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UNIT-I

STRENGTH OF MATERIALS

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CHAPTER 1

INTRODUCTION

OBJECTIVE QUESTIONS

1. Actual rupture stress is
(a) Breaking stress
(b) Maximum load/original cross-sectional area
(c) Load at breaking point/true strain
(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. Ratio of lateral strain to linear strain within elastic limit, is known as
(a) Young's modulus (b) Bulk modulus
(c) Modulus of rigidity (d) Poisson's ratio

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. In a tensile test, near the elastic limit zone,
(a) Tensile strain increases more quickly
(b) Tensile strain decreases more quickly
(c) Tensile strain increases in proportion to the stress
(d) Tensile strain decreases in proportion to the stress

7. The property of a material by virtue of which it can be beaten or rolled into plates is called
(a) Malleability (b) Ductility
(c) Plasticity (d) Elasticity

8. Change in the unit volume of a material under tension with increase in its Poisson's ratio will
(a) Increase (b) Decrease
(c) Remain same (d) Unpredictable

9. The phenomenon of slow extension of the material, i.e. stress increasing with the time at a constant load is called
(a) Creeping (b) Yielding
(c) Breaking (d) Plasticity

10. For steel, the ultimate strength in shear as compared to in tension is nearly
(a) same (b) half
(c) one-third (d) two-third

11. Tensile strength of a material is obtained by dividing the maximum load during the test by the
(a) Area at the time of fracture
(b) Original cross-sectional area
(c) Average of (a) and (b)
(d) Minimum area after fracture

12. Maximum elastic strain energy that can be stored in a body is known as
(a) Impact energy (b) Resilience
(c) Proof resilience (d) None of the above

13. Proof stress
(a) Is the safest stress
(b) Causes a specified permanent deformation in a material, usually 0.1%-0.2%
(c) Is used in connection with materials like mild steel
(d) Does not exist

14. A material having same properties in all directions at a given point is known as
(a) Orthotropic material
(b) Isotropic material
(c) Elastic material
(d) Homogenous material

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

16. The stress 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) Plastic point of the material

(c) Breaking point of the material

(d) Yielding point of the material

17. When it is indicated that member is elastic, it means that when force is applied, it will

(a) Not deform (b) Be safest

(c) Stretch (d) Not stretch

18. A material capable of absorbing large amount of energy before fracture is known as

(a) ductility (b) toughness

(b) resilience (d) shock proof

19. If the thickness and width of each plate of a laminated spring be t and w respectively, then its moment of inertia is equal to

(a) $\frac{wt^3}{12}$ (b) $\frac{t^2w^3}{12}$

(c) $\frac{wt^2}{12}$ (d) $\frac{tw^2}{12}$

20. During a tensile test on a specimen of $1 cm^2$ cross-section, maximum load observed was 8 tonnes and area of cross-section at neck was 0.5 cm^2. Ultimate tensile strength of specimen is

(a) 4 $tonnes/cm^2$ (b) 8 $tonnes/cm^2$

(c) 16 $tonnes/cm^2$ (d) 22 $tonnes/cm^2$

21. A material obey's hooke's law up to

(a) Plastic limit (b) Elastic limit

(c) Yield point (d) Limit of proportionality

22. True stress-strain curve for materials is plotted between

(a) Load/original cross-sectional area and change in length/original length

(b) Load/instantaneous cross-sectional area and $\log_e \left(\frac{\text{Original area}}{\text{Instantaneous area}}\right)$

(c) Load/instantaneous cross-sectional area and change in length/original length

(d) Load/instantaneous area and instantaneous area/original area

23. The intensity of stress which causes unit longitudinal is called

(a) Unit stress (b) Modulus of rigidity

(c) Bulk modulus (d) Modulus of elasticity

24. Modulus of rigidity is defined as the ratio of

(a) Longitudinal stress and longitudinal strain

(b) Volumetric stress and volumetric strain

(c) Lateral stress and lateral strain

(d) Shear stress and shear strain

25. The ultimate tensile stress of mild steel compared to ultimate compressive stress is

(a) Same (b) More

(c) Less (d) Unpredictable

26. Modular ratio of two materials is the ratio of

(a) Strains

(b) Stress and strain

(c) Shear stress and shear strain

(d) Moduli of elasticity

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

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

(c) Plastic flow (d) Proof stress

28. If a material is loaded beyond yield point stress

(a) It becomes elastic

(b) It becomes ductile

(c) Its resistance to fatigue increases

(d) It loses its tendency to return to its original shape

29. A cylindrical section having no joint is known as

(a) Jointless section (b) Homogeneous section

(c) Perfect section (d) Seamless section

30. The bulk modulus of a material is defined as the ratio of

(a) Volume change to modulus of elasticity

(b) Stress intensity to volumetric strain

(c) Volume change to original volume

(d) Pressure applied to the change in volume

31. 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

32. Modulus of resilience is

(a) Property to resist shocks

(b) The property to store energy without undergoing permanent deformation

(c) An index of elasticity

(d) An index of compressibility

33. Moment of inertia of a square of side d about the diagonal is

(a) $\frac{d^4}{12}$ (d) $\frac{d^4}{24}$

(c) $\frac{d^4}{18}$ (d) $\frac{d^4}{8}$

34. Disruptive strength is the maximum strength of a metal.

(a) When subjected to three principal tensile stresses at right angles to one another and all of equal magnitude.

(b) When loaded in tension

(c) When loaded in compression

(d) When loaded in shear

35. Radius of gyration for a circular section is

(a) Directly proportional to the diameter of the section

(b) Square root of the diameter of the section

(c) Inversely proportional to the diameter of the section

(d) None of the above

36. Strain energy stored in a body of volume V with stress due to gradually applied load is

(a) $\frac{\sigma E}{V}$ (b) $\frac{\sigma E^2}{V}$

(c) $\frac{\sigma V^2}{E}$ (d) $\frac{\sigma^2 V}{2E}$

37. 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

38. Material which exhibit the same elastic properties in given direction at all point is called

(a) Homogeneous (b) Inelastic

(c) Isotropic (d) Isentropic

39. Most elastic material is

(a) Rubber (b) Plastic

(c) Brass (d) Steel

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

(a) 2.1×10^8 kg/cm^2 (b) 2.1×10^6 kg/cm^2

(c) 2.1×10^7 kg/cm^2 (d) 0.1×10^6 kg/cm^2

41. Compound beams are those in which

(a) Reaction components are more than three

(b) Reaction components are three

(c) Reaction components are more than three but for each additional reaction components, one hinge is introduced.

(d) None of the above

42. Condition to determine the reactions of each support of beam is

(a) Algebraic sum of all vertical forces is zero

(b) Algebraic sum of all horizontal forces is zero

(c) Algebraic sum of all moments about any point is zero

(d) All of the above

43. 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

44. The capacity of a material to undergo deformation under tension without rupture is

(a) Mechanical strength (b) Stiffness

(c) Toughness (d) Ductility

[NTPC-DIP - Trainee]

45. Slow and progressive deformation of a material with time under constant stress is called

(a) Creep (b) Erosion

(c) Resilience (d) Fatigue

[NTPC-DIP - Trainee]

46. The resistance to fatigue of a material is measured by

(a) Elastic limit

(b) Young's modulus

(c) Ultimate tensile strength

(d) Endurance limit

[NTPC-DIP - Trainee]

47. A body having same properties throughout its volume is said to be

(a) Isotropic (b) Continuous

(c) Homogeneous (d) Uniform

[NTPC-DIP - Trainee]

48. Lateral strain ($\in'$) can be expressed as

(a) $\frac{\delta l}{l}$ (b) $\frac{l}{\delta l}$

(c) $\mu\in$ (d) $-\mu\in$

[CEMPM - 2018]

49. The ratio of modulus of rigidity to modulus of elasticity of a material for a Poisson's ratio of 0.25 would be

(a) 0.5 (b) 0.4

(c) 0.3 (d) 0.1

[NTPC-DIP - Trainee]

50. When mechanical properties of a material remain same in a particular direction at each point, such a material is called

(a) Isotropic (b) Homogeneous

(c) Orthotropic (d) Anisotropic

[NTPC-DIP - Trainee]

51. The centre of gravity of a plane lamina is not at its geometrical centre, if it is a

(a) Circle (b) Square

(c) Rectangle (d) Right-angled triangle

[NTPC-DIP - Trainee]

52. Which of the following properties of mild steel cannot be determined by a static tensile test of the sample?

(a) Ultimate tensile strength

(b) Ultimate shear strength

(c) Ductility

(d) Poisson's ratio

[NTPC-DIP - Trainee]

53. Stress relaxation is the phenomenon

(a) In which stress remains constant on increasing load

(b) Stress reduced on increasing load

(c) In which deformation tends to loosen the joint and produces a reduced stress

(d) In which parts are not loaded

54. The maximum stress a material can stand before it breaks is called the

(a) Working stress (b) Ultimate stress

(c) Compressive stress (d) Transverse stress

55. The value of Poisson's ratio for steel is between the range of

(a) 0.4 to 0.6 (b) 0.21 to 0.24

(c) 0.01 to 0.2 (d) 0.25 to 0.33

56. The relation between modulus of elasticity (E) and bulk modulus (k) is

(a) E = 3k(1 – 2 Poisson's ratio)

(b) E = 3k(1 + Poisson's ratio)

(c) E = 3k(1 + 2Poisson's ratio)

(d) E = 3k(1 – Poisson's ratio)

57. For a linearly elastic, isotropic and homogeneous material, the number of elastic constants required to relate stress and strain is

(a) Two (b) Three

(c) Four (d) Six

[TSPSC - AE]

58. Young's modulus of elasticity and Poisson's ratio of a material are 1.25×10^5 MPa and 0.34 respectively. The modulus of rigidity of the material will be

(a) 0.4025×10^5 MPa (b) 0.4664×10^5 MPa

(c) 0.8375×10^5 MPa (d) 0.9469×10^5 MPa

[TSPSC - AE]

59. If a material has a modulus of elasticity of 2×10^6 kg/cm^2 and a modulus of rigidity of 0.8×10^6 kg/cm^2, then the approximate value of the Poisson's ratio of the material will be

(a) 0.25 (b) 0.31

(c) 0.45 (d) 0.20

[TSPSC - AE]

60. During tensile testing of a specimen using Universal Testing Machine, the parameters actually measured include

(a) True strain and true stress

(b) Young's modulus and Poisson's ratio

(c) Engineering stress and engineering strain

(d) Load and elongation

[TSPSC - AE]

61. The young's modulus of a material is 125 GPa and Poisson's ratio is 0.25. The modulus of rigidity of the material is

(a) 50 GPa (b) 30 GPa

(c) 5 GPa (d) 500 GPa

62. In a tensile test, when a material is stressed beyond elastic limit, the tensile strain _____ as compared to the stress.

(a) Decreases slowly

(b) Increases slowly

(c) Decreases more quickly

(d) Increases more quickly

63. The property which enables metals to be drawn into wire is

(a) Ductility (b) Malleability

(c) Plastic deformation (d) Elastic deformation

[CEMPM - 2018]

64. Proof resilience is the greatest stored energy at

(a) Limit of proportionality

(b) Elastic limit

(c) Plastic limit

(d) None of these

[NTPC-DIP - ME]

65. The ratio of modulus of elasticity (E) to modulus of rigidity (G) in terms of Poisson's ratio (μ) (in case of the elastic materials) is-

(a) $2(1 - \mu)$ (b) $2(1 + \mu)$

(c) $3(1 - 2\mu)$ (d) $0.5(1 - \mu)$

[QP-Mechanical - I]

66. The property of a material to absorb energy within elastic limits is known as

(a) Elasticity (b) Toughness

(c) Tensile strength (d) Resilience

[QP-Mechanical - I]

67. Strain energy stored in a solid circular shaft is proportional to

(a) GJ (torsional rigidity) (b) $1/(GJ)^2$

(c) (GJ) (d) 1/(GJ)

[QP-Mechanical - I]

124. A circular rod of 100 mm diameter and 500 mm length is subjected to a tensile force of 1000 kN. Determine the modulus of rigidity (G) if E = 2 × 10^5 N/mm^2 and Poisson's = 0.3

(a) 0.335 × 10^5 N/mm^2 (b) 0.521 × 10^5 N/mm^2

(c) 0.7692 × 10^5 N/mm^2 (d) 0.2256 × 10^5 N/mm^2

[ISRO - 2011]

125. Young's modulus of elasticity for a perfectly rigid body is

(a) zero (b) unity

(c) infinity (d) cannot be known

[IOF - 2013]

126. Necking phenomenon in stress-strain is observed for

(a) Brittle materials

(b) Ductile materials

(c) Both brittle as well as ductile materials

(d) None of the above

[IOF - 2013]

127. Elastic modulus of steel is

(a) 70 GPa (b) 210 GPa

(c) 250 GPa (d) 300 GPa

[IOF - 2013]

128. In tensile test of mild steel, necking will start:-

(a) At lower yield stress

(b) At upper yield stress

(c) At ultimate tensile stress

(d) Just before fracture

[UPSSSC-AE]

129. The ratio of Young's modulus and modulus of rigidity for a material having Poisson's ratio 0.2. is

(a) $\frac{12}{5}$ (b) $\frac{5}{12}$

(c) $\frac{14}{5}$ (d) $\frac{5}{14}$

[NTPC - Diploma - 2007]

130. The area under the stress-strain diagram upto the rupture point is known as

(a) Proof resilience (b) Modulus of toughness

(c) Modulus of elasticity (d) Modulus of resilience

[AE - 2018]

131. The modulus of elasticity and rigidity of a linearly elastic isotropic material are 200 GPa and 80 GPa respectively. What is the value of Poisson's ratio of this material?

(a) 0.30 (b) 0.28

(c) 0.25 (d) 0.22

[NTPC-Diploma - 2007, URVUNL-JE - 2014]

132. A cable is cut to half of its original length. The maximum load which the cable can support would.

(a) get reduced to half the value

(b) become two - fold

(c) remain unchanged.

(d) data insufficient to make any comment

133. In a tension test, fracture takes place along a crystallographic plane, on which the normal tensile stresses is maximum. Such plane is called

(a) Shear plane (b) Neutral plane

(c) Cleavage plane (d) Fracture plane

[JKSSB-JE]

134. Few statements about creep in materials are given below:

1. Creep means regaining the original shape after removal of stresses.

2. Creep implies development of additional strains when the material is loaded for prolonged period of time.

3. Creep is more at elevated temperatures.

4. Creep means loading the material in plastic range.

Which of the above statements are all correct?

(a) 1, 2 and 3 (b) 1 and 4

(c) 2 and 3 (d) 2 and 4

[RPSC-AEN - 2013]

135. For a material with the Poisson's ratio v, the modulus of elasticity (E) and the bulk modulus of elasticity (K) are same. Which of the following is correct?

(a) The material has v = 0

(b) The material has v = 1/2

(c) The material has v = 1/3

(d) The material has v = 3/4

[RPSC-AEN - 2013]

136. What is the approximate value of Young's modulus of elasticity of cast iron:

(a) 100 - 105 GPa (b) 200 - 210 GPa

(c) 240 - 250 GPa (d) None of these

[PPAME SIII]

137. A cast iron sample when tested in compression, fails at a compressive stress of 520 N/mm^2. What is its shear strength?

(a) 520 N/mm^2 (b) 260 N/mm^2

(c) 210 N/mm^2 (d) 130 N/mm^2

[NTPC - Diploma - 2007]

138. Which of the following statement is correct ?

(a) Stress is proportional of strain.

(b) Stress is force per unit area.

(c) Within elastic limit, the ratio of stress and strain is called young's modulus.

(d) All of the above

[Uttrakhand JE paper-I 2013]

139. Select the proper sequence for the following

(1) Proportional limit (2) Elastic limit

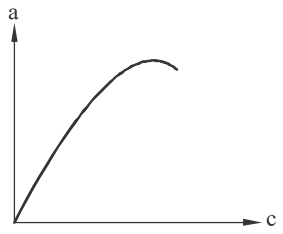
(3) Yield point (4) Fracture/Failure Point

(a) 1- 2- 3- 4 (b) 2- 1- 3- 4

(c) 1- 2- 4- 3 (d) 2- 1- 4- 3

[Uttrakhand JE Paper - II 2008]

140. The above stress - strain diagram is for



[Uttrakhand JE Paper 2013]

(a) Ductile material (b) Brittle material

(c) Soft material (d) None of these

141. Fatigue of a component is due to

(a) Cyclic load (b) Static load

(c) Constant heating (d) none of these

142. Strain is Defined as the ratio of -

(a) Change in volume to original volume

(b) Change in length to original length

(c) Change in lateral dimensions to original lateral dimensions

(d) All of the above

143. When a wire is stretched to double its original length, the longitudinal strain produced in it is-

(a) 0.5 (b) 1.0

(c) 1.5 (d) 2.0

[Chattisgarh JE Paper - II 2008]

144. The value of Poisson's ratio for any material can not exceed

(a) 2.0 (b) 1.414

(c) 1.0 (d) 0.5

[IOF JE 2014]

145. Young's modulus (Y) can be written as.

(a) $Y = \dfrac{\text{Force} \times \text{Area}}{\text{strain}}$ (b) $Y = \dfrac{\text{Force} \times \text{strain}}{\text{Area}}$

(c) $Y = \dfrac{\text{Force}}{\text{strain} \times \text{Area}}$ (d) $Y = \text{Force} \times \text{Strain} \times \text{Area}$

[UPRVUNL JE 2014]

146. The young's modulus E, the shear modulus G and the Poisson's ratio μ for a material are related by the expression.

(a) $E = 2G(1 + 4\mu)$ (b) $E = 3G(1 + 2\mu)$

(c) $E = 3G(1 + 2\mu)$ (d) $E = 2G(1 + \mu)$

147. What would be the ratio of Young's modulus and modulus of rigidity for a Poisson's ratio 0.4 ?

(a) $\dfrac{5}{12}$ (b) $\dfrac{11}{5}$

(c) $\dfrac{14}{5}$ (d) $\dfrac{1}{12}$

148. If 'P' is the tensile stress in a rectangular bar of length 'L' with 'b' and thickness 'd' the volumetric strain is given as.

(a) $P(1+2\mu)/E$ (b) $PL(1+2\mu)/bd$

(c) $P(1-2\mu)$ (d) $P(1-2\mu)/E$

[UPRVUNL JE 2014]

149. The modulus of elasticity in the case of rigid body is

(a) the ratio of stress to strain

(b) equal of zero

(c) equal to infinite

(d) equal to five time that of a flexible body

150. The % of elongation of the piece under tension indicates its.

(a) Brittleness (b) malleability

(c) Stiffness (d) Ductility

151. Limit of proportionality depends upon:

(a) Type of loading (b) type of material

(c) Area of cross section (d) all of the above

[Rajasthan JE 2015]

152. A cylindrical bar of L meter deform axially by '*l*' mm. the strain of bar is .

(a) $\dfrac{\ell}{L}$ (b) $0.1\dfrac{\ell}{L}$

(c) $0.001\dfrac{\ell}{L}$ (d) $100\dfrac{\ell}{L}$

153. A Load of 20,000 N is applied to a cylinder, 40m long and 10m diameter caused an extension of 0.8m and the diameter to decrease by 0.05m the Poisson's ratio of the material is

(a) 2.5 (b) 0.4

(c) 0.0625 (d) 0.25

154. The ratio of ultimate creep strain to elastic strain is known as

(a) Creep - modulus (b) Creep coefficient

(c) Creep - strain ratio (d) Teritiary creep

155. The independent elastic constants for a homogenous and isotropic material are.

(a) E, G, K, μ (b) E, G, K

(c) E, G, μ (d) E, G

❑❑❑

ANSWERS AND EXPLANATIONS

1. ***Ans. (d)***
2. ***Ans. (d)***
3. ***Ans. (d)***
4. ***Ans. (b)***
5. ***Ans. (c)***
6. ***Ans. (a)***
7. ***Ans. (a)***
8. ***Ans. (b)***

$$\frac{P}{\Delta V / V} = k = \frac{E}{3(1-2\mu)}$$

$$\text{as } \mu \uparrow \rightarrow k \uparrow \rightarrow \Delta V \downarrow$$

9. ***Ans. (a)***
10. ***Ans. (d)***
11. ***Ans. (b)***
12. ***Ans. (c)***
13. ***Ans. (b)***
14. ***Ans. (b)***
15. ***Ans. (b)***
16. ***Ans. (d)***
17. ***Ans. (c)***
18. ***Ans. (b)***
19. ***Ans. (a)***
20. ***Ans. (b)***

$$\sigma_{\text{ultimate}} = \frac{\text{load}}{\text{original cross sectional area}}$$

$$= \frac{8}{1} = 8 \text{ tonnes/cm}^2$$

21. ***Ans. (d)***
22. ***Ans. (b)***
23. ***Ans. (d)***

$$E = \frac{\sigma}{\varepsilon} \text{ when } \varepsilon = 1 \Rightarrow \sigma = E$$

24. ***Ans. (d)***
25. ***Ans. (b)***
26. ***Ans. (d)***
27. ***Ans. (c)***
28. ***Ans. (d)***
29. ***Ans. (d)***
30. ***Ans. (b)***

$$K = \frac{P}{\Delta V / V} = \frac{\sigma}{\varepsilon_v}$$

31. ***Ans. (b)***
32. ***Ans. (b)***
33. ***Ans. (a)***
34. ***Ans. (a)***
35. ***Ans. (a)***
36. ***Ans. (d)***
37. ***Ans. (d)***
38. ***Ans. (a)***
39. ***Ans. (d)***
40. ***Ans. (b)***
41. ***Ans. (b)***
42. ***Ans. (d)***
43. ***Ans. (b)***
44. ***Ans. (c)***
45. ***Ans. (a)***
46. ***Ans. (d)***
47. ***Ans. (c)***
48. ***Ans. (d)***

$$\mu = -\left(\frac{\text{Lateral strain}}{\text{Longitudinal strain}}\right)$$

$$\text{Lateral strain} = -\mu \text{ longitudinal strain}$$

49. ***Ans. (b)***
50. ***Ans. (b)***
51. ***Ans. (d)***
52. ***Ans. (b)***
53. ***Ans (c)***

Stress relaxation is decrease in stress in response to same amount of strain. This is because structure is kept in strained condition for some finite interval of time

54. ***Ans (b)***
55. ***Ans. (d)***
56. ***Ans. (a)***

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

57. ***Ans. (a)***
58. ***Ans. (b)***

$$E = 2C(1 + \mu)$$
$$1.25 \times 10^{11} = 2C[1.34]$$
$$1.25 \times 10^{11} = 2.68 \times C$$
$$0.4664 \times 10^5 \text{ MPa} = C$$

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

$$E = 2 \times 10^6 \text{ kg/cm}^2$$
$$C = 0.8 \times 10^6 \text{ kg/cm}^2$$
$$E = 2C(1 + \mu)$$
$$2 \times 10^6 = 2 \times 0.8 \times 10^6 (1 + \mu)$$

138. ***Ans. (d)***

According to Hooke's low

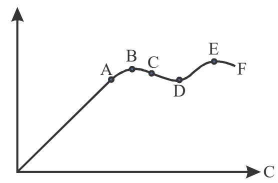
Stress μ Strain

$\sigma \propto e$

$\sigma = Ee$

$$E = \frac{\sigma}{e} = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta l/l}, \text{ or } \Delta\ell = \frac{F\ell}{AE}$$

139. ***Ans. (a)***



A = Proportional limit

B = Elastic limit

C = Yield point

E = Fracture point

140. ***Ans. (b)***

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

141. ***Ans. (a)***

142. ***Ans. (d)***

$$\text{Strain} = \frac{\text{change in dimension}}{\text{original dimension}}$$

Strain is a dimensionless and unitless quantity.

143. ***Ans. (b)***

Longitudinal strain

$$e_1 = \frac{\Delta l}{l} = \frac{l_2 - l_1}{l_1}$$

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

$$e_1 = \frac{2l_1 - l_1}{l_1} = 1.0$$

144. ***Ans. (d)***

$$\frac{\Delta V}{V} = \frac{\sigma}{E}(1-2\mu)$$

$$\because \quad \frac{\Delta V}{V} > 0 \text{ (Always)}$$

$$\frac{\sigma}{E}(1-2\mu) > 0$$

$$1 - 2\mu > \frac{0 \times E}{\sigma}$$

$$1 - 2\mu > 0$$

$$\boxed{\mu < 0.5} \text{ or } \boxed{\mu < \frac{1}{2}}$$

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

146. ***Ans. (d)***

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

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

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

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

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

149. ***Ans. (c)***

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

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

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

152. ***Ans. (c)***

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

$$\text{Then} \quad \text{Strain} = \frac{\text{Elongatinon in length}}{\text{Initial length of Rod}}$$

$$= \frac{\ell \text{ mm}}{\text{Lm}}$$

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

153. ***Ans. (d)***

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

Longitudinal strain=Δl/l = (0.8/40) = 0.02

$$\text{Poisson Ratio} = \frac{\text{Lateral strain}}{\text{Longitudnal strain}}$$

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

154. ***Ans. (b)***

155. ***Ans. (d)***

❑❑❑

Introduction

SCAN ME

CHAPTER 2

AXIALLY LOADED MEMBERS

OBJECTIVE QUESTIONS

1. 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) $\frac{1}{d_1 d_2}$

2. 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) $\frac{\gamma L^4}{2E}$

3. 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

4. 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

5. In a prismatic member made of two materials so joined that they deform equally under axial stress, the unit stresses in two materials are

(a) Equal

(b) Proportional to their respective modulus of elasticity

(c) Inversely proportional to their modulus of elasticity

(d) Average of the sum of modulus of elasticity

6. The extension of uniform bar by its own weight as compared to a bar loaded by same weight at the free end will be

(a) Same (b) Half

(c) One-fourt (d) One-third

7. Two strips of equal lengths and widths are joined together by two rivets, one at each end. One strip is of copper and the other of steel. Now, the temperature of this assembly is lowered, the rivets will undergo,

(a) Bending (b) Single shear

(c) Double shear (d) Both (a) & (b) above

8. The stress induced in a body due to suddenly applied load compared to when it is applied gradually is

(a) Same (b) Half

(c) Two times (d) Four times

9. 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

10. A vertical hanging bar of length l weights 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) $(w + W)\frac{y}{l}$

11. One end of a metallic rod is fixed rigidly and its temperature is raised. It will experience

(a) Zero stress (b) Tensile stress

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

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

(a) Principal stress (b) Tensile stress

(c) Compressive stress (d) Shear stress

13. Maximum stress produced in a rectangular bar under its own weights will.......if all the dimensions of the bar are halved

(a) Remain unchanged (b) Doubled

(c) Halve (d) None of the above

14. A load of 20,000 kg applied to a brass cylinder 40 cm long and 10 cm in diameter caused the length to increase 0.8 cm and the diameter to decrease to 0.005 cm. Poisson's ratio of brass is

(a) 0.025 (b) 0.925

(c) 0.4 (d) 2.5

15. The strain energy stored in a body of volume V due to shear stress τ_s and shear modulus C is

(a) $\frac{\tau_s^2 V}{2C}$ (b) $\frac{\tau_s V^2}{2C}$

(c) $\frac{\tau_s^2 V^2}{C}$ (d) $\frac{2C}{\tau_s^2 V}$

16. Modulus of resilience under simple tension is

(a) $2\sigma_e^2 / E$ (b) σ_e^2 / E

(c) $\sigma_e^2 / 2E$ (d) $\sigma_e^2 / 4E$

Where σ_e is the elastic limit stress of the material

[NTPC-DIP - Trainee]

17. The elongation produced in a bar due to its self-weight is given by

(a) $\frac{9.81\rho l^2}{E}$ (b) $\frac{9.81\rho l^2}{2E}$

(c) $\frac{9.81\rho l}{2E}$ (d) $\frac{9.81\rho^2 l}{2E}$

[NTPC-DIP - Trainee]

18. The relation between E (modulus of elasticity) and k (bulk modulus of elasticity) is

(a) $E = k\left[1 - \frac{2}{m}\right]$ (b) $E = 2k\left[1 - \frac{2}{m}\right]$

(c) $E = 3k\left[1 - \frac{2}{m}\right]$ (d) $E = 4k\left[1 - \frac{2}{m}\right]$

[NTPC-DIP - Trainee]

19. The moduli of elasticity and rigidity of a linearly elastic isotropic material are 200 GPa and 80 GPa respectively. What is the value of Poisson's ratio of this material?

(a) 0.30 (b) 0.28

(c) 0.25 (d) 0.22

[NTPC-DIP - Trainee]

20. For the bar of composite section

(a) The extension in different materials is different

(b) The total external load is equal to the total sum of the loads carried by different materials

(c) The compression in different materials is different

(d) Strain in all materials is unequal

21. If the cross-section of a member is subjected to a uniform shear stress of intensity 'q', then the strain energy stored per unit volume will be given by (C = modulus of rigidity)

(a) $2q^2/C$ (b) $2C/q^2$

(c) $q^2/2C$ (d) $C/2q^2$

[TSPSC - AE]

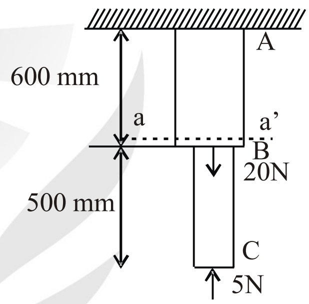
22. A steel rod of $1 cm^2$ cross-sectional area is 1 m long and has a Young's modulus of elasticity 2×10^6 kg/cm^2. It is subjected to an axial pull of 2000 kgf. The elongation of the rod will be

(a) 0.1 cm (b) 0.05 cm

(c) 0.20 cm (d) 0.15 cm

[TSPSC - AE]

23. A stepped bar is hung from the ceiling as shown in the figure. The cross-section of AB = 500 mm^2, and that of BC = 200 mm^2. Assuming that the density of both rods are same and equal to 7500 kg/m^3, find the axial force at a section a-a' just above B. Take g = 10 m/s^2. A downward force of 20 N is acting at B and a force of 5 N at C is acting upwards.



(a) 32.5 N (b) 22.5 N

(c) 90 N (d) 100 N

24. The force which is not considered in the analysis of the truss is

(a) External applied loads

(b) Horizontal forces on joints

(c) Vertical forces joints

(d) Weight of the members

[QP-Mechanical - I]

25. A specimen of steel, 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The modulus of elasticity is

(a) 203718 N/mm^2 (b) 259740 N/mm^2

(c) 209740 N/mm^2 (d) 253718 N/mm^2

[QP-Mechanical - I]

26. A circular rod of 25 mm diameter and 500 mm long is subjected to a tensile force of 60 kN. Determine modulus of rigidity and bulk modulus if Poisson's ratio = 0.3 and young's modulus $E = 2 \times 10^5$ N/mm^2.

(a) 0.7692×10^5 N/mm^2 and 1.667×10^5 N/mm^2

(b) 0.667×10^5 N/mm^2 and 1.857×10^5 N/mm^2

(c) 0.1852×10^5 N/mm^2 and 1.667×10^5 N/mm^2

(d) 0.4692×10^5 N/mm^2 and 1.545×10^5 N/mm^2

[QP-Mechanical - I]

27. The steel bar AB varies linearly in diameter from 25 mm to 50 mm in a length 500 mm. It is held between two unyielding supports at room temperature. What is the stress induced in the bar, if temperature rises by 25°C? Take $E = 2 \times 10^5$ N/mm^2 and $a = 12 \times 10^{-6}$/°C

(a) 110 N/mm^2 (b) 140 N/mm^2

(c) 120 N/mm^2 (d) 150 N/mm^2

[QP-Mechanical - I]

28. A 200 × 100 × 50 mm steel block is subjected to a hydrostatic pressure of 15 MPa. The young's modulus and Poisson's ratio of the material are 200 GPa and 0.3 respectively. The change in the volume of the block is

(a) 100 mm^3 (b) 110 mm^3

(c) 85 mm^3 (d) 90 mm^3

[QP-Mechanical - I]

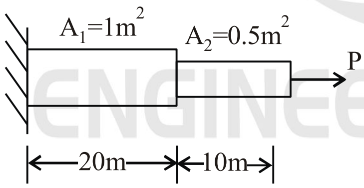
29. Deformation per unit length in the direction of force is known as

(a) Lateral strain (b) Linear strain

(c) Tensile stress (d) Linear stress

[AEM]

30. A rod of variable cross-section (areas A_1 and A_2) fixed at one end is subjected to an axial force P as shown in figure. If the allowable normal stress in tension is 100 MPa then the maximum allowable load P (neglecting stress concentration) is



(a) 100 MN (b) 200 MN

(c) 50 MN (d) 50 N

[DRDO - 2008]

31. A material has a Poisson's ratio of 0.5. If a body is made of this material and subjected to external forces (within the elastic limit) then the final volume of the body is

(a) Thrice that of the initial volume of the body

(b) Twice that of the initial volume of the body

(c) Zero

(d) Equal to the initial volume of the body

[DRDO - 2008]

32. A steel bar of 40 mm x 40 mm square cross-section is subjected to an axial compressive load of 200 kN. If the length of the bar is 2m and E = 200GPa, the elongation of the bar will be :

(a) 1.25 mm (b) 2.70 mm

(c) 4.05 mm (d) 5.40 mm

[RPSC AEN - 2013]

33. A uniform rod of length 'L' cross-section area 'A' and modulus of elasticity 'E' is held rigidly by fixed supports at the ends and an axial load 'P' is applied at mid length of the rod. The strain energy stored is :

(a) $\frac{P^2L}{EA}$ (b) $\frac{P^2L}{4EA}$

(c) $\frac{P^2L}{8EA}$ (d) None of these

[RPSC AEN - 2013]

34. A uniform metal bar of weight 'W', length 'l' cross-sectional area 'A' is hung vertically with its top end rigidly fixed. Which section of the bar will experience maximum stress?

(a) Top-section (b) Mid-section

(c) Bottom-section (d) l/3 from top

35. The resistance force acting on a body causing increase in length of body is known as.......

(a) Tensile stress (b) Compressive stress

(c) Bearing stress (d) Volumetric stress

36. If young modulus = 3×10^5 N/mm^2 Poisson's ratio = 1/4 then bulk modulus is......

(a) 0.1 N/mm^2 (b) 200 kN/mm^2

(c) 4/3 kN/mm^2 (d) 3/4 kN/mm^2

37. For a material young's modulus = 1.2×10^5 N/mm^2 modulus of rigidity = 40 kN/mm^2 the Poisson's ratio will be.....

(a) 0.5 (b) 0.35

(c) 0.25 (d) 1.8

38. On the application of a given load, the length of a wire is stated to increase by 1 mm. If the same force is now applied to a wire of same material but of the length and radius twice the first, the extension produced would be

(a) 0.25 mm (b) 0.5 mm

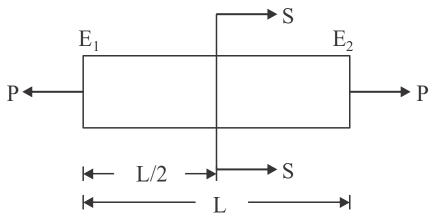
(c) 2.0 mm (d) 4.0 mm

39. A 100 kg lamp is supported by a single electrical copper cable of diameter (d) = 4 mm. What is the stress carried by the cable?

(a) 39 MPa (b) 78 MPa

(c) 11738 MPa (d) 12308 MPa

61. A rod of length L having uniform cross-sectional area A is subjected to a tensile force P as shown in the figure below. If the Young's modulus of the material varies linearly from E_1 to E_2 along the length of the rod, the normal stress developed at the section-SS is



(a) P/A (b) $P(E_1.E_2)/A(E_1 + E_2)$

(c) PE_2/AE_1 (d) PE_1/AE_2

[WRD (Degree)]

62. A bar of mild steel 200 mm long and 50 mm × 50 mm in cross section is subjected to an axial load of 200 kN. If E is 200 GPa, the elongation of the bar will be

(a) 0.16 mm (b) 0.08 mm

(c) 0.04 mm (d) 0.02 mm

[SWM - 2016]

63. The temperature stress is a function of

1. Coefficient of linear expansion
2. Temperature rise
3. Modulus of elasticity

The correct answer is

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

[WRD - 2013]

64. A mild steel bar 1 m long, 100 mm in diameter is subjected to an axial tensile load, so that change in its length is 0.1 mm. If Poisson's ratio of mild steel is 0.3, what is the change in its diameter:

(a) 1 micron (b) 0.3 micron

(c) 0.03 micron (d) None of these

[PPAME SIII]

65. A rod of 2m long at a temperature of 10°C is heated to 80°C. If the coefficient of thermal expansion of the rod is 0.000012°C and E is 100 GPa, the thermal stress under the complete prevention of expansion is:

(a) 96 MPa (b) 84 MPa

(c) 10 MPa (d) 12 MPa

[NLC India - 2020]

66. If the area, length and the stress to which a bar is subjected be all doubled, then the elastic strain energy of the bar will be:

(a) Doubled (b) Three times

(c) Four times (d) Sixteen times

[NHPC - 2013]

67. Consider a bar of length l and Tapering uniformly from d_2 to d_1 and subjected to axial load W. The extension of the bar will be.

(a) $\dfrac{4Wl}{\pi d_1 d_2 E}$ (b) $\dfrac{4WEl}{\pi d_1 d_2}$

(c) $\dfrac{\pi WEI}{4d_1 d_2}$ (d) $\dfrac{\pi Wl}{4d_1 d_2 E}$

[SSC JE 2007]

68. Elongation of bar under it's own weight as compared to that when the bar is subjected to a direct axial load equal to its own weight will be

(a) The same (b) One fourth

(c) Half (d) Doubled

[Chattisgarh JE Paper - II 2008]

69. Find the modulus of elasticity for a rod which tapers uniformly form 30 mm to 15 mm diameter subjected to an axial load of 5.5 kN and extension of the rod is 0.025 mm.

(a) 2.78×10^5 N/mm² (b) 2.18×10^5 N/mm²

(c) 3.78×10^5 N/mm² (d) 3.78×10^5 N/mm²

(Take length l = 350m.m.)

70. If material expands freely due to heating, the type of stresses developed will be

(a) Thermal stress (b) Tensile stress

(c) Compressive stress (d) No stress will develop

71. One end of a metallic rod is fixed rigidly and its, temperature is raised It will experience

(a) Zero stress (b) Tensile stress

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

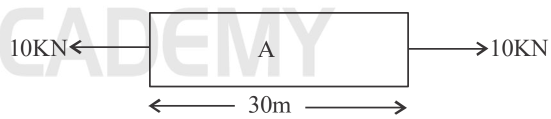
[Uttrakhand JE- Paper. II 2008]

72. If a composite bar of copper and aluminium is heated. The stress developed in copper and aluminium will be

(a) Compressive and tensile (b) Tensile and bending

(c) Shearing and bending (d) Tensile and compressive

73. The total extension of the bar loaded as shown in the Figure is-



A = Area of cross section

E = Modulus of elasticity

(a) 10 × 30 / AE (b) AE / 10 × 30

(c) 10/30 AE (d) 30/10 AE

74. A solid uniform bar of dia 'd' and length l is hanging vertically from it's free end. Elongation of the bar due to self weight is-

(a) Proportional to l and inversely proportional of d^2

(b) Proportional to l^2 and inversely proportional of d^2

(c) Proportional to l but independent of d

(d) Proportional to l^2 but independent of d

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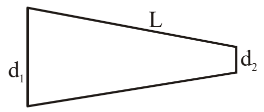
ANSWERS AND EXPLANATIONS

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



elongation (ε) = $\dfrac{4PL}{\pi E d_1 d_2}$

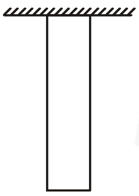
2. ***Ans. (c)***

3. ***Ans. (b)***

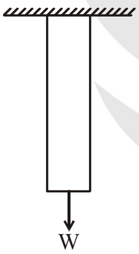
4. ***Ans. (b)***

5. ***Ans. (b)***

6. ***Ans. (b)***



d_1 due to self weight = $\dfrac{\gamma L^2}{2E}$



d_2 due to external load w

$$= \frac{\gamma AL \times L}{AE} = \frac{\gamma L^2}{E}$$

$$\frac{\delta_1}{\delta_2} = \frac{1}{2}$$

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

8. ***Ans. (c)***

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

10. ***Ans. (a)***

11. ***Ans. (a)***

12. ***Ans. (c)***

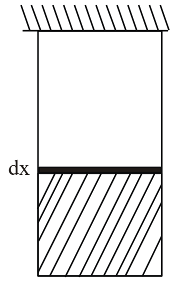
13. ***Ans. (b)***

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

15. ***Ans. (a)***

16. ***Ans. (c)***

17. ***Ans. (b)***



$$\text{Weight} = mg$$

$$= \rho g[A \times x]$$

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

$$= \frac{\rho g[Ax]}{A} = \rho g x$$

$$\text{Strain} = \frac{\sigma}{E} = \frac{\rho g x}{E}$$

$$\frac{\Delta l}{l} = \frac{\rho g x}{E}$$

$$\int_0^l dl = \int_0^l \frac{\rho g x \times dx}{E}$$

$$= \left[\frac{\rho g x^2}{2E}\right]_0^l$$

$$= \frac{\rho g l^2}{2E}$$

18. ***Ans. (c)***

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

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

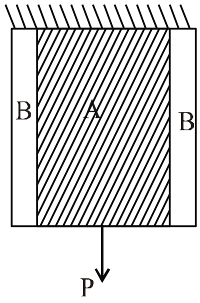
$$200 \times 10^9 = 2 \times 80 \times 10^9[1 + \mu]$$

$$\frac{200}{160} = 1 + \mu$$

$$1.25 = 1 + \mu$$

$$\mu = 0.25$$

20. ***Ans. (b)***



$P = P_A + P_B$

$\varepsilon_A = \varepsilon_B$ = Elongation

21. ***Ans. (c)***

$$S.E = \frac{1}{2} \times \text{Shear stress} \times \text{Shear strain}$$

$$= \frac{1}{2} \times \tau \times \frac{\tau}{C}$$

$$\left[\frac{\text{Shear stress}}{\text{Shear strain}} = C\right]$$

$$= \frac{\tau^2}{2C}$$

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

$A = 1 \text{ cm}^2 = 10^{-4} \text{ m}^2$

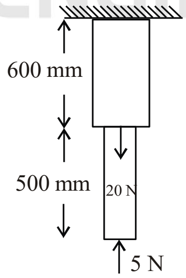
$l = 1 \text{ m}, E = 2 \times 10^6 \text{ kg/cm}^2$

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

$$= \frac{2000 \times 1 \times 10^3}{1 \times 2 \times 10^6}$$

$= 0.1$cm.

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



mass of lower rod = $V \times \rho$

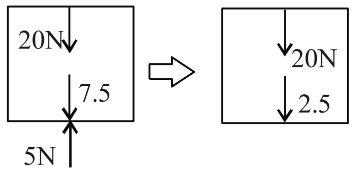
$\Rightarrow \quad \rho \times A \times L$

$\Rightarrow \quad = 7500 \times 200 \times 10^{-6} \times 500 \times 10^{-3}$

$= 0.75$

weight of lower end = mg

$= 0.75 \times 10 = 7.5$ N



axial force at section (a-a) = 22.5N

24. ***Ans. (d)***

25. ***Ans. (a)***

We know that $\Delta L = \frac{PL}{AE}$ or $E = \frac{PL}{A\Delta L}$

$$E = \frac{80 \times 10^3 \times 200}{\frac{\pi}{4} \times (20)^2 \times 0.25}$$

$= 203718.32 \text{ N/mm}^2$

26. ***Ans. (a)***

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

$2 \times 10^5 = 2.6C$

$C = 0.769 \times 10^5$

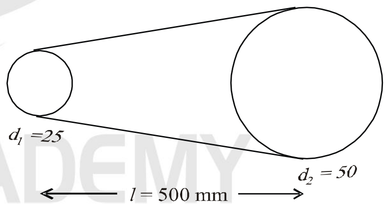
$E = 3K(1 - 2 \times 0.3)$

$2 \times 10^5 = 3K(0.4)$

$2 \times 10^5 = 1.2 \text{ K}$

$1.66 \times 10^5 = \text{K}$

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



$$\delta_{\text{tapered}} = \frac{4PL}{\pi E d_1 d_2}$$

But it is restricted by support's so, support is applying force in opposite direction to restrict the tapered bar

$$\frac{4PL}{\pi E d_1 d_2} = \alpha L \Delta T$$

$$\frac{4P}{\pi E d_1 d_2} = \alpha \Delta T$$

Stress is higher when area is minimum (at d_1)

$$\frac{4P}{\pi d_1^2}\times\frac{d_1}{E\times d_2} = \alpha\Delta T$$

$$\sigma = \alpha\Delta TE\frac{d_2}{d_1}$$

$$= 12\times10^{-6}\times25\times2\times10^5\times\frac{50}{25}$$

$$\Rightarrow 1200 \times 10^{-1}$$

$$= 120 \text{ N/mm}^2$$

28. ***Ans. (d)***

l = 200 mm Pressure = 15 MPa

b = 100 mm E = 200 GPa

μ = 0.3

As $\sigma_x = \sigma_y = \sigma_z = \sigma$, subjected to hydrostatic pressure (pascal's law)

$$\varepsilon_x = \frac{\sigma_x}{E}-\frac{\mu\sigma_y}{E}-\frac{\mu\sigma_z}{E}$$

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

$$\varepsilon_y = \varepsilon_y = \frac{\sigma}{E}[1-2\mu]$$

$$\text{Total } \varepsilon_V = \varepsilon_x+\varepsilon_y+\varepsilon_z = \frac{3\sigma}{E}[1-2\mu]$$

$$\frac{\Delta V}{V} = \frac{3\sigma}{E}[1-2\mu]$$

$$\frac{\Delta V}{10^{-9}(200\times100\times50)} = \frac{3\times15\times10^6}{200\times10^9}[0.4]$$

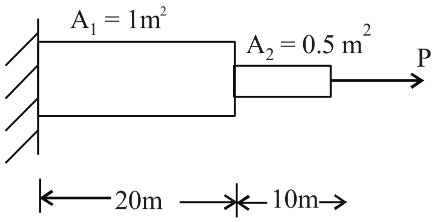
$$\Delta V = \frac{45\times10^6\times0.4\times200\times100\times50\times10^{-9}}{200\times10^9}$$

$$= 90 \times 10^{-9} \text{ m}^3$$

$$= 90 \text{ mm}^3$$

29. ***Ans. (b)***

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



Maximum stress is 100 MPa, occurs at minimum area i.e. 0.5

$$\frac{P}{0.5} = 100 \times 10^6$$

$$P = 100 \times 10^6 \times 0.5$$

$$= 50 \times 10^6 \text{ or } 50 \text{ MN}$$

31. ***Ans. (d)***

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

$$E = 3K(1-2\times0.5)$$

$$E = 3K(0)$$

$$K = \infty$$

if $K = \infty$,

Then $\dfrac{\Delta V}{V} = 0$

So, volumetric strain, if body has 0.5 Poisson's ratio is zero.

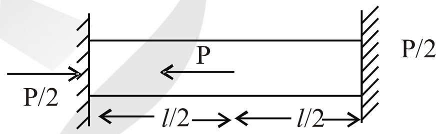
32. ***Ans. (a)***

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

$$= \frac{200\times1000\times2000}{40\times40\times200\times10^3}$$

$$= 1.25\text{mm}$$

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



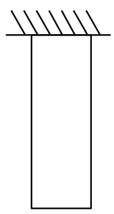
$$\text{Total S.E} = 2\times\text{S.E} = \int\frac{P^2dx}{2AE}$$

$$= 2\int_0^{l/2}\frac{(P/2)^2\cdot dx}{2AE}$$

$$= \frac{2P^2}{8AE}[x]_0^{l/2}$$

$$= \frac{P^2 l}{8AE}$$

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



63. ***Ans. (d)***

64. ***Ans. (d)***

Given,

$$dl = 0.1 \text{ mm}$$
$$D = 100 \text{ mm}$$
$$l = 1 \text{ m} == 1000 \text{ mm}$$
$$\mu = 0.3$$
$$\mu = -\left(\frac{dD/D}{dl/l}\right)$$
$$0.3 = \frac{dD}{100} \times \frac{1000}{0.1}$$
$$= 0.03$$

So, $dD = 0.003$ micron

65. ***Ans. (b)***

$$\sigma_t = E\,\alpha\,\Delta T$$
$$= 100 \times 10^9 \times 0.000012 \times 70$$
$$= 84 \text{ MPa}$$

66. ***Ans. (d)***

$$E_1 = \frac{\sigma^2}{2E} \times A \times L$$

Given, A, L and Stress all doubled.

$$E_2 = \frac{(2\sigma)^2}{2E} \times 2A \times 2L$$
$$E_2 = 16\,E_1$$

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

(A) extension of uniformly tapered circular bar

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

(B) extension of uniformly tapered rectangular bar

$$\Delta l = \frac{Pl}{E(a-b)t} \ln\frac{a}{b}$$

68. ***Ans. (c)***

Elongation of a uniform bar due to it's self weight

$$\Delta l = \frac{Wl}{2AE} \quad \text{... (1)}$$

Elongation of a uniformbar due to a axial load

$$\Delta l = \frac{Wl}{AE} \quad \text{... (2)}$$

(1) ÷ (2)

$$\frac{(\Delta l)_1}{(\Delta l)_2} = \frac{Wl}{2AE} \times \frac{AE}{Wl}$$

$$\boxed{(\Delta l)_1 = \frac{(\Delta l_2)}{2}}$$

69. ***Ans. (b)***

$$\Delta l = \frac{4Wl}{\pi E d_1 . d_2}$$
$$E = \frac{4Wl}{\Delta l \times \pi\, d_1 d_2}$$
$$= \frac{4 \times 5.5 \times 10^3 \times 350}{0.025 \times 3.14 \times 30 \times 15}$$
$$E = 2.18 \times 10^5 \text{ N/mm}^2$$

70. ***Ans. (d)***

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

71. ***Ans. (a)***

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

(1) $\sigma_{th} = f(\alpha, \Delta t, E)\ \alpha_{cu} > \alpha_{Al}$

hence copper bar expands more as compared to aluminium bar so compressive stress is developed in copper bar and tensile stress is developed in aluminium bar.

73. ***Ans. (a)***

74. ***Ans. (d)***

❑❑❑

Axially Loaded Members

SCAN ME