) Non zero constant (b) Infinite (c) Zero (d) Cannot be predicted

45. The Young's modulus of the material of a wire is $6\times10^{12}\ N/m^2$ and there is no transverse strain in it, then its modulus of rigidity will be

(a) $3\times10^{12}\ N/m^2$ (b) $2\times10^{12}\ N/m^2$ (c) $10^{12}\ N/m^2$ (d) None of the above

46. A rod of 2*m* length and radius 1 *cm* is twisted at one end by 0.8 *rad* with respect to other end being clamped. The shear strain developed in its rod will be

(a) 0.002 (b) 0.004 (c) 0.008 (d) 0.016

47. The upper end of a wire 1 *metre* long and 2 *mm* in radius is clamped. The lower end is twisted through an angle of 45^o. The angle of shear is

(a) 0.09^o (b) 0.9^o (c) 9^o (d) 90^o

48. The end of a wire of length 0.5*m* and radius 10^{-3}*m* is twisted through 0.80 *radian*. The shearing strain at the surface of wire will be

(a) 1.6×10^{-3} (b) 1.6×10^{3} (c) 16×10^{3} (d) 16×10^{6}

49. If the interatomic spacing in a steel wire is 3.0*Å* and $Y_{steel} = 20\times10^{10}\ N/m^2$, then force constant is

(a) $6\times10^{-2}\ N/Å$ (b) $6\times10^{-9}\ N/Å$ (c) $4\times10^{-5}\ N/Å$ (d) $6\times10^{-5}\ N/Å$

50. The Young's modulus of a metal is $1.2\times10^{11}\ N/m^2$ and the inter-atomic force constant is $3.6\times10^{-9}\ N/Å$. The mean distance between the atoms of the metal is

(a) 2*Å* (b) 3 *Å* (c) 4.5 *Å* (d) 5 *Å*