SMART EDITION

1
VOLUME

CIVIL ENGINEERING

MCQ

Assistant Engineer & Junior Engineer

Strength of Materials • Structure Analysis
Design of Steel Structure • RCC Design

Complete in-Depth Solutions of All Question | Topic-wise Bifurcation of Questions
Also Useful for State-AE/JE, PSUs and PSCs Exams

ENGINEERS ACADEMY®
Your GATEway to Professional Excellence
IES • GATE • PSUs • JTO • IAS • NET

www.eapublications.org
+ 91-80944 41777

CONTENTS

CHAPTER 1

Basic Properties and Stresses

OBJECTIVE QUESTIONS

1. Actual rupture stress is
(a) Breaking stress
(b) Maximum load/original cross-sectional area
(c) Load at breaking point/original cross-sectional area
(d) Load at breaking point/neck area

2. Elasticity of various materials is controlled by its
(a) Ultimate tensile stress
(b) Proof stress
(c) Stress at yield point
(d) Stress at elastic limit

3. Which of the following is proper sequence
(a) Proportional limit, elastic limit, yielding, failure
(b) Elastic limit, proportional limit, yielding, failure
(c) Yielding, proportional limit, elastic limit, failure
(d) None of the above

4. Ratio of direct stress to volumetric strain in case of a body subjected to three mutually perpendicular stress of equal intensity, is
(a) Young's modulus
(b) Bulk modulus
(c) Modulus of rigidity
(d) None of the above

5. If a material expands freely due to heating it will develop
(a) Thermal stresses (b) Tensile stress
(c) No stress (d) Bending

6. Unit of modulus of elasticity is same as those of
(a) Stress, strain and pressure
(b) Stress, force and modulus of rigidity
(c) Strain, force and pressure
(d) Stress, pressure and modulus of rigidity

7. Impact test enables one to estimate the property of
(a) Hardness (b) Toughness
(c) Strength (d) Creep

8. Proof stress
(a) Is the safest stress
(b) Causes a specified permanent deformation in a material, usually 0.1% or less
(c) Is used in connection with materials like mild steel
(d) Does not exist

9. In compression test, the fracture in cast iron specimen would occur along
(a) The axis of load
(b) An oblique plane
(c) At right angle to axis of specimen
(d) Would not occur

10. The extension of a bar of diameter d, length L and unit weight γ under the action of self weight is given by

(a) $\frac{\gamma L^3}{2E}$ (b) $\frac{6\gamma L^2}{E}$

(c) $\frac{\gamma L^2}{2E}$ (d) $\frac{\gamma L^4}{2E}$

11. A material subjected to reversal stresses does not fail at a stress known as
(a) Fatigue stress (b) Proof stress
(c) Safe stress (d) Endurance stress

12. The Bulk modulus K, the modulus of rigidity N and poisson's ratio 1/m are related by

(a) $\frac{1}{m}=\frac{9KN}{3K+N}$ (b) $\frac{1}{m}=\frac{3K-2N}{6K+2N}$

(c) $\frac{1}{m}=\frac{6K+2N}{3K-2N}$ (d) None of the above

13. The point at which extension of the material takes place more quickly as compared to the increase in load is called

(a) Elastic point of the material

(b) Ultimate point of the material

(c) Breaking point of the material

(d) Yield point of the material

14. Which of the following material is expected to have the least value of young's modulus of elasticity

(a) Wood (b) Copper

(c) Glass (d) Aluminium

15. A cube subjected to three mutually perpendicular stress of equal intensity p expenses a volumetric strain

(a) $\frac{3p}{E}\left(\frac{2}{m}-1\right)$ (b) $\frac{3p}{E}(2-m)$

(c) $\frac{3p}{E}\left(1-\frac{2}{m}\right)$ (d) $\frac{E}{3p}\left(\frac{2}{m}-1\right)$

16. Volumetric strain for a rectangular specimen of length *l*, breadth b and thickness t subjected to a pull of P is given by

(a) e(1 – 2m) (b) $e\left(1-\frac{2}{m}\right)$

(c) e(m – 2) (d) $e\left(\frac{2}{m}-1\right)$

Note : Notations have usual meaning

17. The intensity of stress which causes unit strain is called

(a) Unit stress (b) Modulus of rigidity

(c) Bulk modulus (d) Modulus of elasticity

18. A composite bar fixed at both ends made up of steel and copper bars of equal lengths are heated through 100°C. The stresses developed shall be

(a) Tensile in both the materials

(b) Tensile in steel and compressive in copper

(c) Compressive in steel and tensile in copper

(d) Compressive in both the materials

19. Limit of proportionality depends on

(a) Area of cross-section

(b) Type of loading

(c) Type of material

(d) All of the above

20. Percentage reduction of area in performing tensile test on cast iron may be of the order of

(a) 50% (b) 25%

(c) 0% (d) 15%

21. Ductility of which of the following is maximum?

(a) Mild steel (b) Cast iron

(c) Wrought iron (d) Pig iron

22. Elasticity of a M.S. specimen is defined by

(a) Hooke's law (b) Yield point

(c) Plastic flow (d) Proof stress

23. In a uniform bar supported at one end in position, the maximum stress under self weight of bar shall occur at the

(a) Middle of bar (b) Supported end

(c) Bottom end (d) None of the above

24. Temperature at which uncontrollable creep occurs is called

(a) Homologous temperature

(b) Homophobic temperature

(c) Halophobic temperature

(d) None of these

25. During the tensile test of a glass rod the nature of stress-strain curve is

(a) Straight and dropping

(b) Sudden break

(c) Straight line

(d) Parabolic

26. Order of strength in ductile material

(a) Tensile < shear < compressive

(b) Shear < Tensile < Compressive

(c) Compressive < Shear < Tensile

(d) Shear < Compressive < Tensile

27. Strain Rossettes are used to

(a) Produce strains for testing purpose

(b) Relieve strain in heavily loaded components

(c) Measure strain

(d) Analyse property of materials

28. Poisson's ratio for cork is

(a) 0 (b) 0.2

(c) 0.25 (d) None of the above

29. Longitudinal strain for a specimen is 0.01 and $\mu = 0.25$ it is found to undergo 1 mm change in its thickness. Its thickness will be

(a) 100 mm (b) 200 mm

(c) 400 mm (d) 800 mm

30. Tensile test is carried on _____ materials.

(a) Brittle (b) Malleable

(c) Ductile (d) Plastic

31. Ratio of elongation in a prismatic bar due to its own weight (W) as compared to another similar bar carrying an additional weight (W) will be

(a) 1 : 2 (b) 1 : 3

(c) 1 : 4 (d) 1 : 25

32. A vertical hanging bar of length l weight w kg/unit length and carries a load W at bottom. Tensile force at distance y from the support in the bar will be

(a) $W + w(l - y)$ (b) W

(c) $W + wl$ (d) $(w + W)\frac{y}{l}$

33. A non-yielding support implies that the

(a) Support is frictionless

(b) Support can take any amount of reaction

(c) Support holds member firmly

(d) Slope of the beam at the support is zero

34. Material which exhibit the same elastic properties at two different position is called

(a) Homogeneous (b) Inelastic

(c) Isotropic (d) Anisotropic

35. If a part is constrained to move and heated, it will develop

(a) Principal stress

(b) Tensile stress

(c) Compressive stress

(d) Shear stress

36. Most elastic material is

(a) Rubber (b) Plastic

(c) Brass (d) Steel

37. The value of modulus of elasticity for mild steel is of the order of

(a) 2.1×10^6 kg/cm^2

(b) 2.1×10^8 kg/cm^2

(c) 2.1×10^7 kg/cm^2

(d) 0.1×10^6 kg/cm^2

38. Number of independent elastic constant for an isotropic, homogeneous and elastic material obeying Hooke's law is

(a) 1 (b) 2

(c) 5 (d) 6

39. Two bars of copper and steel are heated. The ratio of expansion in copper and steel will be

(a) 1.33 (b) 0.5

(c) 2.0 (d) 2.5

40. Two bars have same width but one bar has double the depth of the other. The elastic stress of double depth bar compared to the other bar will be

(a) Four times (b) Half

(c) Eight times (d) Same

41. Proof resilience per unit volume of a material is known as

(a) Resilience (b) Proof resilience

(c) Toughness (d) Modulus of resilience

42. The elongation produced in a tapered shaft with end diameters d_1 and d_2 due to tensile or compressive axial load is proportional to

(a) $d_1 + d_2$ (b) $\frac{1}{d_1 + d_2}$

(c) $d_1 d_2$ (d) $\frac{1}{d_1 d_2}$

43. The deformation per unit length is called

(a) Tensile stress

(b) Compressive stress

(c) Shear stress

(d) Strain

[KPSC-JE, Punjab JE. - 2014]

44. A rectangular bar having cross section A, length L, modulus of elasticity E and Poisson's ratio 1/m, is subjected to axial pull of P. The volumetric strain will be given by :

(a) $\frac{PL}{AE}\left(1-\frac{2}{m}\right)$ (b) $\frac{P}{AE}\left(1-\frac{2}{m}\right)$

(c) $\frac{PL}{AE}\left(1-\frac{1}{m}\right)$ (d) $\frac{P}{AE}\left(1-\frac{1}{m}\right)$

[RPSC-VPITI - 2016]

45. The value of Poisson's ratio of the materials lie between: –

(a) 1 and 2 (b) 0 and 1/2

(c) 0 and 1 (d) 2 and 3

[RPSC-VPITI - 2016]

46. The value of stress up to which a member regains its original shape or size after load removal is called :

(a) Elastic limit (b) Proportional Limit

(c) Yield stress (d) Plastic limit

[RPSC-VPITI - 2016]

47. The stress above which a material fractures under large number of reversals of stress is called

(a) Creep (b) Ultimate strength

(c) Endurance limit (d) Residual stress

[RPSC, HPSC - 2014]

48. In a simple tension test, Hooke's law is valid up to the :

(a) Limit of proportionality

(b) Breaking point

(c) Ultimate point

(d) Yield point

[RPSC ACF - 2011, PEB-SUB ER. - 2017]

49. The ratio of young's modulus to modulus of rigidity for a material having poisson's ratio 0.2 is

(a) 2 (b) 2.4

(c) 2.8 (d) 3

50. The ratio of maximum load to the original area of cross-section is

(a) Strain (b) Ultimate stress

(c) Young's modulus (d) Unit stress

51. Choose the correct answer :

The ratio of shear stress and shear strain of an elastic material is

(a) Modulus of rigidity

(b) Shear modulus

(c) Young's modulus

(d) Both (a) and (b)

52. The ratio of longitudinal stress to longitudinal strain within elastic limit is known

(a) Target modulus of elasticity

(b) Bulk modulus of elasticity

(c) Shear modulus of elasticity

(d) Modulus of elasticity

[PEB-SUB ER. - 2017]

53. Proof Resilience is the

(a) Maximum energy stored at elastic limit of a material

(b) Minimum energy stored at elastic limit of a material

(c) Average energy stored at elastic limit of a material

(d) None of these

[GESCOM - AE]

54. Some structural members subjected to long time sustained loads deform progressively with time especially at elevated temperatures. What is such a phenomenon called?

(a) Fatigue (b) Creep

(c) Creep relaxation (d) Fracture

[KPSC - AE]

55. The ratio of total elongation of a bar of uniform cross-section produced under its own weight to the elongation produced by an external load equal to the weight of the bar is

(a) 1/4 (b) 1/2

(c) 1 (d) 2

[KPSC - AE]

56. Compressive test is carried on

(a) Ductile (b) Brittle

(c) Plastic (d) Malleable

57. The length, coefficient of thermal expansion and Young's modulus of bar 'A' are twice that of bar 'B' if the temperature of both bars is increased by the same amount while preventing any expansion, then the ratio of stress developed in bar A to that in bar B will be

(a) 2 (b) 4

(c) 8 (d) 16

[KPSC - AE]

58. A composite system where the components are of equal lengths is subjected to temperature rise. Which one of the following stresses will be developed in the component having highest coefficient of linear expansion?

(a) Compressive stress

(b) Tensile Stress

(c) Shear stress

(d) Zero stress

[KPSC - AE]

59. The stress necessary to initiate yielding is significantly

(a) Higher than that necessary to continue the same

(b) Lesser than that necessary to continue the same

(c) Higher than that necessary to stop the same

(d) Lesser than that necessary to stop the same

[KPSC - AE]

60. The value of the stress induced in a body, when it is suddenly loaded, is _____ times the stress induced when the same load is applied gradually.

(a) Equal to zero (b) One half

(c) Twice (d) Six times

[KPSC - JE, ISRO - 2013]

61. Hooke's law refer to stress and strain in the body holds true upto

(a) Elastic limit (b) Yield point

(c) Plastic limit (d) Breaking point

[KPSC - JE]

62. Ratio of lateral strain to linear strain is called _____

(a) Modulus of elasticity

(b) Modulus of rigidity

(c) Bulk modulus

(d) Poisson's ratio

[MPSC - 2012, KPSC-JE, GETCL - 2015]

63. Volumetric strain is defined as _____.

(a) $\frac{\partial V}{V}$ (b) $\frac{U}{\delta V}$

(c) $\frac{m}{\delta V}$ (d) $\frac{\delta V}{m}$

[KPSC-JE]

64. All forces meeting at a point are _____

(a) Concurrent (b) Non-concurrent

(c) Coplanar (d) Non-coplanar

[KPSC-JE]

65. Which of the following statements is true?

(a) Poisson's ratio of a metal is 1.2

(b) Unit of strain is mm.

(c) Product of modulus of elasticity and moment of inertia is flexural rigidity.

(d) For safety, factor of safety is less than 1.

[KPSC-JE]

66. When is the stress caused by a load transferred through one surface to another surface in contact called?

(a) Tensile stress (b) Transitive stress

(c) Shearing stress (d) None of the above

[KPSC-JE]

67. Stress is defined as

(a) Force per unit area

(b) Force per unit length

(c) Force per unit volume

(d) None of the above

[KPSC-JE]

68. What is the phenomenon of slow extension of materials having constant load, i.e. Increasing with the time called?

(a) Creeping (b) Yielding

(c) Breaking (d) None of these

[KPSC-JE]

69. The relationship between modulus of elasticity (E) and Bulk Modulus (k) and Poisson's ratio (μ) is

(a) $E = 3k(1-2\mu)$ (b) $E = 3k(1+2\mu)$

(c) $E = 3k(1-\mu)$ (d) $E = 3k(1+\mu)$

[PHED-RAJ., LMRC - 2018]

70. The material that has same properties in all directions is called

(a) Homogenous (b) Isotropic

(c) Elastic (d) Orthotropic

[RPSC ACF - 2011, PHED-RAJ.]

71. The relation between, E, G and K is where E-Young's modulus, G - modulus of rigidity, K - bulk modulus

(a) $E = \frac{G+3K}{3GK}$ (b) $E = \frac{3G+K}{9GK}$

(c) $E = \frac{G+3K}{9GK}$ (d) $E = \frac{9GK}{G+3K}$

72. Materials are generally classified as brittle if the percentage of elongation is less than

(a) 5% (b) 15%

(c) 25% (d) 40%

73. Energy stored in a material during its deformation is known as

(a) Elastic energy (b) Plastic energy

(c) Strain energy (d) Potential energy

74. If a composite bar of steel and brass is heated, then the brass bar will be under

(a) Tension (b) Compression

(c) Shear (d) Torsion

75. When a tensile or compressive force (P) acts on a body. If E is the young's modulus, A is cross-sectional area and l is the length, then the change in its length is given by

(a) $\frac{Pl}{AE}$ (b) $\frac{AE}{Pl}$

(c) $\frac{PE}{Al}$ (d) $\frac{PA}{lE}$

76. The rigidity modulus G, in terms of modulus of elasticity E and Poisson's ratio $\frac{1}{m}$ is given by

(a) $G = \frac{E}{2\left(1+\frac{1}{m}\right)}$ (b) $G = \frac{2E}{\left(1+\frac{1}{m}\right)}$

(c) $G = \frac{E}{2\left(1-\frac{1}{m}\right)}$ (d) $G = \frac{E}{\left(1-\frac{1}{m}\right)}$

77. For a given system of coplanar concurrent force, if $\Sigma Fx = -20$ N and $\Sigma Fy = -20$ N, then

(a) $R = -20\sqrt{2}$ N and $\alpha = 45°$ with east

(b) $R = +20\sqrt{2}$ N and $\alpha = 135°$ with east

(c) $R = 20\sqrt{2}$ N and $\alpha = 225°$ with east

(d) $R = -20\sqrt{2}$ N and $\alpha = 315°$ with east

[TSPSC-AE - 2015]

78. If σ and E for a body of volume 2×10^5 mm^3 are 10 N/mm^2 and 1×10^5 N/mm^2, resilience of the body is

(a) 10 N-mm (b) 20 N-mm

(c) 100 N-mm (d) 200 N-mm

[TSPSC-AE - 2015]

79. The unit for modulus of resilience is

(a) Joule (b) Joule/mm

(c) Joule/mm^2 (d) Joule/mm^3

[TSPSC-AE - 2015]

80. Calculate the maximum stress acting on the cross-section of following element :

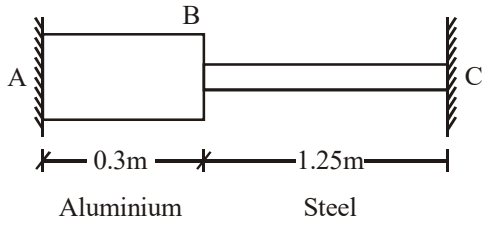
Take $P_1 = 45$ kN, $P_2 = 445$ kN and $P_4 = 130$ kN.

(a) 20 N/mm^2 (b) 22.5 N/mm^2

(c) 28.75 N/mm^2 (d) 6.5 N/mm^2

[MPSC - 2012]

81. At room temperature the rods are shown in figure. When temperature is raised, what is the nature of stresses developed in each rod, if $E_{Al} < E_s$ and $\alpha_{Al} > \alpha_s$?



Supports are unyielding

Aluminium	Steel
dia = 20 mm	dia = 10 mm

(a) Compressive in aluminium and steel

(b) Tensile in aluminium and steel compressive

(c) Compressive in aluminium and tensile in steel

(d) Tensile in aluminium and compressive in steel

[MPSC - 2012]

82. Bulk Modulus is defined as the ratio of normal stress to _____.

(a) Compressive Strain

(b) Normal Strain

(c) Volumetric Strain

(d) Shear Strain

[Haryana JE - 2018]

83. The property of a material by which it can be beaten or rolled into thin plates, is called

(a) Malleability (b) Ductility

(c) Plasticity (d) Elasticity

[ISRO - 2015]

84. Limiting value of Poisson's ratio are :

(a) –1 and 0.5 (b) 1 and 0.5

(c) 0 and 0.5 (d) None of these

[NBCC - 2017]

85. In general brittle materials have adequate resistance to

(a) Compression (b) Bending

(c) Tension (d) Impacts

[Chandigarh JE - 2016]

86. As the elastic limit reaches, tensile strain

(a) Increases more rapidly

(b) Decreases more rapidly

(c) Increases in proportion to the stress

(d) Decreases in proportion to the stress

[Chandigarh JE - 2016]

87. The forces which do not meet at one point and their lines of action do not lie on the same plane are known as

(a) Coplanar concurrent forces

(b) Coplanar non-concurrent forces

(c) Non-coplanar concurrent forces

(d) None of these

[Chandigarh JE - 2016]

88. Find the intensity of stress if a steel rod of 26.9 mm diameter and 4.5 m long is subjected to an axial pull of 55 kN :

(a) 96.77 N/mm^2 (b) 97.77 N/mm^2

(c) 98.77 N/mm^2 (d) 99.77 N/mm^2

[SSC JE - 2016]

89. When a body is elastically stretched, the value of poisson's ratio always remains

(a) Greater than one (b) Less than one

(c) Equal to one (d) None of these

[ISRO - 2018]

90. _____ materials are capable of absorbing large amount of energy prior to fracture.

(a) Elastic (b) Plastic

(c) Ductile (d) Brittle

[Haryana JE - 2018]

91. The loads which tend to increase the length of the body is called

(a) Tensile loads (b) Shearing loads

(c) Bending loads (d) Torsional loads

[Haryana JE - 2018]

92. The ratio of decrease in length to original length is

(a) tensile strain (b) compressive strain

(c) shear strain (d) volumetric strain

[Haryana JE - 2018]

93. Cup and cone failure occurs in

(a) Tensile test

(b) Compressive test

(c) Shear test

(d) All of the above

94. Modulus of rigidity is the ratio of

(a) Linear stress to lateral strain

(b) Lateral strain to linear strain

(c) Linear stress to linear strain

(d) Shear stress to shear strain

[AEC - 2017, ISRO - 2017]

95. Two bars of different materials and same size are subjected to the same tensile force. If the bars have unit elongation in the ratio of 3:5, then the ratio of modulus of elasticity of the two materials will be

(a) 2:5 (b) 3:5

(c) 5:3 (d) 3:4

[ISRO - 2017]

96. Modular ratio of the two materials is the ratio of

(a) Linear stress to linear strain

(b) Shear stress to shear strain

(c) Their modulus of elasticity's

(d) Their modulus of rigidities

[ISRO - 2017]

97. The young's modulus of a material is 150 GPa and Poisson's ratio is 0.25, the modulus of rigidity of the material is

(a) 30 GPa (b) 50 GPa

(c) 60 GPa (d) 100 GPa

[ISRO - 2017]

98. The maximum value of Poisson's ratio for an elastic material is

(a) 0.25 (b) 0.5

(c) 0.75 (d) 0.1

[GETCL - 2015]

99. Under compression loading, what would the area under the stress-strain curve represent?

(a) Elasticity of the material

(b) Fatigue

(c) Breaking stress of the material

(d) Energy required to cause failure

[Coal India - 2017]

100. A bar 40 mm in diameter is subjected to an axial load of 4 kN. The extension of bar for the gauge length 200 mm is 0.003 mm. The decrease in diameter is 0.00018 mm. The Poisson's ratio will be

(a) 0.25 (b) 0.30

(c) 0.33 (d) 0.35

[PMB JE - 2018]

101. In a particular material, if modulus of rigidity is equal to bulk modulus, then Poisson's ratio will be

(a) 1/8 (b) 1/4

(c) 1/2 (d) 1

[PMB JE - 2018]

102. If a composite bar of steel and copper is heated, the copper bar will be under …

(a) Tension (b) Compression

(c) Shear (d) Torsion

[RPSC ACF - 2011]

103. Poisson's ratio a involving …

(a) Elastic Modulus (b) Stresses

(c) Strains (d) None of these

[RPSC ACF - 2011]

104. The necessary condition for equilibrium of body is

(a) $\Sigma H = 0$ (b) $\Sigma V = 0$

(c) $\Sigma M = 0$ (d) All of the above

[RPSC ACF - 2011]

105. A bar 40 mm in diameter and subjected to a tensile force of 40,000 kgs. Undergoes elongation resulting in decrease in diameter, considering the properties of the material as $E = 2\times10^5$ N/mm^2 and Poisson's ratio μ as 0.3, the modulus of rigidity will be :

(a) 76923.07 N/mm^2 (b) 41254.32 N/mm^2

(c) 56898.50 N/mm^2 (d) 86232.11 N/mm^2

[ISRO - 2013]

106. Two circular mild steel bars A and B of equal lengths have diameters 2 cm and 3 cm respectively. Each is subjected to a tensile load of magnitude T. The ratio of elongations of the bars l_A/l_B is

(a) 2/3 (b) 5/8

(c) 9/4 (d) 2/5

[ISRO - 2013]

107. A rod of uniform cross-section A and length L is deformed by δ, when subjected to a normal force P. The young's modulus E of the material is,

(a) $E = \frac{P.\delta}{A.L}$ (b) $E = \frac{A.\delta}{P.L}$

(c) $E = \frac{P.L}{A.\delta}$ (d) $E = \frac{A.L}{P.\delta}$

[ISRO - 2013]

108. The principle of superposition states that the total deflection of a structure under different sets of loads is equal to the sum of deflections under each set of loads acting separately on the structure if the loads are within,

(a) Elastic limit

(b) Limit State

(c) Proportionality limit without buckling

(d) Elastic limit including buckling

[HPSC AE - 2010]

109. For a given material Young's modulus is 200 GN/m^2 and modulus of rigidity is 80 GN/m^2. The value of Poisson's ratio is

(a) 0.15 (b) 0.20

(c) 0.35 (d) 0.25

[HPSC AE - 2010]

110. A bar L meter long and having its area of cross section A, is subjected to a gradually applied tensile load W. The strain energy stored in the bar is

(a) $\frac{WL}{2AE}$ (b) $\frac{WL}{2AE}$

(c) $\frac{W^2L}{AE}$ (d) $\frac{W^2L}{2AE}$

[HPSC AE - 2010]

ANSWERS AND EXPLANATIONS

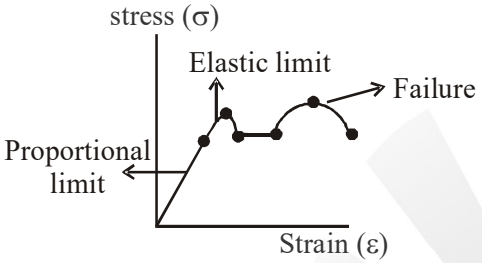
1. ***Ans. (d)***

Rupture stress is defined as the ratio of load at breaking point/neck area.

2. ***Ans. (d)***

Elasticity of various materials is controlled by its stress at elastic limit.

3. ***Ans. (a)***



4. ***Ans. (b)***

$$\text{Bulk modulus} = \frac{\text{direct stress}}{\text{volumetric strain}}$$

5. ***Ans. (c)***

If a material expands freely due to heating it will develop no stress because there is no resistive force.

6. ***Ans. (d)***

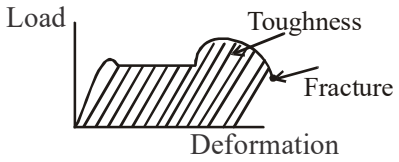
Unit of modulus of elasticity = N/mm^2

Stress unit $\rightarrow$ N/mm^2

Pressure unit $\rightarrow$ N/mm^2

Modulus of rigidity unit $\rightarrow$ N/mm^2

7. ***Ans. (b)***



8. ***Ans. (b)***

9. ***Ans. (b)***

10. ***Ans. (c)***

11. ***Ans. (d)***

12. ***Ans. (b)***

$$E = 3K(1-2\mu)$$

$$E = 2G(1+\mu)$$

$$3K(1-2\mu) = 2G(1+\mu)$$

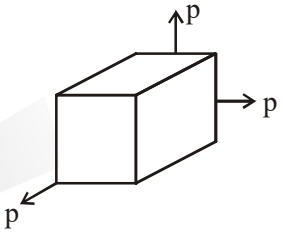
$$3K - 2G = \mu(2G+6K)$$

$$\frac{3K-2G}{2G+6K} = \mu = \frac{1}{m}$$

13. ***Ans. (d)***

14. ***Ans. (a)***

15. ***Ans. (c)***



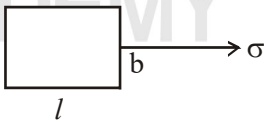
$$\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z \quad [\because \varepsilon_x = \varepsilon_y = \varepsilon_z]$$

$$= 3\left[\frac{p}{E} - \frac{\mu p}{E} - \frac{\mu p}{E}\right]$$

$$= 3\left[\frac{p}{E} - 2\mu\frac{p}{E}\right]$$

$$= \frac{3p}{E}[1-2\mu]$$

16. ***Ans. (b)***



$$\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z$$

$$= \frac{\sigma}{E} - \frac{\mu\sigma}{E} - \frac{\mu\sigma}{E}$$

$$= \frac{\sigma}{E} - \frac{2\mu\sigma}{E}$$

$$= \varepsilon(1-2\mu)$$

17. ***Ans. (d)***

$$E = \frac{\sigma}{\varepsilon}$$

When, $\varepsilon = 1 \Rightarrow \sigma = E$

18. ***Ans. (b)***

19. ***Ans. (c)***

20. ***Ans. (c)***

21. ***Ans. (a)***

22. ***Ans. (a)***

23. ***Ans. (b)***

24. ***Ans. (a)***

25. ***Ans. (b)***

26. ***Ans. (b)***

27. ***Ans. (c)***

28. ***Ans. (a)***

29. ***Ans. (c)***

$$\mu\varepsilon_L = \varepsilon_t$$

$$0.25 \times 0.01 = \frac{1}{t}$$

$$t = \frac{1}{0.25 \times 0.01} = 400 \text{ mm.}$$

30. ***Ans. (c)***

31. ***Ans. (b)***

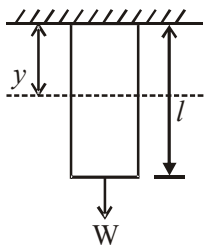
$$\Delta_1 = \Delta_{\text{self weight}} = \frac{\gamma L^2}{2E} = \frac{WL}{2AE}$$

$$\Delta_2 = \Delta_{\text{self weight}} + \Delta_{\text{additional weight}}$$

$$= \frac{WL}{2AE} + \frac{WL}{AE} = \frac{3}{2}\frac{WL}{AE}$$

$$\frac{\Delta_1}{\Delta_2} = \frac{\frac{WL}{2AE}}{\frac{3}{2}\frac{WL}{AE}} = \frac{1}{3}$$

32. ***Ans. (a)***



$F_T = W + w(l - y)$

33. ***Ans. (c)***

34. ***Ans. (a)***

35. ***Ans. (c)***

36. ***Ans. (d)***

37. ***Ans. (a)***

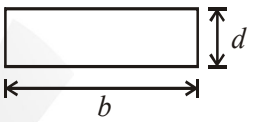
38. ***Ans. (b)***

No. of independent elastic constant = 2

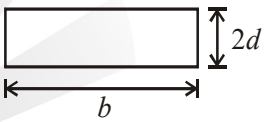
39. ***Ans. (a)***

$$\frac{\Delta_C}{\Delta_S} = \frac{L\alpha_C \Delta T}{L\alpha_S \Delta T} = \frac{\alpha_C}{\alpha_S} = \frac{17 \times 10^{-6}}{13 \times 10^{-6}} = 1.31$$

40. ***Ans. (b)***



$P = \sigma_1 \times A_1$



$P = \sigma_2 \times A_2$

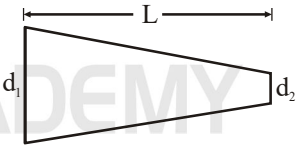
$$\sigma_1 \times b \times d = \sigma_2 \times b \times 2d$$

$$\boxed{\frac{1}{2} = \frac{\sigma_2}{\sigma_1}}$$

41. ***Ans. (d)***

Proof resilience per unit volume of a material is known as modulus of resilience.

42. ***Ans. (d)***



Elongation $(\delta l) = \frac{4PL}{\pi E d_1 d_2}$

43. ***Ans. (d)***

The deformation per unit length is called strain,

$$\text{strain} = \frac{\Delta}{L}$$

44. ***Ans. (b)***

45. ***Ans. (b)***

For engineering material $\rightarrow 0 \le \mu \le 0.5$

46. ***Ans. (a)***

47. ***Ans. (c)***

48. ***Ans. (a)***

49. ***Ans. (b)***

$$E = 2G \times (1 + \mu)$$

$$\frac{E}{G} = 2 \times (1 + \mu)$$

$$= 2 \times (1 + 0.2)$$

$$= 2.4$$

50. ***Ans. (b)***

51. ***Ans. (d)***

$$\text{Modulus of rigidity} = \frac{\text{Shear stress}}{\text{Shear strain}}$$

52. ***Ans. (d)***

$$\text{Modulus of elasticity} = \frac{\text{longitudinal stress}}{\text{longitudinal strain}}$$

53. ***Ans. (a)***

54. ***Ans. (b)***

55. ***Ans. (b)***

$$\frac{\frac{WL}{2AE}}{\frac{WL}{AE}} = \frac{1}{2}$$

56. ***Ans. (b)***

57. ***Ans. (b)***

$$\text{Strain}_A = \alpha_A \Delta T$$

$$\text{Strain}_B = \alpha_B \Delta T$$

$$\sigma_A = E_A \times \text{strain}_A$$

$$= E_A \times \alpha_A \times \Delta T$$

$$\sigma_B = E_B \times \alpha_B \times \Delta T$$

$$\frac{\sigma_A}{\sigma_B} = \frac{E_A \times \alpha_A \times \Delta T}{E_B \times \alpha_B \times \Delta T}$$

Since, $\alpha_A = 2\alpha_B$ and $E_A = 2E_B$

$$= \frac{2E_B \times 2\alpha_B \times \Delta T}{E_B \times \alpha_B \times \Delta T} = 4$$

58. ***Ans. (a)***

59. ***Ans. (a)***

60. ***Ans. (c)***

The value of the stress induced in a body, when it is suddenly loaded is two times the stress induced when the same load is applied gradually.

61. ***Ans. (a)***

Hooke's law holds true upto elastic limit

62. ***Ans. (d)***

$$\text{Poisson's ratio} = -\frac{\text{lateral strain}}{\text{linear strain}}$$

63. ***Ans. (a)***

$$\text{Volumetric strain} = -\frac{\text{Change in volume}}{\text{Original volume}}$$

64. ***Ans. (a)***

65. ***Ans. (c)***

66. ***Ans. (c)***

67. ***Ans. (a)***

$$\text{Stress} = \frac{\text{Force}}{\text{Area}}$$

68. ***Ans. (a)***

69. ***Ans. (a)***

70. ***Ans. (b)***

71. ***Ans. (d)***

$$E = 2G(1 + \mu)$$

$$E = 3K(1 - 2\mu)$$

$$2G(1 + \mu) = 3K(1 - 2\mu)$$

$$2G + 2G\mu = 3K - 6K\mu$$

$$2G - 3K = (-2G - 6K)\mu$$

$$\mu = \frac{2G - 3K}{-(2G + 6K)} = \frac{3K - 2G}{6K + 2G}$$

$$E = 2G\left(1 + \frac{3K - 2G}{6K + 2G}\right)$$

$$= 2G\left[\frac{6K + \cancel{2G} + 3K - \cancel{2G}}{6K + 2G}\right]$$

$$= \frac{\cancel{2}G(9K)}{\cancel{2}(3K + G)} = \frac{9KG}{3K + G}$$

72. ***Ans. (a)***

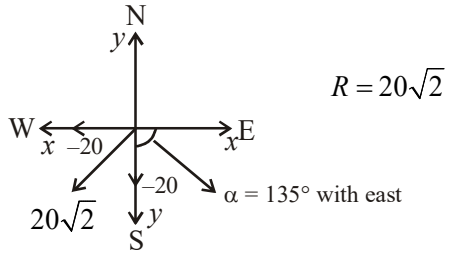
73. ***Ans. (c)***

74. ***Ans. (b)***

75. ***Ans. (a)***

76. ***Ans. (a)***

77. ***Ans. (b)***



$R = 20\sqrt{2}$

78. ***Ans. (c)***

$$\text{Strain energy} = \frac{\sigma^2}{2\times E}\times \text{Volume}$$

$$= \frac{10^2}{2\times 1\times 10^5}\times 10^5$$

$$= 100 \text{ N-mm}$$

79. ***Ans. (d)***

80. ***Ans. (a)***

$$\Sigma f_x = 0$$

$$P_1 + P_3 = P_2 + P_4$$

$$P_3 = 530 \text{ kN}$$

$$\text{Net load at section of } P_2 = 445 - 45$$

$$= 400 \text{ kN}$$

$$\text{Maximum stress} = \frac{400\times 1000}{200\times 100}$$

$$= 20 \text{ N/mm}^2$$

81. ***Ans. (a)***

82. ***Ans. (c)***

83. ***Ans. (a)***

84. ***Ans. (a)***

85. ***Ans. (a)***

86. ***Ans. (a)***

87. ***Ans. (d)***

88. ***Ans. (a)***

$$D = 26.9 \text{ mm}$$

$$L = 4.5 \text{ m}$$

$$\text{Axial pull} = 55 \text{ kN}$$

$$\text{Tension intensity} = \sigma = \frac{55000}{\frac{\pi}{4}\times (26.9)^2}$$

$$= 96.7761$$

89. ***Ans. (b)***

90. ***Ans. (c)***

91. ***Ans. (a)***

92. ***Ans. (b)***

93. ***Ans. (a)***

94. ***Ans. (d)***

$$\text{Modulus of rigidity} = \frac{\text{shear stress}}{\text{shear strain}}$$

95. ***Ans. (c)***

$$\frac{\Delta L_1}{\Delta L_2} = \frac{3}{5}$$

$$\frac{\frac{PL}{AE_1}}{\frac{PL}{AE_2}} = \frac{3}{5}$$

$$\frac{E_2}{E_1} = \frac{3}{5}$$

$$\frac{E_1}{E_2} = \frac{5}{3}$$

96. ***Ans. (c)***

97. ***Ans. (c)***

$$G = \frac{E}{2(1+\mu)} = \frac{150}{2\times(1+0.25)}$$

$$= 60 \text{ GPa}$$

98. ***Ans. (b)***

99. ***Ans. (d)***

100. ***Ans. (b)***

$$\frac{\Delta d}{d} = \mu\frac{\Delta L}{L}$$

$$\frac{0.00018}{40} = \mu\times\frac{0.003}{200}$$

$$\mu = 0.30$$

101. ***Ans. (a)***

$$G = k$$

$$\Rightarrow \quad \frac{E}{2(1+\mu)} = \frac{E}{3(1-2\mu)}$$

$$\Rightarrow \quad 2 + 2\mu = 3 - 6\mu$$

$$\Rightarrow \quad 8\mu = 1$$

$$\Rightarrow \quad \mu = \frac{1}{8}$$

102. ***Ans. (b)***

103. ***Ans. (c)***

104. ***Ans. (d)***

105. ***Ans. (a)***

$$G = \frac{E}{2(1+\mu)}$$

$$G = \frac{2\times10^5}{2(1+0.3)}$$

$$G = 76923.07 \text{ N/mm}^2$$

106. ***Ans. (c)***

$$\Delta l_1 = \frac{T\times l}{\frac{\pi}{4}\times(2)^2\times E},$$

$$\Delta l_2 = \frac{T\times l}{\frac{\pi}{4}\times(3)^2\times E}$$

$$\frac{\Delta l_1}{\Delta l_2} = \frac{\frac{Tl}{\frac{\pi}{4}\times E\times 2^2}}{\frac{Tl}{\frac{\pi}{4}\times E\times 3^2}}$$

$$\frac{\Delta l_1}{\Delta l_2} = \frac{9}{4}$$

107. ***Ans. (c)***

$$\delta = \frac{PL}{AE}$$

$$\Rightarrow \quad E = \frac{PL}{A\delta}$$

108. ***Ans. (a)***

109. ***Ans. (d)***

$$E = 2G(1+\mu)$$

$$200 = 2\times 80(1+\mu)$$

$$\mu = \frac{200}{2\times80} - 1$$

$$\mu = 0.25$$

110. ***Ans. (d)***

$$U = \frac{1}{2}\times W\times\delta$$

$$U = \frac{1}{2}\times W\times\frac{WL}{AE}$$

$$U = \frac{W^2L}{2AE}$$

111. ***Ans. (b)***

112. ***Ans. (b)***

113. ***Ans. (b)***

$$\Delta_{\text{self weight}} = \frac{WL}{2AE}$$

$$\Delta_{\text{load}} = \frac{PL}{AE}$$

$$\text{Total elongation} = \frac{WL}{2AE} + \frac{PL}{AE}$$

114. ***Ans. (c)***

115. ***Ans. (c)***

116. ***Ans. (c)***

117. ***Ans. (d)***

118. ***Ans. (c)***