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MPSC - 2018 (MAIN)
Questions with Detailed Solutions

CIVIL ENGINEERING

PAPER - I

All Queries related to MPSC - 2018 (Main) Solutions are to be sent to the following email address
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MPSC – 2018 (MAIN) Examination

Paper –I (Questions with Detailed Solutions)

01. "The partial derivative of the total internal energy in a beam, with respect to the load applied at any point is equal to the deflection at that point". This is the statement of

(a) Moment area theorem
(b) Castigliano's second theorem
(c) Conjugate beam theorem
(d) Muller –Breslau's influence theorem

01. Ans: (b)

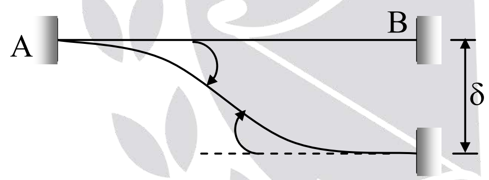
Sol: Castigliono's theorem: The partial derivative of total strain energy with respect to the load gives displacement. $\delta = \dfrac{\partial V}{\partial W}$.

02. For a fixed beam AB, the support B settles by δ downward, then what is the direction of rotation of point A and B?

(a) –ve, –ve
(b) +ve, + ve
(c) +ve , –ve
(d) –ve, + ve

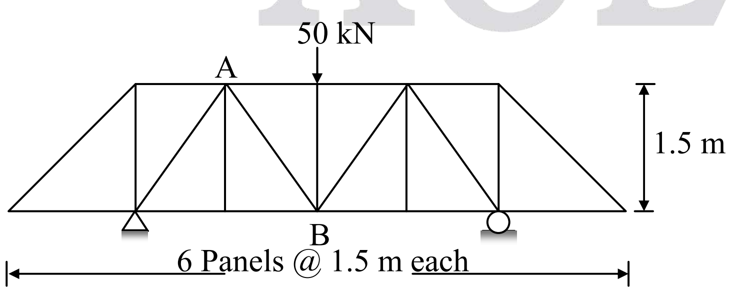
02. Ans: (b)

Sol:



The direction of rotation of point 'A' and 'B' are clockwise (+ve)

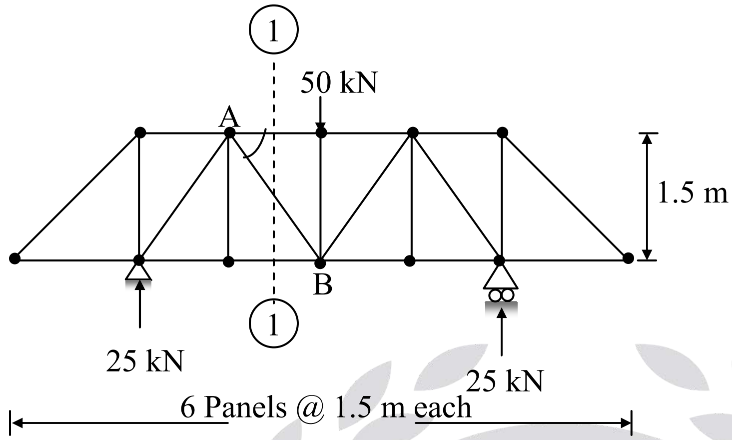
03. The force in member AB of the truss shown in the figure below is



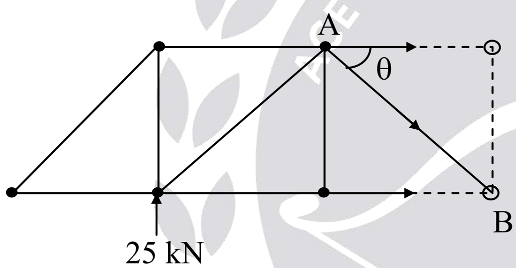
(a) 25 kN (c)
(b) $25\sqrt{2}$ kN (t)
(c) $25\sqrt{2}$ kN (c)
(d) 25 kN (t)

03. Ans: (b)

Sol:



Using method of section:

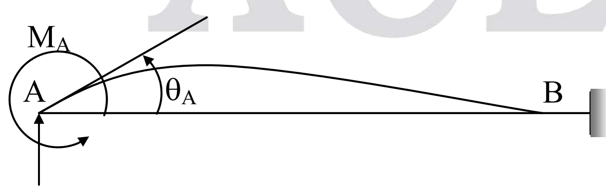


$\Sigma V = 0$

$F_{AB} \sin 45^\circ = 25$

$F_{AB} = 25\sqrt{2}$ kN (Tension)

04. For the given figure, the moment at A, whose far end is fixed, M_A is

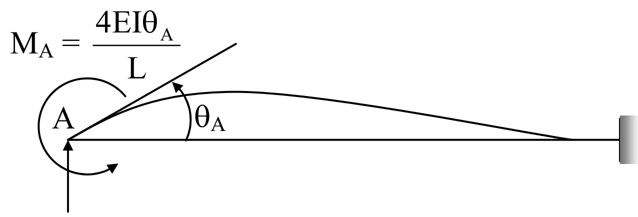


(a) $\frac{3EI}{\ell}\theta_A$ (b) $\frac{4EI}{\ell}\theta_A$

(c) $\frac{2EI}{\ell}\theta_A$ (d) $\frac{6EI}{\ell}\theta_A$

04. Ans: (b)

Sol:



05. The distribution factor is

(a) Ratio of stiffness of member and member

(b) Ratio of stiffness of near joint and far joint

(c) Ratio of stiffness of member and joint (sum of member stiffness)

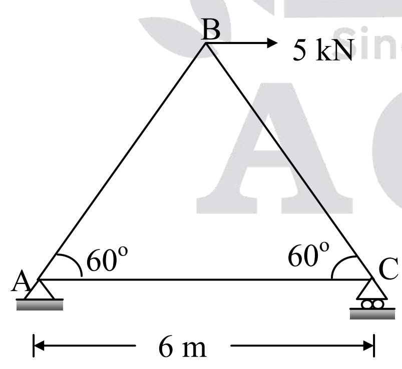
(d) Ratio of stiffness of joint and member

05. Ans: (c)

Sol: Distribution factor (DF) = $\frac{\text{Stiffness of a member}}{\text{Stiffness of a joint}}$

$$DF = \frac{K}{\Sigma K}$$

06. Force in the member BC of the truss shown in the figure below is



(a) 5 kN (tensile)

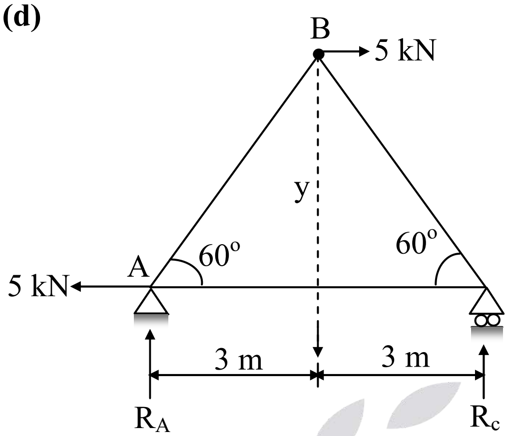
(b) zero

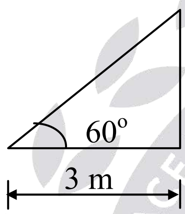
(c) 2.88 kN (compressive)

(d) 5 kN (compressive)

06. Ans: (d)

Sol:





$\tan\theta = \frac{y}{3}$

$y = 3 \tan 60^o$

$y = 3\sqrt{3}$ m

Taking moment about 'A'

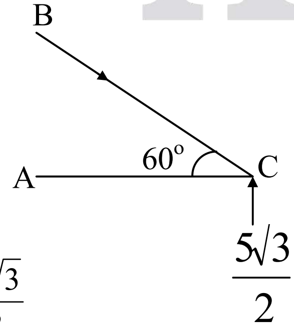
$\Sigma M_A = 0$ (anticlockwise –ve, clockwise +ve)

$-R_C \times 6 + 5 \times 3\sqrt{3} = 0$

$R_C = \frac{15\sqrt{3}}{6}$

$R_C = \frac{5\sqrt{3}}{2}$ kN

At joint 'C' :



$F_{BC} \sin 60^o = \frac{5\sqrt{3}}{2}$

$F_{BC} = 5$ kN (compression)

07. A fixed beam AB of span L is subjected to a clockwise moment M at a distance 'a' from end A. Fixed end moment at end A will be

(a) $\frac{M}{L^2}(L-a)(L-3a)$

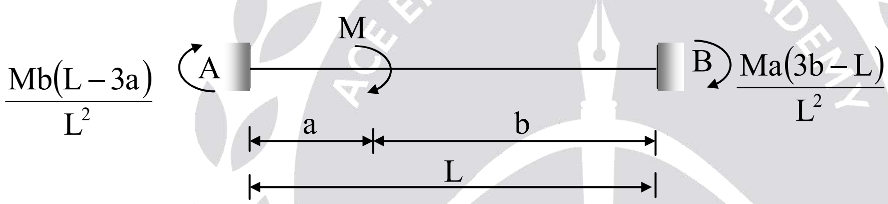
(b) $\frac{M}{L^2}a(2L-3a)$

(c) $\frac{M}{L^2}a(L-a)$

(d) $\frac{M}{L^2}(L-a)(2L-a)$

07. Ans: (a)

Sol:



$$M_{AB} = \frac{Mb(L-3a)}{L^2}$$

$$= \frac{M(L-a)(L-3a)}{L^2}$$

08. A beam of span l is fixed at one end and simply supported at other end. It carries uniformly distributed load of w per unit run over the whole span. The reaction (R) at the simply supported end is

(a) $R = \frac{3}{8}w\ell$

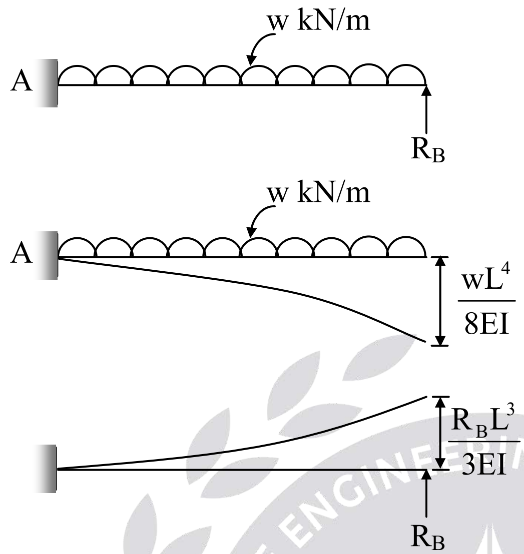
(b) $R = \frac{5}{8}w\ell$

(c) $R = \frac{1}{2}w\ell$

(d) $R = \frac{1}{3}w\ell$

08. Ans: (a)

Sol:



Upward deflection = Downward deflection

$$\frac{R_B L^2}{3EI} = \frac{WL^2}{8EI}$$

$$R_B = \frac{3WL}{8}$$

09. Degree of static indeterminacy of a rigid jointed plane frame having 15 members, 3 reaction components and 14 joints is

(a) 2 (b) 3

(c) 6 (d) 8

09. Ans: (c)

Sol: No. of members (m) = 15

No. of reaction ‘r’ = 3

No. of joints ‘j’ = 14

For rigid jointed plane frame static indeterminacy ‘D_S’ = (3 m +r) – 3j

= (3 × 15 + 3) – 3× 14

= 6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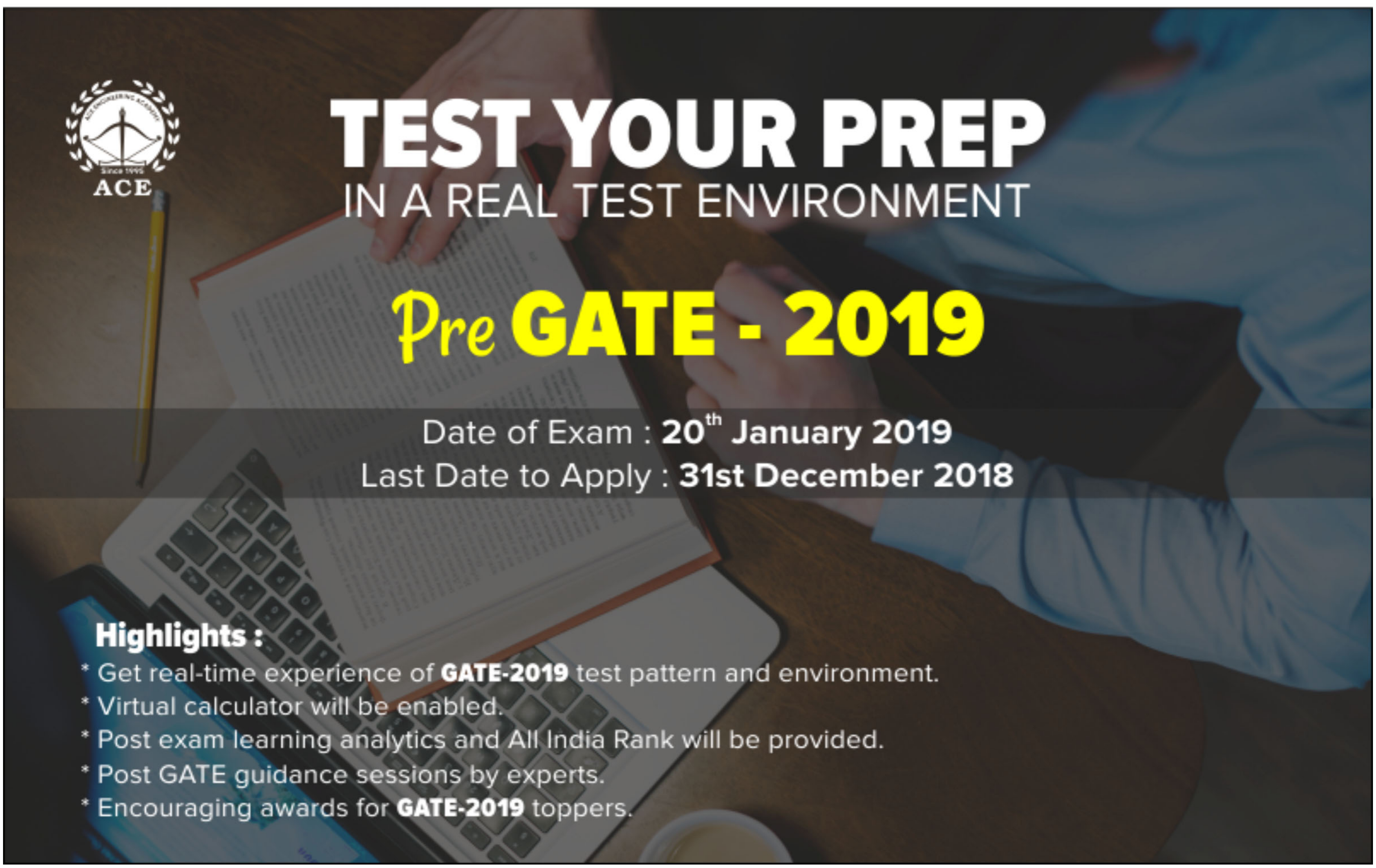
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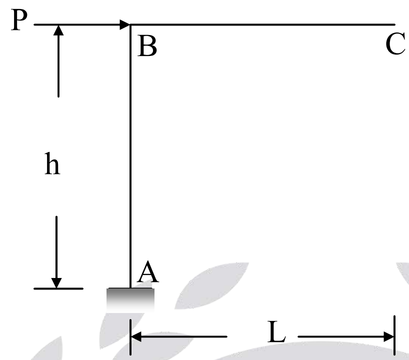
10. A rigid cantilever frame ABC is loaded and supported as shown in the figure below. The horizontal displacement of point C is

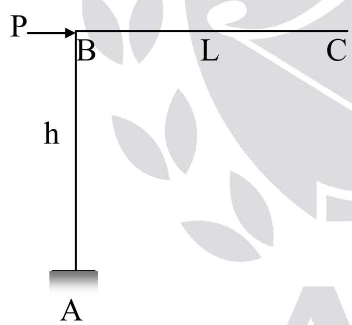


(a) $\frac{2Ph^3}{3EI}$ (b) $\frac{Ph^2(2h+L)}{2EI}$

(c) $\frac{Ph^3}{3EI}$ (d) $\frac{Ph^2(h+L)}{3EI}$

10. Ans: (c)

Sol:

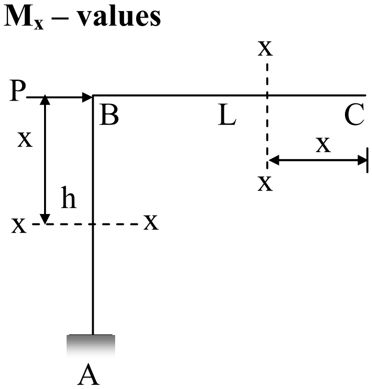


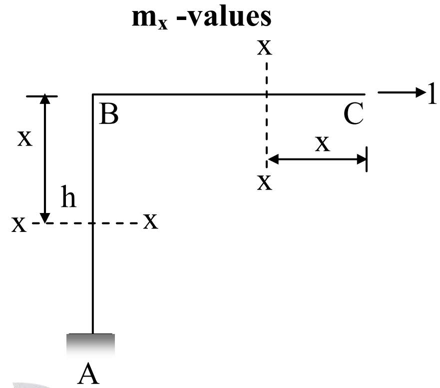
Horizontal displacement at 'C'

$$\delta_{HC} = \int_D^L \frac{M_x m_x}{EI} dx$$

M_x = BM at a section x-x due to real loads

m_x = BM at a section x-x due to virtual unit load applied where we want to find the deflection.

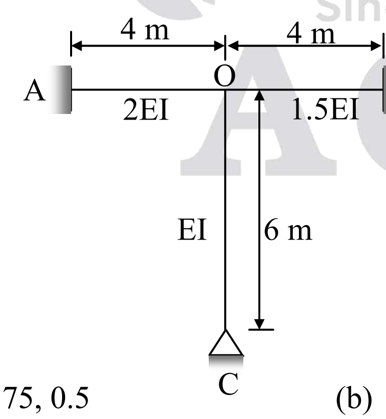




Member	M_x –values	m_x –values	$\int_0^L \frac{M_x m_x}{EI} dx$
CB	0	0	0
BA	–Px	–x	$\int_0^h \frac{(-Px)(-x)}{EI} dx$

$$\delta_{HC} = \int_0^h \frac{(-Px)(-x)}{EI} dx = \frac{Ph^3}{3EI}$$

11. The distribution factor for the members OA, OB and OC are



(a) 0.125, 0.375, 0.5
(b) 0.375, 0.5, 0.125
(c) 0.5, 0.125, 0.375
(d) 0.5, 0.375, 0.125

11. Ans: (d)

Sol: $DF_{OA} = \dfrac{K_{OA}}{\Sigma K_o}$ $\quad DF_{OB} = \dfrac{K_{OB}}{\Sigma K_o}$, $DF_{OC} = \dfrac{K_{OC}}{\Sigma K_o}$

$\Sigma K_o = K_{OA} + K_{OB} + K_{OC}$

$= \dfrac{4(2EI)}{4} + \dfrac{4(1.5EI)}{4} + \dfrac{3EI}{6}$

$= 2EI + 1.5EI + 0.5EI$

$\Sigma K_o = 4EI$

$$\left.\begin{aligned} DF_{OA} &= \frac{K_{OA}}{\Sigma K_o} = \frac{2EI}{4EI} = 0.5 \\ DF_{OB} &= \frac{K_{OB}}{\Sigma K_o} = \frac{1.5EI}{4EI} = 0.375 \\ DF_{OC} &= \frac{K_{OC}}{\Sigma K_o} = \frac{0.5EI}{4EI} = 0.125 \end{aligned}\right\} DF = 1$$

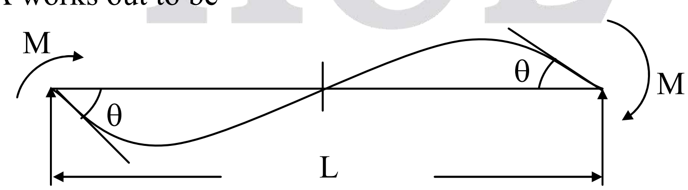
12. The stiffness co-efficient K_{ij} indicate

(a) Force at i due to a unit deformation at j
(b) Deformation at j due to a unit force at i
(c) Deformation at i due to a unit force at j
(d) Force at j due to a unit deformation at i

12. Ans: (a)

Sol: K_{ij} = Force at 'i' due to a unit displacement at 'j'

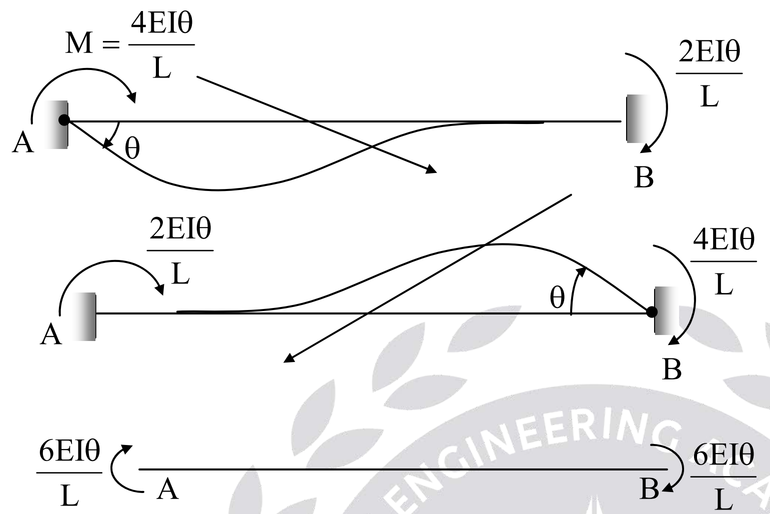
13. A beam EI-constant of span L is subjected to clockwise moments M at both the ends A and B. The rotation of end A works out to be



(a) $\dfrac{ML}{2EI}$
(b) $\dfrac{ML}{3EI}$
(c) $\dfrac{ML}{4EI}$
(d) $\dfrac{ML}{6EI}$

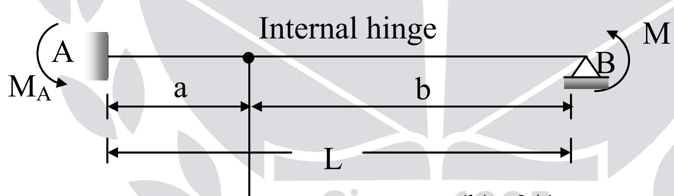
13. Ans: (d)

Sol:



$$M = \frac{6EI\theta}{L} \Rightarrow \theta = \frac{ML}{6EI}$$

14. Carry over factor C_{BA} for the beam shown in the figure below is



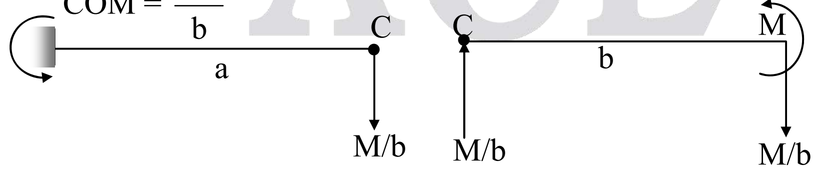
(a) a/b (b) 3/4

(c) a/L (d) 1/2

14. Ans: (a)

Sol:

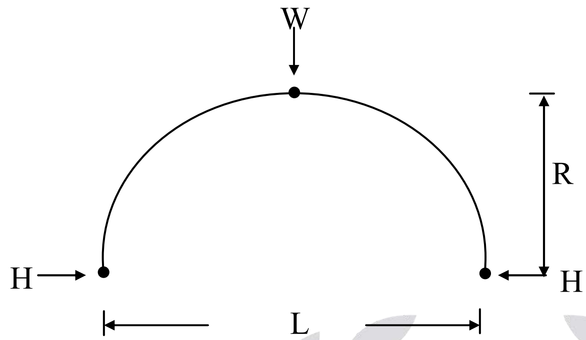
$$COM = \frac{Ma}{b}$$



$$\text{Carry over factor (COF)} \ \frac{COM}{\text{Applied moment}}$$

$$COF = \frac{\frac{Ma}{b}}{M} = \frac{a}{b}$$

15. For a three-hinged parabolic arch, what will be the ratio L/R to satisfy H = W?



(a) 0.50 (b) 1.50

(c) 2.00 (d) 4.00

15. Ans: (d)

Sol: $V_A = V_B = W/2$

$BM_C = 0$ –ve +ve

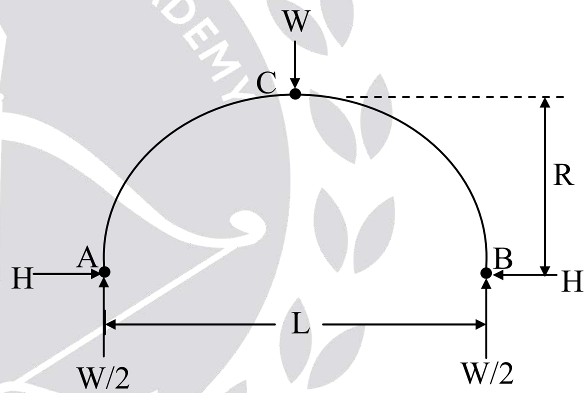
$$\frac{W}{2}\times\frac{L}{2} - H\times R = 0$$

$$H = \frac{WL}{4R}$$

$$H = W$$

$$\frac{WL}{4R} = W$$

$$\frac{L}{R} = 4$$



16. Match the following

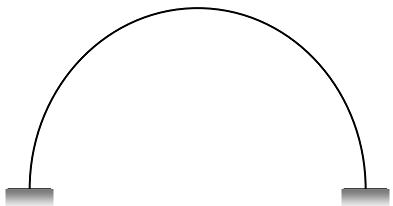
A.	Three-hinged arch	1.	Statically indeterminate to third degree
B.	Two-hinged arch	2.	Statically indeterminate to first degree
C.	Hingeless arch	3.	Statically determinate

Codes:

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

16. Ans: (b)

Sol:



Hingeless arch

Three hinged arch → statically determinate

Two hinged arch → statically indeterminate to first degree

Hingeless arch → Statically indeterminate to third degree

17. What is true for flexibility and stiffness matrix?

1. They are square matrix
2. The diagonal elements are non-zero and having positive values
3. Element ij= Element ji
4. They are inverse of each other

Codes:

(a) 1 and 2

(b) All of the above

(c) 3 and 4

(d) 1, 3 and 4

17. Ans: (b)

18. Muller-Breslau principle in structural analysis is used for

(a) Drawing ILD for any force function

(b) Writing virtual work equation

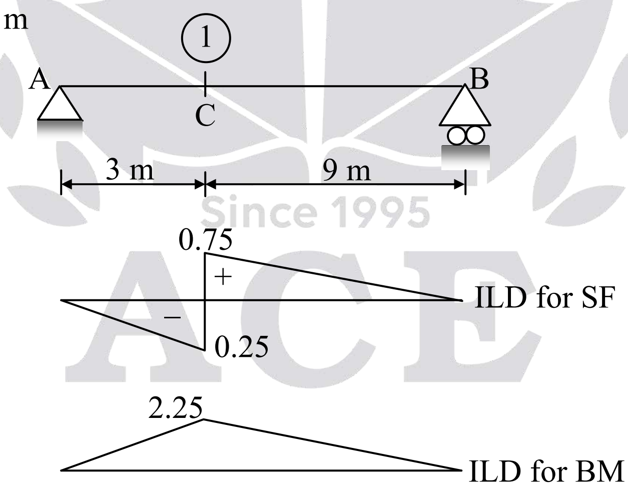
(c) Superposition of load effects

(d) None of the above

18. Ans: (a)

19. The given figure shows ILD for SF and BM at section 1

AC = 3 m, BC = 9 m



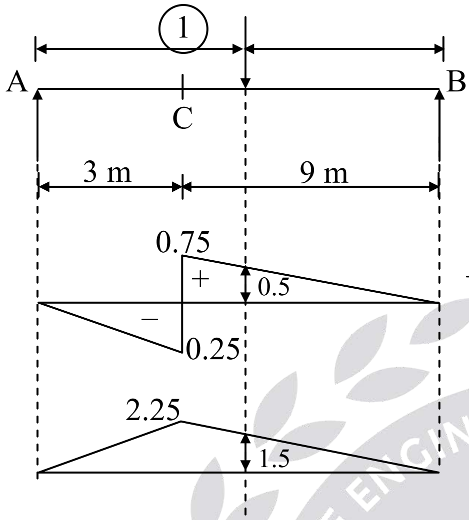
The value of SF and BM at '①' due to concentrated load of 20 kN at mid span will be

(a) 0.75 kN and 2.25 kN (b) 5 kN and 5 kN-m

(c) 7.5 kN and 10 kN-m (d) 10 kN and 30 kN-m

19. Ans: (d)

Sol:



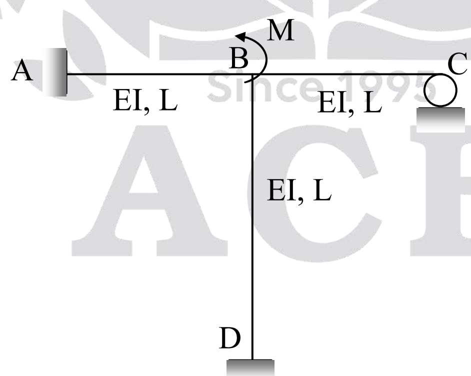
$9 \rightarrow 0.75$
$6 \rightarrow ?$
$\frac{E}{9} \times 0.75 = 0.5$

$9 \rightarrow 2.25$
$6 \rightarrow ?$
$\frac{6}{9} \times 2.25 = 0.5$

Shear force = 20 × 0.5 = 10 kN

Bending moment = 20 × 1.5 = 30 kN-m

20. All members of the frame shown below have the same flexural rigidity EI and length L. If a moment M is applied at joint B, the rotation of the joints is



(a) $\frac{ML}{12EI}$ (b) $\frac{ML}{11EI}$

(c) $\frac{ML}{8EI}$ (d) $\frac{ML}{7EI}$

20. Ans: (b)

Sol: $\theta_B = \dfrac{M_B}{K_B}$

$K_B = K_{BA} + K_{BC} + K_{BD}$

$$= \frac{4EI}{L} + \frac{3EI}{L} + \frac{4EI}{L} = \frac{11EI}{L}$$

$$\theta_B = \frac{M}{11EI/L} = \frac{ML}{11EI}$$

21. A stiffness matrix is to be generated for beam AB as horizontal flexural member. As per the method adopted for calculation of stiffness matrix, if end A is given translational displacement in vertically upward direction, the end forces generated at end 'B' are

(a) No forces at end B

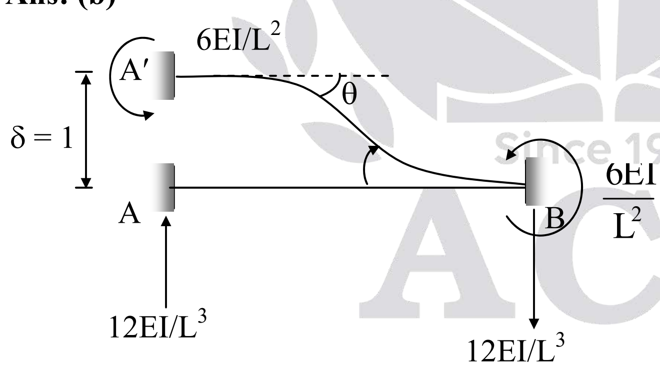
(b) – 12 EI/L^3 vertical force and $6EI/L^2$ moment

(c) –6 EI/L^2 vertical forces and 2EI/L moment

(d) –6 EI/L^2 vertical force and 4EI/L moment

21. Ans: (b)

Sol:



$$\left.\begin{array}{l}\text{Vertical force is } 12\ EI/L^3 \\ \\ \text{Moment is } 6EI/L^2\end{array}\right\}\text{At support 'A'}$$

22. If the stiffness matrix of beam element is given as $\frac{2EI}{L}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$, then the flexibility matrix is

(a) $\frac{L}{6EI}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

(b) $\frac{L}{2EI}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

(c) $\frac{L}{3EI}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

(d) $\frac{L}{6EI}\begin{bmatrix} -1 & 2 \\ 2 & -1 \end{bmatrix}$

22. Ans: (a)

Sol: Stiffness matrix = $K = \frac{2EI}{L}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

Flexibility matrix (δ) = $\frac{L}{2EI} \times \frac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

$= \frac{L}{6EI}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

23. The inclination of a lacing bar with the axis of the compression member is θ. Then 'θ' shall not be less than

(a) 30^o

(b) 40^o

(c) 50^o

(d) 70^o

23. Ans: (b)

Sol: Lacing bars, whether in double or single systems, shall be inclined at an angle not less than 40^o nor more than 70^o to the axis of the built-up member.

24. A column splice is used to increase

(a) the length of the column

(b) the strength of the column

(c) the rigidity of the column

(d) the cross-sectional area of the column

24. Ans: (a)

Sol: Columns splice is adopted when the length or height of the column is required more than the length of column section is available from rolling mills or factory. Also provided to join two different sizes of steel column cross sections.

25. In a cantilever plate girder to prevent web buckling, horizontal stiffeners are provided running along the span. They are provided

(a) below the neutral axis

(b) over the entire cross-section (above as well as below neutral axis)

(c) above the neutral axis

(d) None of the above

25. Ans: (a)

Sol: Horizontal stiffeners are also called longitudinal stiffeners. These increase the buckling resistance and the provided in the compression zone of the web. So, for a cantilever plate girder horizontal stiffeners are provided above the neutral axis.

26. Number of bolts requited in a bolted joint is equal to

(a) $\frac{\text{Force}}{\text{Bolt value}}$ (b) $\frac{\text{Force}}{\text{Strength of bolt in shearing}}$

(c) $\frac{\text{Force}}{\text{Strength of bolt in bearing}}$ (d) $\frac{\text{Force}}{\text{Strength of bolt in tearing}}$

26. Ans: (a)

Sol: Number of bolts required $= \frac{\text{Force}}{\text{Bolt value}}$

27. The deflection of beams may be decreased by

(a) Increasing the depth of beam (b) Increasing the span

(c) Decreasing the depth of beam (d) Increasing the width of beam

27. Ans: (a)

Sol: For simply supported beam deflection at centre $(\delta) = \frac{5W\ell^4}{384EI}$

$$\delta \propto \frac{1}{I}$$

$$\delta \propto \frac{1}{D^4}$$

(So as depth increases deflection is decreases)

28. The Indian standard code which deals with steel structure is

(a) IS : 456

(b) IS : 875

(c) IS : 800

(d) IS : 1893

28. Ans: (c)

29. Slenderness ratio of lacing bars should not exceed

(a) 100

(b) 120

(c) 145

(d) 180

29. Ans: (c)

Sol: The slenderness ratio, KL/r, of the lacing bars shall not exceed 145.

30. The effective length of fillet weld is taken as

(a) the actual length plus twice the size of weld.

(b) the actual length minus twice the size of weld.

(c) the actual length plus thrice the size of weld.

(d) the actual length minus thrice the size of weld.

30. Ans: (b)

Sol: The effective length of fillet weld = actual length – twice the size of weld.

$$= L - 2S$$

31. The fusible material used in welding to dissolve and facilitate the removal of oxides and other undesirable substances is known as

(a) inert material (b) inert gas

(c) flux (d) catalytic agent

31. Ans: (c)

Sol: Material used to prevent, dissolve, or facilitate removal of oxides and other undesirable surface substances.

32. Which of the following equations is correct for both, subjected to both combined shear and tension?

Where, V = Applied shear at service load

V_{sdf} = Design shear strength

T_e = Externally applied tension at service load

T_{ndf} = Design tension strength

(a) $\left(\frac{V}{V_{sdf}}\right)^2 + \left(\frac{T_e}{T_{ndf}}\right)^2 \le 1$ (b) $\left(\frac{V}{V_{sdf}}\right)^2 + \left(\frac{T_e}{T_{ndf}}\right)^2 \ge 1$

(c) $\left(\frac{V}{V_{sdf}}\right) + \left(\frac{T_e}{T_{ndf}}\right) \le 1$ (d) $\left(\frac{V}{V_{sdf}}\right) + \left(\frac{T_e}{T_{ndf}}\right) \ge 1$

32. Ans: (a)

Sol: For safety of bolted connection is checked in combined shear and tension by using interaction equation of IS 800 : 2007

$$\left(\frac{V_b}{V_{db}}\right)^2 + \left(\frac{T_b}{T_{db}}\right)^2 \leq 1.0$$

V_b = Factored shear force on bolt

V_{db} = Design shear capacity of bolt

T_b = Factored Tensile force on bolt

V_{db} = Design Tension capacity of bolt

33. What is the yield strength of bolt of class 4.6 ?

(a) 400 N/mm^2 (b) 240 N/mm^2

(c) 250 N/mm^2 (d) 500 N/mm^2

33. Ans: (b)

Sol: For bolt of grade property 4.6 represents the ultimate tensile strength is 400 N/mm^2 and yield strength 0.6 times 400 which is 240 N/mm^2.

34. What are the different limit states of design as per IS 456 : 2000?

(1) Limit state of failure (2) Limit state of damage

(3) Limit state of collapse (4) Limit state of serviceability

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

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

34. Ans: (c)

35. Maximum shear force for three equal spans of beam/slab occur at

(a) inner side of end support

(b) inner side of support next to end support

(c) outer side of support next to end support

(d) outer side of end support

35. Ans: (c)

Sol: Shear force = (shear coefficient) × design load

= (shear coefficient) × wl

Since all spans are of same length. Maximum shear force occurs on the support having maximum shear coefficient.

As per table 13 of IS 456 (Cl 22.5.1 to 22.5.2) shear force coefficients is maximum at outer side of support next to end support = 0.6

36. In the design of slab, the diameter of reinforcing bars shall not exceed

(a) one-eighth of overall thickness of slab

(b) one-fourth of overall thickness of slab

(c) one-half of overall thickness of slab

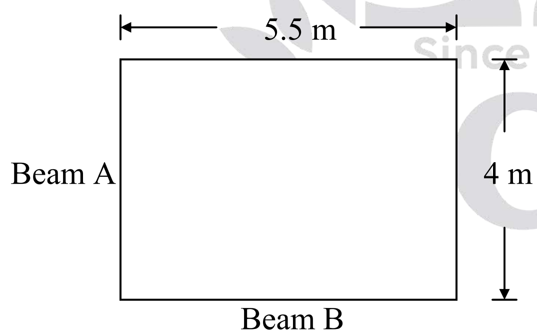
(d) one-third of overall thickness of slab

36. Ans: (a)

Sol: Diameter of reinforce in bar in slab = one-eighth of overall thickness of slab

= D/8

37. Determine the slab area of which load is acting on supporting beams A and B



(a) 5.5 m^2 and 7.0 m^2

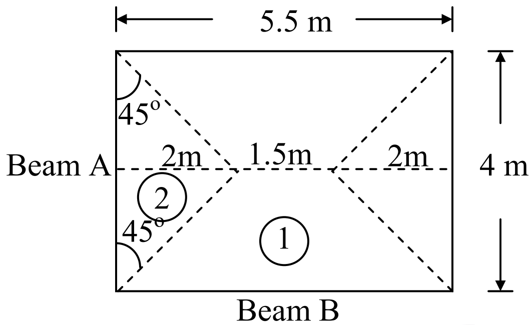
(b) 4.0 m^2 and 5.5 m^2

(c) 7.0 m^2 and 4.0 m^2

(d) 4.0 m^2 and 7.0 m^2

37. Ans: (d)

Sol:



Slab area for A = area of region (2)

$$= 2\times\left[\frac{1}{2}\times 2\times 2\right] = 4.0\,m^2$$

Slab area for B = area of region (1)

$$= \frac{1}{2}\times 2(5.5+1.5)$$

$$= 7.0$$

38. A Tee-beam behaves as a rectangular beam of a width equal to its flange if its neutral axis

(a) remains within the flange

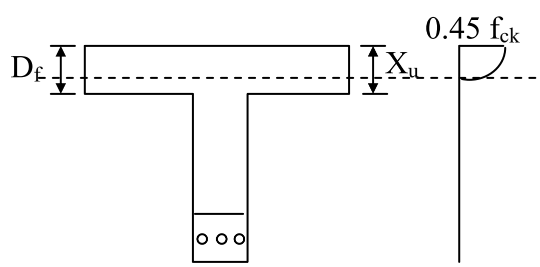
(b) remains below the slab

(c) coincides with the geometrical centre of the beam

(d) None of the above

38. Ans: (a)

Sol: When the neutral axis lies within flange; the T-beam behaves a rectangular beam with width equal to that of flange width.



39. According to IS 456, two-way slabs with corners held down are assumed to be divided in each direction into middle strips and edge strips such that the width of middle strip is

(a) half of the width of the slab

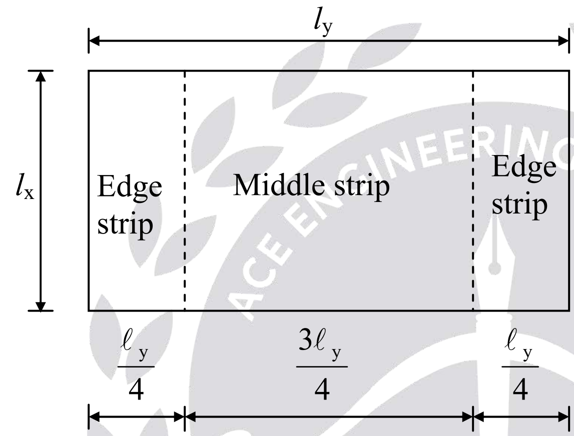
(b) two-third of the width of the slab

(c) three-fourth of the width of the slab

(d) four-fifth of the width of the slab

39. Ans: (c)

Sol:



As per C*l*. D. 1.2 of IS 456, slaps are considered as divided in each direction, into middle strips end strips such that.

Width of middle strip = $\frac{3}{4}(\text{Width of slab})$

Width of end strip at each end = $\frac{1}{8}$ (width of slab)

40. Span effective depth ratio for cantilever for span upto 10 m is

(a) 7 (b) 20

(c) 26 (d) 35

40. Ans: (a)

Sol: Span effective depth ratio for cantilever for span upto 10 m is **‘7’**

Span effective depth ratio for continuous slab for span upto 10 m is **‘26’**

Span effective depth ratio for simply support for span upto 10 m is **‘20’**

41. Effective length of compression member which is effectively held in position and restrained against rotation at both ends is

(a) 0.65 l (b) 0.75 l

(c) 0.80 l (d) 0.85 l

41. Ans: (a)

Sol: As per IS: 456: 2000 theoretical value is 0.5l.

Recommended value of effective length is 0.65l.

42. If 'H' is the total height of the building, under transient wind load the lateral sway at the top should not exceed

(a) $\frac{H}{200}$ (b) $\frac{H}{300}$

(c) $\frac{H}{400}$ (d) $\frac{H}{500}$

42. Ans: (d)

Sol: As per IS: 456 :200 under transient wind load the lateral sway at top should not exceed $\frac{H}{500}$.

43. An axially loaded column is 300× 300 mm in size, effective length of column is 3 m. What is the minimum eccentricity of the axial load for column?

(a) 20 mm (b) 16 mm

(c) 10 mm (d) 0

43. Ans: (a)

Sol: $$e_{x,min} = \begin{cases} \frac{\ell_{unsupported}}{500} + \frac{D_x}{30} \\ 20\,mm \end{cases}$$ (which ever is greater)

$$e_{x,min} = \begin{cases} \frac{3000}{500} + \frac{300}{30} = 16 \\ 20\,mm \end{cases}$$

Greater is 20 mm

44. In reinforced and plain concrete footings on soils, the thickness at the edge shall be not less than

(a) 200 mm (b) 150 mm

(c) 300 mm (d) 250 mm

44. Ans: (d)

Sol: In reinforced and plain concrete footings, the thickness at the edge shall be not less than 150 mm for footing on soils, nor less than 300 mm above the tops of piles for footings on piles.

45. The maximum permissible final deflection of a beam should not exceed

(a) span/350 (b) span/250

(c) span /480 (d) span/500

45. Ans: (b)

Sol: As per IS 456 :

The deflection including the effects of temperature, creep and shrinkage occurring after erection of partitions and the application of finishes should not normally exceed span/350 or 20 mm whichever is less.

46. The maximum effective reinforcement ratio of a bonded prestressed concrete beam at failure according to IS : 1343 is limited to a value of

(a) 0.15 (b) 0.40

(c) 0.25 (d) 0.50

46. Ans: (b)

Sol: As per table 11, of IS 1343, maximum effective reinforcement ratio $\left(\frac{A_p f_p}{bdf_{ck}}\right)$ is 0.4.

47. The moment of resistance of a rectangular section depends upon

(a) ultimate strain in concrete

(b) area of high tensile tendons

(c) tensile strength in concrete

(d) compressive stress in concrete

47. Ans: (d)

Sol: Moment of resistance = CZ = TZ

C = compressive force in concrete

= ∫ compressive stress (dA)

Z = Lever arm

48. In case of prestressed concrete element, which statement is not correct ?

(a) Concrete remains uncracked and it protects steel from corrosion.

(b) It can be used more effectively in liquid retaining structures.

(c) The stiffness of structure is less due to uncracked condition of concrete.

(d) Shear resisting capacity is increased due to pre-compression.

48. Ans: (c)

Sol: Advantage of PSC:

1. More shear resistance due to effect of compressive prestress
2. More effective in water retaining structures
3. Reduced deflection. Hence more stiffener.

49. Pre-stressing force transmitted to concrete as initial internal stress to counteract the internal stress developed due to external loads is called

(a) Stress concept

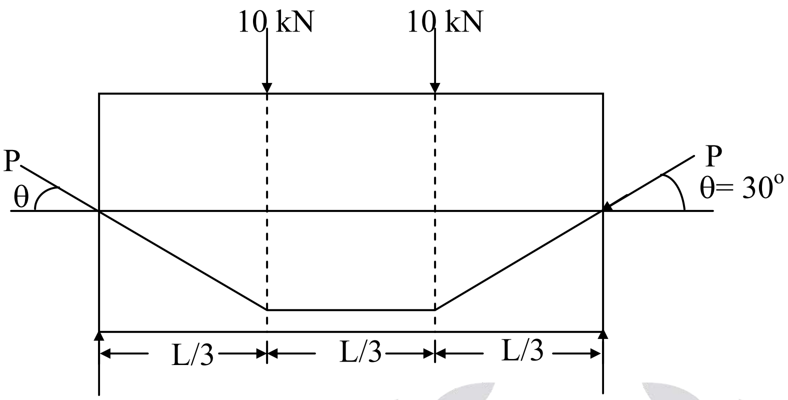
(b) Strength concept

(c) Force concept

(d) Load balancing concept

49. Ans: (d)

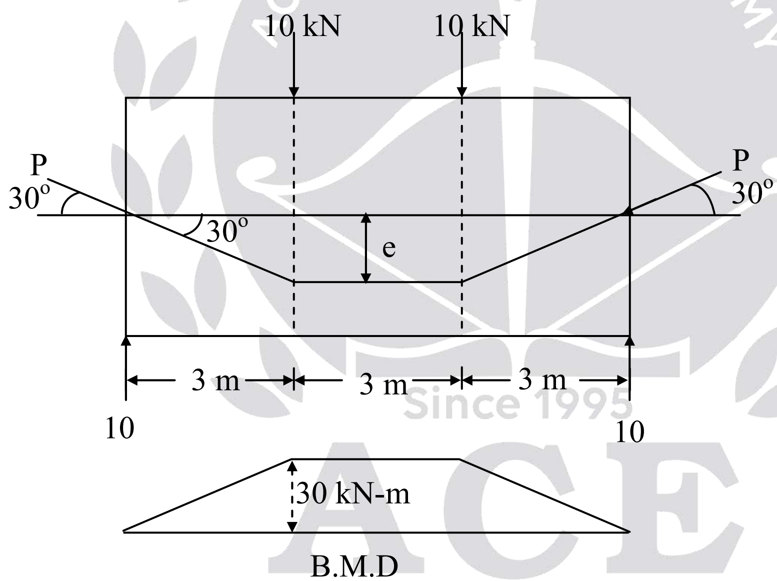
50. A simply supported beam of span 9 m is subjected to two point loads, each of 10 kN acting at $\frac{1}{3}$ of span as shown in the figure. If self-weight of beam is neglected, then how much prestressing force is required to counter-balance the external loads if $\theta = 30°$?



(a) 5 kN
(b) 10 kN
(c) 20 kN
(d) 30 kN

50. Ans: (c)

Sol:



$e = 3 \sin 30^o = \frac{3}{2} = 1.5$ m

For complete load balance:

$P_e = 10 \times 3$

$\Rightarrow P \times 1.5 = 30$

$\Rightarrow P = 20$ kN

51. The approximate value of shrinkage strain for design of post-tensioning member is
Where 't' = age of concrete at transfer in days.

(a) $\frac{0.0001}{\log_{10}(t+2)}$ (b) 0.0003

(c) $\frac{0.0002}{\log_{10}(t+2)}$ (d) $\frac{0.0003}{\log_{10}(t+2)}$

51. Ans: (c)

Sol: For post tensioned beam, total residual shrinkage strain = $\frac{2\times10^{-4}}{\log(t+2)}$

52. The partial safety factors for material strength are

(a) 1.15 for concrete and 1.5 for steel

(b) 1.5 for concrete and 1.15 for steel

(c) 1.5 for both concrete and steel

(d) 1.15 for both concrete and steel

52. Ans: (b)

53. A post-tensioned prestressed concrete beam is having a cross-section of 300 × 300 mm. The area of end block is 100×100 mm. Instead of 100×100 mm end block, 150 mm × 150 mm end block is provided. What will be the reduction in bursting forces? Let the load in tendons be P_k.

(a) 0.03 P_k (b) 0.04 P_k

(c) 0.045 P_k (d) 0.05 P_k

53. Ans: (d)

Sol: As per IS 1343-1980, Clause 18.6.2.2

Bursting force $F_{bst} = P_k\left[0.32 - 0.3\frac{y_{po}}{y_o}\right]$

P_k = Prestress

y_{po} = length of side of bearing plate

y_o = transverse dimension of end zone

Case 1: $F_{bst\,1} = P_k\left[0.32 - 0.3\times\frac{100}{300}\right]$

$= P_k \times 0.22$

Case 2: $F_{bst2} = P_k\left(0.32 - 0.3\times\frac{150}{300}\right)$

$= P_k \times 0.17$

$F_{bst\,1} - F_{bst\,2} = (0.22 - 0.17)\,P_k$

$= 0.05\,P_k$

54. Prestresing in a concrete beam with sloping or curve profile

(a) increases shear strength
(b) increases flexural strength
(c) decreases shear strength
(d) Both (a) and (b)

54. Ans: (d)

Sol: Prestresing in a concrete beam results in improved shear resistance, due to the effect of compressive prestress, which reduces the principal tensile stress.

55. The bearing stress on concrete after accounting for all losses due to relaxation of steel, elastic shortening, creep of concrete, slip and seating of anchorage shall not exceed____

(where, f_{ci} is the concrete strength at transfer, A_{br} is bearing area and A_{pun} is punching area)

(a) $0.16f_{ci}\sqrt{\frac{A_{br}}{A_{pun}}}$ or 0.8 f_{ci} whichever is smaller

(b) $0.48f_{ci}\sqrt{\frac{A_{br}}{A_{pun}}}$ or 0.8 f_{ci} whichever is smaller

(c) $0.25\,f_{ci}\sqrt{\frac{A_{br}}{A_{pun}}}$ or 0.8 f_{ci} whichever is smaller

(d) $0.34f_{ci}\sqrt{\frac{A_{br}}{A_{pun}}}$ or 0.8 f_{ci} whichever is smaller

55. Ans: (b)

Sol: On the areas immediately behind external anchorages, the permissible unit bearing stress on the concrete, after accounting for losses due to relaxation of steel, elastic shortening and seating of anchorages, shall not exceed

$$0.48 f_{ci}\sqrt{\frac{A_{bf}}{A_{pun}}}$$

or 0.8 f_{ck} whichever is smaller, where f_{ci} is the cube strength of transfer, A_{br} is the bearing area and A_{pun} is the punching area.

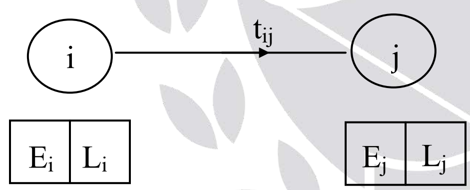
56. The difference between EST of succeeding activity and EFT of the activity under consideration is called

(a) Total float (b) Independent float

(c) Interfering float (d) Free float

56. Ans: (d)

Sol:



Free float = $E_j - E_i - t_{ij}$

57. Which of the following are the methods of scheduling?

(a) Bar charts or Gantt charts (b) Milestone charts

(c) Network analysis (d) All of the above

57. Ans: (d)

Sol: The methods of scheduling in project management are

1. Bar charts
2. Milestone charts
3. Linked bar chart
4. Network techniques

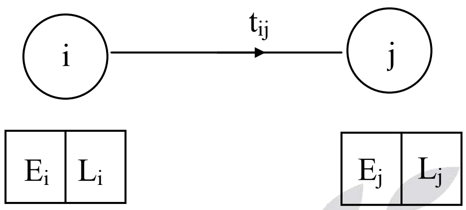
58. The excess of minimum available time over activity duration is called

(a) total float (b) free float

(c) independent float (d) None of the above

58. Ans: (c)

Sol:



The independent float time of an activity is the amount of float time which can be used without affecting either the head or the tail events. It represents the amount of float time available for an activity when its preceding activities are completed at their latest and its succeeding activities being at their earliest time –leaving the minimum time available for its performance.

59. Which of the following are the significant achievements of Taylor towards scientific management approach?

(a) Work study

(b) Incentive scheme

(c) Standardization of tools and equipment or workman and working conditions

(d) All of the above

59. Ans: (c)

60. Which of the following networks is activity oriented?

(a) PERT

(b) CPM

(c) Both (a) and (b)

(d) None of the above

60. Ans: (b)

Sol: CPM is activity oriented network diagram and PERT is event oriented network diagram.

61. The time required to complete an activity under abnormal or extremely adverse conditions in which everything goes wrong is called

(a) optimistic time (b) most likely time

(c) pessimistic time (d) None of the above

61. Ans: (c)

Sol: To take uncertainties into account, PERT network uses three types of time estimates.

(a) Optimistic Time (t_o): Shortest time for an activity, if everything goes well.

(b) Pessimistic Time (t_p): Longest time, if everything goes wrong. (Doesn't include catastrophic effects like earth quake, floods, labour strike, fire etc.)

(c) Most Likely Time (t_l): Time, if normal conditions prevail.

62. What is the purpose of job layout?

(a) To provide more economical methods of working

(b) Shorter leads of materials

(c) Reduction in completion time

(d) All of the above

62. Ans: (d)

63. Which of the following codes is relevant to fire safety?

(a) IS 456 –2000 (b) IS 1256–1967

(c) IS 800 – 1950 (d) None of the above

63. Ans: (d)

Sol: (a) IS 456 –2000 : code of practice for reinforced cement concrete.

(b) IS 1256–1967 : code of practice for building bylaws.

(c) IS 800 – 1950 : code of practice for general steel construction.

64. What is dummy activity?

(a) Activity having zero duration (b) Activity shown by dotted line

(c) Activity which shows dependency (d) All of the above

64. Ans: (d)

Sol: Dummy activity:

- The activity which neither uses any resources nor any time for its completion.
- It is represented by dotted arrow.
- It is a device to identify a dependence among operations.

65. Which of the following sentences is correct?
(a) Except initial and end events, all events in the network are dual role events.
(b) All events in the network are dual role events
(c) There is only one dual role event in the network
(d) None of the above

65. Ans: (a)

Sol: Events with dual function i.e as head event to some activity and as tail events to some activities are known as dual role events. All events except initial and final events are dual role events.

66. PERT stands for
(a) Perfect Evaluation and Review Technique
(b) Programme Elongation and Review Technique
(c) Programme Evaluation and Review Technique
(d) None of the above

66. Ans: (c)

Sol: PERT stands for Programme Evaluation and Review Technique.

67. Floating point form representation of a real number x is denoted by $x = f \times 10^E$ in which 'f' is called
(a) Sign bit
(b) Exponent
(c) Partial derivative
(d) Mantissa

67. Ans: (d)

Sol: Floating point representations is that $x = f \times 10^E$

Where 'f' is a mantissa (or) fractional part

10 is a base

E is an exponent

68. What will be the next approximation for finding a real root of equation $x^3 - 2x - 5 = 0$; if it is solved using the Newton-Raphson method and initial approximation of x = 2?

(a) 2.4 (b) 2.3

(c) 2.1 (d) 2.2

68. Ans: (c)

Sol: Let $f(x) = x^3 - 2x - 5$

Given $x_o = 2$

$f'(x) = 3x^2 - 2$

By Newtons Raphson method

$$x_1 = x_o - \frac{f(x_o)}{f'(x_o)}$$

$$= 2 - \frac{f(2)}{f'(2)}$$

$$= 2 - \frac{(-1)}{10} = 2.1$$

69. An interative formula to find $\sqrt{Y}$ (where Y is a positive number) by the Newton-Raphson technique is given by expression

(a) $x_{i+1} = \frac{1}{4}\left(x_i + \frac{Y}{x_i}\right)$ (b) $x_{i+1} = \frac{1}{3}\left(x_i + \frac{Y}{x_i}\right)$

(c) $x_{i+1} = \frac{1}{2}\left(x_i + \frac{Y}{x_i}\right)$ (d) $x_{i+1} = \frac{1}{4}\left(x_i - \frac{Y}{x_i}\right)$

69. Ans: (c)

Sol: Let $x = \sqrt{Y} \Rightarrow x^2 - Y = 0$

Let $f(x) = x^2 - Y$, $f'(x) = 2x$

By Newton Raphson formula

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

$$= x_i - \frac{x_i^2 - Y}{2x_i} = \frac{1}{2}\left[\frac{x_i^2 + Y}{x_i}\right]$$

$$x_{i+1} = \frac{1}{2}\left[x_i + \frac{TY}{x_i}\right]$$

70. The area under straight line is an estimate of the integral of f(x) between the line a and b and the result of this integration is called trapezoidal rule. The formula in area calculation by this rule is

(a) $I = (a-b)\frac{f(a)+f(b)}{4}$

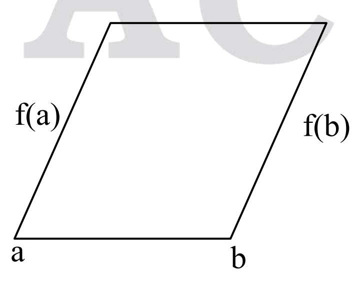
(b) $I = (b-a)\frac{f(b)-f(a)}{2}$

(c) $I = (b-a)\frac{f(a)+f(b)}{2}$

(d) $I = (b-a)\frac{f(a)+f(b)}{3}$

70. Ans: (c)

Sol: We know that, In Trapezoidal rule we estimate the portion of the curve over an integral by straight line, which leads Trapezium as shown below.



Area of Trapezoidal rule = $(b-a)\frac{f(a)+f(b)}{2}$

71. The method in which both sides of equations are multiplied by non-zero constant is classified as

(a) Gaussian elimination method (b) Gaussian inconsistent procedure

(c) Gaussian consistent procedure (d) Gaussian substitute procedure

71. Ans: (a)

Sol: In the Gaussian method we define the augmented matrix $A|B$ as $(A|B)$ = A & B together and we perform row operations

72. The two segment trapezoidal rule of integration is exact for integrating at most _______ order polynomials

(a) first (b) second

(c) third (d) fourth

72. Ans: (a)

Sol: In the Trapezoidal rule we estimate the portion of the curve by straight line. So it gives exact value for first degree polynomials.

73. Division by zero during forward elimination steps in Naive Gaussian Elimination of the set of equation [A] [X] = [C] implies the coefficient matrix [A]

(a) is invertible (b) is non-singular

(c) may be singular or non-singular (d) is singular

73. Ans: (d)

Sol: Gauss Elimination converts a system of linear equation into

$$\begin{bmatrix} 1 & b_{12} & b_{13} & \ldots\ldots & b_{1n} \\ 0 & 1 & b_{23} & \ldots\ldots & b_{2n} \\ 0 & 0 & 0 & \ldots\ldots & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ x_n \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ . \\ . \\ d_n \end{bmatrix}$$

All the pivot elements are made 1

Divide row values by the value of a pivot entry (value of an entry along the top left to bottom right) we assume that pivots are non zero. If one of the pivots is zero, then 'A' becomes singular.

74. What will be the value of function $f(x) = x^3 + 2x - 2 = 0$ in the next iteration if $f(0) = -2$ and $f(1) = 1$?

(a) – 0.625 (b) –0.725

(c) – 0.875 (d) –0.975

74. Ans: (c)

Sol: Given $f(x) = x^3 + 2x - 2$

$f(0) = -2$, $f(1) = 1$

Clearly $f(0)\ f(1) < 0$, By intermediate value theorem root lies between 0 and 1

Let $x_o = 0$, $x_1 = 1$

By Bisection method, $x_2 = \frac{0+1}{2} = 0.5$

$f(0.5) = (0.5)^3 + 2(0.5) - 2$

$= 0.125 + 1 - 2 = -0.875$

75. For the equation $f(x) = x^2 - x - 1 = 0$, a root lies between 1 and 2. The root of equation at second interval by bisection method is

(a) 1.5 (b) 2

(c) 1.66 (d) 1.75

75. Ans: (d)

Sol: $f(x) = x^2 - x - 1$, Let $x_o = 1$, $x_1 = 2$

$f(1) = -1 < 0$

$f(2) = 1 > 0$

Clearly $f(1)\ f(2) < 0$, so root lies between 1 and 2

Iteration 1

$$x_2 = \frac{x_o + x_1}{2} = \frac{1+2}{2} = 1.5$$

$f(1.5) = -0.25 < 0$

Clearly $f(1.5)\ f(2) < 0$, So that root lies between 1.5 and 2

Iteration 2 $x_3 = \frac{1.5+2}{2} = 1.75$

76. The root of equation $x^3 - 4x - 9 = 0$ using the bisection method is

(a) 1.6875 (b) 2.6875

(c) 3.6875 (d) 4.6875

76. Ans: (b)

Sol: Let $f(x) = x^3 - 4x - 9$

$f(3) = 27 - 12 - 9 = 6 > 0$

$f(2) = 8 - 8 - 9 = -9 < 0$

Clearly root lies between 2 and 3 since f(2) f(3) < 0

Let $x_o = 2 \quad x_1 = 3$

Iteration 1:

$$x_2 = \frac{x_o + x_1}{2} = \frac{2+3}{2} = 2.5$$

$F(2.5) = 15.625 - 4(2.5) - 9$

$= -3.375 < 0$

Clearly f(3) f(2.5) < 0, Root lies between 2.5 and 3

Iteration 2:

$$x_3 = \frac{2.5+3}{2} = 2.75$$

$f(2.75) = 20.7969 - 11 - 9$

$= 0.7969 > 0$

Clearly f(2.5) f(2.75) < 0, Root lies between 2.5 and 2.75

Iteration 3: $x_4 = \dfrac{2.5+2.75}{2} = 2.625$

$f(2.625) = -1.141211 < 0$

f(2.625) f (2.75) < 0 root lies between 2.625 and 2.75

Iteration 4:

$$x_5 = \frac{2.625+2.75}{2} = 2.6875$$

$f(2.6875) = -0.33911 < 0$

77. In the solution of simultaneous equations by the Gauss elimination method for solving equations, triangularization leads to

(a) singular matrix (b) upper triangular matrix

(c) diagonal matrix (d) lower triangular matrix

77. Ans: (b)

Sol: In the Gauss elimination method we convert the system AX = B into upper triangular form.

78. Hardness of the stones can be tested by ____ in the laboratory.

(a) Impact strength (b) Abrasion strength

(c) Mohr's scale (d) Crushing strength

78. Ans: (c)

Sol: Test on stone: Property

(a) Impact strength : Toughness

(b) Abrasion strength : Wear and tear

(c) Mohr's scale : Hardness

(d) Crushing strength : Strength

79. Which of the following tests is used for measuring the workability of the concrete?

(a) Chloride penetration test

(b) Slump test

(c) Initial setting time test

(d) Standard consistency test

79. Ans: (b)

Sol: Different tests used for measuring the workability of concrete are

1. Slump Cone Test
2. Compaction Factor Test
3. Vee Bee Consistometer Test
4. Flow Table Test.

80. For aggregate ratio of order of ________, the workability is independent of the Aggregate Cement Ratio.

(a) 1.0 (b) 1.5

(c) 2.0 (d) 3.0

80. Ans: (c)

Sol: In nominal mix method of concrete mix design, aggregate cement ratio concept is not used. The proportions used in this method are

M20 – 1:1.5:3

M15 – 1:2:4

M10 – 1:3:6

M7.5 – 1:4:8

M5 – 1:5:10

Based on observation it can be inferred that an aggregate ratio (coarse aggregate/Fine Aggregate ratio) of 2 is used.

81. Rankine's formula for finding the minimum depth of foundation for loose soil is

(a) $d = \frac{q}{\gamma}\left(\frac{1+\sin\phi}{1-\sin\phi}\right)$ (b) $d = \frac{q}{\gamma}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)^2$

(c) $d = \frac{q}{\gamma}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)$ (d) $d = \frac{q}{\gamma}\left(\frac{1+\sin\phi}{1-\sin\phi}\right)^2$

81. Ans: (b)

Sol: Minimum depth of foundation as per Rankine's formula = $d = \frac{q}{\gamma}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)^2$

82. White lead, red lead, oxides of zinc, oxides of iron are the substances used in formation of paints of

(a) Vehicle (b) Drier

(c) Carrier (d) Base

82. Ans: (d)

Sol: White lead, red lead, oxides of zinc and oxides of iron are the most commonly used base substances used in the formation of paint.

83. What is the name of the wooden plank or slab of concrete or stone usually provided at the bottom of an entrance door?

(a) Jamb (b) Reveal

(c) Cornice (d) Threshold

83. Ans: (d)

Sol: The wooden plank or slab of concrete or stone usually provided at the bottom of an entrance door is called a Threshold. It is the sill of a door.

84. In testing final setting time of cement a needle of

(a) 1 mm square section is used (b) 1 mm diameter is used

(c) 2 mm square section is used (d) 5 mm square section is used

84. Ans: (a)

Sol: The attachment fitted to Vicat apparatus for determining the final setting time has a 1mm square needle at the center with a annular collar.

85. Which of the following is ***not*** a non-destructive method of testing concrete?

(a) Rebound test (b) Radioactive penetration method

(c) Soundness test (d) Dynamic or vibration test

85. Ans: (c)

Sol: The different non-destructive tests used for testing concrete are as follows:

1. Rebound Hammer Test.
2. Ultrasonic Pulse Velocity Test
3. Resonant Frequency Method
4. Hardness Method.
5. Radiation Methods.
6. Magnetic Methods.
7. Acoustic Emission Methods.
8. Penetration and Pull Out Test.

Soundness test is a test used to determine the soundness of cement. It is not a test for concrete.

86. In public halls and auditoriums, the sound persists even after the source of sound has ceased. This persistence of sound is called

(a) Absorption (b) Echoes

(c) Reverberation (d) Reflection of sound

86. Ans: (c)

Sol: Reverberation means the prolonged reflection of sound from wall floor or roof of a hall. It is nothing but persistence of sound after the source of the sound has stopped. When the sound is reflected back (some part of the sound is absorbed) resulting in formation of echoes, but sometimes this reflection of sound does not stop even the sound is died out.

87. The lime which has high calcium oxide content and is dependent for setting and hardening solely on the absorption of carbon dioxide from the atmosphere is known as

(a) Quick lime (b) Fat lime

(c) Hydraulic lime (d) Hydrated lime

87. Ans: (b)

Sol: Fat lime is lime with clay impurities less than 5%. Since it is a very pure form of lime it is dependent for setting and hardening solely on the absorption of carbon dioxide from the atmosphere. For this reason this lime is not used for construction of thick jointed masonry. This lime is generally used for white washing, filling the joints of thin jointed masonry and tiles.

88. What should be the aspect for a bedroom?

(a) West (b) North-West

(c) South –West (d) All of the above

88. Ans: (c)

89. For roominess, length to width ratio should be

(a) 1 : 1 to 1: 5 (b) 1.2 : 1 to 1.5 :1

(c) 1.5 : 1 to 2:1 (d) 1.5 : 1 to 1.75 : 1

89. Ans: (b)

Sol: For roominess and most economical usage, the aspect ratio used for rooms lie between 1.2:1 to 1.5:1

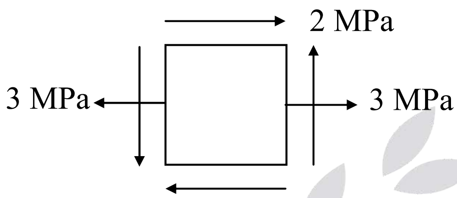
90. At a point in the web of a girder the bending stress (σ_x) is 3 MPa (tensile) and the shearing stress (τ) at the same point is 2 MPa, then the maximum shear stress is

(a) 1.5 MPa (b) 4 MPa

(c) 2.5 MPa (d) 1 MPa

90. Ans: (c)

Sol:



$\sigma_x = 3$ MPa $\sigma_y = 0$ $\tau_{xy} = 2$ MPa

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$= \sqrt{\left(\frac{3-0}{2}\right)^2 + 2^2} = 2.5 \text{ MPa}$$

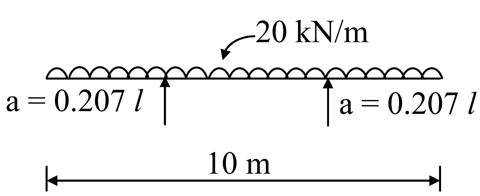
91. A beam of length 10 m carries a uniformly distributed load of 20 kN/m over its entire length and rests on two simple supports. In order that the maximum BM produced in the beam is the least possible, the supports must be placed from the ends at a distance of

(a) 5.86 m (b) 4.14 m

(c) 2.93 m (d) 2.07 m

91. Ans: (d)

Sol:



Maximum Bending moment in beam is least possible, when overhang = $0.207l$

$\therefore$ a = $0.207l$ = 0.207 × 10 = 2.07 m

92. Choose the correct relation between modulus of elasticity (E), modulus of rigidity (G) and bulk modulus (K) from the following options:

(a) $\frac{2}{E} = \frac{9}{G} + \frac{3}{K}$

(b) $\frac{9}{E} = \frac{3}{G} + \frac{1}{K}$

(c) $\frac{3}{E} = \frac{9}{G} + \frac{1}{K}$

(d) $\frac{1}{E} = \frac{9}{G} + \frac{3}{K}$

92. Ans: (b)

Sol:

We have $E = \frac{9KG}{3K + G}$

By rearranging $\frac{1}{E} = \frac{3K + G}{9KG}$

$\Rightarrow \frac{9}{E} = \frac{3K}{KG} + \frac{G}{KG}$

$\Rightarrow \frac{9}{E} = \frac{3}{G} + \frac{1}{K}$

93. In a simple bending theory, one of the assumptions is that the material of the beam is isotropic. This assumption means that the

(a) normal stress remains constant in all directions

(b) normal stress varies linearly in the material

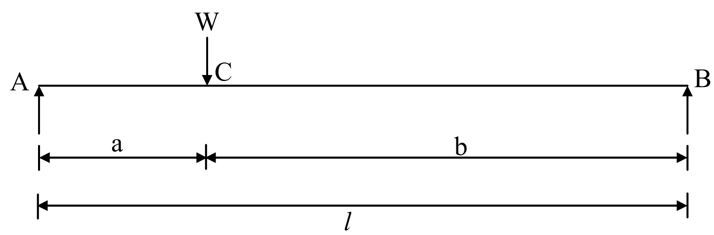
(c) elastic constants are same in all the directions

(d) elastic constants vary linearly in the material

93. Ans: (c)

Sol: Isotropic: Elastic properties are same in all direction at a given point.

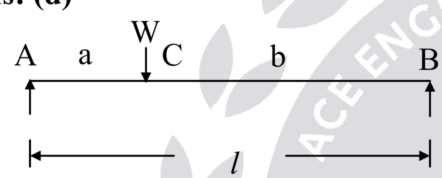
94. A simply supported beam of length 'l' carries a point load 'W' at point 'C' as shown in the figure. The maximum deflection lies at



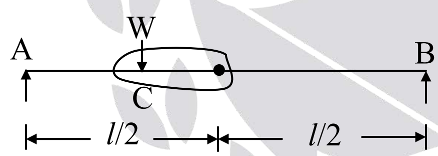
(a) Point A
(b) Point B
(c) Point C
(d) Between points B and C

94. Ans: (d)

Sol:



For SSB, under unsymmetrical loading maximum deflection occurs between point of application of load and mid span.



Region of zero slope (or) maximum deflection. (i.e in between points C and B)

95. In the torsion equation $\frac{T}{J} = \frac{\tau}{R} = \frac{C.\theta}{\ell}$

the term $\frac{J}{R}$ is called

(a) Shear modulus
(b) Section modulus
(c) Polar modulus
(d) None of the above

95. Ans: (c)

Sol: $Z_p = \frac{J}{R} =$ Polar section modulus

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96. Two solid shafts 'A' and 'B' are made of the same material. The shaft 'A' is of 50 mm diameter and shaft 'B' is of 100 mm diameter. The strength of shaft 'B' is __________ of that of shaft 'A'.

(a) one-half (b) double

(c) four times (d) eight times

96. Ans: (d)

Sol:

Shaft A	Shaft B
G	G
$d_A = 50$ min	$d_B = 100$ min
T_A	T_B

For Torsion equation $T = \tau.\ Z_p$

$$T \propto Z_p$$

$$Z_p = \frac{\pi}{16} d^3$$

$$\frac{T_B}{T_A} = \frac{(Z_P)_B}{(Z_P)_A} = \frac{d_B^3}{d_A^3} = \left(\frac{100}{50}\right)^3 = 8$$

97. The shear force on a simply supported beam is proportional to

(a) displacement of the neutral axis (b) sum of the forces

(c) sum of the transverse forces (d) algebraic sum of the transverse forces

97. Ans: (d)

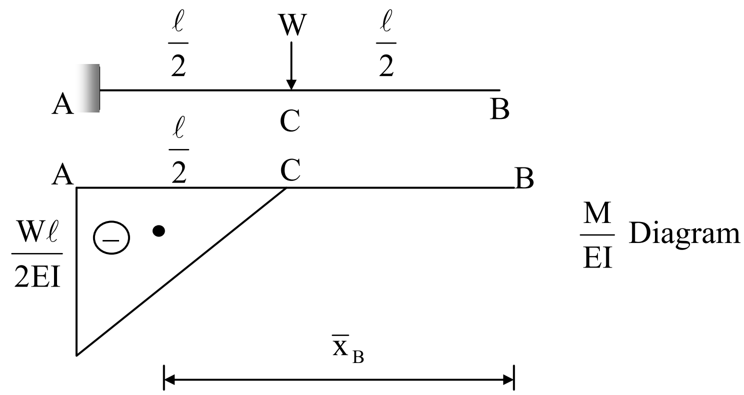
98. Deflection of the free end of cantilever having point load at the mid span is

(a) $\frac{W\ell^3}{3EI}$ (b) $\frac{5W\ell^3}{24EI}$

(c) $\frac{5W\ell^3}{48EI}$ (d) $\frac{W\ell^3}{48EI}$

98. Ans: (c)

Sol:



$y_B = A\bar{x}$

$y_B = (-)\left(\frac{1}{2}\times\frac{W\ell}{2EI}\times\frac{\ell}{2}\right)\left(\frac{\ell}{2}+\frac{2}{3}\times\frac{\ell}{2}\right)$

$= (-)\ \frac{5W\ell^3}{48EI}$

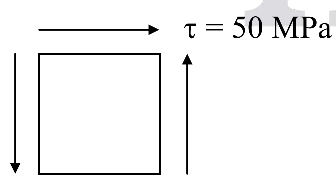
$y_B = \frac{5W\ell^3}{48EI}(\downarrow)$

99. An element in a strained body is subjected to only shear stress of intensity 50 MPa tending to rotate the body in clockwise direction. What is the magnitude of principal stresses?

(a) ± 50 MPa
(b) + 50 MPa, –25 MPa
(c) + 25 MPa, –50 MPa
(d) ± 25 MPa

99. Ans: (a)

Sol:



Under pure shear condition

$\sigma_1 = (-)\ \sigma_2 = \tau = 50$ MPa

$\therefore$ Max normal stress = ± 50 MPa

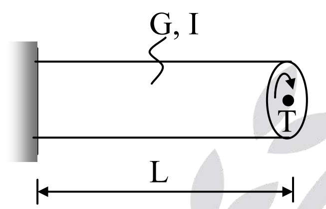
100. Strain energy stored in a solid shaft due to application of Torque 'T' at free end while other end is fixed, if G is shear modulus, J is polar moment of inertia, and L is the length of shaft is/will be

(a) $\frac{TL^2}{GJ}$ (b) $\frac{T^2L^2}{2GJ}$

(c) $\frac{2TL^2}{GJ}$ (d) $\frac{T^2L}{2GJ}$

100. Ans: (d)

Sol:



$$U = \frac{1}{2}T\theta = \frac{1}{2}T\left(\frac{TL}{GJ}\right) = \frac{T^2L}{2GJ}$$