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Tonk Road, Pratap Nagar, Jaipur (Rajasthan)-302033
E-Mail : engineers.academy.india@gmail.com
Website : www.engineersacademy.org
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UNIT-I

STRENGTH OF MATERIALS

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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 + w*l* (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) $\dfrac{1}{d_1 + d_2}$

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

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

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

[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]

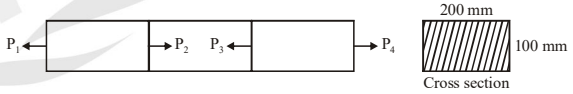
79. The unit for modulus of resilience is

(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 :



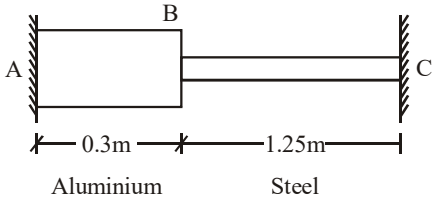
Take $P_1 = 45$ kN, $P_2 = 445$ kN and $P_4 = 130$ kN.

(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 dia = 20 mm Steel 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) $\frac{WL^2}{2AE}$

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

[HPSC AE - 2010]

111. A cantilever beam of tubular section consists of 2 materials, copper as outer cylinder and steel as inner cylinder. It is subjected to a temperature rise of 20°C and $\alpha_{copper} > \alpha_{steel}$. The stresses developed in the tubes will be

(a) Compression in steel and tension in copper

(b) Tension in steel and compression in copper

(c) No stress in both

(d) Tension in both the materials

[HPSC - 2014]

112. Consider following statements: The principle of superpositions is applied to

1. Linear elastic bodies
2. Bodies subjected to small deformations

Of these statements

(a) 1 alone is correct
(b) 1 and 2 are correct
(c) 2 alone is correct
(d) Neither 1 nor 2 is correct

[HPSC - 2014]

113. An elastic bar of length '*l*', cross sectional area 'A', young's modulus of elasticity 'E' and self- weight 'W' is hanging vertically. It is subjected to a load P applied axially at the bottom end. The total elongation of the bar is given by

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

(c) $\frac{WL}{2AE}+\frac{PL}{2AE}$ (d) $\frac{WL}{AE}+\frac{PL}{2AE}$

[HPSC - 2014]

114. The Poisson's ratio of a stable, isotropic, linear elastic material cannot be less than :

(a) 0.50 (b) 0.00
(c) –1.00 (d) –0.50

[DDA JE - 2018]

115. The area under the stress-strain curve for a material is usually used to estimate the ___.

(a) Fatigue of the material
(b) Energy required to cause a failure
(c) Toughness of the material
(d) Hardness of the material

[DDA JE - 2018]

116. Shear span is defined as the zone where:

(a) Bending moment is zero
(b) Shear force is zero
(c) Shear force is constant
(d) Bending moment is constant

[UKPSC AE - 2007]

117. Eccentricity is defined as the distance from the load to the

(a) Point of minimum stress
(b) Edge of the section
(c) Point of maximum stress
(d) Centre of the section

[Jharkhand SSC JE - 2016

118. The material of a rubber balloon has Poisson's ratio of 0.5. If uniform pressure is applied to blow the balloon, the volumetric strain of the material will be –

(a) 0.25 (b) 0.50
(c) Zero (d) 0.20

[RSMSSB-JE-2020]

119. The value of Poisson's ratios of the materials lie between

(a) 0 and 1 (b) 2 and 3
(c) 1 and 2 (d) 0 and 1/2

[RSMSSB-JE-2020]

120. The most useful geosynthetic physical property which is closely related to engineering performance is

(a) Thickness (b) Mass per unit area
(c) Strength (d) Stiffness

[UPPSC-AE-2020]

121. In terms of bulk modulus (K) and modulus of rigidity (C), the Poisson's ratio can be expressed as

(a) $\frac{3K-4C}{6K+4C}$ (b) $\frac{3K+4C}{6K-4C}$

(c) $\frac{3K-2C}{6K+2C}$ (d) $\frac{3K+2C}{6K-2C}$

[UPPSC-AE-2020]

122. A ductile structure is defined as one for which the plastic deformation before fracture

(a) is smaller than the elastic deformation
(b) vanishes
(c) is equal to the elastic deformation
(d) is much larger than elastic deformation

[UPPSC-AE-2020]

123. The diagram showing the variation of axial load along the span is called

(a) Shear force Diagram
(b) Bending moment diagram
(c) Thrust diagram
(d) Influence Line Diagram

[PHED-RAJ., PMB JE - 2018]

124. If P is the weight of a prismatic bar and L is its length, what is the deflection of the bar due to self weight if AE is the Axial Rigidity :

(a) PL/AE (b) 2PL/8E
(c) PL/8E (d) PL/2AE

[UPPCL JE - 2016]

125. The stress developed in a bar which is not free to expand due to increase in temperature, is given as :

(a) $p = \alpha tE$ (b) $p = \frac{\alpha}{tE}$

(c) $p = \frac{t}{\alpha E}$ (d) $p = \frac{E}{\alpha t}$

Where α is the coefficient of thermal expansion and t = temperature increased.

[RPSC-AE(Pre) : 2013]

126. A sample of a metal is tested in tension, and it is found that there is a strain of 0.0080 at a corresponding stress of 450 N/mm^2. On the removal of the load a permanent strain of 0.0015 is found to be present. The value of modulus of elasticity for the metal :

(a) 1.44×10^5 N/mm^2 (b) 1.77×10^5 N/mm^2

(c) 0.692×10^5 N/mm^2 (d) 0.30×10^5 N/mm^2

[RPSC(Vice Principal/Suptdt.)-2018]

127. A material which obeys Hooke's law is subjected to direct stress σ_0. At its elastic limit, which of the following statements is true ?

(a) Strain is equal to $\frac{\sigma_0}{E}$

(b) Maximum shear stress = $\frac{\sigma_0}{2}$

(c) Strain energy = $\left(\frac{\sigma_0^2}{2E}\right) \times$ Volume

(d) All option are correct

[NCL : 2020]

128. If the Young's modulus of elasticity of a material is twice its modulus of rigidity, then the Poisson's ratio of the material is

(a) 1 (b) –0.5

(c) 0.5 (d) None of these

[NCL : 2020]

129. A round steel bar of overall length 20 cm consists of two equal portion of 10 cm each having diameter of 4 cm and 5 cm respectively, if the rod is subjected to a tensile load of 10 tones then what will be the elongation (where modulus of elasticity E = 2×10^6 kg/cm^2) ?

(a) $\frac{1}{10\pi}\left[\frac{1}{25}+\frac{1}{16}\right]$ (b) $\frac{2}{10\pi}\left[\frac{1}{25}+\frac{1}{16}\right]$

(c) $\frac{3}{10\pi}\left[\frac{1}{25}+\frac{1}{10}\right]$ (d) $\frac{4}{10\pi}\left[\frac{1}{25}+\frac{1}{16}\right]$

[Junior Engineer]

130. ***Assertion (A) :*** Normal stress of one nature (compressive or tensile) acting along one of the three orthogonal axes of a member will produce strains of the same nature in its direction and strains of opposite nature along the other two directions.

Reason (R): Sum of the strains along the three orthogonal axes equals to the volumetric strains.

Of these statements:

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

(b) Both A and R are true but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

[GPSC-2019]

131. What would be the shape of the failure surface of a standard cast iron specimen subjected to torque?

(a) Cup and cone shape

(b) Plane surface perpendicular to the axis

(c) Pyramid type wedge shaped

(d) Helicoidal surface

[GPSC-2019]

132. A square steel rod 20 mm × 20 mm in section is to carry an axial load of 100 kN. Calculate the stress.

(a) 2,50,000 kN/m^2 (b) 1,50,000 kN/m^2

(c) 3,50,000 kN/m^2 (d) 4,50,000 kN/m^2

[CE : 25.02.2018 (Shift-2)]

133. Hooke's law equally holds good for:

(a) Tension as well as shear

(b) Tension as well as torsion

(c) Tension as well as compression

(d) Tension as well as bending

134. A steel rod 1.0 m long is subjected to a tensile force of 20 kN. Calculate the cross sectional area of rod, if it experiences an elongation of 1.5 mm. Take modulus of elasticity for the rod material is 200 Gpa.

(a) 66.66 mm^2 (b) 78.25 mm^2

(c) 96.11 mm^2 (d) 50.25 mm^2

135. A steel bar having cross sectional area of 100 π mm^2 is subjected to a tensile force of 40 kN. Determine the tensile stress.

(a) 200.05 MPa. (b) 175.25 MPa.

(c) 127.23 MPa (d) 150 MPa

136. A steel bar with a cross-sectional area of 2500 mm^2 is subjected to an axial pull of 150 kN. The extension over a gauge length of 100 mm is 0.05 mm and the decrease in each side is 0.00625 mm. calculate the poisson's ratio:

(a) 0.5 (b) 0.01

(c) 0.9 (d) 0.25

137. The ratio of Young's modulus of high tensile steel to that of mild steel is about:

(a) 1 (b) 1.5

(c) 0.5 (d) 2

138. Transverse shear load applied to a beam normally results in

(a) Normal stress only

(b) Shear stress only

(c) Normal and shear stress

(d) Axial stress only

[GPSC-2019]

139. The stress in a steel bar is given as 250000 kN/m^2 and length of the bar is 40 m. Calculate the shortening of the bar if E = 2.14 × 10^8 N/mm^2

(a) 0.305 mm (b) 0.250 mm

(c) 0.160 mm (d) 0.0467 mm

140. In steel bars having a well-defined yield plateau, yield stress is specified at:

(a) 0.2 percent proof stress

(b) 1 percent proof stress

(c) 0.1 percent proof stress

(d) 2 percent proof stress

141. Which of the following instrument is used to measure the deformation?

(a) Extensometer (b) Barometer

(c) Speedometer (d) Impact test apparatus

142. The resisting force parallel to the plane is known as _____.

(a) Pulling force (b) Shearing resistance

(c) Normal force (d) Pushing force

143. If a specimen is loaded beyond the elastic limit and then unloaded, a permanent strain is left in the specimen. This is known as _____.

(a) permanent Set (b) temporary set

(c) elongation set (d) formation set

144. The analysis procedure accepting Hooke's law is known as _____.

(a) Linear analysis (b) Parabolic analysis

(c) Curved analysis (d) Elliptical analysis

145. Find the minimum diameter of a steel wire, which is used to raise a load of 4000 N if the stress in the rod is not to exceed 95 MN/sq. meter.

(a) 3.54 mm (b) 10.40 mm.

(c) 7.32 mm (d) 5.47 mm

146. Axial force in a member is considered positive when it produces ____ in a member.

(a) strain (b) tension

(c) pressure (d) stress

147. Two rods of different materials having coefficient of linear expansion α_1, α_2, and Young's moduli E_1, E_2 respectively are fixed between to massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending to the rods. If $\alpha_1 : \alpha_2 = 2 : 3$, the thermal stress developed in the two rods are equal, what is the ratio of E_1 to E_2 ?

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

(c) 3 : 2 (d) 4 : 9

[JPSC AE]

148. The stress developed due to external force in an elastic material

(a) Depends on elastic constant

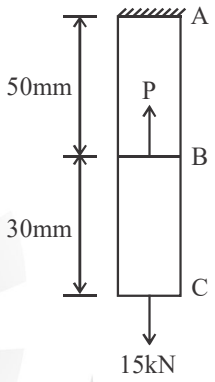
(b) Does not depend on elastic constant

(c) Depends partially on elastic constant

(d) Depends on limit of proportionality

[JPSC AE]

149. A steel bar ABC of uniform cross-section 100 mm^2 is suspended vertically and loaded as shown in the figure. If the lower end of bar C does not move when loads are applied (neglect Self-weight), then the value of force P is (E_s = 200 kN/mm^2)



(a) 24 kN (b) 42 kN

(c) 36 kN (d) 15 kN

[JPSC AE]

150. A steel rod of c/s area 100 mm^2 and 1 m long is subjected to a tensile force of 40 kN. What is the total elongation of the rod? If modulus of elasticity of steel is 200 GPa.

(a) 0.5 mm (b) 0.7 mm

(c) 1.2 mm (d) 2.0 mm

[UKSSSC Draftman 2017]

151. Due to external loading, the length of member is decreased by d*l*. The ratio of decrease in length to original length is called

(a) Intensity of stress (b) Compressive stress

(c) Shear strain (d) Compressive strain

[MPSC]

152. A bar of diameter 30 mm is subjected to a tensile load such that the measured extension on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0045 mm. Calculate the Poisson Ratio :

(a) $\frac{1}{3}$ (b) $\frac{1}{4}$

(c) $\frac{1}{5}$ (d) $\frac{1}{6}$

[MPSC]

153. The ability of the material to deform permanently under compression without breaking is called

(a) Malleability (b) Ductility

(c) Softness (d) hardness

[SJVN JE 2021]

154. The maximum limit of stresses which may be applied indefinitely large number of times without causing failure by fatigue is known as

(a) Endurance limit (b) Plastic limit

(c) Elastic limit (d) Stress limit

[SJVN JE 2021]

155. In a bar of length L, diameter D and cross-sectional area A, the strain produced is S under the action of load W. The Young's modulus of elasticity for the wire is

(a) W/DLS (b) WL/DS

(c) W/AS (d) SDA/WL

[SJVN JE 2021]

156. Identify the correct order in which the points appear in the stress-strain diagram for mild steel?

(a) Elastic limit, Limit of proportionality, Upper yield point, Ultimate stress point, Fracture point

(b) Limit of proportionality, Elastic limit, Upper yield point, Ultimate stress point, Fracture point

(c) Limit of proportionality, Upper yield point, Elastic limit, Ultimate stress point, Fracture point

(d) Elastic limit, Limit of proportionality, Upper yield point, Fracture point, Ultimate stress point

[Punjab SSSB]

157. A rod of length L and diameter D is subjected to a tensile load P. Which of the following is sufficient to calculate the resulting change in diameter ?

(a) Young's modulus

(b) Shear Modulus

(c) Poisson's ratio

(d) Young's modulus and shear modulus

[Pujab SDO 2021]

158. According to Hooke's law, A material is said elastic if it returns to it's original, unloaded dimensions when the load is removed. It can be expressed as :

(a) stress / strain = constant

(b) stress / strain = force

(c) stress + strain = constant

(d) stress – strain = constant

[Punjab JE]

159. What value of tensile stress is required to produce a strain of 10×10^{-4} in copper? Find the result in Mpa. (Assume Young's modulus of copper = 50 Gpa)

(a) 150 MPa (b) 50 MPa

(c) 200 MPa (d) 500 MPa

[Punjab JE]

160. A 58 kN compressive load is applied to a 7 cm diameter, 2 cm tall, aluminium cylinder. Calculate value of stress in MPa.

(a) 20.80 MPa (b) 16.50 MPa

(c) 15.08 MPa (d) 20.08 MPa

[Punjab JE]

161. A 10 inch long silver wire is stretched to total length of 11.50 inches. Find the value of strain.

(a) 0.015 (b) 0.15

(c) 0.25 (d) 0.025

[Punjab JE]

162. _____is a mechanical property of linear elastic solid materials which defines the relationship between stress and strain in a material.

(a) Poisson's ratio (b) Lateral modulus

(c) Bulk modulus (d) Young's modulus

[Punjab JE]

163. A rectangular steel bar; which is of 2.8 m long and 15 mm thick, is subjected to an axial tensile load of 40 kN. If width of the bar varies from 75 mm at one end to 30 mm at the end, then what is the extension of the bar if E = 2×10^6 N./mm^2 ?

(a) 0.076 nm (b) 0.50 mm

(c) 0.86 mm (d) 0.36 mm

[Punjab JE]

164. Given that an element in a body of homogeneous isotropic material subjected to plane stresses, ϵ_x, ϵ_y and ϵ_z are normal strains in x, y and z direction respectively and 'μ' is the Poisson's ratio, the magnitude of unit volume change of the element is given by

(a) $\epsilon_x + \epsilon_y + \epsilon_z$ (b) $\epsilon_x + \mu\ (\epsilon_y + \epsilon_z)$

(c) $\mu(\epsilon_x + \epsilon_y + \epsilon_z)$ (d) $\frac{1}{\epsilon_x}+\frac{1}{\epsilon_y}+\frac{1}{\epsilon_z}$

[PUDA Draftman 2013]

165. The modulus of elasticity for structural steel is normally

(a) 200000 N/sq. mm

(b) 100000 N/sq. mm

(c) 300000 N/sq. mm

(d) 400000 N/sq. mm

[OPSC AE 2015]

166. If the Poisson's ratio for a material is 0.5, then the elastic modulus for the material is :

(a) Three times its shear modulus

(b) Four times its shear modulus

(c) Equal to its shear modulus

(d) Not determinable

[JPSC AE]

ANSWERS AND EXPLANATIONS

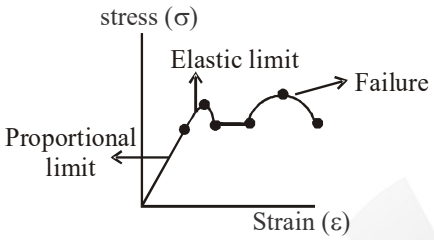
1. ***Ans. (d)***

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)***

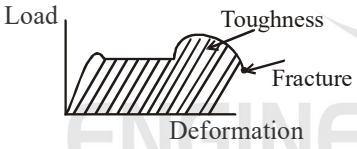
Unit of modulus of elasticity = N/mm^2

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)***

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

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

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

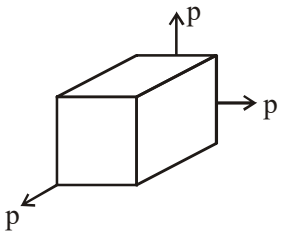
$$3K - 2G = \mu(2G+6K)$$

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

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

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

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



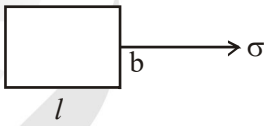
$$\varepsilon_v = \varepsilon_x + \varepsilon_y + \varepsilon_z \quad [\because \varepsilon_x = \varepsilon_y = \varepsilon_z]$$

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

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

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

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)***

144. ***Ans. (a)***

145. ***Ans. (c)***

$$\text{Stress} = \frac{P}{A}$$

$$95\times10^6\ \frac{N}{m^2} = \frac{4000N}{\frac{\pi}{4}(d)^2}$$

$$d = 7.32\ \text{mm}$$

146. ***Ans. (b)***

When the tensile force is subjected to the body, it gets elongated and its strain is positive.

147. ***Ans. (c)***

$$E = \frac{PL}{A\Delta\ell}$$

$$\frac{\Delta\ell}{L} = \alpha\Delta T$$

$$E = \frac{P}{A\alpha\Delta T}$$

$$P = EA\alpha\Delta T$$

$$E_1A\ \alpha_1\ \Delta T = E_2A\ \alpha_2\ \Delta T$$

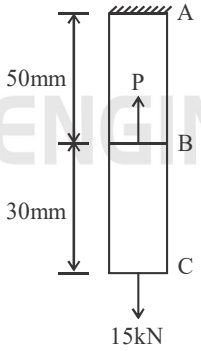
$$\frac{2}{3} = \frac{E_2}{E_1}$$

$$\frac{E_1}{E_2} = \frac{3}{2}$$

148. ***Ans. (d)***

The factors to determine the deformations produced by a stress system acting on the material with in elastic limits are constants so, the stress developed due to external force in an elastic material does not depend on the elastic constant.

149. ***Ans. (a)***



$$\delta_{AB} + \delta_{BC} = 0$$

$$\frac{-(P-15)\times50}{AE} + \frac{15\times30}{AE} = 0$$

$$-5P + 75 + 45 = 0$$

$$5P = 120$$

$$P = 24\ \text{kN}$$

150. ***Ans. (d)***

$$\Delta = \frac{PL}{AE} = \frac{40\times10^3\times1000}{100\times2\times10^5}$$

$$= 2\ \text{mm}$$

151. ***Ans. (d)***

$$\text{Compressive strain} = \frac{-\delta\ell}{\ell}$$

152. ***Ans. (a)***

$$\mu = \frac{\text{lateral strain}}{\text{longitudinal strain}}$$

$$= \frac{\frac{\Delta D}{D}}{\frac{\Delta\ell}{\ell}} = \frac{\frac{0.0045}{30}}{\frac{0.09}{200}}$$

$$= 0.33$$

153. ***Ans. (a)***

154. ***Ans. (a)***

The endurance limit of a material is defined as the stress below which a material can endure an infinite number of repeated load cycles without exhibiting failure.

155. ***Ans. (c)***

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

$$\frac{\Delta}{L} = \text{Strain} = S$$

$$E = \frac{PL}{A\Delta} = \frac{P}{AS} = \frac{W}{AS}$$

156. ***Ans. (b)***

The order will be proportional limit, elastic limit, upper yield point, lower yield point, ultimate tensile strength, failure.

157. ***Ans. (b)***

We can find the change in length or longitudinal elongation by the formula

$$\Delta L = \frac{PL}{AE}$$

For this we required E. and to find a decrease in the diameter of rod we need to know Poission's ratio. From the relation $E = 2G\ (1 + \mu)$

We can calculate Poission's ratio if we know shear modulus and young's modulus.

158. ***Ans. (a)***

Hooke's law is valid upto the limit of proportionality.

159. ***Ans. (b)***

$$E = \frac{\text{Stress}}{\text{Strain}}$$

Stress = $50 \times 10^3 \times 10 \times 10^{-4} = 50$ MPa

160. ***Ans. (b)***

$$\text{Stress} = \frac{P}{A} = \frac{58\times10^3}{\frac{\pi}{4}\left(7\times10^{-2}\right)^2}$$

$$= 15.07 \text{ Mpa}$$

161. ***Ans. (b)***

$$\text{Strain} = \frac{\Delta}{L} = \frac{11.5-10}{10} = 0.15$$

162. ***Ans. (d)***

163. ***Ans. (a)***

Extension of bar,

$$\delta l = \frac{PL}{tE\left(b_1-b_2\right)}\log_e\left(\frac{b_1}{b_2}\right)$$

$$= \frac{40\times10^3\times2.8\times1000}{15\times2\times10^6\times\left(75-30\right)}\log_e\left(\frac{75}{30}\right)$$

$$= 0.076 \text{ mm}$$

164. ***Ans. (a)***

$$\frac{\Delta V}{V} = \epsilon_x + \epsilon_y + \epsilon_z$$

165. ***Ans. (a)***

166. ***Ans. (a)***

167. ***Ans. (a)***

168. ***Ans. (d)***

169. ***Ans. (c)***

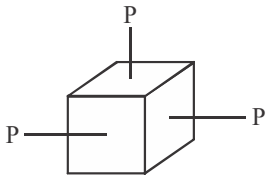
$$\Delta_T = \Delta_1 + \Delta_2 + \Delta_3$$

$$= \frac{PL}{AE} + \frac{PL}{2AE} + \frac{PL}{AE}$$

$$= \frac{2PL}{AE} + \frac{1}{2}\frac{PL}{AE}$$

$$= \frac{5}{2}\frac{PL}{AE}$$

170. ***Ans. (c)***



$$\epsilon_V = \epsilon_x + \epsilon_y + \epsilon_z$$

$$= 3\epsilon_x$$

171. ***Ans. (d)***

According to Hooke's low

Stress μ Strain

$$\sigma \propto \varepsilon$$

$$\sigma = E\varepsilon$$

$$E = \frac{\sigma}{\varepsilon} = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta l/l},$$

or $$\Delta l = \frac{F\ell}{AE}$$

172. ***Ans. (b)***

Young's modulus depends upon the composition of material. It does not depend upon type of loading.

173. ***Ans. (b)***

The elastic limit of brittle materials is comparatively low, there is no yield point in brittle materials.

174. ***Ans. (b)***

The phenomenon of necking is found in ductile materials like mild steel.

175. ***Ans. (a)***

When change in length occurs in the direction of applied load, the strain is known as linear strain/longitudinal strain and if change in length takes place perpendicular (normal) to the direction of applied load. The strain is called lateral strain

176. ***Ans. (b)***

Longitudinal strain

$$\varepsilon_1 = \frac{\Delta l}{l} = \frac{l_2 - l_1}{l_1}$$

$\because$ $$l_2 = 2l_1$$

$$\varepsilon_1 = \frac{2l_1 - l_1}{l_1} = 1.0$$

177. ***Ans. (c)***

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

lateral strain = strain normal to applied load = e_y

linear strain = strain in the direction of applied load = e_x

$$\therefore \quad \mu = -\frac{e_y}{e_x}$$

178. ***Ans. (c)***

$$\Delta l = \frac{Pl}{AE}, \quad E = \frac{Pl}{A \times \Delta l}$$

$$\because \quad P/A = \sigma = \text{stress}$$

$$\because \quad e = \frac{\Delta l}{l} = \text{strain}$$

$$\because \quad E = \frac{P}{A \times e} = \frac{\text{Force}}{\text{Area} \times \text{strain}}$$

179. ***Ans. (b)***

$$\Delta l = (\Delta l)_1 + (\Delta l)_2 + (\Delta l)_3$$

$$\Delta l = \frac{P_1 l_1}{A_1 E_1} + \frac{P_2 l_2}{A_2 E_2} + \frac{P_3 l_3}{A_3 E_3}$$

$P_1 = 10T$, $P_2 = 7T$ $P_3 = 9T$

$A_1 = A_2 = A_3 = A$,

$E_1 = E_2 = E_3 = E$

$$\Delta l = \frac{1}{AE}\left(P_1 l_1 + P_2 l_2 + P_3 l_3\right)$$

$$\Delta l = \frac{1}{AE}\left(10 \times 10 + 7 \times 10 + 9 \times 10\right)$$

$$\Delta l = \frac{26 \times 10}{AE} \text{ m.m}$$

180. ***Ans. (c)***

For composite bar

(A) $P_{total} = P_{steel} + P_{Al}$

$$1200 = \sigma_{steel} \times A_{steel} + \sigma_{Al} \times A_{Al}$$

$$\because \quad A_{steel} = A_{Al} = 3cm^2 = 300mm^2$$

$$\therefore \quad 1200 = 300\,(\sigma_{steel} + \sigma_{Al}) \quad -(1)$$

(B) $(\Delta l)_{steel} = (\Delta l)_{Al}$

$$\frac{\sigma_{steel} l_{steel}}{E_{steel}} = \frac{\sigma_{Al} \times l_{Al}}{E_{Al}}$$

$$(\because\ l_{steel} = l_{Al}) \quad \frac{\sigma_{steel}}{E_{steel}} = \frac{\sigma_{Al}}{E_{Al}}$$

$$\sigma_{steel} = \frac{\sigma_{Al}}{e_{Al}} \times E_{steel} = \frac{\sigma_{Al}}{E_{Al}} \times 3E_{Al}$$

$$\sigma_{steel} = 3\sigma_{A1} \qquad \ldots(2)$$

Substituting in (1)

$$\frac{12000}{300} = 3\sigma_{steel} + \sigma_{Al}$$

$$\sigma_{A1} = \frac{12000}{300 \times 4}, \quad \sigma_{A1} = 10\frac{N}{mm^2}$$

Substituting in (2)

$$\sigma_{steel} = 3 \times 10 = 30\frac{N}{mm^2}$$

181. ***Ans. (b)***

$$\Delta l = \frac{4Wl}{\pi E d_1 . d_2}$$

$$E = \frac{4Wl}{\Delta l \times \pi\, d_1 d_2}$$

$$= \frac{4 \times 5.5 \times 10^3 \times 350}{0.025 \times 3.14 \times 30 \times 15}$$

$$E = 2.18 \times 10^5 \text{ N/mm}^2$$

182. ***Ans. (d)***

No stress is developed because stress is resistance per unit area and there is no resistance.

183. ***Ans. (d)***

Thermal stress $\boxed{\sigma_{th} = f(\alpha, \Delta t, E)}$

184. ***Ans. (a)***

185. ***Ans. (d)***

186. ***Ans. (a)***

$$\text{Bulk modulus (K)} = \frac{\text{Normal stress}}{\text{Volumetric strain}}$$

187. ***Ans. (a)***

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

$$200 = 2\,G\,(1 + 0.25)$$

$$G = \frac{200}{2 \times 1.25}, \quad G = 80 \text{ kN/m}^2$$

188. ***Ans. (d)***

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

$$E = 2 \times 100(1+0.25) = 200 \times 1.25$$

$$E = 250 \text{ GPa}$$

189. ***Ans. (c)***

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

$$E = \frac{E}{G}2(1+0.4) = 2 \times 1.4 = 2.8$$

$$\frac{E}{G} = 2.8 = \frac{14}{5}$$

190. ***Ans. (c)***

191. ***Ans. (b)***

$$\Delta l = \frac{Wl}{2AE} = \frac{wl^2}{2E}$$

$\because$ w = specific weight $= \rho g = \frac{W}{V}$

$\because$ $W = w \times V$

$\therefore$ $$\Delta l = \frac{w \times V l}{2AE} = \frac{(\rho g) \times (A \times l) \times l}{2AE}$$

$$\Delta l = \frac{\rho g l^2}{2E}, \quad g = 9.81 \frac{m}{sec^2}$$

$$\Delta l = \frac{9.8 l \rho l^2}{2E}$$

192. ***Ans. (c)***

In a rigid body modulus of elasticity is equal infinite because in it value of strain is zero.

193. ***Ans. (c)***

Length of cylindrical bar = L meter deformation due to axially load = l mm.

$$\text{Then strain} = \frac{\text{elongatinon in length}}{\text{Initial length of Rod}}$$

$$= \frac{\ell \text{ mm}}{\text{L m}} = \frac{\ell}{1000L} \text{ OR } 0.001\left(\frac{\ell}{L}\right)$$

194. ***Ans. (d)***

$$\text{lateral strain} = \Delta d/d = \left(\frac{0.05}{10}\right) = 0.005$$

Longitudinal strain $= \Delta l/l = (0.8/40) = 0.02$

$$\text{Poisson ratio} = \frac{\text{lateral strain}}{\text{longitudnal strain}}$$

$$\mu = \frac{0.005}{0.02} = 0.25$$

195. ***Ans. (b)***

196. ***Ans. (a)***

197. ***Ans. (d)***

198. ***Ans. (d)***

199. ***Ans. (c)***

200. ***Ans. (c)***

201. ***Ans. (d)***

Maximum stress induced due to suddenly applied load

$$\sigma = 2\frac{W}{A}, \quad \sigma = \frac{2 \times 10}{10},$$

$$\sigma = 2\frac{\text{tonne}}{cm^2}$$

202. ***Ans. (b)***

203. ***Ans. (d)***

204. ***Ans. (b)***

205. ***Ans. (a)***

206. ***Ans. (a)***

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