Fully Solved

3200 MCQs

Useful For

ESE | GATE | PSUs

Civil Engineering

by

B. Singh (Ex. IES)

CMD, MADE EASY Group

MADE EASY Publications

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PREFACE

B. Singh (Ex. IES)

It gives me great happiness to introduce the second edition on Civil Engineering containing nearly 3200 MCQs which focuses in-depth understanding of subjects at basic and advanced level which has been segregated topic-wise to disseminate all kind of exposure to students in terms of quick learning and deep apt. The chapter wise segregation has been done to align with contemporary competitive examination pattern. Attempt has been made to bring out all kind of probable competitive questions for the aspirants preparing for ESE, GATE, PSU. The content of this book ensures threshold level of learning and wide range of practice questions which is very much essential to boost the exam time confidence level and ultimately to succeed in all prestigious engineer's examinations. It has been ensured from MADE EASY team to have broad coverage of subjects at chapter level.

Year by year number of competitors are increasing and the variety of questions asked in examination is widening, under such scenario this book will definitely help students to enhance their skills required to succeed in competitive exams like ESE, GATE, PSUs, State Engineering Services etc.

While preparing this book utmost care has been taken to cover all the chapters and variety of concepts which may be asked in the exams. The solutions and answers provided are upto the closest possible accuracy. The full efforts have been made by MADE EASY Team to provide error free solutions and explanations.

I have true desire to serve student community by way of providing good sources of study and quality guidance. I hope this book will be proved an important tool to succeed in competitive examinations. Any suggestions from the readers for the improvement of this book are most welcome.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

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Unit I / Strength of Materials

1. Properties of Metals, Simple Stress-Strain and Elastic Constants

Q.1 A material has identical properties in all directions, it is said to be
(a) homogeneous (b) isotropic
(c) elastic (d) orthotropic

Q.2 The term nominal stress in stress-strain curve for mild steel implies
(a) average stress (b) actual stress
(c) yield stress (d) stress at necking

Q.3 For metallic minerals creep becomes an important consideration at
(a) 500°C
(b) 550°C
(c) half of the melting point temperature on absolute scale
(d) any temperature

Q.4 Clapeyron's theorem is associated with the analysis of
(a) simply supported beams
(b) fixed beams
(c) continuous beams
(d) cantilever beams

Q.5 A rubber band is elongated to double its initial length, its true strain is
(a) 0.500 (b) 0.693
(c) 1.00 (d) 1.386

Q.6 A prismatic beam has uniform
(a) depth (b) width
(c) strength (d) cross-section

Q.7 In the case of pure bending, the beam will bend into an arc of a
(a) circle (b) parabola
(c) ellipse (d) hyperbola

Q.8 If the modulus of elasticity is zero, the material is said to be
(a) rigid (b) elastic
(c) flexible (d) plastic

Q.9 The compressibility of a material is proportional to
(a) Poisson's ratio μ
(b) modulus of elasticity (E)
(c) reciprocal of E
(d) reciprocal of μ

Q.10 If a beam with the rectangular cross-section is obtained by cutting from circular log of timber, then for the beam to have strongest section in bending, the ratio of breadth to depth should be
(a) 0.500 (b) 0.707
(c) 0.717 (d) 0.786

Q.11 According to St. Venant's principle
(a) Deformations of all materials for a given loading are equal
(b) It is a method of determining stress conditions at the end of the plates
(c) Stress conditions approach uniformly as the distance from the point of applications of the load increase
(d) After a point of time the stresses in a loaded member tend to relieve

Q.12 Notched bar tests are frequently used for testing the
(a) impact strength of a material
(b) hardness of a material
(c) machinability of a metal
(d) corrosion resistance of the material

Q.13 In the creep test, the following type of stress is applied to the specimen
(a) uniaxial compression
(b) uniaxial tension
(c) biaxial compression or tension
(d) alternating stress

Q.14 A free bar of length l is uniformly heated from 0°C to a temperature t°C, α is the coefficient of linear expansion and E is the modulus of elasticity. The stress in the bar is
(a) $\alpha\, t\, E$ (b) $\alpha\, t\, E/2$
(c) zero (d) None of these

Q.15 A test specimen is stressed slightly beyond the yield point and then unloaded. Its yield strength
(a) decreases
(b) increases
(c) remains same
(d) becomes equal to ultimate tensile strength

Q.16 Cup-and-cone type fracture occurs in the case of
(a) cast iron
(b) round specimen of ductile metals
(c) tough steel
(d) soft brass

Q.17 Materials having elongation less than 5% are considered brittle. In such cases, factor of safety is based on
(a) yield stress
(b) endurance limit
(c) limit of proportionality
(d) ultimate stress

Q.18 A rod of length 'l' and cross-sectional area 'A' rotates about an axis passing through one end of the rod. The extension produced in the rod due to centrifugal forces is (w is the weight of the rod per unit length and ω is the angular velocity of rotation of the rod)
(a) $\omega w l^2 gE$ (b) $\omega^2 w l^3/3gE$
(c) $\omega^2 w l^3/gE$ (b) $3gE/\omega^2 W l^3$

Q.19 Young's modulus of elasticity and Poisson's ratio of a material are 1.25 x 10^5 MPa and 0.34 respectively. The modulus of rigidity of the material is
(a) 0.4025×10^5 MPa
(b) 0.4664×10^5 MPa
(c) 0.8375×10^5 MPa
(d) 0.9469×10^5 MPa

Q.20 In a homogeneous, isotropic elastic material, the modulus of elasticity E in terms of G and K is equal to
(a) $(G + 3K)/9KG$ (b) $(3G + K)/9KG$
(c) $9KG/(G + 3K)$ (d) $9KG/(K + 3G)$

Q.21 The unit of elastic modulus is the same as those of
(a) stress, shear modulus and pressure
(b) strain, shear modulus and force
(c) shear modulus, stress and force
(d) stress, strain and pressure

Q.22 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

Q.23 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 is equal to (G = modulus of rigidity)
(a) $2q^2/G$ (b) $2G/q^2$
(c) $q^2/2G$ (d) $G/2q^2$

Q.24 In the case of an engineering material under unidirectional stress in the x-axis, the Poisson's ratio is equal to (symbols have their usual meanings)
(a) $\varepsilon_y/\varepsilon_x$ (b) ε_y/σ_x
(c) ε_y/σ_s (d) σ_y/ε_x

Q.25 A 100 mm long and 50 mm diameter steel rod fits snugly between two rigid walls 100 mm apart at room temperature. Young's modulus of elasticity and coefficient of linear expansion of steel are 2×10^5 N/mm^2 and 12×10^{-6}/°C respectively. The stress developed in the rod due to a 100°C rise in temperature will be
(a) 6×10^{-11} N/mm^2 (b) 6×10^{-10} N/mm^2
(c) 240 N/mm^2 (d) 2400 N/mm^2

Q.26 During tensile testing of a specimen using a Universal Testing Machine, the parameters actually measured include
(a) true stress and true strain
(b) Poisson's ratio and Young's modulus
(c) engineering stress and engineering strain
(d) load and deflection

Q.27 If the value of Poisson's ratio is zero, then it means that
(a) the material is rigid
(b) the material is perfectly plastic
(c) there is no longitudinal strain in the material
(d) the longitudinal strain in the material is infinite

Q.28 The stretch in a steel rod of circular section, having a length l subjected to a tensile load P and tapering uniformly from a diameter d_1, at one end to a diameter d_2 at the other end, is given by
(a) $Pl/4Ed_1d_2$ (b) $Pl\pi/Ed_1d_2$
(c) $Pl/4E(d_1 - d_2)$ (d) $4Pl/\pi Ed_1d_2$

Q.29 If 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) indeterminate

Q.30 The Poisson's ratio of a material which has Young's modulus of 120 GPa, and shear modulus of 50 GPa, is
(a) 0.1 (b) 0.2
(c) 0.3 (d) 0.4

Q.31 A rod of material $E = 200 \times 10^3$ MPa and $\alpha = 10^{-3}$ mm/mm/°C is fixed at both the ends. It is uniformly heated such that the increase in temperature is 30°C. The stress developed in the rod is
(a) 6000 N/mm^2 (tensile)
(b) 6000 N/mm^2 (compressive)
(c) 2000 N/mm^2 (tensile)
(d) 2000 N/mm^2 (compressive)

Q.32 The deformation of a bar under its own weight as compared to that when subjected to a direct axial load equal to its own weight will be
(a) the same (b) one-fourth
(c) half (d) double

Q.33 The number of independent elastic constants required to express the stress-strain relationship for linearly elastic isotropic material is
(a) one (b) two
(c) three (d) four

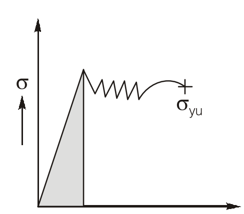
Q.34 A tapering bar (diameters of end sections being d_1 and d_2) and a bar of uniform cross-section 'd' have the same length and are subjected to the same axial pull. Both the bars will have the same extension if 'd' is equal to
(a) $(d_1 + d_2)/2$ (b) $\sqrt{d_1d_2}$
(c) $\sqrt{d_1d_2/2}$ (d) $\sqrt{(d_1 + d_2)/2}$

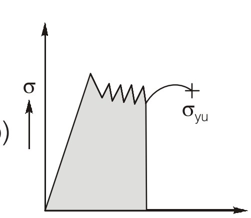
Q.35 The number of elastic constants for a completely anisotropic elastic material which follows Hooke's law is
(a) 2 (b) 4
(c) 21 (d) 25

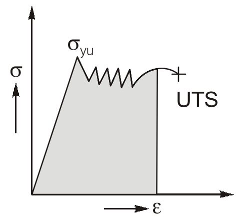
Q.36 For a given material, the modulus of rigidity is 100 GPa and Poisson's ratio is 0.25. The value of modulus of elasticity in GPa is
(a) 125 (b) 150
(c) 200 (d) 250

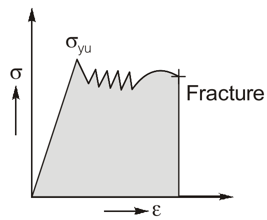
Q.37 A cube having each side of length 'a' is constrained in all directions and is heated uniformly so that the temperature is raised to T°C. If α is the thermal coefficient of expansion of the cube material and E is the modulus of elasticity, the stress developed in the cube is
(a) $\dfrac{\alpha TE}{\nu}$ (b) $\dfrac{\alpha TE}{(1-2\nu)}$
(c) $\dfrac{\alpha TE}{2\nu}$ (d) $\dfrac{\alpha TE}{(1+2\nu)}$

Q.38 Toughness for mild steel under uniaxial tensile loading is given by the shaded portion of the stress-strain diagram as shown in

(a)


(b)


(c) 

(d) 

Q.39 Which one of the following is correct in respect of Poisson's ratio (ν) limits for an isotropic elastic solid?

(a) $-\infty \le \nu \le \infty$ (b) $1/4 \le \nu \le 1/3$
(c) $-1 \le \nu \le 1/2$ (d) $-1/2 \le \nu \le 1/2$

Q.40 A bar of copper and steel form a composite system. They are heated to a temperature of 40°C. What type of stress is induced in the copper bar?

(a) tensile (b) compressive
(c) shear (d) None of these

Q.41 A cube with a side length of 1 cm is heated uniformly 1°C above the room temperature and all the sides are free to expand. What will be the increase in volume of the cube? (Given coefficient of thermal expansion is α per °C)

(a) $3\,\alpha$ cm^3 (b) $2\,\alpha$ cm^3
(c) α cm^3 (d) zero

Q.42 If E, G and K denote Young's modulus of elasticity, Modulus of rigidity and Bulk modulus, respectively, for an elastic material then which one of the following can be possibly true?

(a) $G = 2K$ (b) $G = E$
(c) $K = E$ (d) $G = K = E$

Q.43 Consider the following statements:

1. Strength of steel increases with carbon content
2. Young's modulus of steel increases with carbon content
3. Young's modulus of steel remains unchanged with variation of carbon content

Which of these statements is/are correct?

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

Q.44 A solid uniform metal bar of diameter D and length L is hanging vertically from its upper end. The elongation of the bar due to self weight is

(a) Proportional to L and inversely proportional to D^2
(b) Proportional to L^2 and inversely proportional to D^2
(c) Proportional to L but independent of D
(d) Proportional to L^2 but independent of D

Q.45 E, G, K and ν represent the elastic modulus, shear modulus, bulk modulus and Poisson's ratio respectively of a linearly elastic, isotropic and homogeneous material. To express the stress-strain relations completely for this material, at least

(a) E, G and ν must be known
(b) E, K and ν must be known
(c) any two of the four must be known
(d) All the four must be known

Q.46 Steel has its yield strength of 400 N/mm^2 and modulus of elasticity of 2×10^5 MPa. Assuming the material to obey Hooke's law up to yielding, what is its proof resilience?

(a) 0.8 N/mm^2 (b) 0.4 N/mm^2
(c) 0.6 N/mm^2 (d) 0.7 N/mm^2

Q.47 In a tensile test, near the elastic limit zone

(a) tensile stress increases at a faster rate
(b) tensile stress decreases at a faster rate
(c) tensile stress increases in linear proportion to the strain
(d) tensile stress decreases in linear proportion to the strain

Q.48 Given that for an element in a body of homogeneous isotropic material subjected to plane stress; e_x, e_y and e_z are normal strains in x, y and z directions respectively and μ is the Poisson's ratio, the magnitude of unit volume change of the element is given by

(a) $e_x + e_y + e_z$ (b) $e_x - (e_y + e_z)$
(c) $\mu(e_x + e_y + e_z)$ (d) $\frac{1}{e_x} + \frac{1}{e_y} + \frac{1}{e_z}$

Q.49 The ratio of the lateral pressure of the bulk storage material at the time of emptying to that at the time of filling is
(a) less than one
(b) equal to or less than one
(c) equal to one
(d) greater than one

Q.50 The stress below which a material has a high probability of not failing under reversal of stress is known as
(a) tolerance limit (b) elastic limit
(c) proportional limit (d) endurance limit

Q.51 Consider the following statements:
The principal of super position is applied to:
1. Linear elastic bodies.
2. Bodies subjected to small deformations.
Which of these statements is/are correct?
(a) 1 alone (b) 1 and 2
(c) 2 alone (d) Neither 1 nor 2

Q.52 If all the dimensions of a bar are increased in the proportion n : 1, the proportion with which the maximum stress produced in the prismatic bar by its own weight, will increase in the ratio
(a) 1 : n (b) n : 1
(c) $1:\frac{1}{n}$ (d) $\frac{1}{n}:1$

Q.53 A bar is subjected to an axial tensile stress. If the volumetric strain in the bar is 0.44 times the axial strain, what is the Poisson's ratio of the material?
(a) 0.44 (b) 0.30
(c) 0.28 (d) None of these

Q.54 On a plane, resultant stress is inclined at an angle of 30° with the plane. If the normal stress on the plane is 50 MPa, what is the shear stress on the plane.
(a) 43.3 MPa (b) 86.6 MPa
(c) 100 MPa (d) None of these

Q.55 A bar of a square section $a \times a$ subjected to a tensile load P on a plane inclined at 45° to the axis of the bar, normal stress will be
(a) $\frac{2P}{a^2}$ (b) $\frac{P}{a^2}$
(c) $\frac{P}{2a^2}$ (d) $\frac{P}{4a^2}$

Q.56 Two tie rods are connected, through a pin of a cross-sectional area of 40 mm^2. If the tie rods carry a tensile load of 10 kN, the shear stress in the pin is
(a) 125 MPa (b) 250 MPa
(c) 500 MPa (d) None of these

Q.57 A spherical ball of volume 1000 cm^3 is subjected to a hydrostatic pressure of 90 N/mm^2 and bulk modulus of the material is 190 kN/mm^2. What is the change in volume of the ball?
(a) 473 mm^3 (b) 940 mm^3
(c) 502 mm^3 (d) None of these

Q.58 In stress-strain curve, the area upto elastic limit stress indicates which mechanical property?
(a) Ductility (b) Strength
(c) Resilience (d) None of these

Q.59 In σ-ϵ curve for mild steel, load at which considerable extension occurs with decrease in resistance is known as?
(a) Upper yield point (b) Breaking load
(c) Ultimate load (d) None of these

Q.60 A composite bar is made of steel and aluminium strips, with $A_a = 3A_s$, where A_a and A_s are areas of cross-section of aluminium and steel bars, respectively $E_s/E_a = 3$. Due to an external load, if the stress developed in the aluminium is 30 MPa, then what is the stress developed in the steel bar?
(a) 10 MPa (b) 30 MPa
(c) 90 MPa (d) None of these

Q.61 A copper bar of area of cross-section 200 mm^2 is encased in a steel tube of area of cross-section 400 mm^2. Due to an external load, the stress in copper bar is 10 MPa and load on composite bar is P. What is the load shared by the steel bar? $\frac{E_s}{E_{cu}} = 2$
(a) 0.5 P (b) 0.6 P
(c) 0.8 P (d) None of these

Q.62 A bimetallic strip is made of two metals with equal areas of cross-section. Due to temperature change, the stress developed in one strip is –40 N/mm^2. What is the stress developed in another component of the composite bar?
(a) –40 N/mm^2 (b) 20 N/mm^2
(c) 40 N/mm^2 (d) –20 N/mm^2

Q.63 Three strips of same area of cross-section share a load of 5.5 kN. If their Young's modulus are in the ratio of $E_1 = 2E_2 = 3E_3$, then what is the load, shared by the strip with Young's modulus E_1

(a) 3 kN (b) 3.5 kN
(c) 2.5 kN (d) 2 kN

Q.64 A steel rail track is laid by joining 30 m long rails end to end. At 30°C there is no stress in the rails. At 50°C, what will be the stress in the rails if $\alpha = 11 \times 10^{-6}$/°C and $E = 2 \times 10^5$ N/mm²

(a) 88 MPa (b) 44 MPa
(c) 22 MPa (d) 11 MPa

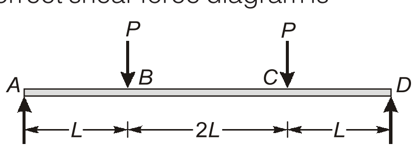
Q.65 True stress σ is related with conventional stress σ_0 as

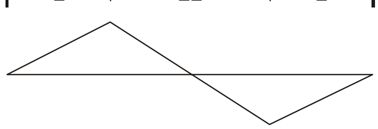
(a) $\frac{\sigma}{\sigma_0} = (1+\epsilon)^2$ (b) $\frac{\sigma}{\sigma_0} = \frac{1}{(1+\epsilon)^2}$

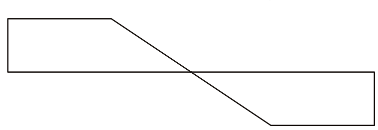
(c) $\frac{\sigma}{\sigma_0} = \frac{1}{1+\epsilon}$ (d) $\frac{\sigma}{\sigma_0} = 1+\epsilon$

2. Shear Force and Bending Moment

Q.66 For the loaded beam shown in the figure, the correct shear force diagram is



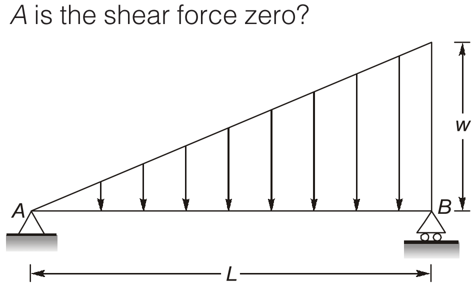
(a) 

(b) 

(c) 

(d) 

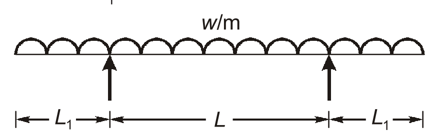
Q.67 For the simply supported beam, shown in the figure below at what distance from the support *A* is the shear force zero?



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

(c) $\frac{L}{2}$ (d) $\frac{L}{\sqrt{3}}$

Q.68 For the beam shown in the given figure, the maximum positive bending moment is equal to the maximum negative bending moment. The value of L_1 is



(a) $\frac{L}{\sqrt{2}}$ (b) $\frac{L}{\sqrt{3}}$

(c) $\frac{L}{2}$ (d) $\frac{L}{2\sqrt{2}}$

Q.69 The maximum bending moment due to a moving load on a fixed ended beam occurs

(a) at a support
(b) always at the mid span
(c) under the load only
(d) None of the above

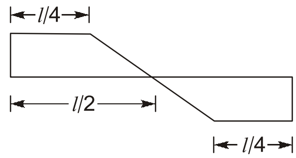
Q.70 If a beam is subjected to a constant bending moment along its length then the shear force will

(a) also have a constant value every where along its length
(b) be zero at all sections along the beam
(c) be maximum at the centre and zero at the ends
(d) be maximum at the ends and zero at the centre

Q.71 If the shear force acting at every section of a beam is of the same magnitude and of the same direction, then it represents a

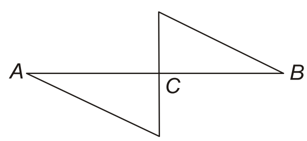
(a) simply supported beam with a concentrated load at the centre
(b) overhang beam having equal overhang at both supports and carrying equal concentrated loads acting in the same direction at the free ends
(c) cantilever subjected to concentrated load at the free end
(d) simply supported beam having concentrated loads of equal magnitude and in the same direction acting at equal distances from the supports

Q.72 The shear force diagram shown in the figure is that of a



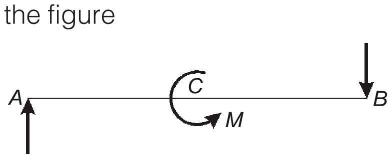
(a) freely supported beam with symmetrical point load about mid-span
(b) freely supported beam with symmetrical uniformly distributed load about mid-span
(c) simply supported beam with positive and negative point loads symmetrical about the mid-span
(d) simply supported beam with symmetrical varying load about mid-span

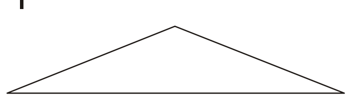
Q.73 If the bending moment diagram for a simply supported beam is of the form as given in figure then the load acting on the beam is

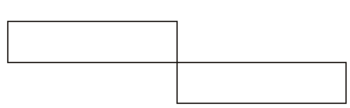


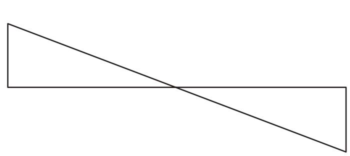
(a) a concentrated force at C
(b) a uniformly distributed load over the whole length of the beam
(c) equal and opposite moments applied at A and B
(d) a moment applied at C

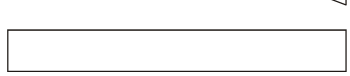
Q.74 A beam is simply supported at its ends and is loaded by a couple at its mid-span as shown in figure. Shear force diagram for the beam is given by the figure



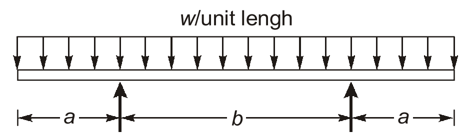
(a) 

(b) 

(c) 

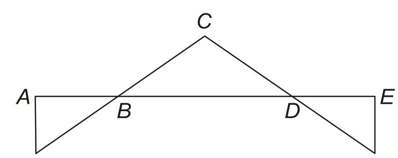
(d) 

Q.75 A horizontal beam carrying uniformly distributed load is supported with equal overhangs as shown in the figure below. The resultant bending moment at the mid-span shall be zero if a/b is

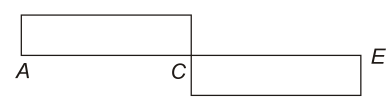


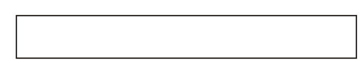
(a) 3/4 (b) 2/3
(c) 1/2 (d) 1/3

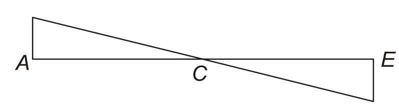
Q.76 Bending moment distribution in a beam is shown in the figure below.

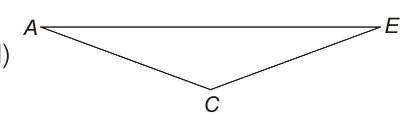


The shear force diagram will be given by

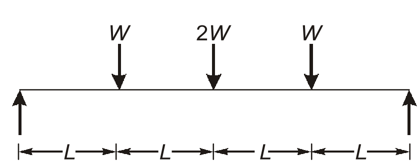
(a) 

(b) 

(c) 

(d) 

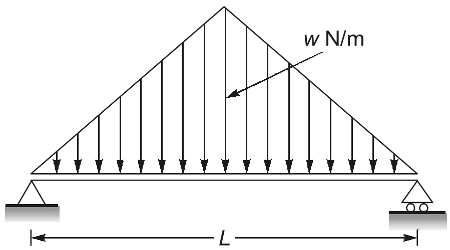
Q.77 A simply supported beam is loaded as shown in the figure. The maximum shear force in the beam will be



(a) Zero (b) W
(c) 2 W (d) 4 W

Q.78 The shape of the bending moment diagram for a cantilever beam carrying a uniformly distributed load over its length is
(a) a straight line (b) a hyperbola
(c) an ellipse (d) a parabola

Q.79 A simply supported beam is subjected to a distributed loading as shown in the diagram given



What is the maximum shear force in the beam?

(a) $wL/4$ (b) $wL/2$

(c) $wL/3$ (d) $wL/6$

Q.80 The point of contraflexure is a point where

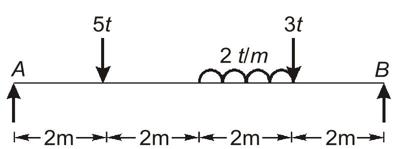
(a) Shear force changes sign

(b) Bending moment changes sign

(c) Shear force is maximum

(d) Bending moment is maximum

Q.81 The ratio of reactions R_A and R_B of the simply supported beam (as shown) is



(a) 1/2 (b) 2/3

(c) 1 (d) 3/2

Q.82 The bending moment in a simple supported beam can be calculated with the help of influence line drawn for the following types of load

(a) a single point load

(b) a uniformly distributed load

(c) a number of point loads

(d) All of the above three

Q.83 In a simply supported beam of length 'L' with a triangular load varying from zero at one end to the maximum value at the other end, the maximum bending moment is

(a) $\frac{wL^2}{3}$ (b) $\frac{2wL^2}{9\sqrt{3}}$

(c) $\frac{wL}{4}$ (d) $\frac{wL^2}{9\sqrt{3}}$

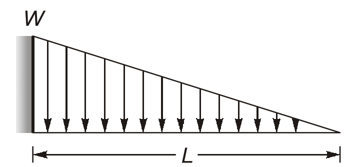
Q.84 For a simply supported beam of length L, the bending moment M is described as $M = a(x - x^3/L^2)$, $0 \le x < L$; where a is a constant. The shear force will be zero at

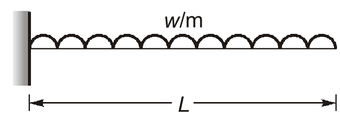
(a) the supports (b) $x = L/2$

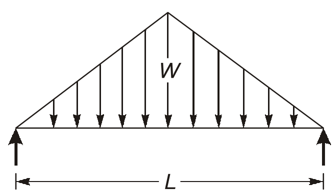
(c) $x = L/\sqrt{3}$ (d) $x = L/3$

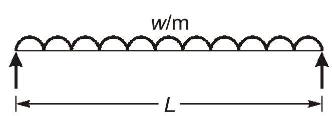
Q.85 Match **List-I** (Type of beam with type of loading) with **List-II** (Maximum BM formula) and select the correct answer using the codes given below the lists:

List-I

A. 

B. 

C. 

D. 

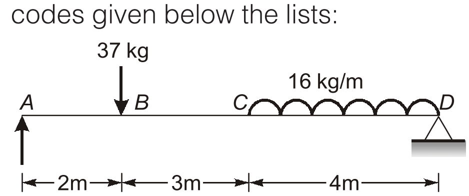
List-II

1. $\frac{WL^2}{12}$
2. $\frac{wL^2}{6}$
3. $\frac{wL^2}{2}$
4. $\frac{wL^2}{8}$

Codes:

	A	B	C	D
(a)	2	3	1	4
(b)	1	2	3	4
(c)	4	3	1	2
(d)	2	1	4	3

Q.86 With reference to following figure, match **List-I** with **List-II** and select the correct answer by using codes given below the lists:

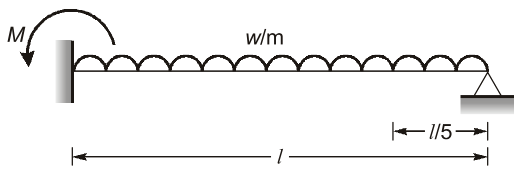


List-I	List-II
A. SF at A	1. 6 kg
B. SF at B	2. 58 kg
C. SF at C	3. 43 kg
D. SF at D	4. 48 kg

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	3	1	4	2
(c)	3	1	1	2
(d)	2	4	1	3

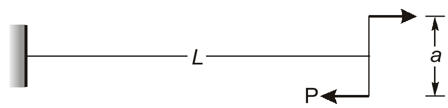
Q.87 In figure the maximum bending moment at the fixed end of the cantilever caused by the UDL is M.



The bending moment at a section $l/5$ from the free end is

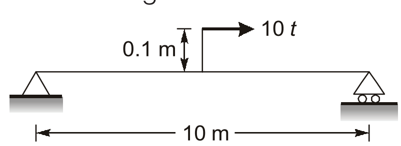
(a) 4% of M (b) 5% of M
(c) 10% of M (d) 20% of M

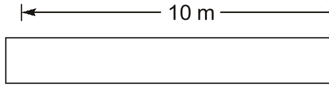
Q.88 The shear force along the beam shown in the figure is

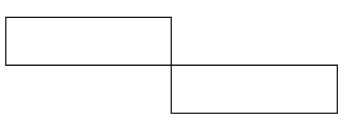


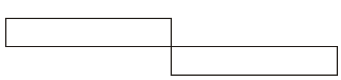
(a) uniformly varying
(b) uniform
(c) zero
(d) concentrated at A and B only

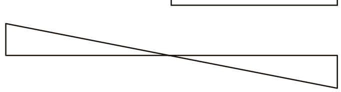
Q.89 The correct shear force diagram for the beam shown in the figure is



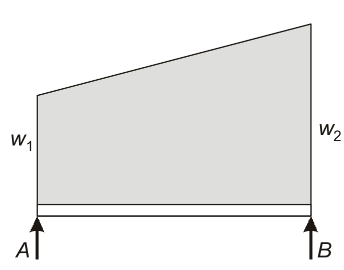
(a) 

(b) 

(c) 

(d) 

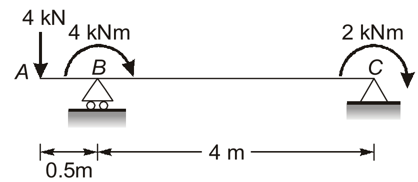
Q.90 A simply supported beam of span l is loaded (as shown) with a udl of intensity w_1 per unit length at A and w_2 per unit length at B the shear force at the support B is given by



(a) $\frac{(w_1+w_2)l}{3}$ (b) $\frac{(w_1+w_2)l}{6}$

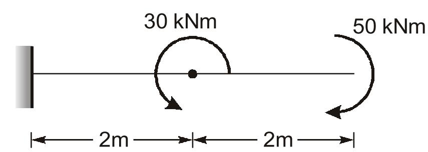
(c) $\frac{w_1 l}{6}+\frac{w_2 l}{3}$ (d) $\frac{w_2 l}{3}+\frac{w_2 l}{6}$

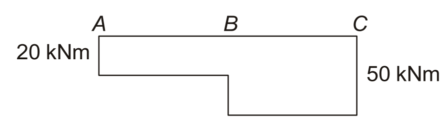
Q.91 The beam shown in the given figure has a design value of bending moment of

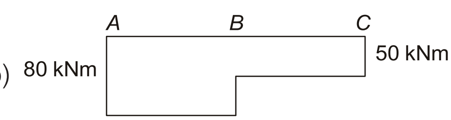


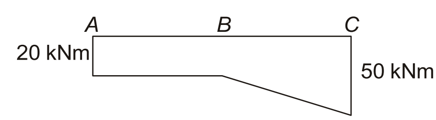
(a) 8 kN-m (b) 6 kN-m
(c) 4 kN-m (d) 2 kN-m

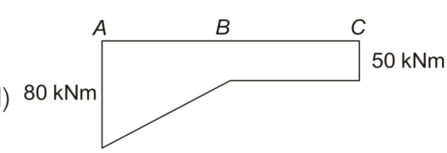
Q.92 A cantilever beam is subjected to moments as shown in the given figure. The BM diagram for the beam will be



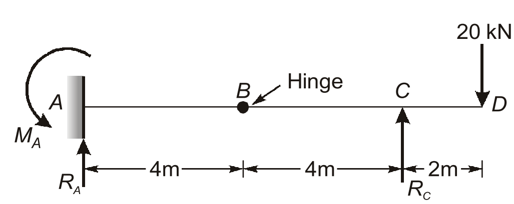
(a) 

(b) 

(c) 

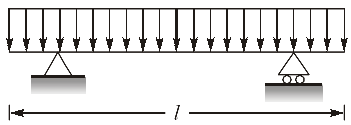
(d) 

Q.93 The fixed end moment M_A of the beam shown in the given figure is



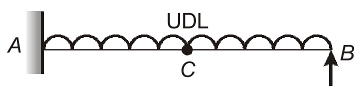
(a) +40 kNm (b) –40 kNm
(c) +80 kNm (d) –80 kNm

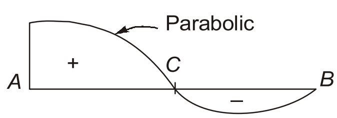
Q.94 A simply supported beam with equal overhang on both sides is loaded as shown in the figure. If the bending moment at mid-span is zero, then the percentage overhang on each side will be

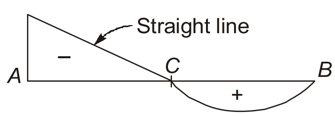


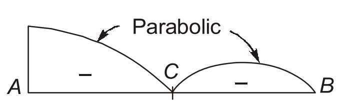
(a) 33.3 (b) 25
(c) 20 (d) 15

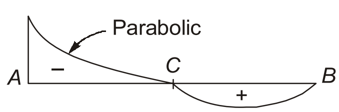
Q.95 A propped cantilever beam shown in the figure given is having internal hinge at its mid-span. Which one of the following is the shape of bending moment diagram for the given loading?



(a)


(b)


(c)


(d)


Q.96 In the case of I-section, the web resists mainly
(a) axial force
(b) shear force
(c) bending moment
(d) both shear force and bending moment

Q.97 A 10 m long beam carries point loads. When SF diagram is drawn, there are two rectangles of 10 kN × 2 m side; one is starting from one end and above the base and other starting from the other end and below the base line. The BM at the centre of the beam is
(a) 20 kNm (b) 30 kNm
(c) 40 kNm (d) 50 kNm

Q.98 A beam of overall length l with equal overhangs on both sides carries a uniformly distributed load over the entire length. To have numerically equal bending moments at centre of the beam and at supports, the distance between the supports should be:
(a) 0.277 l (b) 0.403 l
(c) 0.586 l (d) 0.707 l

3. Bending and Shear Stress

Q.99 A simply supported beam of span L carries a concentrated load W at mid-span. If the width b of the beam is constant and its depth is varying throughout the span, then what should be its mid-span depth, when design stress is f?

(a) $\sqrt{\dfrac{6WL}{bf}}$ (b) $\dfrac{6WL}{bf}$

(c) $\sqrt{\dfrac{3WL}{2bf}}$ (d) $\dfrac{3WL}{2bf}$

Q.100 A beam of T-section has I = 1200 cm^4 and depth = 12 cm. Flange of the section is in compression. If the maximum tensile stress is two times the maximum compressive stress, what is section modulus in compression?
(a) 300 cm^3 (b) 200 cm^3
(c) 100 cm^3 (d) None of these

Q.101 The width of a beam of uniform strength having a constant depth d, length L, simply supported at the ends with a central load W is

(a) $\dfrac{2WL}{3fd^2}$ (b) $\dfrac{3WL}{2fd^2}$

(c) $\dfrac{2fL}{3Wd^4}$ (d) $\dfrac{3fL^2}{3Wd}$

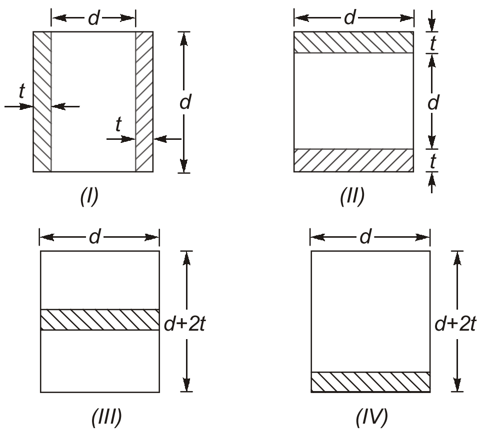
Q.102 A beam of rectangular cross-section is 100 mm wide and 200 mm deep. If the section is subjected to a shear force of 20 kN, the maximum shear stress is
(a) 1 N/mm^2 (b) 1.125 N/mm^2
(c) 1.33 N/mm^2 (d) 1.5 N/mm^2

Q.103 The ratio of the flexural strengths of two square beams one placed with two sides horizontal and the other placed with one diagonal vertical and other horizontal is

(a) $\sqrt{2}$ (b) $\sqrt{3}$

(c) $\sqrt{5}$ (d) $\dfrac{1}{\sqrt{2}}$

Q.104 The modular ratio of the materials used in the flitched beam is 10 and the ratio of the allowable stresses is also 10. Four different sections of the beam are shown in the given figures. The material shown hatched has larger modulus of elasticity and allowable stress than the rest.



Which one of the following statements is true for the beam under consideration?

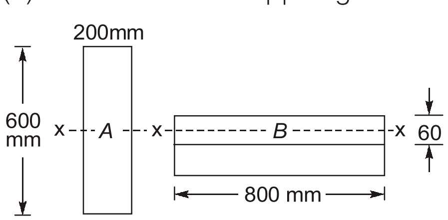
(a) All the given sections would support the same magnitude of load.

(b) Sections II, III and IV would support equal loads which is more than what section I would support.

(c) Sections I and II would support equal loads which is more than what section III and IV would support.

(d) Section II would support greatest load.

Q.105



Cross-sections of two beams *A* (600 mm × 200 mm) and *B* (800 mm × 60 mm) are shown in the figure given above. Both the beams have the same material. By how many times is the beam *A* stronger than the beam *B* in resisting bending

(a) 80 (b) 60

(c) 50 (d) 25

Q.106 A beam of uniform strength refers to which one of the following?

(a) A beam in which extreme fibre stresses are same at all cross-sections along the length of the beam

(b) A beam in which the moment of inertia about the axis of bending is constant at all cross-section of the beam

(c) A beam in which the distribution of bending stress across the depth of cross-section is uniform at the all cross-sections of the beam

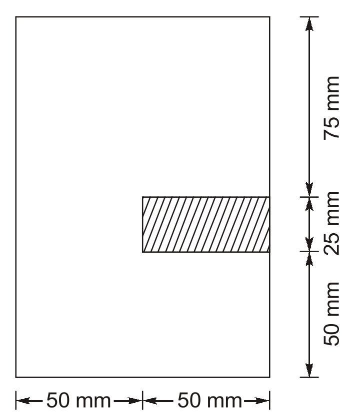
(d) A beam in which the bending stress is uniform at the maximum bending moment cross-section.

Q.107 Maximum shear stress in a circular cross-section is

(a) $\frac{9}{8}q_{av}$ (b) $\frac{4}{3}q_{av}$

(c) $\frac{3}{2}q_{av}$ (d) $\frac{8}{3}q_{av}$

Q.108 A beam with the cross-section given below is subjected to a positive bending moment (causing compression at top) of 16 kNm acting around the horizontal axis. The tensile force acting on the hatched area of cross-section is



(a) Zero (b) 5.9 kN

(c) 8.9 kN (d) 17.8 kN

Q.109 Shear stress in a beam having triangular cross-section is maximum at

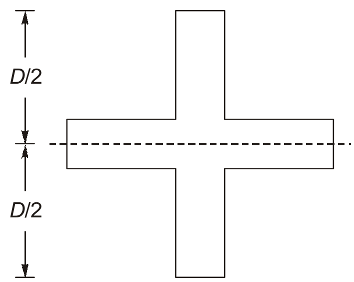
(a) extreme top fibre

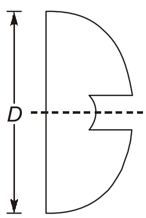
(b) mid-depth

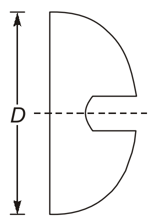
(c) neutral axis

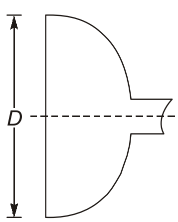
(d) extreme bottom fibre

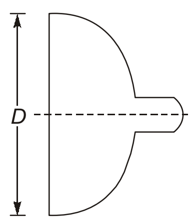
Q.110 The cross-section of a beam in bending is as shown in the figure. It is subjected to shear force acting in the plane of cross-section. Which among the following figure shows the correct shear stress distribution across the depth of the cross-section of the beam?



(a) 

(b) 

(c) 

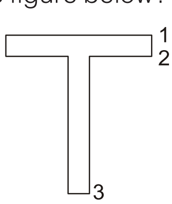
(d) 

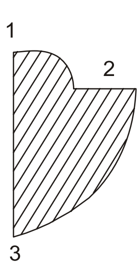
Q.111 A beam of square cross-section ($B \times B$) is used as a beam with one diagonal horizontal. The location of the maximum shear stress from the neutral axis will be at distance of

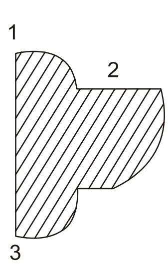
(a) Zero (b) $\frac{B}{4}$

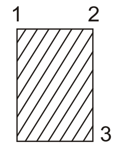
(c) $\frac{B}{4\sqrt{2}}$ (d) $\frac{B}{8}$

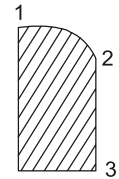
Q.112 Which one of the following diagrams indicates the shear stress distribution for the beam as shown in the figure below?



(a) 

(b) 

(c) 

(d) 

Q.113 A beam is of I-section with flanges 200 mm × 10 mm and web 180 mm × 10 mm. Due to the bending moment applied on the beam section, maximum stress developed in the beam section is 100 MPa, what is the stress developed at inner edge of the flange?

(a) 110 MPa (b) 100 MPa
(c) 90 MPa (d) 120 MPa

Q.114 A MS beam is subjected to a bending moment, such that a stress of 100 MPa is developed in a layer at a distance of 100 mm from the neutral layer. If E = 200 GPa, what is the radius of curvature of the beam?

(a) 400 m (b) 200 m
(c) 100 m (d) 50 m

Q.115 A cantilever of uniform strength σ, having rectangular section of constant breadth b but variable depth d is subjected to a UDL throughout its length. If the depth of the section is 150 mm at the fixed end, then what is the depth of the middle of the length of cantilever

(a) 150 mm (b) 100 mm
(c) 75 mm (d) 125 mm

Q.116 A beam with a square section of 80 mm × 80 mm is simply supported at its ends. A load W is applied at the centre of the beam. If the maximum shear stress developed in the beam section is 6 N/mm^2. What is the magnitude of W?

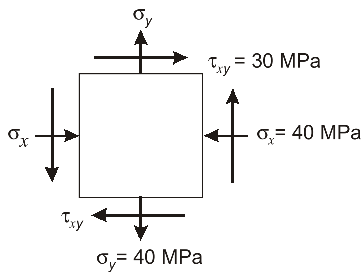
(a) 2.56 kN (b) 25.6 kN
(c) 51.2 kN (d) 5.12 kN

Q.117 A I-section is subjected to transverse shear force. At which layer maximum shear stress is developed?

(a) Neutral axis
(b) At top edge of flange
(c) At bottom edge of flange
(d) None of these

4. Principal Stress and Strain

Q.118 The state of stress at a point in a loaded member is shown in figure. The magnitude of maximum shear stress is



(a) 10 MPa (b) 30 MPa
(c) 50 MPa (d) 100 MPa

Q.119 At a point in a strained body carrying two unequal unlike principal stresses p_1 and p_2 ($p_1 > p_2$), the maximum shear stress is given by
(a) $p_1/2$ (b) $p_2/2$
(c) $(p_1 - p_2)/2$ (d) $(p_1 + p_2)/2$

Q.120 The radius of Mohr's circle of stress of a strained element is 20 N/mm^2 and minor principal tensile stress is 10 N/mm^2. The major principal stress is
(a) 30 N/mm^2 (b) 50 N/mm^2
(c) 60 N/mm^2 (d) 100 N/mm^2

Q.121 The principal stresses σ_1, σ_2 and σ_3 at a point respectively are 80 MPa, 30 MPa and –40 MPa. The maximum shear stress is
(a) 25 MPa (b) 35 MPa
(c) 55 MPa (d) 60 MPa

Q.122 Plane stress at a point in a body is defined by principal stress 3σ and σ. The ratio of the normal stress to the maximum shear stress on the plane of maximum shear stress is
(a) 1 (b) 2
(c) 3 (d) 4

Q.123 A shaft subjected to torsion experiences a pure shear stress τ on the surface. The maximum principal stress on the surface which is at 45° to the axis will have a value
(a) $\tau \sin^2 45°$ (b) $2\tau \cos 45°$
(c) $\tau \cos^2 45°$ (d) $2\tau \sin 45° \cos 45°$

Q.124 Principal strains at a point are 100×10^{-6} and -200×10^{-6}. What is the maximum shear strain at the point?
(a) 300×10^{-6} (b) 200×10^{-6}
(c) 150×10^{-6} (d) 100×10^{-6}

Q.125 In a plane stress problem there are normal tensile stresses σ_x and σ_y accompanied by shear stress τ_{xy} at a point along orthogonal Cartesian coordinates x and y respectively. If it is observed that the minimum principal stress on a certain plane is zero then
(a) $\tau_{xy} = \sqrt{\sigma_x + \sigma_y}$ (b) $\tau_{xy} = \sqrt{\sigma_x - \sigma_y}$
(c) $\tau_{xy} = \sqrt{\sigma_x \sigma_y}$ (d) $\tau_{xy} = \sqrt{\frac{\sigma_x}{\sigma_y}}$

Q.126 A point in a strained body is subjected to a tensile stress of 100 MPa on one plane and a tensile stress of 50 MPa on a plane at right angle to it. If these planes are carrying shear stresses of 50 MPa, then the principal stresses are inclined to the larger normal stress at an angle of
(a) $\tan^{-1}(2)$ (b) $\frac{1}{2}\tan^{-1}(2)$
(c) $\frac{1}{2}\tan^{-1}\left(\frac{2}{3}\right)$ (d) $\frac{1}{2}\tan^{-1}\left(\frac{1}{3}\right)$

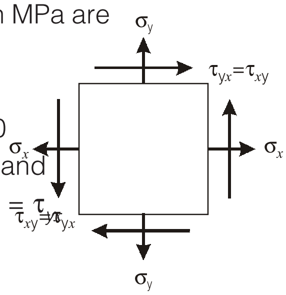
Q.127 If the normal cross-section A of a member is subjected to a tensile force P, the resulting normal stress on an oblique plane inclined at angle θ to transverse plane will be
(a) $\frac{P}{A}\sin^2\theta$ (b) $\frac{P}{A}\cos^2\theta$
(c) $\frac{P}{2A}\sin^2\theta$ (d) $\frac{P}{2A}\cos^2\theta$

Q.128 If the principal stresses at point in a strained body are p_1 and p_2 ($p_1 > p_2$), then the resultant stress on a plane carrying the maximum shear stress is equal to
(a) $\sqrt{p_1^2 + p_2^2}$ (b) $\sqrt{\frac{p_1^2 + p_2^2}{2}}$
(c) $\sqrt{\frac{p_1^2 - p_2^2}{2}}$ (d) $\sqrt{p_1^2 - p_2^2}$

Q.129 If ϵ_1 and ϵ_2 ($\epsilon_1 > \epsilon_2$) are the maximum and minimum strains in the neighbourhood of a point in a stressed material of Young's modulus E and Poisson's ratio μ, then the maximum principal stress will be given by
(a) $E\epsilon_1$
(b) $E(\epsilon_1 + \epsilon_2)$
(c) $E(\epsilon_1 + \mu\epsilon_2)/(1 - \mu^2)$
(d) $E(\epsilon_2 + \mu\epsilon_1)/(1 - \mu^2)$

Q.130 On the element shown below in the figure, the stress in MPa are

$\sigma_x = 110$
$\sigma_y = 30$ and
$\tau_{xy} = 30 = \tau_{yx}$

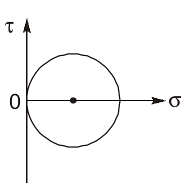


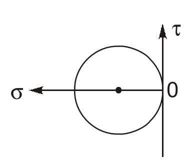
The radius of Mohr's circle '*r*' and principal stresses σ_1 and σ_2 are in (MPa) respectively
(a) 50, 120, 20 (b) 55, 110, 30
(c) 60, 20, 140 (d) 70, 20, 120

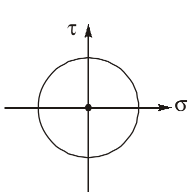
Q.131 The radius of Mohr's circle gives the value of
(a) minimum normal stress
(b) minimum shear stress
(c) maximum normal stress
(d) maximum shear stress

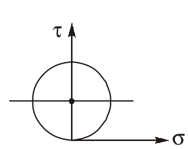
Q.132 A body is subjected to two normal strains of magnitude $\in_x = 0.003$ and $\in_y = 0.002$. The shearing strain on a plane inclined at 30° with $\in_x$ is
(a) $\frac{\sqrt{3}}{2} \times 10^{-3}$ (b) $\frac{\sqrt{3}}{4} \times 10^{-3}$
(c) $\frac{1}{2} \times 10^{-3}$ (d) $\frac{1}{4} \times 10^{-3}$

Q.133 Which one of the following Mohr's circles represents the state of pure shear?

(a) 

(b) 

(c) 

(d) 

Q.134 A bar is subjected to a uniaxial tensile stress 'σ'. The tangential stress on a plane inclined at θ to the bar would be
(a) $\frac{\sigma \sin 2\theta}{2}$ (b) $\sigma \sin 2\theta$
(c) $\frac{\sigma \cos 2\theta}{2}$ (d) $\sigma \cos 2\theta$

Q.135 Consider the following statements:
1. On planes having maximum and minimum principal stresses, there will be no tangential stress.
2. Shear stresses on mutually perpendicular planes are numerically equal.
3. Maximum shear stress is equal to half the sum of the maximum and minimum principal stresses.

Which of these statements is/are correct?
(a) 1 only (b) 1 and 2
(c) 2 and 3 (d) 1 and 3

Q.136 Normal stresses of equal magnitude σ, but of opposite signs, act at a point of a strained material in perpendicular direction. What is the magnitude of the stress on a plane inclined at 45° to the applied stresses?
(a) 2σ (b) σ/2
(c) σ/4 (d) Zero

Q.137 Two planes *xy* and *yz* are passing through a point in a strained material. The normal and shear stresses on *xy* plane are +80 MPa, –30 MPa respectively and normal and shear stresses on plane *yz* are +30 MPa and +30 MPa respectively. What is the angle between the planes?
(a) 180° (b) 135°
(c) 90° (d) 45°

Q.138 In a rectangular strain gauge rosette, the strain recorded are $\in_0 = 400\,\mu$ strain, $\in_{45°} = 300\,\mu$ strain and $\in_{90°} = 200\,\mu$ strain, what is the maximum principal strain at the point
(a) 500 μ strain (b) 400 μ strain
(c) 300 μ strain (d) 200 μ strain

Q.139 Principal stresses at a point are $p_1 = 200$ MPa and $p_2 = 100$ MPa. What is the maximum angle of obliquity θ.
(a) $\theta = \sin^{-1}(0.25)$ (b) $\theta = \sin^{-1}(0.333)$
(c) $\theta = \sin^{-1}(0.5)$ (d) $\theta = \sin^{-1}(0.75)$

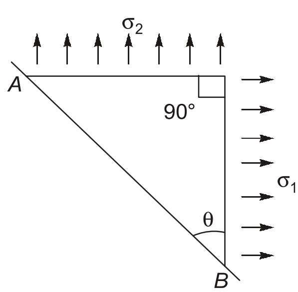
Q.140 The major and minor principal stresses at a point are 120 MPa and 40 MPa, respectively what is the normal stress on a plane of τ_{max} stress.
(a) 120 MPa (b) 80 MPa
(c) 40 MPa (d) 60 MPa

Q.141 The major and minor principal stresses at a point are 120 MPa and 60 MPa respectively, on the plane passing through the point, the shear stress on the plane is 15 MPa. What is the angle of this plane with the plane of major principal stress?
(a) 45° (b) 30°
(c) 15° (d) 60°

Q.142 Major principal stress at a point is 220 MPa. The radius of Mohr's stress circle is 70 MPa. What is the minor principal stress at the point?
(a) 150 MPa (b) 100 MPa
(c) 80 MPa (d) 50 MPa

Q.143 In the figure below, σ_1 and σ_2 are the maximum and minimum principal stresses. In order that the resultant stress on plane *AB* is $\sqrt{\left(\frac{\sigma_1+\sigma_2}{2}\right)^2+\left(\frac{\sigma_1-\sigma_2}{2}\right)^2}$

The value of θ should be



(a) 30° (b) 45°
(c) 60° (d) 75°

Q.144 A system of pure shear stress produces on an inclined plane
(a) a tensile stress and a compressive stress
(b) only tensile stresses
(c) only compressive stresses
(d) no direct stresses

5. Theories of Failure

Q.145 A certain steel has proportionality limit of 300 N/mm^2 in simple tension. It is subjected to principal stress of 120 N/mm^2 (tensile), 60 N/mm^2 (tensile) and 30 N/mm^2 (compressive). The factor of safety according to maximum shear stress theory is
(a) 1.50 (b) 1.75
(c) 1.80 (d) 2.00

Q.146 All the theories of failure, will give nearly the same result when
(a) when one of the principal stresses at a point is large in comparison to the other
(b) when shear stresses act
(c) when both the principal stresses are numerically equal
(d) For all situations of stress

Q.147 The principal stresses developed at a point are +60, –60, 0 MPa. Using shear strain energy theory, factor of safety obtained is $\sqrt{3}$. What is yield stress of the material?
(a) 60 MPa (b) 120 MPa
(c) $60\sqrt{3}$ MPa (d) 180 MPa

Q.148 For ductile material the suitable theory of failure is
(a) maximum principal stress theory
(b) maximum shear stress theory
(c) both (a) and (b)
(d) None of these

Q.149 Which of the following theories of failure is most appropriate for a brittle material?
(a) Maximum principal strain theory
(b) Maximum principal stress theory
(c) Maximum shear stress theory
(d) Maximum strain energy theory

Q.150 In a structural member, there are perpendicular tensile stresses of 100 N/mm^2 and 50 N/mm^2. What is the equivalent stress in simple tension, according to the maximum principal strain theory? (Poisson's ratio = 0.25)
(a) Zero (b) 87.5 N/mm^2
(c) 50 N/mm^2 (d) 100 N/mm^2

Q.151 Permissible bending moment in a circular shaft under pure bending is *M*, according to maximum principal stress theory of failure. According to maximum shear theory of failure, the permissible bending moment in the shaft is
(a) M/2 (b) M
(c) $\sqrt{2}$M (d) 2 M

Q.152 A shaft subjected to pure torsion is to be designed which of the following theories gives the largest diameter of shaft?
(a) Maximum principal stress
(b) Maximum shear stress theory
(c) Strain energy theory
(d) All the above theories give same diameter

Q.153 If maximum principal stress σ_1 = 60 N/mm^2, σ_2 and σ_3 of value zero act on a cube of unit dimensions, then the maximum shear stress energy stored in it would be

(a) $\frac{1800}{G}$ (b) $\frac{600}{G}$

(c) $\frac{1200}{G}$ (d) $\frac{300}{G}$

Q.154 In a 2*D* stress system, the two principal stress are p_1 = 180 N/mm^2 (tensile) and p_2 (compressive). For the materials, yield stress in simple tension and compression is 240 N/mm^2 and Poisson's ratio is 0.25. According to maximum normal strain theory for what value of p_2 shall yielding commence?

(a) 240 N/mm^2 (b) 180 N/mm^2

(c) 195 N/mm^2 (d) 200 N/mm^2

Q.155 Graphical representation of which one of the following theories is by an ellipse?

(a) Maximum principal strain theory

(b) Distortion energy theory

(c) Maximum shear stress theory

(d) None of these

Q.156 At a point in a strained material, the principal stresses are p_1, p_2 and 0. What combination of principal stresses will give same FOS by yielding according to the maximum shear stress theory and the distortion energy theory of failure?

(a) $p_1 = -p_2$ (b) $p_1 = 0.5p_2$

(c) $p_1 = p_2$ (d) $p_1 = 2p_2$

Q.157 A shaft is subjected to a torque and an axial compressive force. Shear stress due to torque is 30 MPa and axial compressive stress due to force is 80 MPa. If σ_{yp} = 270 MPa, what is FOS as per the maximum principal stress theory, Poisson's ratio = 0.3?

(a) 3.0 (b) 2.90

(c) 2.80 (d) None of these

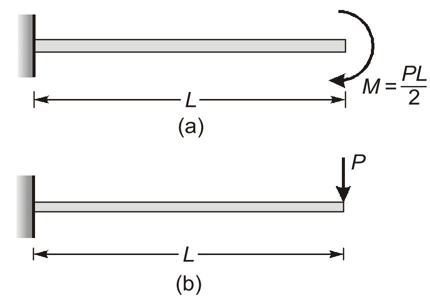
6. Deflection of Beams

Q.158 A simply supported beam with width '*b*' and depth '*d*' carries a central load W and undergoes deflection δ at the centre. If the width and depth are interchanged, the deflection at the centre of the beam would attain the value

(a) $\left(\frac{d}{b}\right)\delta$ (b) $\left(\frac{d}{b}\right)^2\delta$

(c) $\left(\frac{d}{b}\right)^3\delta$ (d) $\left(\frac{d}{b}\right)^{1/2}\delta$

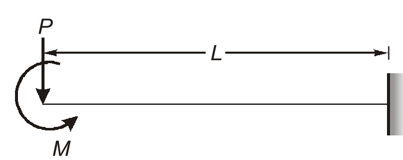
Q.159 Two identical cantilevers are loaded as shown in figure. If slope at the free end of the cantilever in figure (a) is θ, the slope at the free end of the cantilever in figure (b) will be



(a) $\frac{\theta}{3}$ (b) $\frac{\theta}{2}$

(c) $\frac{2\theta}{3}$ (d) θ

Q.160 The given figure shows a cantilever of span *L* subjected to a concentrated load *P* and moment *M* at the free end. Deflection at the free end is given by



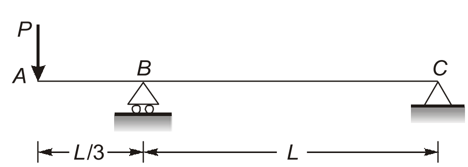
(a) $PL^2/2EI + ML^2/3EI$

(b) $PL^3/3EI + ML^2/2EI$

(c) $PL^3/2EI + ML^2/3EI$

(d) $PL^3/48EI + ML^2/48EI$

Q.161 An overhang beam of uniform *EI* is loaded as shown



The deflection at the free end will be

(a) $\frac{PL^3}{81EI}$ (b) $\frac{PL^3}{27EI}$

(c) $\frac{4PL^3}{81EI}$ (d) $\frac{2PL^3}{27EI}$

Q.162 A horizontal beam of length l of uniform cross-section is pinned at ends A and B. At end A there is a anticlockwise moment M and at end B there is clockwise moment $2M$. The slope at end A and end B are respectively

(a) $\frac{2ML}{3EI}$ and $\frac{5ML}{7EI}$ (b) $\frac{ML}{3EI}$ and $\frac{5ML}{6EI}$

(c) $\frac{ML}{EI}$ and $\frac{5ML}{7EI}$ (d) $\frac{2ML}{3EI}$ and $\frac{5ML}{6EI}$

Q.163 A cantilever beam of length 'l' carries a UDL 'w' from fixed end till mid span. The deflection at the free end is given by

(a) $\frac{5wl^4}{384EI}$ (b) $\frac{7wl^4}{384EI}$

(c) $\frac{7wl^4}{128EI}$ (d) $\frac{wl^4}{384EI}$

Q.164 A cantilever beam of length 'L' is subjected to a concentrated load P at free end what is the deflection at the centre of beam?

(a) $\frac{5PL^3}{48EI}$ (b) $\frac{PL^3}{24EI}$

(c) $\frac{5PL^3}{6EI}$ (d) $\frac{PL^3}{3EI}$

Q.165 A 4-metre long beam, simply supported at its ends; carries a point load 'W' at its centre. If the slope at the ends of beam is 1°, then deflection at the centre of beam is

(a) 10.56 mm (b) 18.32 mm
(c) 23.27 mm (d) 39.37 mm

Q.166 A simply supported beam AB of span 'l' has a uniform cross-section throughout. It carries a central concentrated load W and another load which is uniformly distributed over the entire span, its total magnitude being W. The maximum deflection in the beam is

(a) $\frac{9}{384}\frac{Wl^3}{EI}$ (b) $\frac{13}{384}\frac{Wl^3}{EI}$

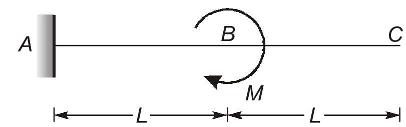
(c) $\frac{10}{384}\frac{Wl^3}{EI}$ (d) $\frac{15}{384}\frac{Wl^3}{EI}$

Q.167 A cantilever beam of span 'l' and uniform flexural rigidity 'EI' is loaded with an upward force 'W' at the mid point and downward force 'P' at the free end. The deflection at the free end will be zero if

(a) $W = \frac{3P}{2}$ (b) $W = 2P$

(c) $W = \frac{16P}{5}$ (d) $W = 5P$

Q.168 For cantilever beam shown in the figure, the deflection at C due to a couple M applied at B is equal to



(a) $\frac{ML^2}{2EI}$ (b) $\frac{ML^2}{EI}$

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

Q.169 Consider the following statements.

1. Conjugate beam can be used to determine slopes and deflection in a non-prismatic beam.
2. Conjugate beam may be statically indeterminate.
3. Conjugate beam method gives absolute slope and deflection.

The correct answer is

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

Q.170 Which of the following statements are correct. Macaulay's method for calculation of slope and deflection in a beam is suitable for

1. Prismatic beams only.
2. Several concentrated loads and can be extended to uniformly distributed loads.
3. Both prismatic and Non-prismatic beams.

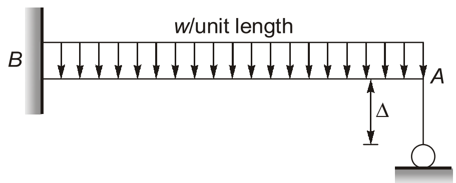
(a) Only 1 (b) 1 and 2
(c) Only 3 (d) 2 and 3

Q.171 A simply supported beam of span L and depth d carries a central load W. The ratio of maximum deflection to maximum bending stress is

(a) $\frac{L^2}{6Ed}$ (b) $\frac{L^2}{8Ed}$

(c) $\frac{L^2}{12Ed}$ (d) $\frac{L^2}{48Ed}$

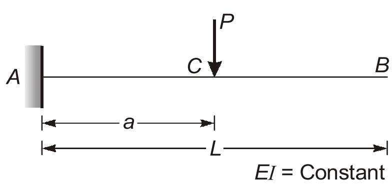
Q.172 Calculate the reaction at the roller support for the cantilever beam shown in the figure?



(a) $\frac{3wl}{8} - \frac{3EI\Delta}{l^3}$ (b) $\frac{5wl}{8} - \frac{3EI\Delta}{l^3}$

(c) $\frac{wl}{8EI} - \frac{6EI\Delta}{l^3}$ (d) $\frac{3wl}{8} - \frac{6EI\Delta}{l^3}$

Q.173 A cantilever carries a load P as shown in the given figure

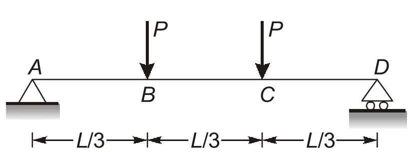


The deflection at B is

(a) $\frac{Pa^2}{2EI}(L-a)$ (b) $\frac{Pa^2}{3EI}(L-a)$

(c) $\frac{Pa^2}{2EI}\left(L-\frac{a}{3}\right)$ (d) $\frac{Pa^2}{3EI}\left(L-\frac{a}{3}\right)$

Q.174 A simply supported beam of uniform flexural rigidity is loaded as shown in the given figure. The rotation at the end A is



(a) $\frac{PL^2}{9EI}$ (b) $\frac{PL^2}{6EI}$

(c) $\frac{PL^2}{18EI}$ (d) $\frac{PL^2}{12EI}$

Q.175 The maximum deflection of simply supported beam occurs at zero

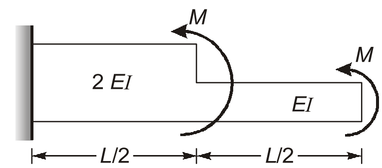
(a) bending moment location

(b) shear force location

(c) slope location

(d) shear force location and also zero bending moment location

Q.176 The stepped cantilever is subjected to moments, M as shown in the figure below. The vertical deflection at the free end (neglecting self weight) is



(a) $\frac{ML^2}{8EI}$ (b) $\frac{ML^2}{4EI}$

(c) $\frac{ML^2}{2EI}$ (d) Zero

Q.177 A simply supported beam of length 'L' carries two equal unlike couples. M at the two ends. The central deflection of the beam is given by

(a) $\frac{ML^2}{4EI}$ (b) $\frac{ML^2}{16EI}$

(c) $\frac{ML^2}{64EI}$ (d) $\frac{ML^2}{8EI}$

Q.178 A simply supported beam of span 'l' is subjected to clockwise moments M at both the ends A and B. The rotation of end A will be

(a) $\frac{ML}{2EI}$ (b) $\frac{ML}{3EI}$

(c) $\frac{ML}{4EI}$ (d) $\frac{ML}{6EI}$

Q.179 A beam of length L, simply supported at its ends and carries a UDL w throughout its length. The centre of the beam is propped so that centre is brought to the level of ends. The reaction at the prop is

(a) 0.33 wL (b) 0.5 wL

(c) 0.675 wL (d) None of these

Q.180 A simply supported beam of length 6 m carries a concentrated load W at its centre such that BM at centre of the beam is 6 kNm. If EI is the flexural rigidity of the beam then deflection at the centre is

(a) $\frac{9}{EI}$ (b) $\frac{18}{EI}$

(c) $\frac{36}{EI}$ (d) $\frac{54}{EI}$

Q.181 A beam AB of 10 m long is supported over a span of 8 m with equal overhang on both the sides. A load W is applied at the centre of the beam. What is the slope at free ends of the beam?

(a) $\pm\frac{6.25W}{EI}$ (b) $\pm\frac{5W}{EI}$

(c) $\pm\frac{4W}{EI}$ (d) None of these

Q.182 Slope and deflection of beams of varying flexural rigidity may be easily computed by the method of

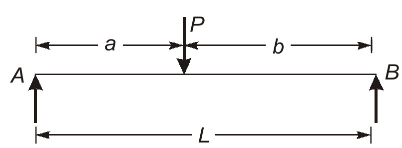
(a) Macaulay

(b) Mohr

(c) Conjugate beam

(d) Moment distribution

Q.183 A simply supported beam of length L carries a point load P as shown. The maximum deflection occurs at



(a) $\sqrt{\frac{L^2-b^2}{3}}$ from A

(b) $\sqrt{\frac{L^2-b^2}{3}}$ from B

(c) $\frac{L^2-b^2}{3}$ from A

(d) $\frac{L^2-b^2}{3}$ from B

Q.184 A simply supported beam of length $(a + b)$ carries a concentrated load W at a distance 'a' from one end. If EI is flexural rigidity of the bar, the deflection under the load will be:

(a) $\frac{W}{EI}\frac{a^2}{6(a+b)}$ (b) $\frac{W}{EI}\frac{b^2}{6(a+b)}$

(c) $\frac{W}{EI}\frac{a^2b^2}{4(a+b)}$ (d) $\frac{W}{EI}\frac{a^2b^2}{3(a+b)}$

Q.185 For the application of moment area method for finding deflection at a section in a beam

(a) the position of atleast one tangent to the elastic curve, at any section should be known

(b) the M/EI diagram must be triangle

(c) the beam must be of uniform moment of inertia

(d) the BM diagram if known is sufficient

7. Thin & Thick Cylinders and Spheres

Q.186 A thick cylinder is subjected to an internal pressure of 60 MPa. If the hoop stress on the outer surface is 150 MPa, then the hoop stress on the internal surface is

(a) 105 MPa (b) 180 MPa

(c) 210 MPa (d) 135 MPa

Q.187 The ratio of circumferential stress to longitudinal stress in a thin cylinder subjected to internal hydrostatic pressure is

(a) 1/2 (b) 1

(c) 2 (d) 4

Q.188 From design point of view, spherical pressure vessels are preferred over cylindrical pressure vessels because they

(a) are most effective in fabrication

(b) have uniform higher circumferential stress

(c) have uniform lower circumferential stress

(d) have a larger volume for the same quantity of material used

Q.189 A thin cylindrical shell of internal diameter D and thickness 't' is subjected to internal pressure 'p'. The change in diameter is given by

(a) $\frac{pD^2}{4tE}(2-m)$ (b) $\frac{pD^2}{4tE}(1-2m)$

(c) $\frac{pD^2}{2tE}(1-2m)$ (d) $\frac{pD^2}{2tE}(2-m)$

Q.190 A thin cylinder of thickness 't', width 'b' and internal radius 'r' is subjected to a pressure 'p' on the entire internal surface. What is the change in radius of the cylinder? (μ is the Poisson's ratio and E is the modulus of elasticity)?

(a) $\frac{p^2r(2-\mu)}{Et}$ (b) $\frac{pr^2(2-\mu)}{Et}$

(c) $\frac{pr^2(2-\mu)}{2Et}$ (d) $\frac{p(1-\mu)}{Etr^2}$