इन्जीनियरिंग सेवा परीक्षा, 2009
Engineering Service Examination.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : O–FTF–J–DFA

Test Booklet Series

Serial No. 18821

A

TEST BOOKLET

CIVIL ENGINEERING

Paper—I

Time Allowed : Two Hours

Maximum Marks : 200

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES ***NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet***. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. What is the ratio of the elastic modulus of structural timber in longitudinal direction to that in the transverse direction ?
   (a) 1/2 to 1
   (b) 1/10 to 1/20
   (c) 1 to 2
   (d) 10 to 20

2. What is the modulus of elasticity of standard timber (Group B) in (MN/cm^2) ?
   (a) 0·5 to 1·0
   (b) 1·0 to 1·25
   (c) 1·25 to 1·5
   (d) 1·5 to 1·75

3. What is the treatment for making timber fire-resistant ?
   (a) ASCU treatment
   (b) Abel's process
   (c) Creosoting
   (d) Tarring

4. How is the process of treatment of wood using a preservative solution and forcing air in at a pressure designated ?
   (a) Ruping process
   (b) Lawri process
   (c) Full cell process
   (d) Empty cell process

5. Modular bricks are of nominal size 20×10×10 cm and 20% of the volume is lost in mortar between joints. Then what is the number of modular bricks required per cubic meter of brickwork ?
   (a) 520
   (b) 500
   (c) 485
   (d) 470

6. In order to achieve a safe compressive strength of 20 kg/cm^2 in a brick masonry, what should be the suitable range of crushing strength of bricks ?
   (a) 35 kg/cm^2 to 70 kg/cm^2
   (b) 70 kg/cm^2 to 105 kg/cm^2
   (c) 105 kg/cm^2 to 125 kg/cm^2
   (d) More than 125 kg/cm^2

7. What is the requirement of water (expressed as % of cement w/w) for the completion of chemical reactions in the process of hydration of OPC ?
   (a) 10 to 15%
   (b) 15 to 20%
   (c) 20 to 25%
   (d) 25 to 30%

8. Which factors comprise maturity of concrete ?
   (a) Compressive strength and flexural strength of concrete
   (b) Cement content per cubic metre and compressive strength of concrete
   (c) Curing age and curing temperature of concrete
   (d) Age and aggregate content per cubic metre of concrete

9. What is the minimum value of individual test results (in N/mm^2) for compressive strength compliance requirement for concrete M20 as per codal provision ?
   (a) $f_{ck} - 1$
   (b) $f_{ck} - 3$
   (c) $f_{ck} - 4$
   (d) $f_{ck} - 5$

(Contd.)

10. For what reason is it taken that the nominal maximum size of aggregate may be as large as possible ?

(a) Larger the maximum size of aggregate, more the cement required and so higher the strength.

(b) Larger the maximum size of aggregate, smaller is the cement requirement for a particular water cement ratio and so more economical the mix.

(c) Larger the maximum size of aggregate, lesser are the voids in the mix and hence also lesser the cement required.

(d) Larger the maximum size of aggregate, more the surface area and better the bond between aggregates and cement, and so higher the strength.

11. What is the representative geometric mean size of an aggregate sample if its fineness modulus is 3·0 ?

(a) 150 μm

(b) 300 μm

(c) 600 μm

(d) 12 μm

12. A square steel bar of 50 mm side and 5 m long is subjected to a load whereupon it absorbs a strain energy of 100 J. What is its modulus of resilience ?

(a) $\frac{1}{125}$ Nmm/mm^3

(b) 125 mm^3/Nmm

(c) $\frac{1}{100}$ Nmm/mm^3

(d) 100 mm^3/Nmm

13. What is the ratio of flexural strength (fcr) to the characteristic compressive strength of concrete (fck) for M25 grade concrete ?

(a) 0·08

(b) 0·11

(c) 0·14

(d) 0·17

14. Which of the following tests compares the dynamic modulus of elasticity of samples of concrete ?

(a) Compression test

(b) Ultrasonic pulse velocity test

(c) Split test

(d) Tension test

15. Which one of the following is correct regarding the most effective requirements of durability in concrete ?

(a) Providing reinforcement near the exposed concrete surface.

(b) Applying a protective coating to the exposed concrete surface.

(c) Restricting the minimum cement content and the maximum water cement ratio and the type of cement.

(d) Compacting the concrete to a greater degree.

16. A solid metal bar of uniform sectional area throughout its length hangs vertically from its upper end. Details of the bar are : length = 6 m, material density = 8×10^{-5} N/mm^3 and E = 2×10^5 N/mm^2. What will be the total elongation of the bar in mm ?

(a) $\frac{288}{10^4}$

(b) $\frac{48}{10^4}$

(c) $\frac{144}{10^4}$

(d) $\frac{72}{10^4}$

(Contd.)

17. A circular rod of diameter 30 mm and length 200 mm is subjected to a tensile force. The extension in rod is 0·09 mm and change in diameter is 0·0045 mm. What is the Poisson's ratio of the material of the rod ?

(a) 0·30

(b) 0·32

(c) 0·33

(d) 0·35

18. For a material having modulus of elasticity equal to 208 GPa and Poisson's ratio equal to 0·3, what is the modulus of rigidity ?

(a) 74·0 GPa

(b) 80·0 GPa

(c) 100·0 GPa

(d) 128·5 GPa

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

(a) Cup and cone shape at the centre.

(b) Plane surface perpendicular to the axis of the specimen.

(c) Pyramid type wedge-shaped surface perpendicular to the axis of the specimen.

(d) Helicoidal surface at 45° to the axis of the specimen.

20. Given E as the Young's modulus of elasticity of a material, what can be the minimum value of its bulk modulus of elasticity ?

(a) $\frac{E}{2}$

(b) $\frac{E}{3}$

(c) $\frac{E}{4}$

(d) $\frac{E}{5}$

21. At a point in a piece of stressed material the stresses are :

$\sigma_x = \alpha kN/m^2$ tensile (normal)

$\tau_{XY} = \tau_{YX} = \beta kN/m^2$ (shearing).

Although the values of α and β are not known yet the principal stresses are equal to each other being (5 kN/m^2). What is the radius of Mohr's circle ?

(a) $2{\cdot}5 + (\alpha + \beta)$

(b) $2{\cdot}5 + \frac{(\alpha + \beta)}{2}$

(c) 0

(d) 2·5

22. What is the radius of Mohr's circle in case of bi-axial state of stress ?

(a) Half the sum of the two principal stresses.

(b) Half the difference of the two principal stresses.

(c) Difference of the two principal stresses.

(d) Sum of the two principal stresses.

23. A circular column of external diameter D, and internal diameter d, carries an eccentric load such that tension is developed nowhere. What shall be the diameter of the core ?

(a) $\frac{D^2 + d^2}{8d}$

(b) $\frac{D^2 - d^2}{8d}$

(c) $\frac{D^2 + d^2}{4d}$

(d) $\frac{D^2 - d^2}{4d}$

(Contd.)

24. A mild steel bar of square cross section 25 mm×25 mm is 1 m long. It is subjected to bi-axial stress $\sigma_x = 480$ N/mm² (Tension) and $\sigma_y = 400$ N/mm² (Compression). $E = 2\times10^5$ N/mm², $\mu = 0{\cdot}3$, what is the elongation of the bar in mm in x direction ?

(a) 1·0

(b) 1·5

(c) 2·0

(d) 3·0

25.

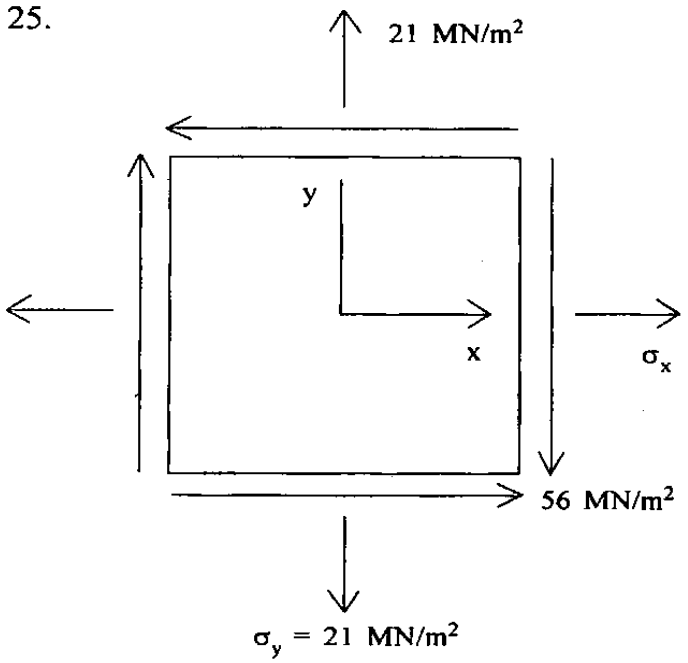


Figure shows a state of plane stress. If the minimum principal stress is – 7 MN/m² then what is the value of σ_x ?

(a) 30 MN/m²

(b) 68 MN/m²

(c) 98 MN/m²

(d) 105 MN/m²

26. The details of the principal stresses at a certain point in a steel member are as follows :

Major principal stress $\sigma_1 = 180$ N/mm² (Tensile)

Major principal stress σ_2 is (Compressive)

If the uniaxial tensile yield stress is 240 N/mm², according to maximum shear stress theory, what would be the value of σ_2 in N/mm² which yielding will commence ?

(a) 120 tension

(b) 90 tension

(c) 80 compression

(d) 60 compression

27. An element of a structure is subjected to two Principal stresses σ_1 and σ_2.

$\sigma_1 = 200$ N/mm² (Tensile),

σ_2 is Compressive.

The yield stress both in simple tension and compression for the material is 240 N/mm². Poisson's ratio $\mu = 0{\cdot}25$; what is the value of σ_2 in N/mm² as per maximum normal strain theory at which the yield of the material will commence ?

(a) 240

(b) 200

(c) 180

(d) 160

(Contd.)

28. A structural beam subjected to sagging bending has a cross-section which is an unsymmetrical I-section. The overall depth of the beam is 300 mm. The flange stresses in the beam are :

$\sigma_{top} = 200$ N/mm²

$\sigma_{bottom} = 50$ N/mm²

What is the height in mm of the neutral axis above the bottom flange ?

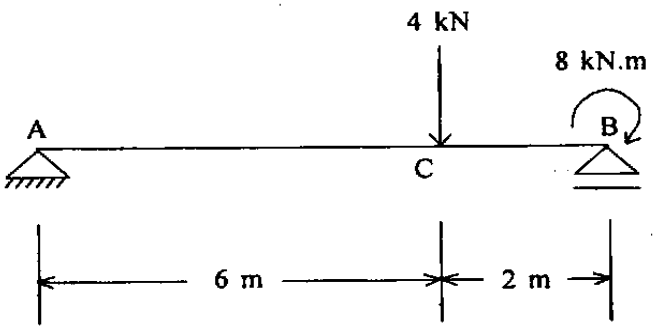
(a) 240 mm

(b) 60 mm

(c) 180 mm

(d) 120 mm

29.



A simply supported beam AB is loaded as shown in the figure above. What is the SF in kN in the portion AC of the beam ?

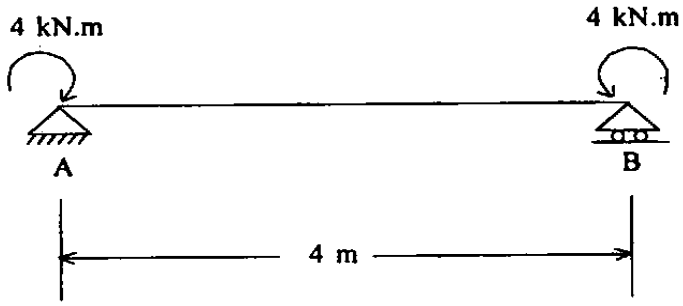
(a) 2

(b) 4

(c) 0

(d) 6

30.



A simply supported beam AB of span 4 m is subjected to terminal couples as shown in the figure above. If EI is in kN.m², what is the magnitude of the central deflection of the beam in metres ?

(a) $\frac{4}{EI}$

(b) $\frac{8}{EI}$

(c) $\frac{2}{EI}$

(d) $\frac{16}{EI}$

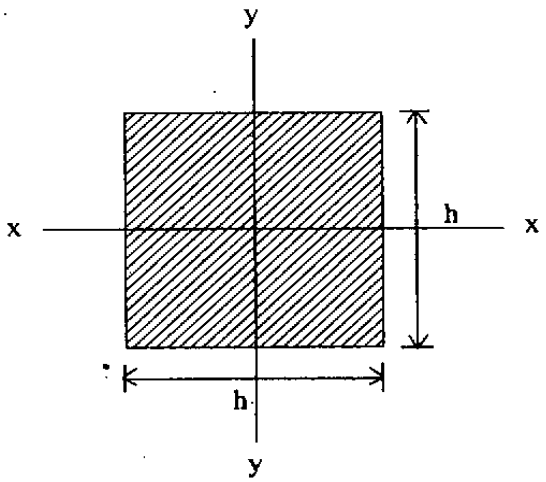
31. A timber beam is 100 mm wide and 150 mm deep. The beam is simply supported and carries a central concentrated load W. If the maximum stress in shear is 2 N/mm², what would be the corresponding load W on the beam ?

(a) 20 kN

(b) 30 kN

(c) 40 kN

(d) 25 kN

32. 

A square section as shown in the figure above is subjected to bending moment M. What is the maximum bending stress ?

(a) $\sigma_{bc} = \sigma_{bt} = \frac{12\,M}{h^3}$

(b) $\sigma_{bc} = \sigma_{bt} = \frac{6\,M}{h^3}$

(c) $\sigma_{bc} = \sigma_{bt} = \frac{9\,M}{2h^3}$

(d) $\sigma_{bc} = \sigma_{bt} = \frac{9\,M}{h^3}$

33. A 40 mm diameter shaft is subjected to a twisting moment M_t. If shear stress developed in shaft is 5 N/mm^2, what is the value of the twisting moment ?

(a) 628·8 Nm

(b) 328·4 Nm

(c) 62·8 Nm

(d) 30·4 Nm

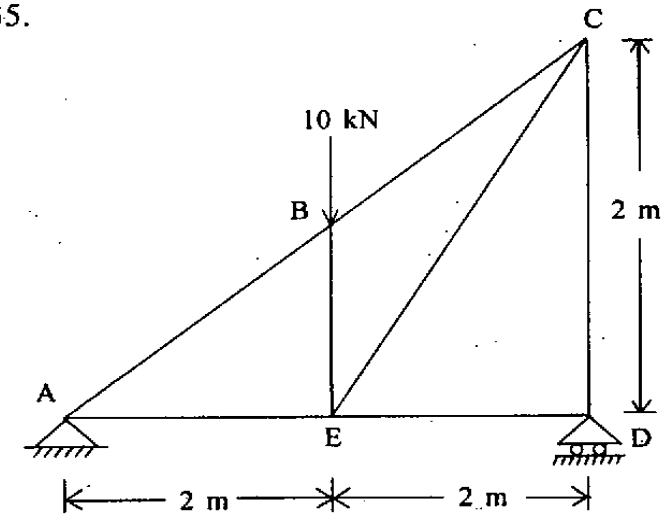
34. Torsion applied to a circular shaft results in a twist of 1° over a length of 1 m. The maximum shear stress induced is 120 N/mm^2 and the modulus of rigidity of the shaft material is $0{\cdot}8\times10^5$ N/mm^2. What is the radius of the shaft ?

(a) $\frac{300}{\pi}$

(b) $\frac{180}{\pi}$

(c) $\frac{90}{\pi}$

(d) $\frac{270}{\pi}$

35. 

The above figure shows a pin-jointed frame. What are the forces in members BE, CD and ED ?

(a) 10 kN, 5 kN and 5 kN

(b) 10 kN, 5 kN and Zero

(c) 5 kN, 10 kN and Zero

(d) 5 kN, 5 kN and Zero

(Contd.)

36. A mild steel rod tapers uniformly from 30 mm diameter to 12 mm diameter in a length of 300 mm. The rod is subjected to an axial load of 12 kN. $E = 2\times10^5$ N/mm^2. What is the extension of the rod in mm ?

(a) $\frac{4\pi}{5}$

(b) $\frac{2}{5\pi}$

(c) $\frac{\pi}{5}$

(d) $\frac{1}{5\pi}$

37. A square beam laid flat is then rotated in such a way that one of its diagonal becomes horizontal. How is its moment capacity affected ?

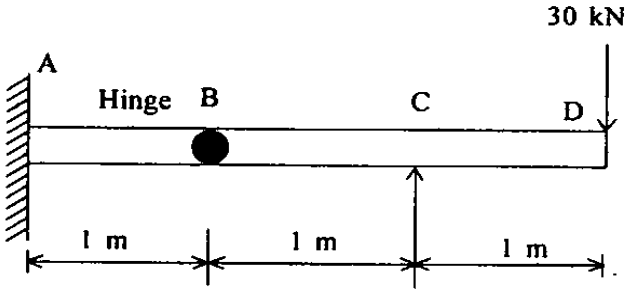
(a) Increases by 41·4%

(b) Increases by 29·27%

(c) Decreases by 29·27%

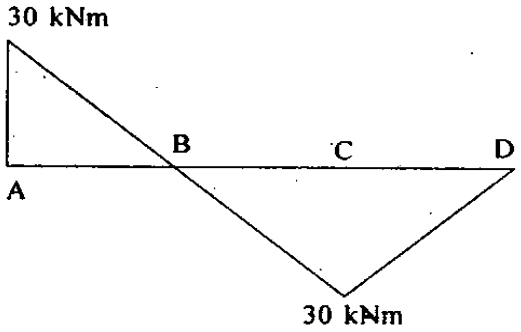
(d) Decreases by 41·4%

38.

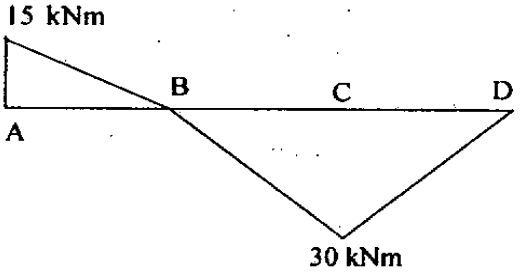


Which one of the following is the correct bending moment diagram for a propped cantilever beam shown in figure above ?

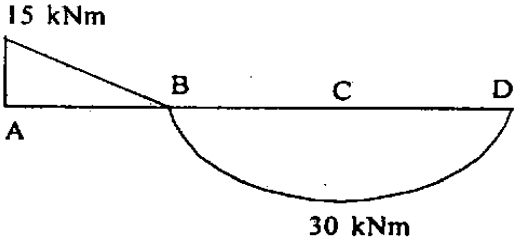
(a)



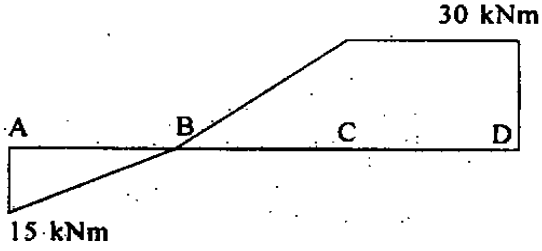
(b)



(c)



(d)



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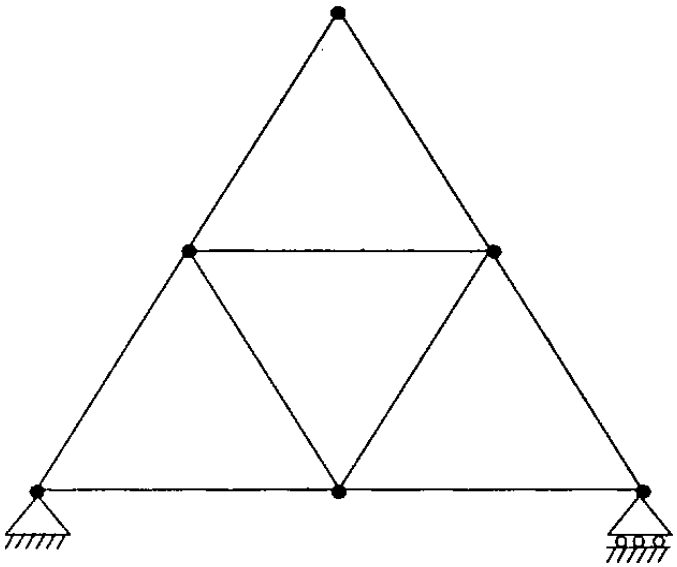
39.



Consider the following statements with respect to the above figure of a typical articulated frame :

1. The frame is internally determinate and externally indeterminate.
2. The frame is internally indeterminate and externally determinate.
3. The frame is internally as well as externally determinate.
4. The frame is internally as well as externally indeterminate.

Which of the above statements is/are correct ?

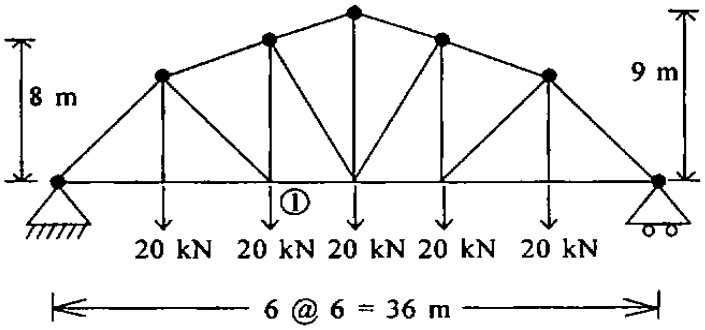
(a) 1 only

(b) 1 and 2

(c) 3 only

(d) 3 and 4

40.



What is the force in member 1 for the structure shown in figure above ?

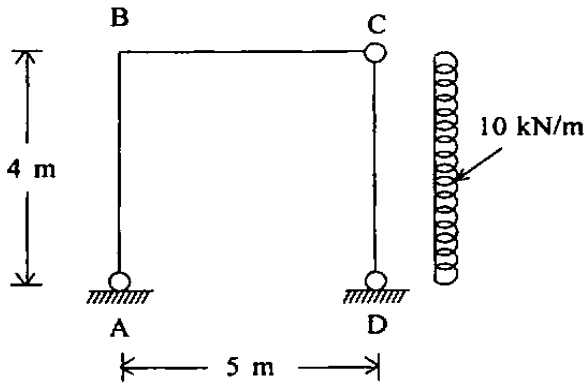
(a) 30 kN

(b) 60 kN

(c) 75 kN

(d) 80 kN

41.



What is the value of vertical reaction at A for the frame shown in figure above ?

(a) 0

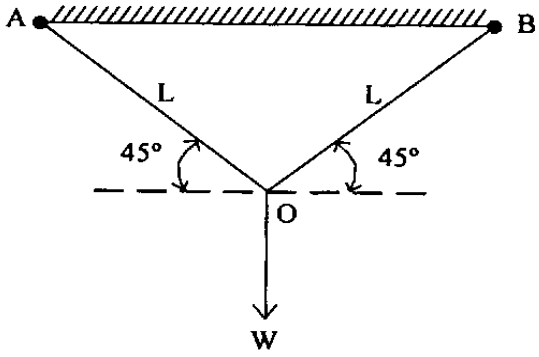
(b) 10 kN

(c) 16 kN

(d) 20 kN

(Contd.)

42.



Two bars AO and BO are of uniform area 'A' and are hinged at O. What is the vertical deflection at O when elastic modulus is uniformly E ?

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

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

(c) $\frac{WL}{AE}$

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

43. A fixed end beam of uniform cross-section is loaded uniformly throughout the span. What is the proportion of the bending moment at the centre to the end moment considering only elastic conditions ?

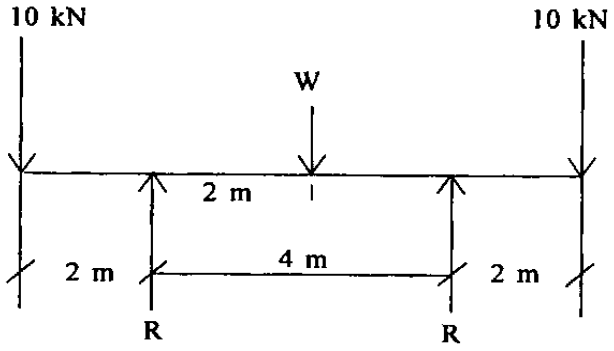
(a) 1 : 1

(b) 1 : 2

(c) 1 : 4

(d) 2 : 3

44.



A beam of uniform flexural rigidity supports a set of loads as shown in figure above. What is the value of W if the magnitudes of bending moment at midspan and at support of the beam are numerically equal ?

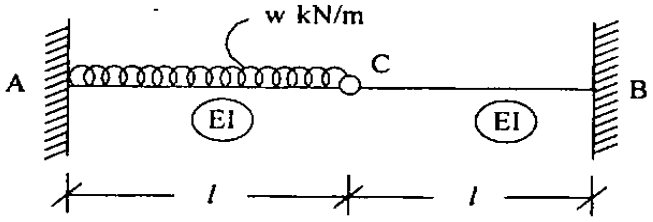
(a) 20 kN

(b) 40 kN

(c) 60 kN

(d) 80 kN

45.



What is the reaction on the pin C for a beam as shown in the figure above ?

(a) $\frac{3}{8}$ Wl kN

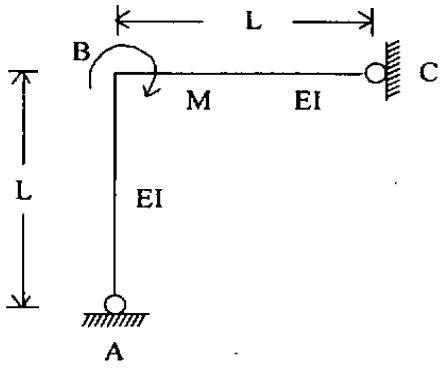
(b) $\frac{1}{2}$ Wl kN

(c) $\frac{1}{4}$ Wl kN

(d) $\frac{3}{16}$ Wl kN

(Contd.)

46.



What is the rotation of the member at C for a frame as shown in figure above ?

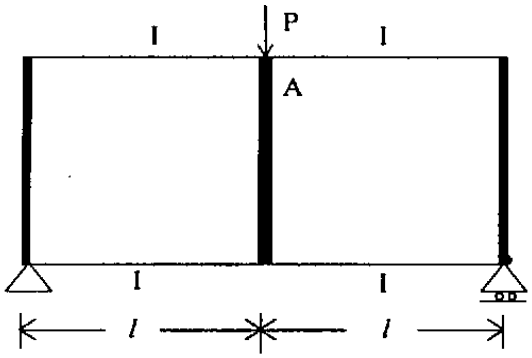
(a) $\frac{ML}{3EI}$

(b) $\frac{ML}{4EI}$

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

(d) $\frac{ML}{12EI}$

47.



What is the moment at A for a frame as shown in figure above ? Each member indicated in dark lines has very large moment of inertia.

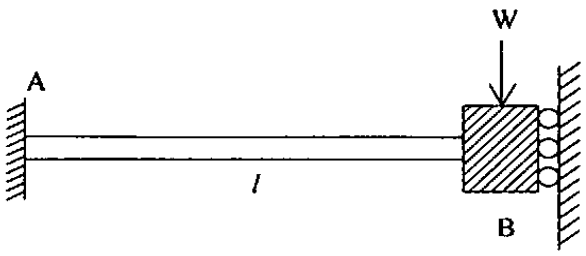
(a) $\frac{PL}{2}$

(b) $\frac{PL}{4}$

(c) $\frac{PL}{8}$

(d) $\frac{PL}{16}$

48.



What is the bending moment at the end B for the guided beam as shown in the figure above considering the beam to be held rigidly at B against rotation and to support a load W ?

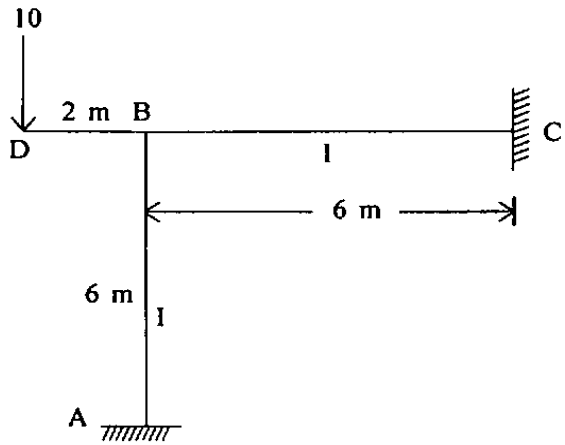
(a) Zero

(b) $\frac{Wl}{4}$

(c) $\frac{Wl}{2}$

(d) Wl

49.



What is the value of θ_B for the beam shown in figure above ?

(a) Zero

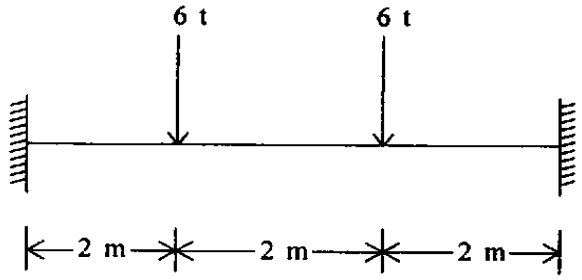
(b) $\frac{15}{EI}$ anticlockwise

(c) $\frac{30}{EI}$ anticlockwise

(d) $\frac{30}{EI}$ clockwise

(Contd.)

50.



A beam of uniform section fixed at both ends and of span 6 m is acted upon by two concentrated loads of 6 t each as shown in figure above. What is the fixed end moment at each end ?

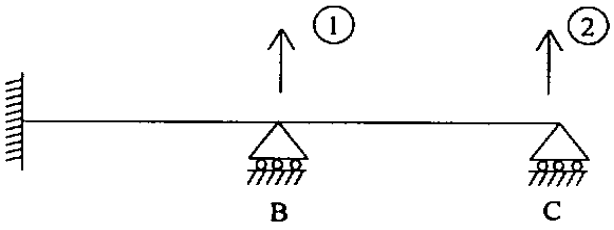
(a) 6 tm

(b) 8 tm

(c) 10 tm

(d) 12 tm

51.



Flexibility matrix of the beam shown above is :

$$\delta = \frac{1}{3\,EI}\begin{bmatrix} 1 & 2 \\ 2 & 8 \end{bmatrix}$$

If support B settles by $\frac{\Delta}{EI}$ units, what is the reaction at B ?

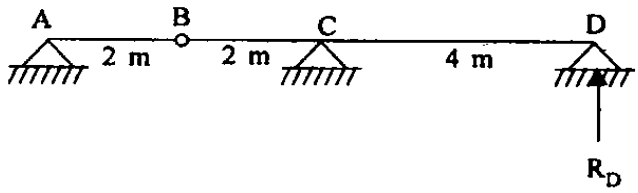
(a) 0·75 Δ

(b) 3·0 Δ

(c) 6·0 Δ

(d) 24·0 Δ

52.



What is the ordinate of influence line at B for reaction R_D in above figure ?

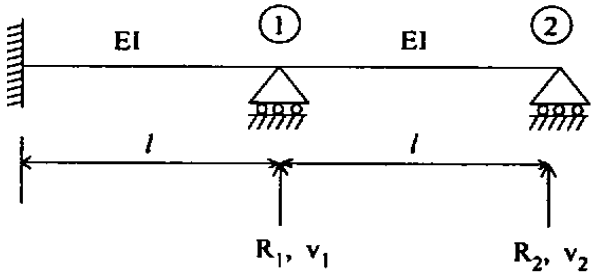
(a) 0·5

(b) 0·4

(c) 0·2

(d) Zero

53.



What is the value of flexibility coefficient f_{12} for the continuous beam shown in figure above ?

(a) $\frac{l^3}{3\,EI}$

(b) $\frac{l^3}{2\,EI}$

(c) $\frac{l^3}{8\,EI}$

(d) $\frac{l^3}{1{\cdot}2\,EI}$

(Contd.)

54. What is the area of influence line diagram for the reaction at the hinged end of a uniform propped cantilever beam of span L ?

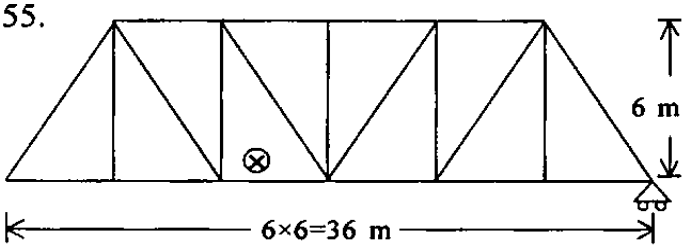
(a) $\frac{L}{8}$

(b) $\frac{L}{2}$

(c) $\frac{L}{4}$

(d) $\frac{3L}{8}$

55.



What is the maximum ordinate for influence line for the force in the member marked X ?

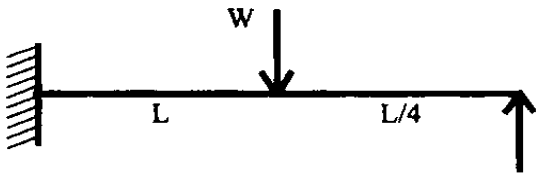
(a) 1·0

(b) 1·33

(c) 1·50

(d) 2·50

56.



A propped cantilever beam of uniform moment capacity M_0 is shown in figure above. What is the collapse load W ?

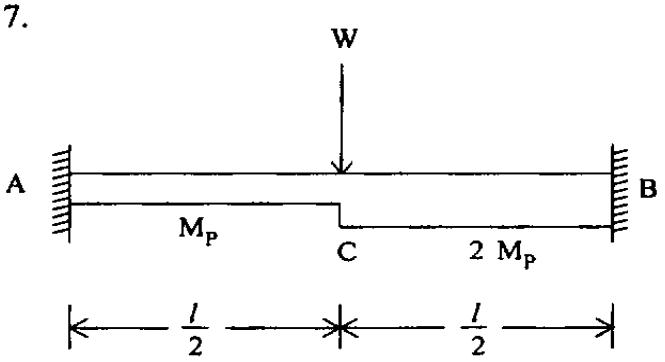
(a) $\frac{12}{L}M_0$

(b) $\frac{8}{L}M_0$

(c) $\frac{6}{L}M_0$

(d) $\frac{3}{L}M_0$

57.



What is the collapse load in terms of M_p and l for the beam shown in figure above ?

(a) $\frac{M_P}{l}$

(b) $\frac{5M_P}{l}$

(c) $\frac{10M_P}{l}$

(d) $\frac{20M_P}{l}$

58. A prismatic beam (shape factor, S) fixed at both ends carries UDL throughout the span. What is the ratio of collapse load to yield load ?

(a) $\frac{4}{3}$ S

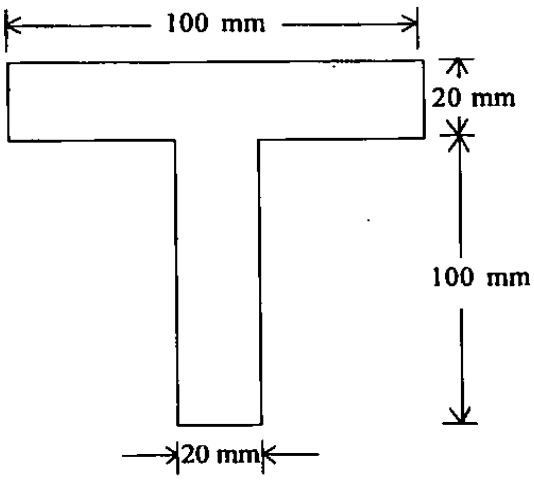
(b) $\frac{3}{4}$ S

(c) $\frac{5}{3}$ S

(d) $\frac{3}{5}$ S

(Contd.)

59.



What is the distance between elastic neutral axis and plastic neutral axis for the cross-section as shown in figure above ?

(a) 60 mm

(b) 50 mm

(c) 40 mm

(d) 20 mm

60. Steel of yield strength 400 MPa has been used in a structure. What is the value of the maximum allowable tensile strength ?

(a) 240 MPa

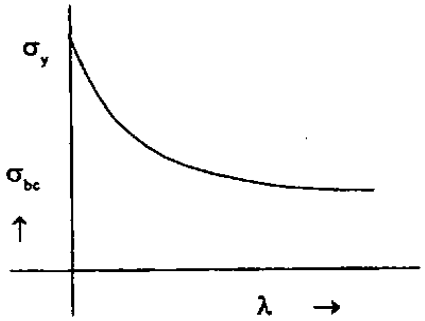
(b) 200 MPa

(c) 120 MPa

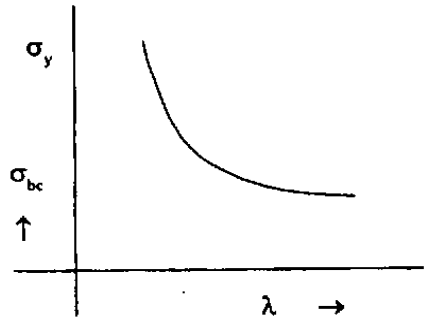
(d) 96 MPa

61. Which one of the following graphs represents the compressive strength (σ_{bc}) versus slenderness ratio (λ) ?

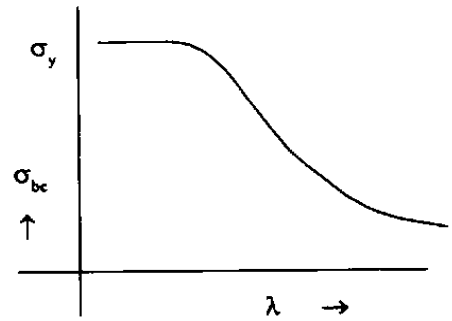
(a)



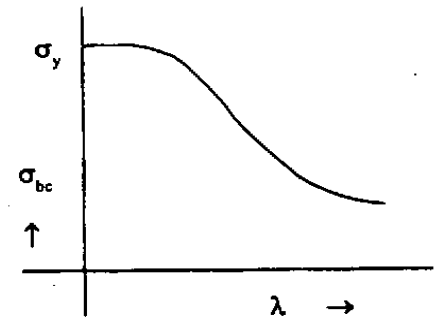
(b)



(c)



(d)



(Contd.)

62. A steel plate is 300 mm wide and 10 mm thick. A rivet of nominal diameter of 16 mm is driven into it. What is the net sectional area of the plate ?

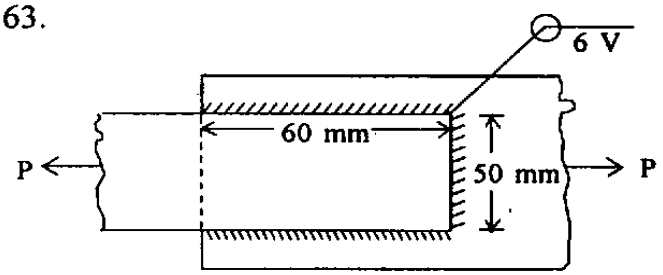
(a) 2600 mm²

(b) 2760 mm²

(c) 2830 mm²

(d) 2840 mm²

63.



What is the safe load P that can be transmitted by the fillet-welded joint shown in figure above if the safe allowable shear stress in the fillet-weld is 108 MPa ?

(a) 60 kN

(b) 66 kN

(c) 77 kN

(d) 81 kN

64. A cantilever steel beam of 3 m span carries a uniformly distributed load of 20 kN/m inclusive of self-weight. The beam comprises of ISLB200@198 N/m, flange = 100 mm×7·3 mm; web thickness = 5·4 mm; I_{xx} = 1696·6 cm⁴; I_{yy} = 115·4 cm⁴. What is the maximum bending stress in the beam ?

(a) 132·62 N/mm²

(b) 530·47 N/mm²

(c) 1949·74 N/mm²

(d) 3899·48 N/mm²

65. A tension member consists of two angles placed back to back. For which one of the following configurations, will the load carrying capacity of the tension member be maximum ?

(a) Gusset plate is in between the two angles and tacking rivets are provided

(b) Gusset plate is in between the two angles and no tacking rivets are provided

(c) Gusset plate is on one side of the two angles and tacking rivets are provided

(d) Gusset plate is on one side of the two angles and no tacking rivets are provided

66. For a welded plate girder with vertical stiffeners, what is the maximum depth of web provisionable in design when the thickness of the web plate is 5 mm ?

(a) 425 mm

(b) 1000 mm

(c) 1250 mm

(d) 2000 mm

67. A symmetric plate girder is of I section of depth D. The flange plates are of area A_f each and the web plate is of area A_w. What is the plastic section modulus of the above section provisionable for design ?

(a) $\left(A_f + \frac{A_w}{4}\right)d$

(b) $\left(A_f + \frac{A_w}{6}\right)d$

(c) $\left(A_f + \frac{A_w}{8}\right)d$

(d) $\left(A_f + \frac{A_w}{12}\right)d$

(Contd.)

68. An ISMB 300 beam has modulus of section of 600×10^3 mm^3. Plates of 200 mm × 10 mm are added by welding them one on each flange to have total depth of section as 320 mm. What is the section modulus of the plated section ?

(a) 462×10^3 mm^3

(b) 550×10^3 mm^3

(c) 710×10^3 mm^3

(d) 1220×10^3 mm^3

69. A column bearing truss in an open industrial shed is 6 m height between its own base and the bottom of the truss. What is the effective height of the column taken for calculation of compressive strength ?

(a) 4·8 m

(b) 6·0 m

(c) 7·2 m

(d) 9·0 m

70. Which one of the following values represents the maximum slenderness ratio of any connection member which normally acts as a tie in a roof truss but can be subjected to possible reversal of stresses from the action of wind or seismic force ?

(a) 150

(b) 200

(c) 250

(d) 350

71. Consider the following statements :

1. When wind load is the primary load, no increase in the allowable stresses is provided for in members or fasteners.
2. Due to wind load acting along with dead and live loads, increase in allowable stress upto 33·33% can be provided for.
3. Due to wind load acting along with dead load, increase in allowable stress of 25% in foundation bolts can be provided for.

Which of the above statements is/are correct ?

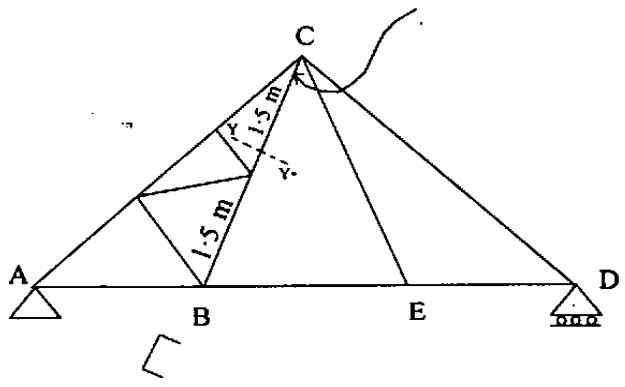
(a) 1, 2 and 3

(b) 1 only

(c) 2 and 3

(d) 3 only

72. MC100 [γ_x = 40 mm, γ_y = 15 mm]



Section YY

What is the slenderness ratio to be considered in design for member BC in the structure shown above ?

(a) 75

(b) 150

(c) 100

(d) 200

(Contd.)

73. A simply supported beam of uniform cross-section has span 'L' and is loaded by a point load 'P' at its mid-span. What is the length of the elastoplastic zone of the plastic hinge ?

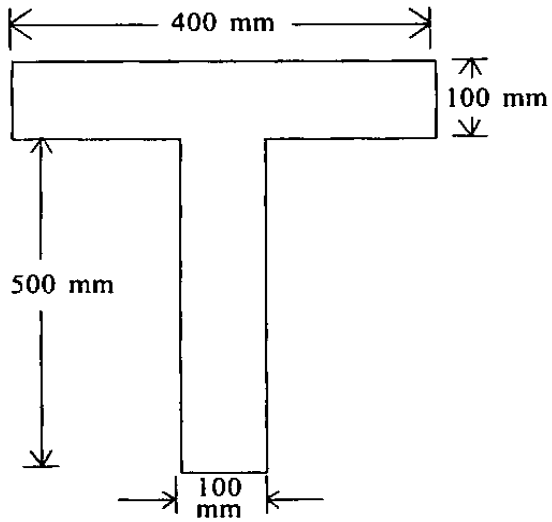
(a) $\frac{L}{3}$

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

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

(d) $\frac{3L}{4}$

74.



In a T-section shown in figure above, what is the distance of plastic neutral axis as measured down from top ?

(a) 100 mm

(b) 150 mm

(c) 200 mm

(d) 300 mm

75. Consider the following statements :

Torsional restraint in a beam can be achieved by providing :

1. Web or flange cleats at the end connections.
2. External support to the end of the compression flange.
3. Bearing stiffness acting in conjunction with the bearing of the beam.

Which of the above statements is/are correct ?

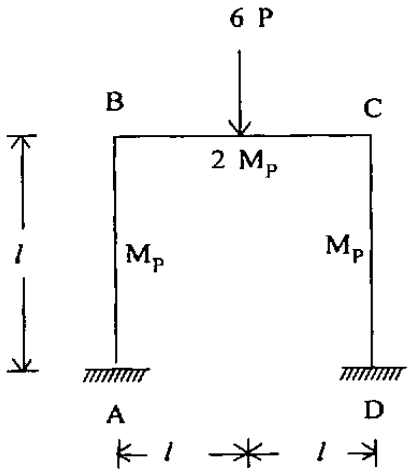
(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

76.



At the point of collapse, what is the value of horizontal thrust at point A in the loaded frame shown in figure ?

(a) 3 P

(b) 2 P

(c) 1·5 P

(d) P

(Contd.)

77. In limit state design method, the moment of resistance for a balanced section using M20 grade concrete and HYSD steel of grade Fe415 is given by $M_{u,lim} = Kbd^2$, what is the value of 'K' ?

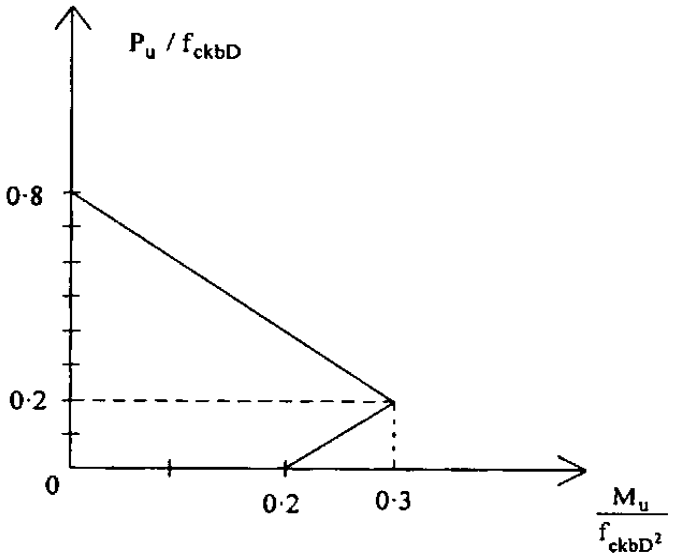
(a) 2·98

(b) 2·76

(c) 1·19

(d) 0·89

78.



A RC column of square cross-section (400×400 mm²) has its column load-moment interaction diagram as shown in figure above. What is the maximum uniaxial eccentricity at which a factored load P_u = 640 kN can be applied safely ? (Take f_{ck} = 20 MPa)

(a) 300 mm

(b) 400 mm

(c) 600 mm

(d) 800 mm

79. How is the deflection in RC beams controlled as per IS456 ?

(a) By using large aspect ratio

(b) By using small modular ratio

(c) By controlling span / depth ratio

(d) By moderating water-cement ratio

80. At what stress does the first flexural crack appear in RCC beams made of M25 grade concrete ?

(a) 3·0 MPa

(b) 3·5 MPa

(c) 4·0 MPa

(d) 4·5 MPa

81. What is the adoptable maximum spacing between vertical stirrups in an RCC beam of rectangular cross-section having an effective depth of 300 mm ?

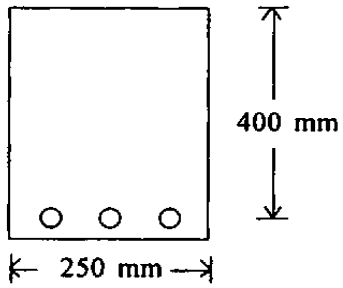
(a) 300 mm

(b) 275 mm

(c) 250 mm

(d) 225 mm

82.



A simply supported RC beam having clear span 5 m and support width 300 mm has the cross-section as shown in figure. What is the effective span of the beam as per IS456 ?

(a) 5300 mm

(b) 5400 mm

(c) 5200 mm

(d) 5150 mm

(Contd.)

83. Consider the following statements dealing with flexural reinforcement to be terminated in the tension zone :

1. The shear at the cut-off point not to exceed two-third of the otherwise permitted value.
2. Shear reinforcement is provided along each terminated bar overlapping three-fourth of the appropriate distance from the cut-off point.
3. For 36 mm and smaller bars, the continuing bars shall provide double the area required for flexure at the cut-off and shear does not exceed three-fourth of the permitted value.

Which of the above statements is/are correct ?

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

84. Match List-I with List-II and select the correct answer using the code given below the lists :

List-I	*List-II*
A. IS-875	1. Earthquake resistant design
B. IS-1343	2. Loads
C. IS-1893	3. Liquid storage structure
D. IS-3370	4. Prestressed concrete

Code :

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

85. What is the modular ratio to be used in the analysis of RC beams using working stress method if the grade of concrete is M20 ?

(a) 18·6
(b) 13·3
(c) 9·9
(d) 6·5

86. Considering modular ratio as 13, grade of concrete as M20 and grade of steel as 415, what is the ratio of balanced depth of neutral axis as per working stress method to the balanced depth of neutral axis as per limit state method ?

(a) $\frac{12}{7}$
(b) $\frac{11}{3}$
(c) $\frac{7}{12}$
(d) $\frac{3}{11}$

87. What is the anchorage value of a standard hook of a reinforcement bar of diameter D ?

(a) 4D
(b) 8D
(c) 12D
(d) 16D

(Contd.)

88. How is the base-level bending moment of a cantilever retaining wall expressed as a function of its height H ?

(a) H^1

(b) H^2

(c) H^3

(d) H^4

89. Match List-I with List-II and select the correct answer using the code given below the lists :

List-I	*List-II*
A. At end support, for imposed load (not fixed)	1. 0·5
B. At inside support, next inner to end support, for imposed load (fixed)	2. 0·55
C. At end support, for dead load and (fixed) imposed load	3. 0·60
D. At all other interior supports (other than at 'B'), for imposed load (fixed)	4. 0·45
	5. 0·4

Code :

	A	B	C	D
(a)	5	3	2	4
(b)	4	2	5	1
(c)	1	2	3	4
(d)	5	3	2	1

90. Match List-I with List-II and select the correct answer using the code given below the lists :

List-I	*List-II*
A. Moment and shear coefficients	1. Durability
B. Fire resistance	2. Stability
C. Sliding	3. Analysis of structure
D. Span to depth ratio of beam	4. Deflection limits

Code :

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

91. Match List-I with List-II and select the correct answer using the code given below the lists :

List-I	*List-II*
A. $\frac{V_U}{bd}$	1. Modulus of rupture
B. $0{\cdot}7\sqrt{f_{CK}}$	2. Development length
C. $5000\sqrt{f_{CK}}$	3. Nominal shear stress
D. $\frac{\phi f_s}{4\tau_B}$	4. Hook anchorage value
	5. Modulus of concrete

Code :

	A	B	C	D
(a)	3	1	5	2
(b)	2	1	4	3
(c)	3	5	1	4
(d)	2	4	1	3

(Contd.)

92. Consider the following statements :

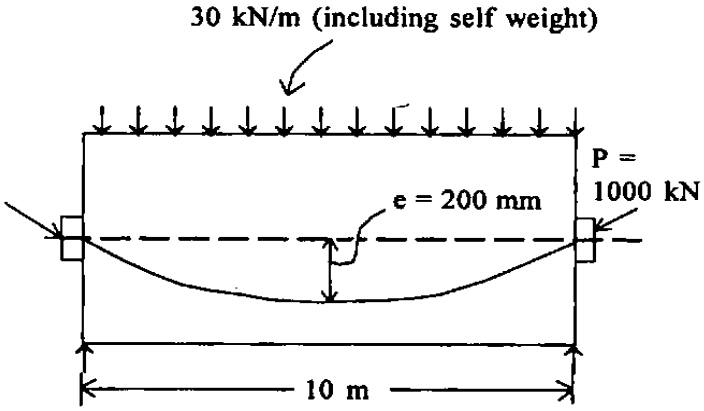
The shear resistance of structural concrete members may be improved by :

1. Axial prestressing.
2. Vertical prestressing.
3. Inclined prestressing.

Which of the above statements is/are correct ?

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

93.



What is the net downward load to be considered for the analysis of the prestressed concrete beam provided with a parabolic cable as shown in the figure ?

(a) 12 kN/m
(b) 13 kN/m
(c) 14 kN/m
(d) 15 kN/m

94. What shall be the maximum area of reinforcement (i) in compression and (ii) in tension to be provided in an RC beam, respectively, as per IS456 ?

(a) 0·08% and 2%
(b) 2% and 4%
(c) 4% and 2%
(d) 4% and 4%

95. Consider the following statements for minimum reinforcement to be provided in a wall as a ratio of vertical reinforcement to gross concrete area :

1. 0·0012 for deformed bars.
2. 0·0015 for all other types of bars.
3. 0·0012 for welded wire fabric with wires not larger than 16 mm in diameter.

Which of the above statements is/are correct ?

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

96. An equipment costs Rs. 25 Lakhs with an estimated salvage value of Rs. 5 Lakhs after 5 years of useful life. What is the approximate equated annual cost for use of the equipment ?

(a) Rs. 4 Lakhs
(b) Rs. 10 Lakhs
(c) Rs. 13 Lakhs
(d) Rs. 17 Lakhs

(Contd.)

97. Consider the following parameters :

1. The stability of the footing.
2. The strength of the boom.
3. The counterweight.
4. Size of aggregates.

Which of the above parameters governs the load capacity of a crane ?

(a) 1 only
(b) 1, 2 and 3
(c) 2 and 3 only
(d) 2, 3 and 4

98. A preliminary survey indicates that 20% of the time of a gang of workers is spent idly. What is the total number of observations required to determine the proportion of idle time with 95% confidence limit ? Critical value at this level of confidence is 1·96.

(a) 236 observations
(b) 246 observations
(c) 256 observations
(d) 266 observations

99. An engine was tested at local atmospheric pressure of 73 cm of mercury and local temperature of 10°C, and was found to develop X_1 units of power. If it was later worked at conditions of 75 cm of mercury as local atmospheric pressure and at local temperature of 16°C, what proportion of X_1 will it then develop ?

(a) nearly $\frac{1}{60}$ times more
(b) nearly $\frac{1}{60}$ times less
(c) nearly $\frac{1}{50}$ times more
(d) nearly $\frac{1}{50}$ times less

100. Consider the following equipments :

1. Drag line
2. Power shovel
3. Hoe
4. Crawler dozer

Which of the above may be used for excavation of materials and loading them into trucks ?

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 2, 3 and 4

101. A power shovel is fitted with an engine of 150 f.w.h.p. It operates on full load for 6 minutes followed by 8 minutes of idling at one-third power. Its hourly utilization is for 3 cycles. What is its utilization factor ?

(a) 0·398
(b) 0·433
(c) 0·467
(d) 0·528

102. A construction equipment has a useful life of 4 yrs after which it is to be replaced by a new one. If the interest rate is 6%, what is the nearest value of the sinking fund factor ?

(a) 0·023
(b) 0·23
(c) 0·17
(d) 0·31

(Contd.)

103. Consider the following statements :

1. There is no large difference in speed between wheeled tractors and crawlers.
2. The operating cost of crawlers is generally more than for wheeled tractors.
3. Both, viz, wheeled tractors as well as crawlers, need to be mounted on trailers for long distance hauls.
4. Wheeled tractors may occasionally suffer slips whereas crawlers do not.

Which of the above statements is/are NOT correct ?

(a) 1 only

(b) 1 and 2

(c) 1 and 3

(d) 3 and 4

104. A 1·75 m^3 capacity tractor loader has a forward loaded speed of 240 m/min, returning unloaded speed of 300 m/min and operates at 80% of the specified speed. It hauls earth over a distance of 60 m with fixed time per trip being 25 seconds. What is its effective cycle time ?

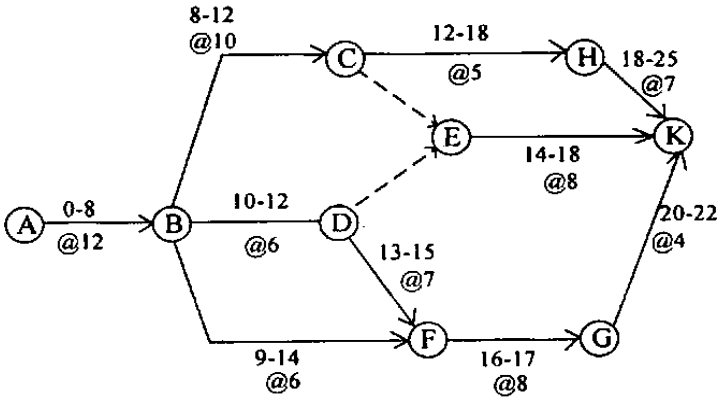
(a) 54·25 seconds

(b) 55·50 seconds

(c) 56·75 seconds

(d) 58·75 seconds

105.



The scheduled durations, by the convention 'after/at the end of indicated day number' and the cost per day of duration, of each activity are shown in the network above. What are the costs incurred on day numbers 13 and 17 ?

(a) 14 and 20

(b) 11 and 18

(c) 14 and 21

(d) 11 and 21

106. A 1·6 m^3 capacity tractor loader works at a site with an effective per-round-trip time of 64 seconds. Effective delivery of excavated material is 90%. If utilization is 50 minutes per hour working, what will be the productivity in a 4-hour shift ?

(a) 253 m^3

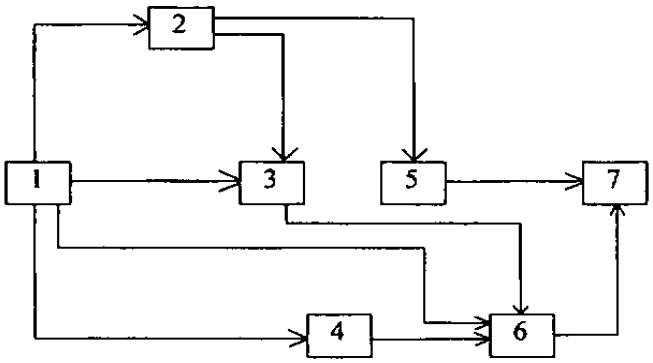
(b) 262 m^3

(c) 270 m^3

(d) 282 m^3

(Contd.)

107.



How many links are deletable in the A-O-N network shown above ?

(a) None

(b) One

(c) Two

(d) Three

108. What is the duration by which the completion time of any activity can be delayed without affecting the start of any of the succeeding activities ?

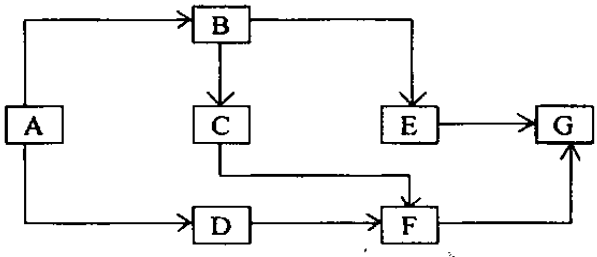
(a) Interfering float

(b) Free float

(c) Independent float

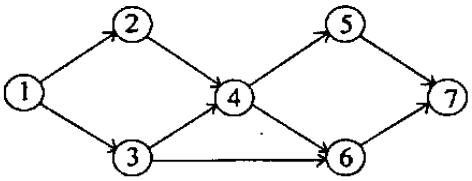
(d) Total float

109. Consider the accompanying A-O-N diagram :

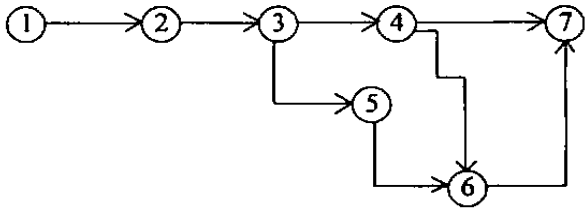


Which one of the following A-O-A diagrams correctly represents this A-O-N diagram ?

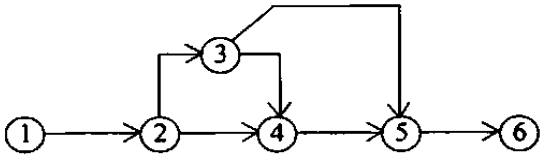
(a)



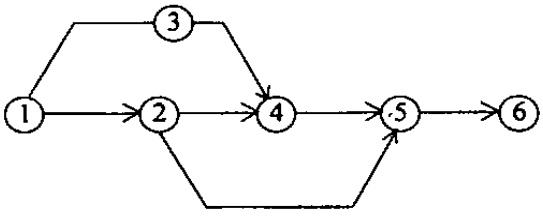
(b)



(c)



(d)



(Contd.)

110. Match List-I with List-II and select the correct answer using the code given below the lists :

List-I (Equipment)	*List-II (Category)*
A. Derrick crane	1. Excavating equipment
B. Hoe	2. Hauling equipment
C. Clamshell	3. Hoisting equipment
D. Dumper Truck	4. Vertical lifting equipment

Code :

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

111. Which one of the following is associated with a critical activity in a A-O-A network ?

(a) Maximum float

(b) Minimum float

(c) Zero float

(d) Free float

112. A uniform series of income is available in perpetuity, which will yield an amount of Rs. 4,000/- at the end of each 4-year period. Sinking fund (deposit) factor, @ 8% p.a., for discrete compounding, is 0·222. For the same interest rate, what will be the capitalized equivalent income 'now' ?

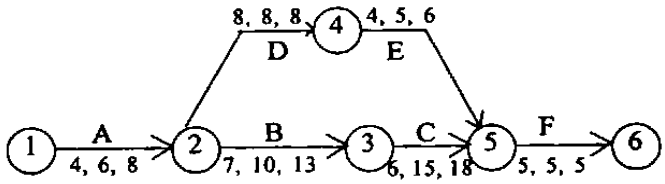
(a) Rs. 11,100

(b) Rs. 12,500

(c) Rs. 14,285

(d) Rs. 16,000

113.



What is the porportional variation; and what is : the 'range' of project duration : the network as shown with the indicated probabilistic a, m, b durations of the respective activities ?

(a) $\frac{1}{15}$, 28 to 42

(b) $\frac{1}{15}$, 30 to 45

(c) $\frac{1}{12}$, 28 to 42

(d) $\frac{1}{12}$, 30 to 45

(Contd.)

114. Which one of the following relates to determination of critical path in PERT ?

(a) Event oriented slack

(b) Activity oriented float

(c) Event oriented float

(d) Activity oriented slack

Directions :—

Each of the next **Six (06)** items consists of two statements, one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the codes given below :

Codes :

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

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

(c) A is true but R is false

(d) A is false but R is true

115. Assertion (A) : The rate of hydration is faster in finer cements.

Reason (R) : The surface area finer cement is more in case of finer cement.

116. Assertion (A) : Strength of concrete is reduced due to segregation.

Reason (R) : Reducing the workability of concrete mix results in segregation.

117. Assertion (A) : The lower the difference between the minimum strength and the mean strength of a concrete mix, the lower the cement content to be used.

Reason (R) : The method for controlling the difference between the minimum strength and the mean strength is quality control.

118. Assertion (A) : Shearing force may be defined as the rate of change of loading moment.

Reason (R) : Shearing force at a section is the algebraic sum of the forces to the left of the section.

119. Assertion (A) : The provision of lateral reinforcement in RCC columns is not mandatory.

Reason (R) : The lateral reinforcement in RCC columns helps in preventing possible bulking of longitudinal reinforcement.

120. Assertion (A) : Method of moment distribution is classifiable as a force method.

Reason (R) : The method consists of computing end moments due to end rotation of the member.

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