Elasticity

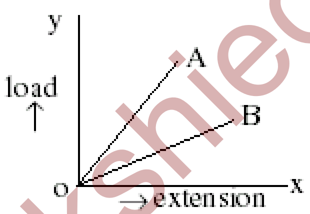
1. **The strain produced in the stretched spring is**
   1) Volume Strain 2) Shearing Strain
   3) Tensile Strain 4) None of the above

2. **A body subjected to strain a number of times does not obey Hooke's law due to**
   1) Yield point 2) Breaking stress 3) Elastic fatigue 4) Permanent set

3. **The modulus of elasticity is dimensionally equivalent to**
   1) Stress 2) Surface Tension 3) Strain 4) Coefficient of Viscosity

4. **Which of the following substances has the highest elasticity?**
   1) Rubber 2) Steel 3) Copper 4) Wood

5. **In the given figure if the dimension of the wires are the same and materials are different Young's modulus is less for**



   1) A 2) B 3) Both 4) None

6. **A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break**
   1) When the mass is at the lowest point.
   2) When mass is at the highest point.
   3) When wire is horizontal.
   4) When mass is at an angle of $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$ from upward vertical.

7. **Steel is preferred for making springs over copper because**

1)Young's modulus of steel is more than that of copper.

2) Steel is cheaper.

3) Young's modulus of copper is more.

4) Steel is less likely to be oxidized.

8. **The possible value of Poisson's ratio is**

1) 0.9 2) 0.8 3) 0.4 4) 1

9. **The breaking stress of a wire depends on**

1) Material of a wire 2) Shape of cross section

3) Length of the wire 4) Radius of the wire

10. **The property of metals whereby they could be drawn into thin wires beyond their elastic limit without breaking is**

1) Ductility 2) Malleability 3) Elasticity 4) Hardness

11. **When an elastic material with young's modulus 'y' is subjected to a stretching stress 'S' the elastic energy stored per unit volume of the material is ---**

1) $\frac{YS}{2}$ 2) $\frac{S^2Y}{2}$ 3) $\frac{S^2}{2Y}$ 4) $\frac{S}{2Y}$

12. **A wire of length 'L' and cross sectional area 'A' is made up of a material of young's modulus 'Y'. If the wire is stretched by 'X' the work done is**

1) $\frac{YAX}{L}$ 2) $\frac{YAX^2}{2}$ 3) YAX^2 4) $\frac{YAX^2}{2L}$

13. **The formula for strain energy per unit volume**

a) 1/2 (stress)(strain) **b) 1/2 Y (strain)^2**

c) $\frac{1}{2}$ x y (stress) **d) $\frac{1}{2}$ x $\frac{\text{(strain)}}{\text{Y}}$**

1) a, b are correct 2) a, c are correct 3) c, d are correct 4) a, b, c are correct

14. **Four springs of force constants K_1=1000N/m, K_2=1500 N/m, K_3=2500 N/m and K_4=2000 N/m are subjected to different loads producing same extension. Arrange the springs with work done in descending order**

1) 1,2,3,4 2) 3, 4, 1, 2 3) 3, 2, 1, 4 4) 3, 4, 2, 1

15. Consider the statements A and B and identify the correct answer given below.

A) If the volume of a body remains unchanged, when subjected to tensile strain, the value of Poisson's ratio is 1/2

B) Phosphor bronze has low Young's modulus and high rigidity modulus

1) A and B are correct 2) A and B are wrong

3) A is correct and B is wrong 4) A is wrong and B is right

16. The breaking stress of wire depends upon

1) Length of wire 2) Radius of wire 3) Material of wire 4) Shape of cross section

17. Which of the following affects the elasticity of a substance?

1) Hammering and annealing 2) Change in temperature

3) Impurity in substance 4) All of these

18. Consider an ideal mono-atomic gas of volume at pressure P. The bulk modulus at constant temperature is

1) $\frac{p}{2}$ 2) P 3) γ P 4) $\frac{PdP}{dV}$

19. The following four wires are made of the same material subjected to same force arrange them with their elongations in ascending order

a) l = 50cm and r = 0.5mm **b) l = 100cm and r = 1mm**

c) l = 200cm and r = 2mm **d) l = 300cm and r = 3mm**

(1) a, b, c, d (2) c, d, a, b (3) a, d, c, b (4) d, c, b, a

20. (A): Young's modulus for a perfectly plastic body is zero.

(R): For a perfectly plastic body, restoring force is zero.

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

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

21. (A): Identical springs of steel and copper are equally stretched. More work will be done on the steel spring.

(R): Steel is more elastic than copper.

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

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

22. Assertion (A): Ductile metals are used to prepare thin wires.

Reason (R): In the stress-strain curve of ductile metals, the length between the points representing elastic limit and breaking point is very small.

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

2) Both (A) and (R) are true and (R) is not correct explanation of (A).

3) (A) is true but (R) is false.

4) (A) is false but (R) is true.

23. Match the following.

List I	List II
(a) Spring constant	**(e)** $\frac{1}{2}\frac{(stress)^2}{Y}$
(b) Tensile strength	**(f)** $-\frac{\Delta p}{\Delta V / V}$
(c) Bulk modulus	**(g) Breaking stress**
(d) Potential energy/ Unit volume	**(h)** $\frac{AY}{L}$

(1) a-h, b-g, c-f, d-e (2) a-g, b-h, c-e, d-f

(3) a-e, b-h, c-f, d-g (4) a-h, b-e, c-f, d-g

24. Match the list I with List II.

List I	List II
(a) Annealing	**(e) Increasing the strength of a solid**
(b) Compressibility	**(f) Maximum stress for which an object may not break**
(c) Tensile strength	**(g) Slow cooling after heating**
(d) Work hardening	**(h) Reciprocal of Bulk modulus**

(1) a-e, b-g, c-f, d-h (2) a-e, b-f, c-g, d-h (3) a-g, b-f, c-h, d-e (4) a-g, b-h, c-f, d-e

25. Consider the statements A and B, identify the correct answer given below:

(A): If the volume of a body remains unchanged when subjected to tensile strain, the value of Poisson's ratio is $^1/_2$.

(B): Phosphor bronze has low Young's modulus and high rigidity modulus.

1) A and B are correct 2) A and B are wrong

3) A is correct and B is wrong 4) A is wrong and B is right

26. Which of the following relations is not correct Y = young's modulus, K = bulk modulus, n= rigidity modulus, σ = poisons ratio

1) $1/Y = 9\eta K/(3K+\eta)$ 2) $Y/\eta = 2(1+\sigma)$

3) $Y/3K = (1-2\sigma)$ 4) $(Y/\eta)+(Y/3K)=3$

27. a) A wire is stiffer if Y is large.

b) A wire is stiffer if Y is small.

c) A wire is stronger if the breaking stress is large.

d) A wire is stronger if the breaking stress is small.

1) b, c 2) b, d 3) a, d 4) a, c

28. a) Spring constant is directly proportional to the length of the wire.

b) The spring constant is directly proportional to the cross – sectional area of the wire.

c) The spring constant is inversely proportional to the length of the wire.

d) The spring constant is inversely proportional to the cross sectional area of the wire.

1) b, c 2) a, b 3) a, d 4) c, d

29. When a very long rod suspended in air will break under its own weight. The maximum length of the rod will depend on

a) Breaking stress **b) Density**

c) Cross – sectional ` **d) Acceleration due to gravity**

1) a, b, c 2) a, b, d 3) b, c, d 4) a, b, c, d

30. Identify the correct statements.

a) Each time an object is subjected to stress; its internal structure undergoes change in the course of time.

b) Poisson's ratio is a modulus of elasticity.

c) Rigidity modulus is relevant for both solids and liquids.

d) The strength of a material can be improved by incorporating for eign atoms.

1) a, b 2) a, c 3) a, d 4) b, c

31. When a wire is stretched to double its length?

a) Stress = Young's modulus **b) Strain = 1**

c) Radius is halved **d) Y = 2 x elastic deformation energy**

1) a, b, c　　2) b, c, d　　3) a, c, d　　4) a, b, d

32. Arrange the following materials in the increasing order of elasticity.

a) Steel　　b) Lead　　c) Rubber　　d) Glass

1) c, b, d, a　　2) a, b, c, d　　3) a, d, b, c　　4) b, d, a, c

33. Arrange the elastic modulii, stretch modulus (Y), shear modulus (n) and bulk modulus (K), in the decreasing order for typical materials.

1) Y, n, K　　2) Y, K, n　　3) K, Y, n　　4) n, K, Y

34. Arrange the following parameters for elasticity, yield point (Y), Limit of proportionality (P), range of Hooke's law (H) and Breaking stress (B)., in the increasing order of stress.

1) B, Y, P, H　　2) H, Y, P, B　　3) H, P, Y, B　　4) H, Y, B, P

35. Arrange the compressibility of the liquids Mercury (M) Ethyl alcohol (E). Glycerin (G), and Water (W), in the decreasing order.

1) E, W, G, M　　2) M, G, W, E　　3) E, G, W, M　　4) M, W, G, E

36. Match the following.

List – I	**List – II**
a) Plastic deformation	e) Failure of an object after repeated application of stresses that are well under its original breaking strength
b) Elastic fatigue	f) Maximum stress that can applied to an object without its being permanently deformed
c) Elastic Limit	g) Ability to deform a great deal beyond the elastic limit
d) Ductility	h) When the elastic limit is exceeded and the tension is removed, the rod remains longer than it was originally

1) a – g, b – h, c – e, d – f　　2) a – f, b – h, c – g, d – e

3) a – h, b – e, c – f, d – g　　4) a – h, b – f, c – e, d – g

37. Match the following.

List – I	**List – II**
a) Annealing	e) Increasing the strength of a solid
b) Compressibility	f) Maximum stress for which an object may not break
c) Tensile strength	g) Slow cooling after heating
d) Work hardening	h) Reciprocal of Bulk modulus

1) a – e, b – g, c – f, d – h 2) a – e, b – f, c – g, d – h

3) a – g, b – f, c – h, d – e 4) a – g, b – h, c – f, d – e

38. **Assertion (A): A wire may be stiffer than another wire B. But B may stronger than A.**

Reason (R): A high young's modulus does not necessarily imply a high value for the breaking stress.

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

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

3) A is true but R is false.

4) R is true but R is false.

39. **Assertion (A): To increase the strength of a solid, it is necessary to impede the motion of dislocation sin its structure. One way is to increase the number of dislocations by hammering the metal or squeezing it between rollers.**

Reason (R): The dislocations then become so numerous and tangled together that they interfere with each other's motion.

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

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

3) A is true but R is false.

4) R is true but R is false.

40. **Assertion (A): A hippopotamus has thicker legs for its size than a mouse does.**

Reason (R): The compressive load on the leg bones of an animal depends on its weight, which in turn varies as the cube L^3 of a representative linear dimension L such as its length or height. The strength of a bone, however, depends on its cross – sectional area which for similar animals varies as L^2. A large animal must have relatively thicker leg bones than a small one because L^3 increases faster than L^2

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

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

3) A is true but R is false.

4) R is true but R is false.

41. The area of cross-section of a wire is $10^{-5}m^2$ when its length is increased by 0.1% a tension of 1000N is produced. The Young's modulus of the wire will be ----

1) 10^{12} Nm^{-2} 2) 10^{11} Nm^{-2} 3) 10^{9} Nm^{-2} 4) 10^{10} Nm^{-2}

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

1) l = 50cm and diameter 0.5mm 2) l = 100cm and diameter 1.0mm

3) l = 200cm and diameter 2.0mm 4) l = 300cm and diameter 3.0mm

43. If stress is numerically equal to young's modulus the elongation will be

1) $\frac{1}{4}$ the original length 2) $\frac{1}{2}$ the original length

3) Equal to the original length 4) Twice the original length

44. A metallic ring of radius 'r' and cross sectional area A is fitted into a wooden circular disc of radius R (R > r). If the Young's modulus of the material of the ring is Y, the force with which the metal ring expands is

1) $\frac{AYR}{r}$ 2) $\frac{AY(R-r)}{r}$ 3) $\frac{Y(R-r)}{Ar}$ 4) $\frac{YR}{AR}$

45. When the tension on a wire is 4N its length is l_1. When the tension on the wire is 5N its length is l_2. Find its natural length.

1) $5\ell_1 - 4\ell_2$ 2) $4\ell_1 - 5\ell_2$ 3) $10\ell_1 - 8\ell_2$ 4) $8\ell_1 - 10\ell_2$

46. When a tension 'F' is applied, the elongation produced in uniform wire of length l, radius r is e, when tension 2F is applied, the elongation produced in another uniform wire of length 2l and radius 2r made of same material is

1) 0.5e 2) 1.0e 3) 1.5e 4) 2.0e

47. Two bars A and B of circular cross section and of same volume made of same material are subjected to tension. If the diameter of A is half that of B and if the force applied to both the rods is the same and it is in the elastic limit the ratio of extension of A to that of B will be

1) 16 2) 8 3) 4 4) 2

48. **Two wires of same length and thickness are joined end to end. Their Young's modulii are 15x10^{10}pa and 20x10^{10}pa. If the combination is stretched by a certain load, the elongations of these wires will be in the ratio**

1) 3:4 2) 4:3 3) 1:1 4) 1:2

49. **Two rods of different materials having coefficients of linear expansion α_1 and α_2 and Young's modulii Y_1 and Y_2 respectively are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temp. There is no bending of rods. If $\alpha_1 : \alpha_2$ = 2:3. The thermal stresses developed in the two rods are equal if $Y_1 : Y_2$ is equal to**

1) 4: 9 2) 3: 2 3) 9: 4 4) 2: 2

50. **A cubical ball is taken to a depth of 200m in a sea. The decrease in volume observed to be 0.1%. The bulk modulus of the ball is -- (g = 10 ms^{-2})**

1) 2x10^7 Pa 2) 2x10^6 Pa 3) 2x10^9 Pa 4) 1.2x10^9 Pa

51. **The increase in length of a wire on stretching is 0.025%. If its poisons ratio is 0.4, then the percentage decrease in the diameter is:**

1) 0.01 2) 0.02 3) 0.03 4) 0.04

52. **The breaking stress of steel is 7.9x10^9 Nm^{-2} and density of steel is 7.9x10^3 kgm^{-3} and g = $10ms^{-2}$. The maximum length of steel wire that can hang vertically without breaking is**

1) 10^3 m 2) 10^4 m 3) 10^2 m 4) 10^5 m

53. **A metal cube of side length 8.0 cm has its upper surface displaced with respect to the bottom by 0.10 mm when a tangential force of 4 x 10^9 N is applied at the top with bottom surface fixed. The rigidity modulus of the material of the cube is**

1) 4 x 10^9 N/m^2 2) 5 x 10^9 N/m^2 3) 8 x 10^9 N/m^2 4) 1x 10^8 N/m^2

54. **A load of 1kg weight is attached to one end of a steel wire of cross sectional area 3 and Young's modulus 10^{11} N/m^2. The other end is suspended vertically from a hook on a wall, and then the load is pulled horizontally and released. When the load passes through its lowest position the fractional change in length is (g=10m/s^2)**

1) 10^{-4} 2)10^{-3} 3) 10^3 4) 10^4

55. The radii and Young's modulus of two uniform wires A & B are in the ratio 2:1 and 1:2 respectively. Both the wires are subjected to the same longitudinal force. If increase in the length of wire A is 1%, then the percentage increase in length of wire B is

1) 1 2) 1.5 3) 2 4) 3

56. A wire whose cross sectional area is 2 mm^2 is stretched by 0.1 mm by a certain load. If a similar wire of triple the area of cross section is stretched by the same load, the elongation of the second wire would be

1) 0.33m 2) 0.033mm 3) 0.3mm 4) 0.0033 mm

57. 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)

1) Zero 2) $l/2$ 3) l 4) $2l$

58. The increase in pressure required to decrease the 200 liters volume of a liquid by 0.004% in k Pa is: (bulk modulus of the liquid = 2100 MPa)

1) 8.4 2) 84 3) 92.4 4) 168

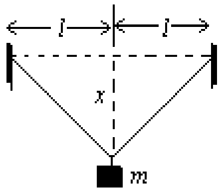
59. A copper solid cube of 60mm side is subjected to a compressible pressure of 2.5 x 10^7 Pa. If the bulk modulus of copper is 1.25 x 10^{11} Pascal, the change in the volume of cube is

1) -43.2 mm^3 2) -43.2m^3 3) -43.2 cm^3 4) -432 m m^3

60. When a wire of length 10m is subjected to a force of 100 N along its length, the lateral strain produced is 0.01X 10^{-3}. The Poisson's ratio was found to be 0.4. If the area of cross-section of wire is 0.025, its Young's modulus is

1) 1.6 x 10^8 N/m^2 2) 2.5 x 10^{10} N/m^2 3)12.5 x 10^{11} N/m^2 4)16 x 10^9 N/m^2

61. **A steel wire of diameter d, area of cross-section A and length 2*l* is clamped firmly at two points A and B which are 2*l* m apart and in the same plane. A body of mass m is hung from the middle point of wire such that the middle point sags by x lower from original position. If Young's modulus is Y then m is given by**



1) $\frac{1}{2}\frac{YAx^2}{gl^2}$ 2) $\frac{1}{2}\frac{YAl^2}{gx^2}$ 3) $\frac{YAx^3}{gl^3}$ 4) $\frac{YAl^2}{gx^2}$

62. **A metal rod of Young's modulus 210^{10} Nm^{-2} undergoes an elastic strain of 0.02% the energy per unit volume stored in the rod in joule/m^3 is**

1) 400 2) 800 3) 1200 4) 1600

63. **The work done in stretching a wire by 1mm is 2J. The work necessary for stretching another wire of same material but with double the radius of cross-section and half the length by 1mm is in Joules**

1) 16 2) 8 3) 4 4) ¼

64. **Two wires of same radius and length are subjected to the same load. One wire is of steel and the other is of copper. It the Young's modulus of steel is twice that of copper, the ratio of elastic energy stored per unit volume in steel to that of copper wire is**

1) 1:2 2) 2:1 3) 1:4 4) 4:1

65. **A spring of force constant 800N/m has an extension of 5cm. The work done in extending it from 5cm to 15cm is**

1) 16J 2) 8J 3) 32J 4) 24J

66. **A hollow cylinder of inner radius 3 cm and outer radius 5 cm and a solid cylinder of radius 2 cm are subjected to the same force. If they are made of same material and of same length, then the ratio of their elongations is**

1) 1: 1 2) 1: 2 3) 1: 4 4) 2: 3

67. The length of a rubber cord is l_1 meters when the tension is 4N and l_2 meters when the the tension is 5N. The length in meters when the tension is 9 N is

1) $5l_1 - 4l_2$ 2) $5l_2 - 4l_1$ 3) $9l_1 - 8l_2$ 4) $8l_2 - 5l_1$

69. Two wires A & B are identical in shape and size and are stretched by same magnitude of force. Then the extensions are found to be 0.2% and 0.3% respectively. Find the ratio of their Young's modulii

1) 2 : 3 2) 3 : 2 3) 4 : 9 4) 9 : 4

70. One end of a uniform wire of length L and of weight 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 find the stress in the wire at height (3L/4) from its lower end?

1) $\left(\frac{w_1 + (3w/4)}{S}\right)$ 2) $\left(\frac{w + (3w_1/4)}{S}\right)$ 3) $\frac{w_1 + w}{4}$ 4) $\left(\frac{3w_1 + (w/4)}{S}\right)$

71. A light rod of length 200cm is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One of the wires is made of steel and is of cross-section 0.1sq.cm and the other is of brass of cross-section 0.2 sq.cm. Find the position along the rod at which a weight may be hung to produce (i) equal stresses in both wires and (ii) equal strains in both wires.

$Y_{brass} = 10 \times 10^{11}$ dyne/cm^2 and $Y_{steel} = 20 \times 10^{11}$ dyne/cm^2

1) 133.3cm; 100cm 2) 167cm; 50cm 3) 200cm; 100cm 4) None

72. A long steel wire of length 'L' is suspended from the ceiling of a room. A sphere of mass 'm' and radius 'r^1' is attached to the lower end of the wire. The height of the ceiling is ($L+2r^1+l$). When the sphere is made to oscillate as a pendulum, its lowest point just touches the floor. The velocity of the sphere at the lowest point will be ($L >> r^1, l$ and r is the radius of the wire)

1) $\sqrt{\frac{\pi r^2 ye}{m} - Lg}$ 2) $\sqrt{\frac{\pi r^2 y}{me} - Lg}$ 3) $\sqrt{\frac{y\pi r^2 e}{m}}$ 4) None

73. A metal cube of side length 8.0cm has its upper surface displaced with respect to the bottom by 0.10 mm when tangential force of 410^4N is applied at the top with bottom surface fixed. The rigidity modulus of the material of the cube is

1) $410^9 Nm^{-2}$ 2) $510^9 Nm^{-2}$ 3) $810^9 Nm^{-2}$ 4) $10^8 Nm^{-2}$

74. A metal rope of density $6000 kgm^{-3}$ has breaking stress $9.8 \times 10^8 Nm^{-2}$. This rope is used to measure the depth of the sea. Then the depth of the sea that can be measured without breaking is -----

1) 10×10^3 m 2) 20×10^3 m 3) 30×10^3 m 4) 40×10^3 m

75. The upper end of a wire of radius 4mm and length 100cm is clamped and its other end is twisted through an angle of 30^0 then the angle of shear is

1) 0.012^0 2) 0.12^0 3) 1.2^0 4) 12^0

76. A uniform metal rod of $2mm^2$ cross section is heated from 0^0C to 20^0C. The coefficient of linear expansion of the rod is $12\ 10^{-6}/^oC$. Its Young's modulus of elasticity is $10^{11} Nm^{-2}$. The energy stored per unit volume of the rod is

1) $2880 Jm^{-3}$ 2) $1500 Jm^{-3}$ 3) $5760 Jm^{-3}$ 4) $1440 Jm^{-3}$

77. Two springs of spring constants 1500N/m and 3000 N/m respectively are stretched by the same force. The potential energy possessed by the two will be in the ratio

1) 4:1 2) 1:4 3) 2:1 4) 1:2

78. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to mass less spring of spring constant K.A mass (m) hangs freely from the free end of the spring. The area of cross-section and Young's modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released it will oscillate with a time period T equal to

1) $2\pi\sqrt{\frac{m}{k}}$ 2) $2\pi\sqrt{\frac{m(YA+KL)}{YAK}}$ 3) $2\pi\sqrt{\frac{mYA}{KL}}$ 4) $2\pi\sqrt{\frac{mL}{YA}}$

79. A mass m kg is whirled in a vertical plane by tying it at the end of a flexible wire of length l and area of cross section 'A'. When the mass is at its lowest position the strain produced in the wire is, if Young's modulus of the wire is 'Y' (if V=$\sqrt{5g\ell}$)

1) $\frac{AY}{6mg}$ 2) $\frac{6mg}{AY}$ 3) $\frac{5mg}{AY}$ 4) $\frac{AY}{5mg}$

80. On all the six surfaces of a unit cube, equal tensile force of *F* is applied. The increase in length of each side will be (*Y* = Young's modulus, σ = Poisson's ratio)

1) $\frac{F}{Y(1-\sigma)}$ 2) $\frac{F}{Y(1+\sigma)}$

3) $\frac{F(1-2\sigma)}{Y}$ 4) $\frac{F}{Y(1+2\sigma)}$

Key

1) 2 2) 3 3) 1 4) 2 5) 2 6) 1 7) 1 8) 3 9) 1

10) 1 11) 3 12) 4 13) 1 14) 4 15) 3 16) 3 17) 4 18) 2

19) 4 20) 1 21) 1 22) 3 23) 1 24) 4 25)3 26) 1 26) 1

27) 4 28) 1 29) 2 30) 3 31) 3 32) 1 33) 2 34).3 35)1

36) 3 37) 4 38) 1 39) 1 40) 1 41) 2 42) 1 43) 3 44) 2

45) 1 46) 2 47) 1 48) 2 49) 2 50) 3 51) 1 52) 4 53) 2 54)1

55) 3 56) 2 57)3 58) 2 59) 1 60) 1 61) 3 62) 1 63) 1

64) 1 65) 2 66) 3 67) 2 68) 1 69) 2 70) 1 71) 1 72) 1

73) 2 74) 2 75) 2 76) 1 77) 3 78) 2 79) 2 80) 3

Hints

41. $y = \dfrac{F}{A\left(\dfrac{e}{l}\right)} = \dfrac{10^3}{10^{-5} \times 10^{-3}} = 10^{11}\ N/m^2$

$\left[\therefore \dfrac{\Delta l}{l} = \dfrac{0.1}{100} = 10^{-3}\right]$

42. $e = \dfrac{Fl}{y(\pi r^2)} \Rightarrow e \propto \dfrac{l}{r^2}$ (Same y and F)

i.e. if $\dfrac{l}{r^2}$ is more, then extension is more

43. $y = \dfrac{stress}{strain}$

$y = \dfrac{y}{strain}$

Strain = 1

$\dfrac{\Delta l}{l} = 1$ e = l

44. $F = YA\left(\dfrac{\Delta l}{l}\right)$

$F = YA\,\dfrac{2\pi(R-r)}{2\pi r}$

$F = \dfrac{YA\,(R-r)}{r}$

45. $(l_1 - l) = \dfrac{T_1 l}{Ay} \rightarrow 1$

$(l_2 - l) = \dfrac{T_2 l}{Ay} \rightarrow 2$

$\dfrac{(1)}{(2)} \rightarrow \dfrac{l_1 - l}{l_2 - l} = \dfrac{T_1}{T_2}$

$l = \dfrac{l_1 T_2 - l_2 T_1}{T_2 - T_1}$

46. $y = \frac{Fl}{Ae}$

$\frac{F_1 l_1}{r_1^2 e_1} = \frac{F_2 l_2}{r_2^2 e_2}$

$e_2 = \frac{F_2 l_2}{r_2^2} \times \frac{r_1^2 e_1}{F_1 l_1}$

$= \frac{(2F)(2l) \times r^2 \times e}{4r^2 F l}$ $\quad e_2 = 1.0$ e

47. $e \propto \frac{1}{A^2} \propto \frac{1}{r^4}$

$\frac{e_A}{e_B} = \frac{re_B^4}{rA_A^4} = \left(\frac{2}{1}\right)^4 = \frac{16}{1}$

48. $e \propto \frac{1}{y} \Rightarrow \frac{e_1}{e_2} = \frac{y_2}{y_1} = \frac{20}{15} = \frac{4}{3}$

49. $F = y\ A \propto (\Delta t) = \left(\frac{F}{A}\right) = y \propto \Delta t$

$y \propto = const \Rightarrow y \propto \frac{1}{\alpha}$

$\frac{y_1}{y_2} = \frac{\alpha_2}{\alpha_1}$

$\frac{y_1}{y_2} = \frac{3}{2}$

50. $k = \frac{PV}{\Delta V} = \frac{(hdg)V}{\Delta V}$

$k = \frac{200 \times 10^3 \times 10}{0.1/100} = 2 \text{ x } 10^9$ Pa

51. $\frac{\Delta l}{l} = 0.025\%$

$\sigma = \frac{\Delta D / D}{\Delta l / l} \Rightarrow \sigma = \frac{\frac{\Delta D}{D} \times 100}{\frac{\Delta l}{l} \times 10V}$

$$0.4=\frac{\frac{\Delta D}{D}\times 100}{0.025}$$

$$\therefore \frac{\Delta D}{D}\times 100=0.01$$

52 $l=\frac{P.S}{dg}=\frac{7.9\times 10^{9}}{7.9\times 10^{3}\times 10}$ = 10^5m

53. $\eta=\frac{F}{A\left[\frac{\Delta x}{l}\right]}$

54. $\frac{e}{l}=\frac{3mg}{AY}$

55. $\frac{S_{tB}}{S_{tA}}=\frac{r_A{}^2}{r_B{}^2}\frac{Y_A}{Y_B}$

56. $e\ \alpha\ \frac{1}{A^2}$

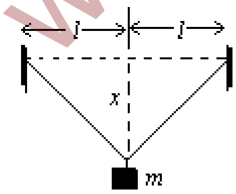
57. In both the cases, the tension in the wire remains the same. So, elongation will be the same.

58. $\Delta P=K\left(\frac{\Delta V}{V}\right)$

59. $\Delta V=\frac{\Delta PV}{K}$

60. $\sigma=\frac{-\left(\frac{\Delta r}{r}\right)}{\left(\frac{\Delta l}{l}\right)};Y=\frac{Fl}{Ae}$

61.



For equilibrium,

$mg=2T\sin\theta$

Here $\sin\theta=\tan\theta=\frac{x}{l}$

$T = \frac{YA}{l}$, $\Delta l = \frac{YA}{l}(l^2 + x^2)^{1/2} - l$

$\simeq \frac{YAx^2}{2l^2}$

From (i) $mg = 2\frac{YAx^2}{2l^2}\frac{x}{l}$ or $m = \frac{YAx^3}{gl^3}$

62. $\frac{E}{V} = \frac{1}{2} \times stress \times strain$

$\frac{E}{V} = \frac{1}{2}(y)\ (strain)^2$

$strain = \frac{0.02}{1.00} = 2 \times 10^{-4}$

$\therefore \frac{E}{v} = \frac{1}{2} \times 2 \times 10^{10} \times 4 \times 10^{-8}$ = 4 x 10^2

$\frac{E}{V} = 400\ Joule/m^3$

63. $W = \frac{1}{2}\left(\frac{F}{A}\right)(strain)(volume)$

$= \frac{1}{2}\left(\frac{F}{A}\right)\left(\frac{e}{l}\right) \times A \times l$

$W = \frac{1}{2}F\,e \Rightarrow W \propto F \propto \frac{VAe}{l} \Rightarrow W \propto \frac{r^2}{l}$

$\frac{2}{w_2} = \frac{r_1^2}{r_2^2} \times \frac{l_2}{l_1} = \frac{r^2}{4r^2} \times \frac{l}{2l} = \frac{1}{8}$

W_2 = 16 Joules

64. $\frac{E}{V} \propto y$

$\frac{\left(\frac{E}{V}\right)_s}{(E/V)_c} = \frac{y_s}{y_c} = \frac{y}{2y} = \frac{1}{2}$

65. $W = \frac{1}{2}k(x_2^2 - x_1^2)$

$= \frac{1}{2} \times 800\ [225 - 25] \times 10^{-4}$ = 400 [200] x 10^{-4}

W = 8 J

66. $e \propto \frac{1}{r^2} \Rightarrow \frac{e_1}{e_2} = \frac{r_2^2}{r_1^2} = \frac{2^2}{5^2 - 3^2} = \frac{4}{25-9}$

$\frac{e_1}{e_2} = \frac{4}{16} = \frac{1}{4}$

67. $Y = \frac{Fl}{Ae}$

$\frac{4l}{A(l_1 - l)} = \frac{5l}{A(l_2 - l)} = \frac{9l}{A(x-l)}$

$4l_2 - 4l = 5l_1 - 5l$

$5l_1 - 4l_2 = l$

$\frac{5}{l_2 - l} = \frac{9}{x-l} \Rightarrow 5x - 5l = 9l_2 - 9l$

$5x = 9l_2 - 4l$

$x = \frac{9l_2 - 45(5l_1 - 4l_2)}{5}$

$x = \frac{25l_2 - 20l_1}{5}$

$x = 5l_2 - 4l_1$

68. $\frac{e_1}{e_2} = \frac{l_1}{l_2} \times \frac{r_2^2}{r_1^2}$

$\frac{x}{e_2} = \left(\frac{1}{\pi}\right)\left[\frac{1}{\pi(1)}\right] = \frac{1}{\pi^2}$

$e_2 = \pi^2 x$

69. $\frac{y_1}{y_2} = \frac{e_2}{e_1} = \frac{0.3}{0.2} = \frac{3}{2}$

70. $stress \frac{F}{A} = \frac{\left(w_1 + \frac{3W}{4}\right)}{s}$

71. Stress in steel = stress in brass

$\frac{T_B}{A_B} = \frac{T_s}{A_s} \Rightarrow \frac{T_s}{T_B} = \frac{A_s}{A_B} = \frac{10^{-3}}{2 \times 10^{-3}} = \frac{1}{2}$

$T_S\, x = T_B\, (2 - x)$

$$\frac{T_s}{T_B} = \frac{2-x}{x} = \frac{1}{2} \Rightarrow x = 1.33m$$

$$strain = \frac{stress}{y} \Rightarrow \frac{T_s / A_s}{y_s} = \frac{T_B / A_B}{y_B}$$

$$\frac{T_s}{T_B} = \frac{A_s y_s}{A_B y_B} = \frac{(1\times10^{-3})\ 2\times10^{11}}{(2\times10^{-3}\times10^{11})} = 1m = 100\text{ cm}$$

72. $F = T_B = \dfrac{mv^2}{r} + mg$

But $F = \dfrac{yAe}{L} = \dfrac{y(\pi r^2)e}{L}$

$$\frac{y(\pi r^2)e}{L} = \frac{mv^2}{r} + mg$$

$$y(\pi r^2)e = mv^2 + mgL$$

$$mv^2 = y(\pi r^2)e - mgl$$

$$V^2 = \frac{y(\pi r^2)e}{m} - gl$$

$$V = \sqrt{\frac{y(\pi r^2)e}{m} - Lg}$$

73. $\eta = \dfrac{F}{A.\frac{e}{L}} = \dfrac{F}{L.\frac{e}{L}} = \dfrac{F}{Le}$

$$\eta = \frac{4\times10^4}{8\times10^{-2}\times10\times10^{-5}} = 5\times10^9\ N/m^2$$

74. $l_{own} = \dfrac{Breaking\ \ stress}{dg} = \dfrac{9.8\times10^8}{6000\times9.8}$

75. $L\phi = r\theta = \phi = sheright\ angle$

θ = Twist angle

$$\phi = \frac{r.\theta}{L} = \frac{4\times10^{-3}\times30^0}{100\times10^{-2}} = 0.012^0$$

76. Energy per unit volume

$$= \frac{1}{2}\times strees\times strain = \frac{1}{2}\times Y\,(\alpha^2\,\Delta t^2) = \frac{1}{2}\times10^{11}\times12\times10^{-6}\times4\times10^2\times12\times10^{-6} = 2880\ J/m^3$$

77. $PE_{spring} = \frac{1}{2}k.e^2 = \frac{f^2}{2k}$

F =const

$PE \propto \frac{1}{k}$

$PE_1 : PE_2 = k_2 : k_1 = 2 : 1$

78. $K^1 = \frac{k.\frac{yA}{L}}{K + \frac{yA}{L}} = \frac{YAk}{YA + kL}$

$\therefore T = 2\pi\sqrt{\frac{m(YA + kL)}{YAK}}$

79. When mass is at lowest position tension in wire = 6mg

Elongation $= e = \frac{Fl}{AY} = \frac{6mgl}{AY}$

80. Tensile strain on each face $= \frac{F}{Y}$

Lateral strain due to the other two forces acting on perpendicular faces $= \frac{-2\sigma F}{Y}$

Total increase in length $= (1 - 2\sigma)\frac{F}{Y}$