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

TEST BOOKLET
CIVIL ENGINEERING
Paper—I

A

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.

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

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) $\dfrac{1}{125}$ Nmm/mm³

    (b) 125 mm³/Nmm

    (c) $\dfrac{1}{100}$ Nmm/mm³

    (d) 100 mm³/Nmm

13. What is the ratio of flexural strength (f_{cr}) to the characteristic compressive strength of concrete (f_{ck}) 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/mm³ and E = 2×10^5 N/mm². What will be the total elongation of the bar in mm ?

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

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

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

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

(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) $\dfrac{E}{2}$
    (b) $\dfrac{E}{3}$
    (c) $\dfrac{E}{4}$
    (d) $\dfrac{E}{5}$

21. At a point in a piece of stressed material the stresses are :
    $$\sigma_X = \alpha \, kN/m^2 \text{ tensile (normal)}$$
    $$\tau_{XY} = \tau_{YX} = \beta \, kN/m^2 \text{ (shearing).}$$
    Although the values of α and β are not known yet the principal stresses are equal to each other being (5 kN/m²). What is the radius of Mohr's circle ?
    (a) $2·5 + (\alpha + \beta)$
    (b) $2·5 + \dfrac{(\alpha + \beta)}{2}$
    (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) $\dfrac{D^2 + d^2}{8d}$
    (b) $\dfrac{D^2 - d^2}{8d}$
    (c) $\dfrac{D^2 + d^2}{4d}$
    (d) $\dfrac{D^2 - d^2}{4d}$

4

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). $E = 2 \times 10^5$ N/mm², $\mu = 0.3$, 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.

$\sigma_y = 21$ MN/m²
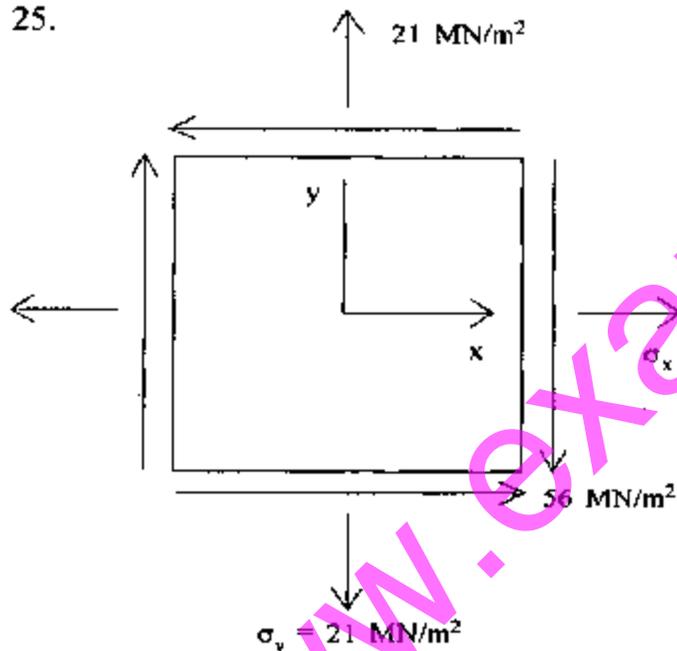
Figure shows a state of plane stress. If the minimum principal stress is – 7 MN/m² then what is the value of σ_x ?

   (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 $\mu = 0.25$; 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

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 :

$$\sigma_{top} = 200 \ \text{N/mm}^2$$

$$\sigma_{bottom} = 50 \ \text{N/mm}^2$$

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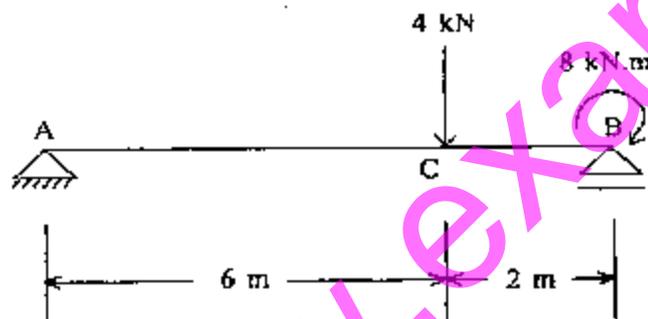
A simply supported beam AB is loaded as shown in the figure above. What is the SF in kN in the portion AC of the beam ?

(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) $\dfrac{4}{EI}$

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

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

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

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

6

32.
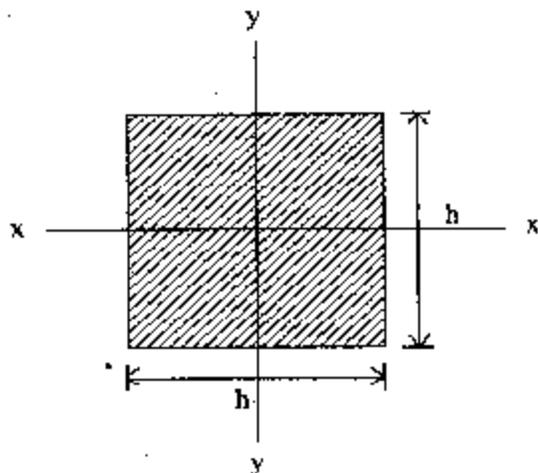
A square section as shown in the figure above is subjected to bending moment M. What is the maximum bending stress ?

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

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

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

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

33. A 40 mm diameter shaft is subjected to a twisting moment M_t. If shear stress developed in shaft is 5 N/mm², 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/mm² and the modulus of rigidity of the shaft material is 0.8×10^5 N/mm². What is the radius of the shaft ?

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

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

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

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

35.
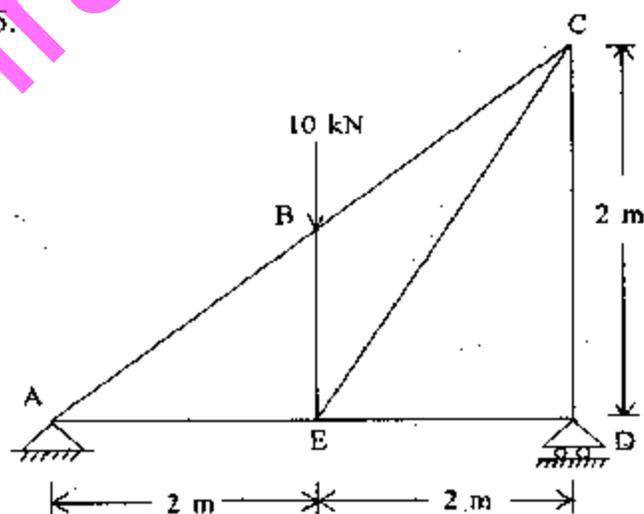
The above figure shows a pin-jointed frame. What are the forces in members BE, CD and ED ?

(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. $E = 2 \times 10^5$ N/mm². What is the extension of the rod in mm ?

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

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

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

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

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.

30 kN

A Hinge B   C   D

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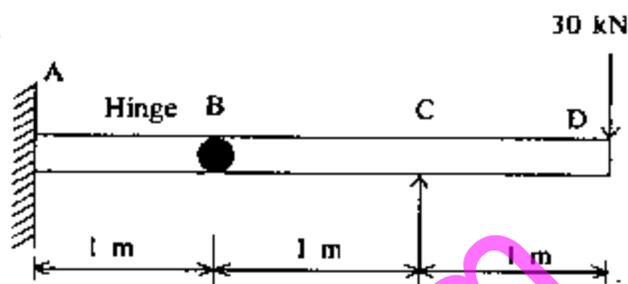
Which one of the following is the correct bending moment diagram for a propped cantilever beam shown in figure above ?

(a) 30 kNm ... A B C D ... 30 kNm

(b) 15 kNm ... A B C D ... 30 kNm

(c) 15 kNm ... A B C D ... 30 kNm

(d) 30 kNm ... A B C D ... 15 kNm

(Contd.)
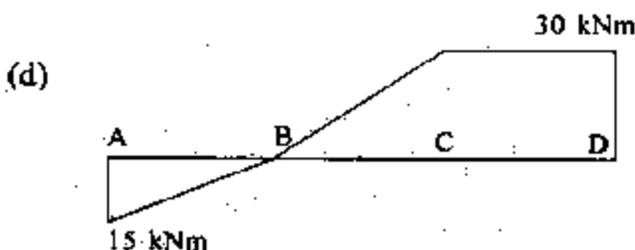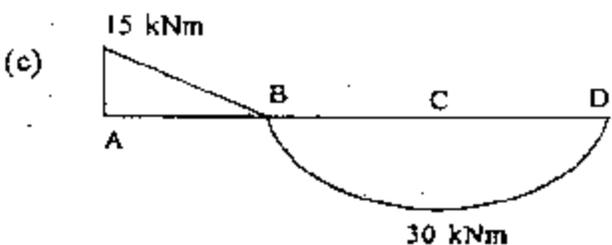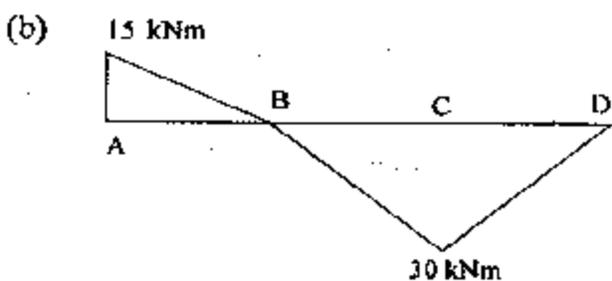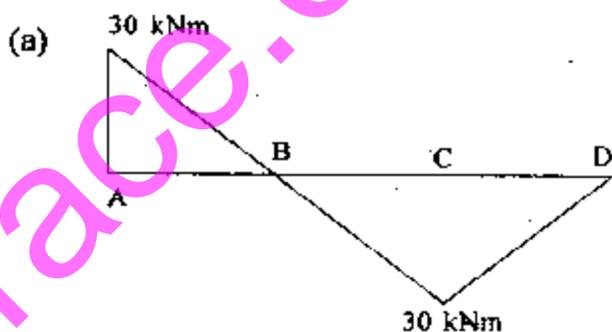
39.
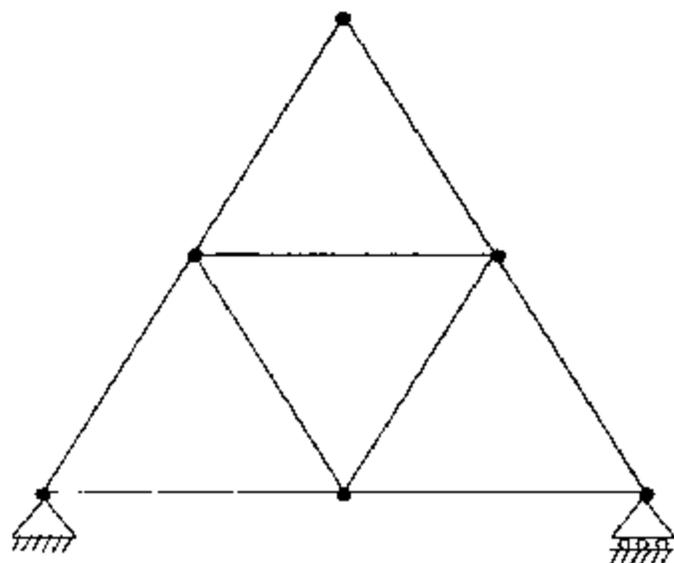
Consider the following statements with respect to the above figure of a typical articulated frame :

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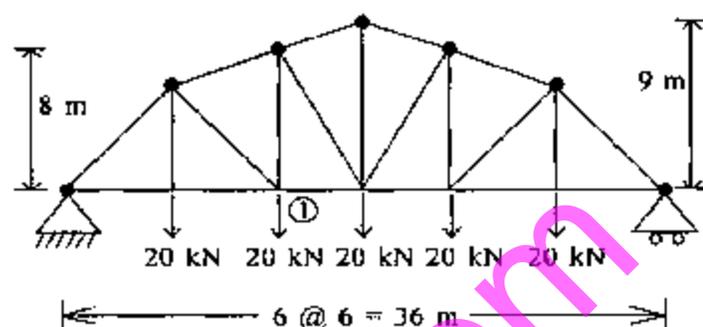
What is the force in member 1 for the structure shown in figure above ?

(a) 30 kN

(b) 60 kN

(c) 75 kN

(d) 80 kN

41.
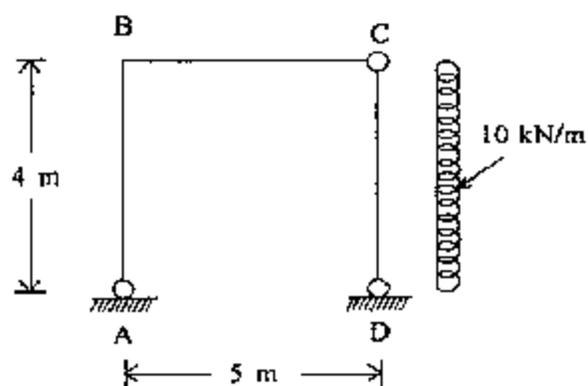
What is the value of vertical reaction at A for the frame shown in figure above ?

(a) 0

(b) 10 kN

(c) 16 kN

(d) 20 kN

42.
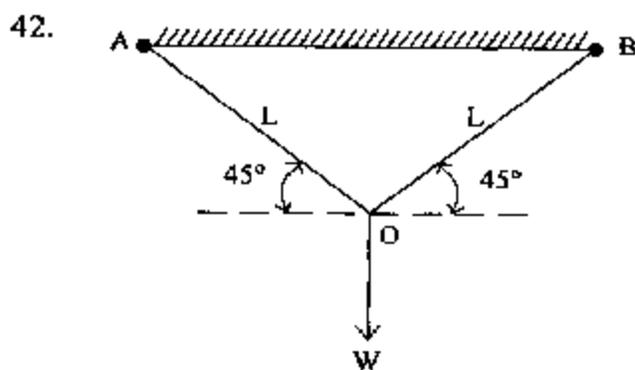
Two bars AO and BO are of uniform area 'A' and are hinged at O. What is the vertical deflection at O when elastic modulus is uniformly E ?

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

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

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

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

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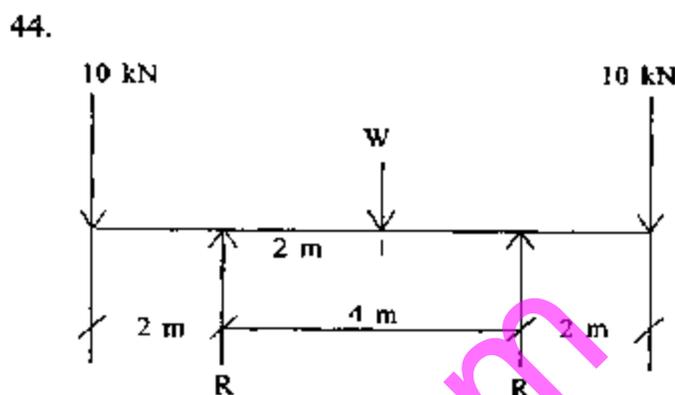
A beam of uniform flexural rigidity supports a set of loads as shown in figure above. What is the value of W if the magnitudes of bending moment at midspan and at support of the beam are numerically equal ?

(a) 20 kN

(b) 40 kN

(c) 60 kN

(d) 80 kN

45.
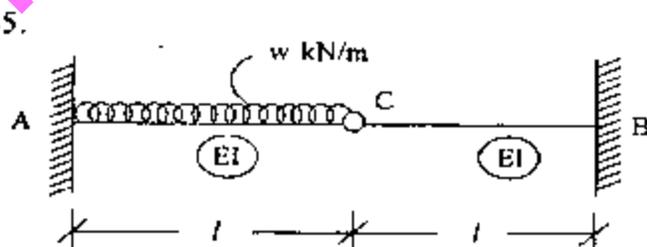
What is the reaction on the pin C for a beam as shown in the figure above ?

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

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

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

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

46.
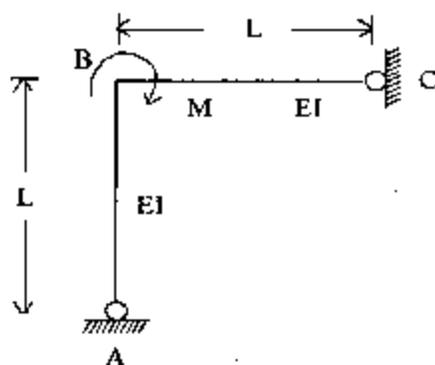
What is the rotation of the member at C for a frame as shown in figure above ?

(a) $\dfrac{ML}{3\,EI}$

(b) $\dfrac{ML}{4\,EI}$

(c) $\dfrac{ML}{6\,EI}$

(d) $\dfrac{ML}{12\,EI}$

47.
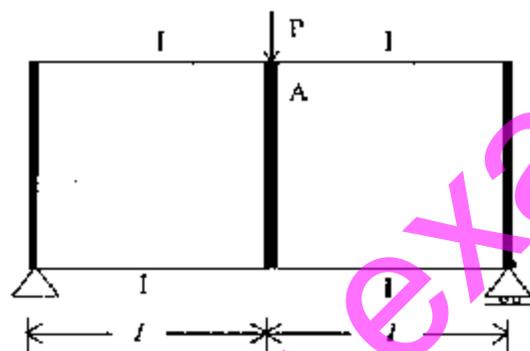
What is the moment at A for a frame as shown in figure above ? Each member indicated in dark lines has very large moment of inertia.

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

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

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

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

48.
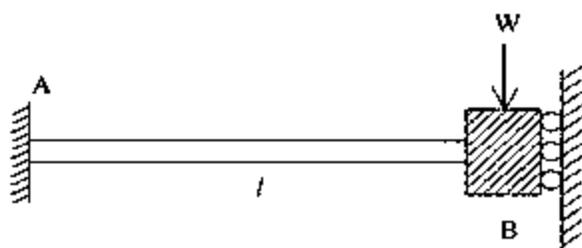
What is the bending moment at the end B for the guided beam as shown in the figure above considering the beam to be held rigidly at B against rotation and to support a load W ?

(a) Zero

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

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

(d) Wl

49.
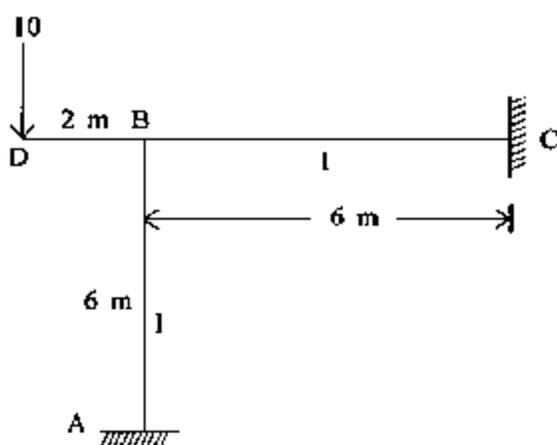
What is the value of θ_B for the beam shown in figure above ?

(a) Zero

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

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

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

11

(Contd.)

50.
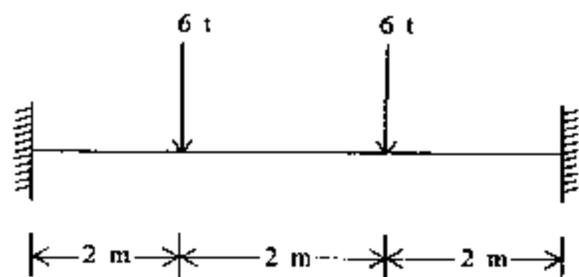
A beam of uniform section fixed at both ends and of span 6 m is acted upon by two concentrated loads of 6 t each as shown in figure above. What is the fixed end moment at each end ?

(a) 6 tm

(b) 8 tm

(c) 10 tm

(d) 12 tm

51.

B   C
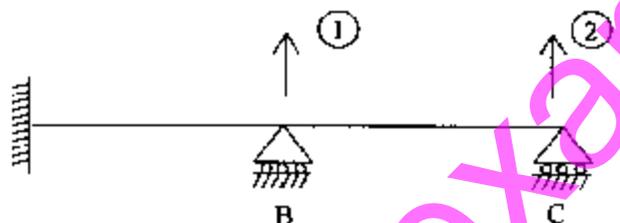
Flexibility matrix of the beam shown above is :

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

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

(a) $0.75\,\Delta$

(b) $3.0\,\Delta$

(c) $6.0\,\Delta$

(d) $24.0\,\Delta$

52.
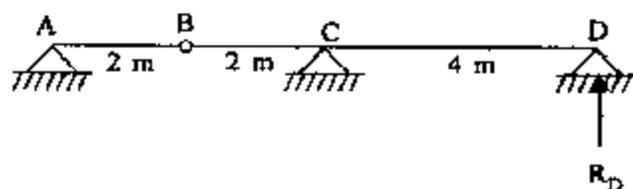
What is the ordinate of influence line at **B** for reaction R_D in above figure ?

(a) 0.5

(b) 0.4

(c) 0.2

(d) Zero

53.
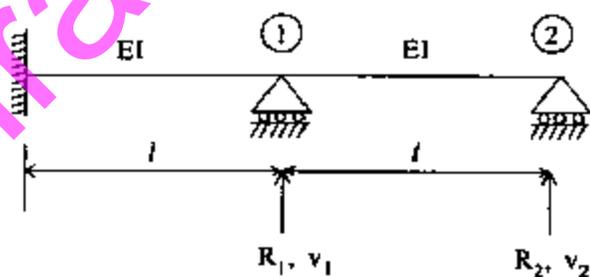
What is the value of flexibility coefficient f_{12} for the continuous beam shown in figure above ?

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

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

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

(d) $\dfrac{l^3}{1.2\,EI}$

(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) $\dfrac{L}{8}$

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

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

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

55.
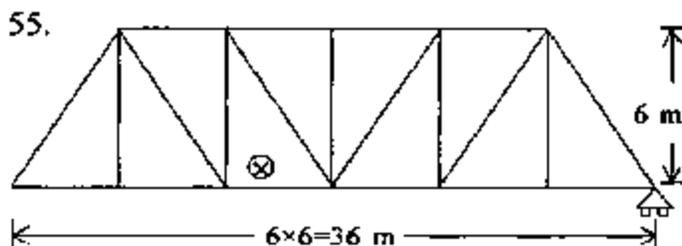
What is the maximum ordinate for influence line for the force in the member marked X ?

(a) 1·0

(b) 1·33

(c) 1·50

(d) 2·50

56.
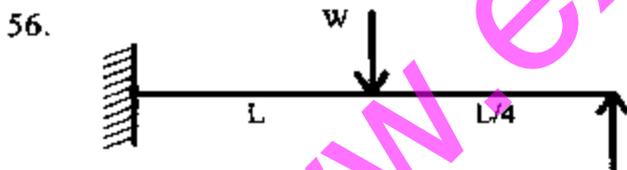
A propped cantilever beam of uniform moment capacity M_0 is shown in figure above. What is the collapse load W ?

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

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

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

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

57.
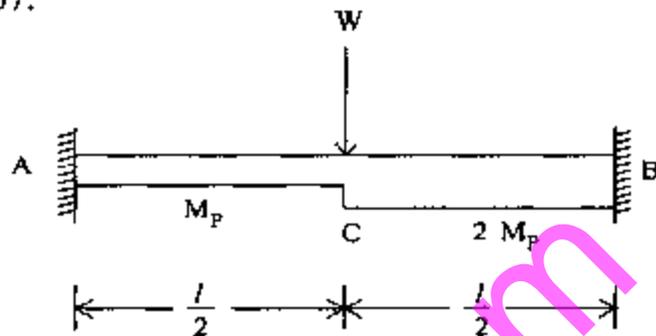
What is the collapse load in terms of M_p and l for the beam shown in figure above ?

(a) $\dfrac{M_p}{l}$

(b) $\dfrac{5M_p}{l}$

(c) $\dfrac{10M_p}{l}$

(d) $\dfrac{20M_p}{l}$

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) $\dfrac{4}{3}$ S

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

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

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

(Contd.)

59.
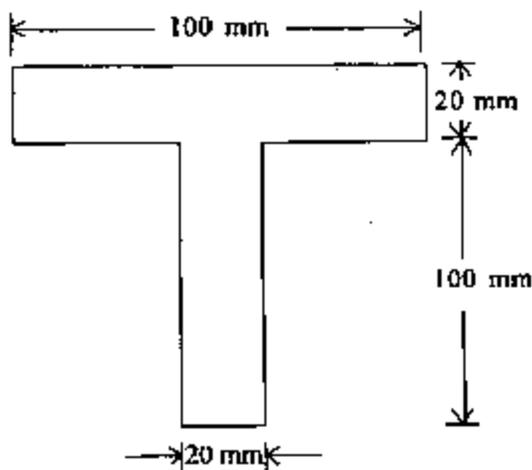
What is the distance between elastic neutral axis and plastic neutral axis for the cross-section as shown in figure above ?

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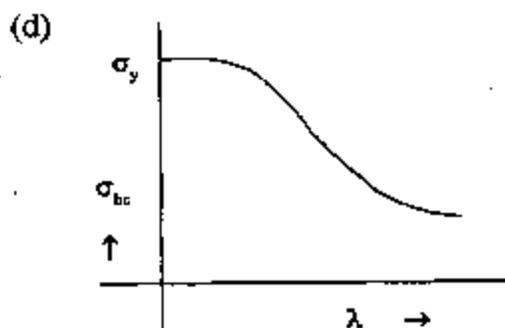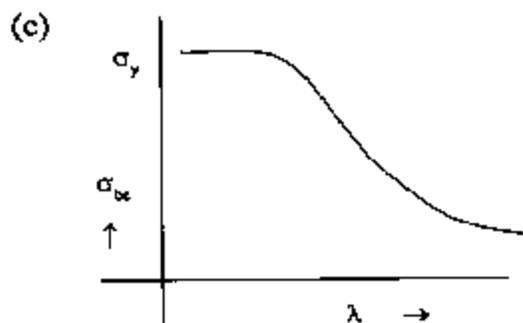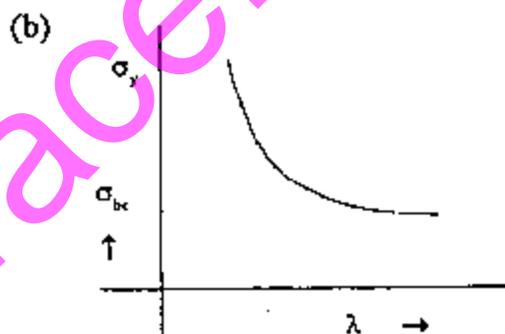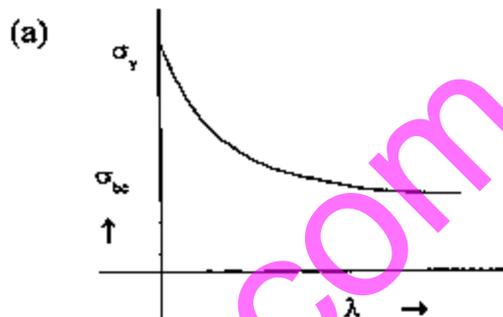
62. A steel plate is 300 mm wide and 10 mm thick. A rivet of nominal diameter of 16 mm is driven into it. What is the net sectional area of the plate ?

   (a) 2600 mm²

   (b) 2760 mm²

   (c) 2830 mm²

   (d) 2840 mm²

63.
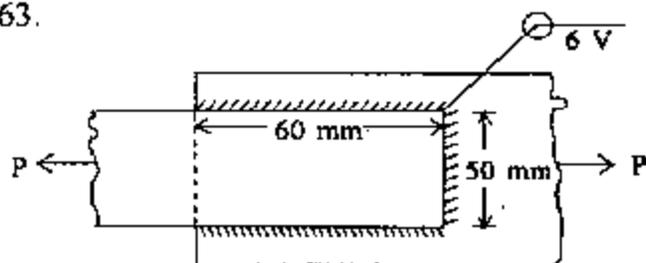
What is the safe load P that can be transmitted by the fillet-welded joint shown in figure above if the safe allowable shear stress in the fillet-weld is 108 MPa ?

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

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

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

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

(Contd.)

68. An ISMB 300 beam has modulus of section of 600×10^3 mm³. 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 mm³

    (b) 550×10^3 mm³

    (c) 710×10^3 mm³

    (d) 1220×10^3 mm³

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 [$\gamma_x = 40$ mm, $\gamma_y - 15$ mm]
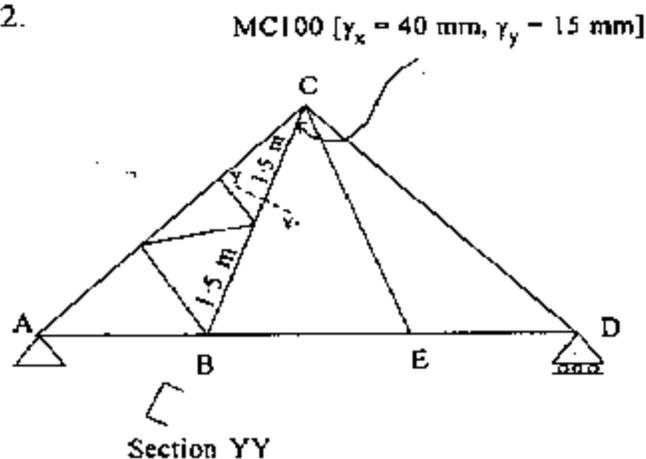
Section YY

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) $\dfrac{L}{3}$

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

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

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

74.
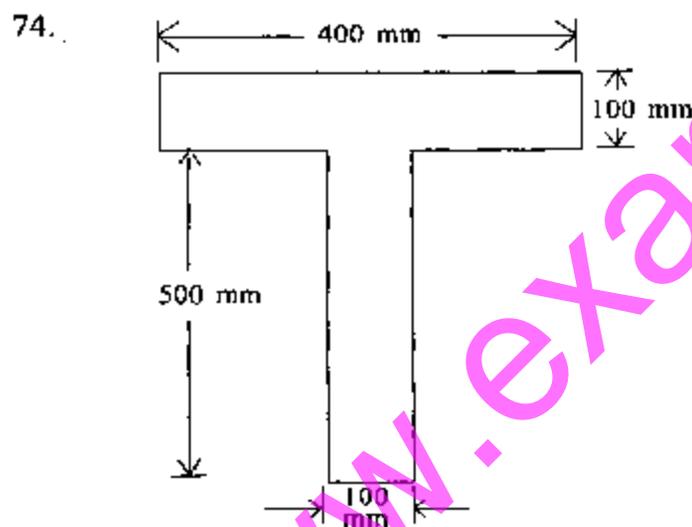
In a T-section shown in figure above, what is the distance of plastic neutral axis as measured down from top ?

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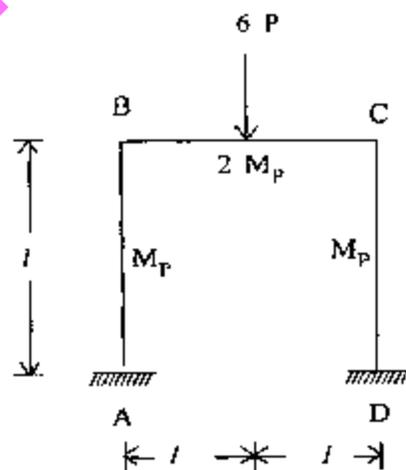
At the point of collapse, what is the value of horizontal thrust at point A in the loaded frame shown in figure ?

(a) 3 P

(b) 2 P

(c) 1·5 P

(d) P

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.
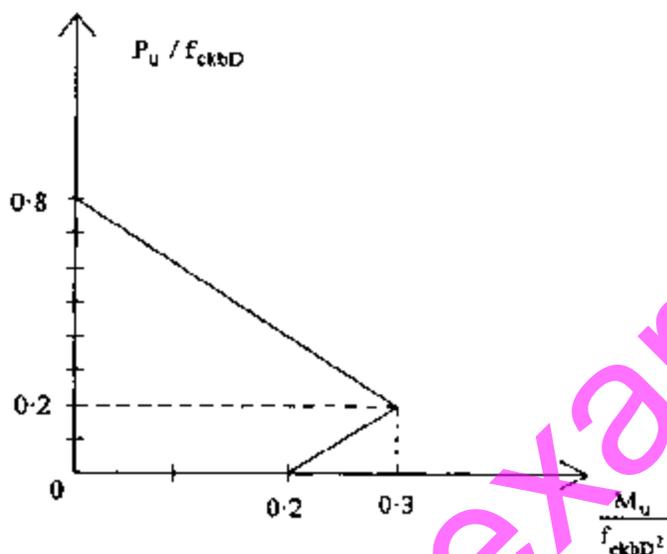
A RC column of square cross-section (400×400 mm^2) has its column load-moment interaction diagram as shown in figure above. What is the maximum uniaxial eccentricity at which a factored load $P_u = 640$ kN can be applied safely? (Take $f_{ck} = 20$ MPa)

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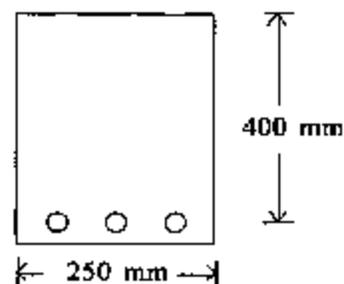
A simply supported RC beam having clear span 5 m and support width 300 mm has the cross-section as shown in figure. What is the effective span of the beam as per IS456?

(a) 5300 mm

(b) 5400 mm

(c) 5200 mm

(d) 5150 mm

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

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.	$\dfrac{V_U}{bd}$	1.	Modulus of rupture
B.	$0.7\sqrt{f_{CK}}$	2.	Development length
C.	$5000\sqrt{f_{CK}}$	3.	Nominal shear stress
D.	$\dfrac{\phi f_s}{4\tau_B}$	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.

30 kN/m (including self weight)

e = 200 mm

P = 1000 kN

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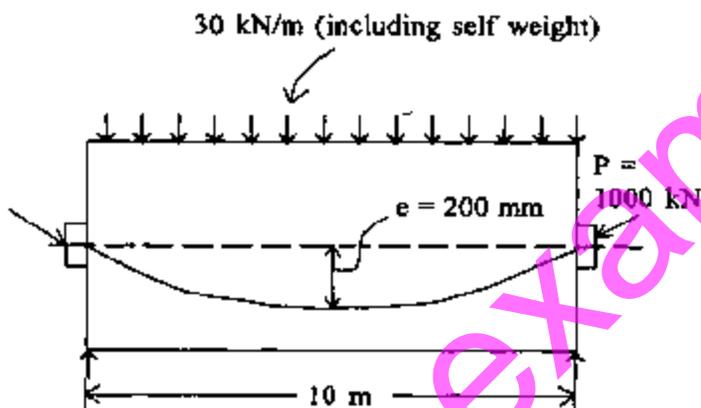
What is the net downward load to be considered for the analysis of the prestressed concrete beam provided with a parabolic cable as shown in the figure ?

(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

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 m³ 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.
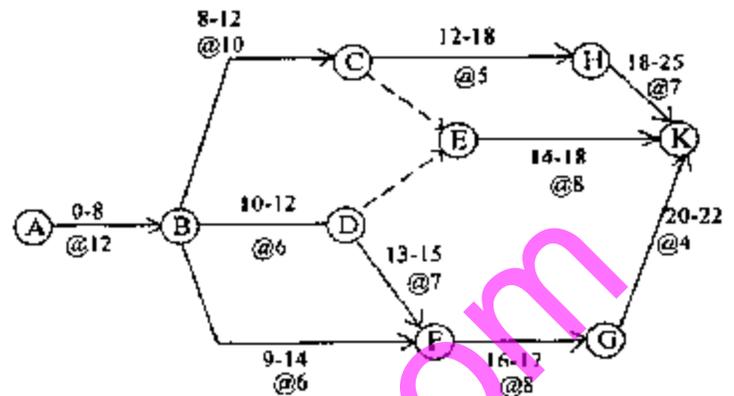
The scheduled durations, by the convention 'after/at the end of indicated day number' and the cost per day of duration, of each activity are shown in the network above. What are the costs incurred on day numbers 13 and 17 ?

(a) 14 and 20

(b) 11 and 18

(c) 14 and 21

(d) 11 and 21

106. A 1·6 m³ 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 m³

(b) 262 m³

(c) 270 m³

(d) 282 m³

107.
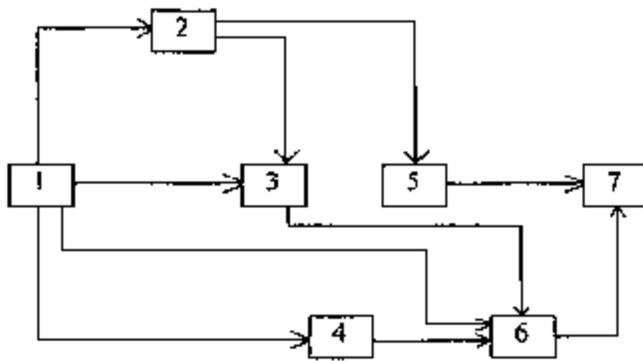
How many links are deletable in the A-O-N network shown above ?

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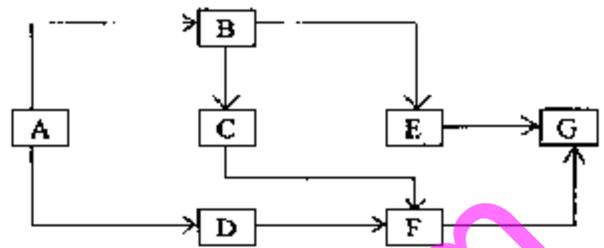
Which one of the following A-O-A diagrams correctly represents this A-O-N diagram ?

(a)

(b)

(c)

(d)

24
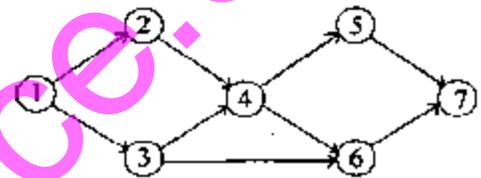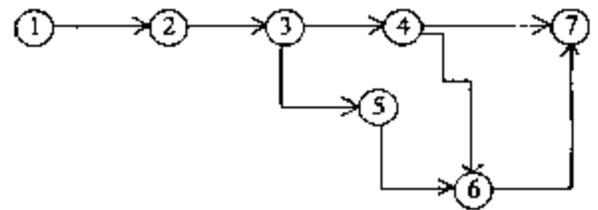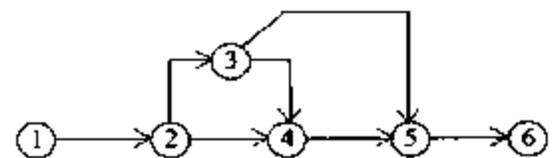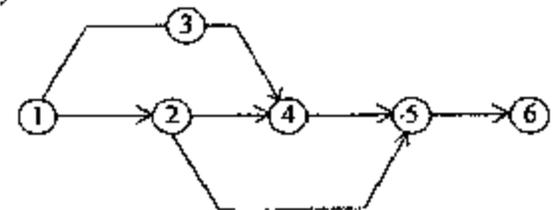
110. Match List-I with List-II and select the correct answer using the code given below the lists :

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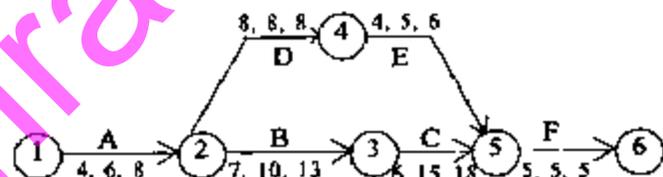
What is the porportional variation; and what is : the 'range' of project duration : the network as shown with the indicated probabilistic a, m, b durations of the respective activities ?

(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.

26

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

T.B.C. : O–FTF–J–DFB

Test Booklet Series

Serial No. 16357

TEST BOOKLET

A

CIVIL ENGINEERING

Paper—II

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 responses 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.

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

1.

Consider the above figure relating to buoyancy in water. What will be the downward force upon the top of the body *ABCDEF* ?

(a) The weight of the liquid column *ABCHG*

(b) The weight of the liquid column *DEFGH*

(c) The weight of the liquid column *ABCHG* – the weight of the liquid column *DEFGH*

(d) The weight of the liquid column *ABCHG* + the weight of the liquid column *DEFGH*

2. Consider the following statements in respect of two-dimensional incompressible flow with velocity components u and v in x and y directions respectively :

1. The continuity equation is $\dfrac{\partial u}{\partial x} = \dfrac{\partial v}{\partial y}$

2. The acceleration in x-direction is $a_x = \dfrac{\partial u}{\partial t} + u\dfrac{\partial u}{\partial x} + v\dfrac{\partial u}{\partial y}$

3. The condition of irrotationality is $\dfrac{\partial u}{\partial y} = \dfrac{\partial v}{\partial x}$

4. The equation of a streamline is $u\,dy = -v\,dx$

Which of the above statements are correct?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1, 2 and 3

(d) 3 and 4

3. Consider the following

1. Force on pipe bends and transitions

2. Jet propulsion

3. Flow velocities in open channel

4. Vortex flow

Which of the above admit employing the moment of momentum equation?

(a) 1 and 2 only

(b) 1, 2 and 3

(c) 1 and 3 only

(d) 2, 3 and 4

4. Consider the following statements :

1. Shear stress is maximum at the centre line.

2. Maximum velocity is 3/2 times the average velocity.

3. Discharge varies inversely with the coefficient of viscosity.

4. Slope of hydraulic gradient line increases linearly with the velocity of flow.

Which of the above statements are correct in connection with a steady laminar flow through a circular pipe?

(a) 1, 3 and 4

(b) 3 and 4 only

(c) 1 and 3 only

(d) 2 and 4

5. Consider the following statements :

Cavitation generally results from a combination of several influences

1. by reduction of pressure intensity below a limiting value
2. by increase in either elevation or the velocity of flow
3. by reduction of pressure load in the system
4. by decrease in the velocity of flow

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 and 4

6. Consider the following factors :

1. The change in the shape and size of the channel cross-section
2. The change in the slope of the channel
3. The presence of obstruction
4. The change in the frictional forces at the boundaries

Which of the above factors would cause a gradually varied flow?

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 2 and 4 only

(d) 3 and 4 only

7. The power transmitted through a pipeline is maximum when the head lost due to friction in the pipe is equal to

(a) the total supply head

(b) half of the total supply head

(c) one-third of the total supply head

(d) one-fourth of the total supply head

8. Consider the following with respect to the application of the Navier-Stokes equations :

1. Laminar flow in circular pipes
2. Laminar flow between concentric rotating cylinders
3. Laminar unidirectional flow between stationary parallel plates
4. Laminar unidirectional flow between parallel plates having relative motion

Which of the above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

9. In a siphon system employed for carrying water from a reservoir A at a higher elevation to another reservoir B at lower elevation, both being separated by a higher hill, what will be the pressure at the 'Summit' (S)?

(a) Equal to the pressure at the water surface of reservoir A

(b) Higher than the pressure at the water surface of reservoir A

(c) Equal to the pressure at the water surface of reservoir B

(d) Less than the pressure at both A and B above

10. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I	List–II
A. Rehbock formula	1. Sutro weir
B. Francis formula	2. Rectangular suppressed weir
C. A special trapezoidal weir	3. Rectangular side-contracted weir
D. Linear proportional weir	4. Cippolletti weir

Code :

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

11. While selecting a centrifugal pump for your requirement of head and discharge on the basis of its performance characteristics, which one of the following criteria is to be adopted?

(a) Head, discharge and efficiency

(b) Head and discharge only

(c) Discharge only

(d) Head only

12. Consider the following statements :

The function of the impeller in a centrifugal pump is to

1. convert the pressure energy into hydraulic energy

2. convert the hydraulic energy into mechanical energy

3. convert the mechanical energy into hydraulic energy

4. transform most of the kinetic energies to pressure energy

Which of the above statements is/are correct?

(a) 1 only

(b) 3 only

(c) 1, 2 and 3

(d) 2, 3 and 4

13. A centrifugal pump gives maximum efficiency when its impeller blades are

   (a) bent forward

   (b) bent backward

   (c) straight

   (d) wave-shaped

14. Match List–I with List–II and select the correct answer using the code given below the Lists :

   List–I
   (Component)

   List–II
   (Function)

   A. Spiral casing

   1. To allow flow of water through it to produce a torque for the rotation of the runner

   B. Stay ring

   2. To direct the water on the runner at an appropriate angle

   C. Guide vane

   3. To distribute the flow over the periphery of the runner

   D. Runner

   4. To act as column helping to support the electrical generator above the turbine

   Code :

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

15. By which one of the following, a small quantity of water may be lifted to a great height?

   (a) Hydraulic ram

   (b) Hydraulic crane

   (c) Hydraulic lift

   (d) Hydraulic coupling

16. What is 'Hydrological Cycle'?

   (a) Processes involved in the transfer of moisture from sea to land

   (b) Processes involved in the transfer of moisture from sea back to sea again

   (c) Processes involved in the transfer of water from snowmelt in mountains to sea

   (d) Processes involved in the transfer of moisture from sea to land and back to sea again

17. Consider the following with respect to a 'double-mass curve' :

   1. Plot of accumulated rainfall with respect to two chrono-logical orders

   2. Plot for estimating multiple missing rainfall data

   3. Plot for checking the consistency of the rainfall data

   4. Plot of accumulated annual rainfall of a station vs. accumulated rainfall of a group of stations

   Which of the above are correct?

   (a) 1 and 3

   (b) 2 and 3

   (c) 3 and 4

   (d) 1 and 4

18. Generally to estimate PMP, $P_m = 42 \cdot 16 D^{0 \cdot 475}$ is used (P_m is maximum depth of precipitation, D = duration). What are the units of P_m and D in the equation?

(a) mm, sec

(b) cm, sec

(c) mm, hr

(d) cm, hr

19. A triangular direct runoff hydrograph due to a storm has a time base of 60 hr and a peak flow of $30 \, \text{m}^3/\text{s}$ occurring at 20 hr from the start. If the catchment area is $300 \, \text{km}^2$, what is the rainfall excess in the storm?

(a) 50 mm

(b) 20 mm

(c) 10·8 mm

(d) 8·3 mm

20. A 3 hr unit hydrograph U_1 of a catchment of area $235 \, \text{km}^2$ is in the form of a triangle with peak discharge $30 \, \text{m}^3/\text{s}$. Another 3 hr unit hydrograph U_2 is also triangular in shape and has the same base width as U_1, but has a peak flow of $90 \, \text{m}^3/\text{s}$. What is the catchment area of U_2?

(a) 117·5 km^2

(b) 235 km^2

(c) 470 km^2

(d) 705 km^2

21. Consider the following chemical emulsions :

1. Methyl alcohol

2. Cetyl alcohol

3. Stearyl alcohol

4. Kerosene

Which of the above chemical emulsions is/are used to minimize the loss of water through the process of evaporation?

(a) 1 only

(b) 1 and 4

(c) 2 and 4

(d) 2 and 3

22. A catchment area of 60 ha has a runoff coefficient of 0·40. If a storm of intensity 3 cm/h and duration longer than the time of concentration occurs in the catchment, then what is the peak discharge?

(a) 2·0 m^3/s

(b) 3·5 m^3/s

(c) 4·5 m^3/s

(d) 2·5 m^3/s

23. The land use of an area and the corresponding runoff coefficients are as follows :

Sl No.	Land use	Area (ha)	Runoff coefficient
1.	Roads	10	0·70
2.	Lawn	20	0·10
3.	Residential area	50	0·30
4.	Industrial area	20	0·80

What is the equivalent runoff coefficient?

(a) 0·15

(b) 0·36

(c) 0·40

(d) 0·51

24. The head on a sharp-crested rectangular weir of height 1·6 m and crest length 1·2 m was incorrectly observed to be 0·13 m when it was actually 0·15 m. What was the percentage error in the computed value of flow rate?

(a) 0·5%

(b) 1·0%

(c) 2·0%

(d) 1·5%

25. Consider the following with respect to measurement of stream flow during flood :

1. Timing of the travel of floats released in the stream

2. Use of weir formula for spillways provided on a dam

3. Calculation of flow through a contracted opening at a bridge

4. Using a current meter

Which of the above is/are reliable and accurate?

(a) 1

(b) 4 only

(c) 3 and 4

(d) 2 and 3

26. Under which one of the following categories is the river Ganga classified in the reach through UP and Bihar?

(a) Straight river

(b) Meandering river

(c) Braided river

(d) Deltaic river

27. Which of the following categories best describes the Hirakud reservoir?

    (a) Reservoir for irrigation and power

    (b) Reservoir for flood control, power and irrigation

    (c) Reservoir for irrigation and water supply

    (d) Reservoir for recreation and fishery

28. During a particular stage of the growth of a crop, consumptive use of water is 2·8 mm/day. If the amount of water available in the soil is 25% of 80 mm depth of water, what is the frequency of irrigation?

    (a) 9 days

    (b) 13 days

    (c) 21 days

    (d) 25 days

29. Consider the following statements :

Irrigation water has to be supplied to the crops when the moisture level falls

    1. below field capacity

    2. to wilting point

    3. below wilting point

Which of the above statements is/are correct?

    (a) 1

    (b) 2 only

    (c) 3 only

    (d) 2 and 3

30. A groundwater basin consists of $10 \, km^2$ area of plains. The maximum groundwater table fluctuation has been observed to be 1·5 m. Consider specific yield of the basin as 10%. What is the available groundwater storage in million cubic metres?

    (a) 1·0

    (b) 1·5

    (c) 2·5

    (d) 2·0

31. In a canal irrigation project, 76% of the culturable command area (CCA) remained without water during Kharif season; and 58% of CCA remained without water during Rabi season in a particular year. Rest of the areas got irrigated in each crop respectively. What is the intensity of irrigation for the project in that year?

(a) 134%

(b) 76%

(c) 66%

(d) 58%

32. What is the critical combination of vertical and horizontal earthquake accelerations to be considered for checking the stability of a gravity dam in reservoir full condition?

(a) Vertically upward and horizontally downstream

(b) Vertically upward and horizontally upstream

(c) Vertically downward and horizontally upstream

(d) Vertically downward and horizontally downstream

33. What is the height of wave which is likely to be generated by a wind of 80 km/hr in a reservoir having a fetch of 50 km?

(a) 0·5 m

(b) 1·0 m

(c) 2·0 m

(d) 3·0 m

34. Consider the following statements :

1. Giving equal weightages to horizontal and vertical creeps for design of weir foundations is one of the drawbacks of Kennedy's theory.

2. Khosla's theory of design of foundations for weirs is based on potential theory.

3. Piping problem can be reduced by increasing the length of floor.

4. In Lane's weighted creep theory, horizontal creep is given less weightage compared to vertical creep.

Which of the above statements is/are correct?

(a) 1

(b) 2, 3 and 4

(c) 2 and 4 only

(d) 3 and 4 only

35. Consider the following statements related to undersluices provided in diversion weirs on permeable foundations :

1. They are fully gate-controlled and have crest at the same level as the weir crest when no silt excluders are provided.

2. They scour the silt deposited on the river bed in the pockets upstream of the canal head regulator.

3. It is not necessary to provide end pile line on the downstream end of the undersluice floor.

4. The discharge capacity of the undersluice is 10–15% of the maximum flood or two times the maximum discharge of the offtaking canal or maximum winter discharge, whichever is the highest.

Which of the above statements is/are correct?

(a) 1

(b) 2 and 4 only

(c) 2, 3 and 4

(d) 3 and 4 only

36. What is the most important design parameter used in designing a continuous flow rectangular sedimentation tank for removal of discrete particles?

(a) Length of the tank

(b) Surface overflow rate

(c) Depth of the tank

(d) Temperature of the water to be treated

37. Effluent from a wastewater treatment plant (flow rate = $8640 \ m^3/d$, temperature = 25 °C) is discharged to a surface stream (flow rate = $1 \cdot 2 \ m^3/s$, temperature = 15 °C). What is the temperature of the stream after mixing?

(a) 10 °C

(b) 15·77 °C

(c) 20 °C

(d) 24·99 °C

38. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Type of impurity)	List–II (Harm caused)
A. Excess of nitrates	1. Brackish water
B. Excess of fluorides	2. Goiter
C. Lack of iodides	3. Fragile bones
D. Excess of chlorides	4. Blue babies

Code :

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

39. The concentration of OH⁻ ion in a water sample is measured as 17 mg/L at 25 °C. What is the pH of the water sample?

    (a) 10

    (b) 11

    (c) 12

    (d) 13

40. Which combination of surface water quality parameters will indicate sweep coagulation as the preferred mechanism of coagulation?

    (a) High turbidity—low alkalinity

    (b) High turbidity—high alkalinity

    (c) Low turbidity—high alkalinity

    (d) Low turbidity—low alkalinity

41. Which one of the following processes of water softening requires recarbonation?

    (a) Lime-soda ash process

    (b) Hydrogen-cation exchanger process

    (c) Sodium-cation exchanger process

    (d) Demineralization

42. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Water/Wastewater treatment)	List–II (Operating problem)
A. Trickling filter	1. Negative head
B. Activated sludge process	2. Fly-breeding
C. Rapid gravity filter	3. Sludge bulking
D. Anaerobic sludge digester	4. pH reduction

    Code :

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

43. Consider the following treatment process units in a water treatment plant :

1. Coagulation
2. Disinfection
3. Sedimentation
4. Filtration

Which is the correct sequence of the process units in the water treatment plant?

    (a) 2–4–3–1

    (b) 1–4–3–2

    (c) 2–3–4–1

    (d) 1–3–4–2

44. Which one of the following tests of water/wastewater employs Erichrome Black T as an indicator?

   (a) Hardness

   (b) COD

   (c) Residual chlorine

   (d) DO

45. Which of the following pollutants are generally **not** removed in a sewage treatment plant?

   (a) Inorganic suspended solids

   (b) Dissolved organic solids

   (c) Oil and grease

   (d) Dissolved inorganic solids

46. What is the theoretical oxygen demand of 300 mg/L glucose solution?

   (a) 300 mg/L

   (b) 320 mg/L

   (c) 350 mg/L

   (d) 400 mg/L

47. Which one of the following types of samples is relevantly employed for the design of wastewater treatment plant?

   (a) Grab sample

   (b) Composite sample

   (c) Integrated sample

   (d) Any sample

48. A drain carrying sewage of BOD = 200 mg/L and flow rate of $50 \, m^3/s$ joins a river whose upstream BOD is 8 mg/L and flow rate is $500 \, m^3/s$. Assume immediate and complete mixing of drain with the river. What is the estimated downstream BOD of the river flow?

   (a) 20·4 mg/L

   (b) 25·4 mg/L

   (c) 104·4 mg/L

   (d) 70·4 mg/L

49. A 12·5 mL sample of treated wastewater requires 187·5 mL of odor-free distilled water to reduce the odor to a level that is just perceptible. What is the threshold odor number (TON) for the wastewater sample?

   (a) 0·07

   (b) 1·07

   (c) 15

   (d) 16

50. Which one of the following parameters is *not* included in the routine characterization of solid waste for its physical composition?

   (a) Moisture content

   (b) Density

   (c) Particle size analysis

   (d) Energy value

51. Which one of the following toxic gases has physiological action as asphyxiant?

   (a) SO_2

   (b) NO_2

   (c) Cl_2

   (d) CO

52. Assuming annual travel for each vehicle to be 20000 km, what is the quantity of NO_x produced from 50000 vehicles with emission rate of 2·0 g/km/vehicle?

   (a) 1800 tonnes

   (b) 1900 tonnes

   (c) 2000 tonnes

   (d) 2100 tonnes

53. What are the air pollutants responsible for acid rain within and downwind areas of major industrial emissions?

   (a) Hydrogen sulfide and oxides of nitrogen

   (b) Sulfur dioxide and oxides of nitrogen

   (c) Carbon dioxide and hydrogen sulfide

   (d) Methane and hydrogen sulfide

54. Consider the following air pollutants :

   1. NO_x
   2. PAN
   3. CO_2
   4. CO

   Which of the above air pollutants is/are present in an auto exhaust gas?

   (a) 1 only

   (b) 1 and 2

   (c) 2 and 3

   (d) 1, 3 and 4

55. Consider the following properties for clays X and Y :

Sl. No.	Properties	Clay X (%)	Clay Y (%)
1.	Liquid limit	42	56
2.	Plastic limit	20	34
3.	Natural water content	30	50

Which of the clays, X or Y, experiences larger settlement under identical loads; is more plastic; and is softer in consistency?

(a) X, Y and X

(b) Y, X and X

(c) Y, X and Y

(d) X, X and Y

56. A clay sample, originally 26 mm thick at a void ratio of 1·22, was subjected to a compressive load. After the clay sample was completely consolidated, its thickness was measured to be 24 mm. What is the final void ratio?

(a) 1·322

(b) 1·421

(c) 1·311

(d) 1·050

57. For a sandy soil with soil grains spherical in shape and uniform in size, what is the theoretical void ratio?

(a) 0·61

(b) 0·71

(c) 0·91

(d) 0·81

58. A soil has liquid limit = 35, plastic limit = 20, shrinkage limit = 10 and natural moisture content = 25%. What will be its liquidity index, plasticity index and shrinkage index?

(a) 0·67, 15 and 25

(b) 0·33, 15 and 10

(c) 0·67, 25 and 15

(d) 0·33, 20 and 15

59. A cohesive soil yields a maximum dry density of 16 kN/m^3 during a standard Proctor Compaction test. If the specific gravity is 2·65, what would be its void ratio?

(a) 0·552

(b) 0·624

(c) 0·712

(d) 0·583

60. Consider the following :

1. Increase in shear strength and bearing capacity

2. Increase in slope stability

3. Decrease in settlement of soil

4. Decrease in permeability

Which of the above with respect to compaction of soil is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2, 3 and 4

61. For a sheet pile wall constructed in a soil having effective grain size = 0·1 mm, the difference of the upstream and downstream water levels is 3 m. If the flow net drawn for the problem yields 2 as the ratio of number of head drops to number of flow channels, then what is the discharge in unit of $m^3/s/m$ length of sheet pile wall?

(a) $3·0 \times 10^{-4}$

(b) $3·0 \times 10^{-2}$

(c) $1·5 \times 10^{-4}$

(d) $1·5 \times 10^{-2}$

62. Consider the following statements :

1. Quicksand is a special variety of sand.

2. Quicksand is not a material but a hydraulic condition.

3. In nature, quicksand condition is observed usually in coarse silt or fine sand.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

63. In a 6 m thick stratum of fine sand having submerged density of $11 \ kN/m^3$, quicksand condition occurred at a depth of 4·2 m of excavation. What is the depth of lowering of groundwater table required for making an excavation 5 m deep? Take density of water as $10 \ kN/m^3$.

(a) 3·85 m   (b) 1·68 m

(c) 1·1 m   (d) 0·897 m

64. Consider the following statements :

1. Permeability of a soil decreases as the effective stress acting on the soil increases.

2. The presence of organic matter in the soil increases its permeability.

3. Entrapped air decreases the permeability of a soil.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

65. A 1 m thick layer of saturated clay, drained at both faces, settles by 10 cm in one year. If a thin layer of pervious soil is introduced in the middle of this layer, then what will be the period during which the settlement of 10 cm will be completed?

(a) 4 years

(b) 0·5 year

(c) 0·25 year

(d) 2 years

66. Which one of the following conditions is valid in case of unconfined compression test in comparison to triaxial test?

(a) Minor principal stress = 0

(b) Minor principal stress = 0·5 × major principal stress

(c) Minor principal stress = major principal stress

(d) Major principal stress = 3 × minor principal stress

67. In an unconfined compression test on stiff clay, if the failure plane made an angle of 52° to the horizontal, what would be the angle of shearing resistance?

(a) 16°   (b) 14°

(c) 12°   (d) 13°

68. On which of the following soils is the standard penetration test useful?

1. Cohesionless soils
2. Medium clays
3. Gravelly soils
4. Very stiff clays

Select the correct answer using the code given below :

Code :

(a) 1 only

(b) 1 and 3

(c) 1 and 2

(d) 3 and 4

69. Consider the following statements :

1. Standard penetration test (SPT) is conducted by pushing a cone into soil at the rate of 2 cm/s.
2. Standard penetration test results are unreliable in deposits containing large number of boulders.
3. Dutch cone is a static penetrometer.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 3 only

70. What is the intensity of active earth pressure at a depth of 10·0 m in dry sand with an angle of shearing resistance of 30° and unit weight of 18 kN/m^3?

(a) 50 kN/m^3

(b) 60 kN/m^3

(c) 70 kN/m^3

(d) 80 kN/m^3

71. When a vertical face excavation was made in a clayey silt, having density of 20 kN/m^3, it failed at a depth of excavation of 4 m. What is the cohesive strength (in kN/m^2) of the soil, if its angle of internal friction was 30°?

(a) 23·1   (b) 20·0

(c) 11·6   (d) 10·2

72. If an SPT test gave the average blow count of 32 in fine sand below water table, then what is the corrected value of blow count?

(a) 22·1   (b) 23·5

(c) 24·2   (d) 24·8

73. Consider the following statements :

1. The soil obtained from wash boring is a representative sample.
2. Recovery ratio will be high during drilling in sound rock.
3. Hollow stem augers are sometimes used to drill holes in silty sand.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 3 only

74. The standard penetration resistance value obtained in a deep deposit of sand at a depth of 6·0 m was 28. The unit weight of sand is 18·0 kN/m^3. What is the corrected value of number of blows for overburden pressure?

  (a) 60   (b) 57

  (c) 59   (d) 55

75. The net ultimate bearing capacity of a purely cohesive soil

  (a) depends on the width of the footing and is independent of the depth of the footing

  (b) depends on the width as well as the depth of the footing

  (c) depends on the depth, but is independent of the width, of the footing

  (d) is independent of both the width and the depth of the footing

76. A soil has a low allowable bearing capacity. The soil deposit contains compressible loess. A foundation is to be provided for a structure carrying a heavy load. Which one of the following foundation types is to be adopted?

  (a) Strap footing

  (b) Continuous footing

  (c) Raft foundation

  (d) Combined spread foundation

77. Consider the following statements :
Increasing width of footing results in

  1. increase in settlement of a consolidating clay layer

  2. increase in bearing capacity of sandy soils

  3. decrease in bearing capacity of clays

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

78. Consider the following statements with respect to an anchored sheet pile wall :

  1. Failure occurs due to bulging.

  2. Failure occurs due to rotation.

  3. Large yield is observed above the anchor rod.

  4. Large yield is observed below the anchor rod and above the dredge line.

Which of the above statements is/are correct?

  (a) 1 only

  (b) 2 and 3

  (c) 1 and 4

  (d) 3 and 4

79. Consider the following statements :

  1. Underreamed piles are precast piles with one or more underreams in each pile.

  2. The ratio of pile shaft size to bulb size in an underreamed pile may be 0·33 to 0·50.

  3. In a multibulb underreamed pile, the load-carrying capacity is a function of the area of cross-section of the lowest bulb.

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

80. Consider the following statements :

1. Underreamed piles are designed as bearing piles.
2. In multiple-bulb underreamed piles, the bulbs are spaced at 1·5 to 2·0 times the diameter of the underream, the centre of the first underream being at a minimum depth of 1·75 m.
3. The length of traditional underreamed pile ranges from 3 m to 4 m.

Which of the above statements is/are correct?

(a) 2 and 3

(b) 1 and 2

(c) 2 only

(d) 1 and 3

81. Consider the following clay minerals :

1. Kaolinite
2. Montmorillonite
3. Illite

What is the correct sequence in an increasing order of their plasticity index?

(a) 1–2–3

(b) 3–2–1

(c) 1–3–2

(d) 3–1–2

82. Which one of the following conditions requires geodetic surveying?

(a) Horizontal curve ranging

(b) Vertical curve ranging

(c) Survey of a country

(d) Reconnaissance survey

83. Which of the following coordinate systems is the most convenient way to specify the position of the star on celestial sphere?

(a) Latitude and longitude

(b) Altitude and azimuth

(c) Declination and right ascension

(d) Declination and hour angle

84. Consider the following equipments :

1. Tacheometer
2. Odometer
3. Passometer
4. Perambulator

Which of the above equipments can be employed for measurement of horizontal distance?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2, 3 and 4

85. Consider the following statements :

In surveying operations, the word 'reciprocal' can be associated with

1. ranging
2. levelling
3. contouring

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

86. Which of the following sights will be applicable for a change point?

(a) Back sight

(b) Intermediate sight and fore sight

(c) Fore sight

(d) Back sight and fore sight

87. The whole circle bearings of lines *OP* and *OQ* are 18°15' and 335°45' respectively. What is the value of the included angle *QOP*?

(a) 307°30'

(b) 42°30'

(c) 354°00'

(d) 177°00'

88. Which one of the following linear methods of setting out a circular curve needs reference of the centre of the curve?

(a) Offset from chord produced

(b) Radial offset

(c) Perpendicular offset

(d) Successive bisection of arcs

89. Consider the following statements :

Reciprocal levelling is a method of levelling adopted when

1. the difference of levels between two points at a considerable distance apart is to be determined with great precision

2. it is not possible to set up the level midway between two points as in the case of a deep valley or a river

3. error due to improper centering of level is to be eliminated

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

90. Consider the following statements :

Errors eliminated by taking both face observations are those due to

1. horizontal axis not being perpendicular to the vertical axis

2. non-parallelism of the axis of telescope level and line of collimation

3. imperfect adjustment of vertical circle vernier

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

91. If everyone of the three angles of a triangle has a probable error of ± 1″, then what will be the probable error in the sum of the so-measured internal angles of the triangle?

(a) ± 1″

(b) ± 3″

(c) ± 9″

(d) ± √3″

92. How many sidereal days are there in a solar year?

(a) 365·2840

(b) 366·2422

(c) 360·2500

(d) 365·0000

93. Consider the following statements :

A sidereal year can be defined as the time interval

1. between two successive transits of the sun through the meridian of any of the fixed stars
2. between two successive vernal equinoxes
3. between two successive passages of the sun through perigee

Which of the above statements is/are correct?

(a) 3 only

(b) 1 and 2

(c) 2 and 3

(d) 1 only

94. Which one of the following methods of computing area assumes that the short lengths of the boundary between the ordinates are parabolic arcs?

(a) Average ordinate rule

(b) Middle ordinate rule

(c) Simpson's rule

(d) Trapezoidal rule

95. Which one of the following errors is more severe in plane-table surveying?

(a) Defective sighting

(b) Defective orientation

(c) Movement of board between sights

(d) Non-horizontality of board when points sighted are at large differences of their elevation

96. Which one of the following tests is performed in the laboratory to determine the extent of weathering of aggregates for roadworks?

(a) Soundness test

(b) Crushing test

(c) Impact test

(d) Abrasion test

97. Which one of the following geometric features requires the magnitudes of weaving angle and weaving distance for its design?

(a) Rotary design

(b) Right-angle intersection

(c) Roundabout

(d) Grade-separated junction

98. Which one of the following methods is used in the design of rigid pavements?

(a) CBR method

(b) Group index method

(c) Westergaard's method

(d) McLeod's method

99. In which one of the following yards, are reception, sorting and dispatch of railway wagons done?

(a) Loco yard

(b) Marshalling yard

(c) Goods yard

(d) Passenger yard

100. Which one of the following is **not** a desirable property of the subgrade soil as a highway material?

(a) Stability

(b) Ease of compaction

(c) Good drainage

(d) Bitumen adhesion

101. Hot bitumen is sprayed over freshly constructed bituminous surface followed by spreading of 6·3 mm coarse aggregates and rolled. Which one of the following is indicated by this type of construction?

(a) Surface dressing

(b) Gravel-bitumen mix

(c) Liquid seal coat

(d) Seal coat

102. Radius of relative stiffness of cement concrete pavement does **not** depend upon which one of the following?

(a) Modulus of subgrade reaction

(b) Wheel load

(c) Modulus of elasticity of cement concrete

(d) Poisson's ratio of concrete

103. For conditions obtaining in India, at which location in a cement concrete pavement will the combined stresses due to traffic wheel load and temperature have to be critically checked during design?

(a) Corner

(b) Corner and interior

(c) Corner and edge

(d) Corner, edge and interior

104. Which one of the following sets of factors is related to design of thickness rigid pavement by Westergaard method?

(a) CBR value and stiffness index of soil

(b) Deflection factor and traffic index

(c) Swelling index and bulk modulus

(d) Radius of relative stiffness and modulus of subgrade reaction

105. Consider the following in relation to group index of soil :

1. Liquid limit

2. Sandy loam

3. Plasticity index

4. Percent passing 75 microns sieve

Which of the above is/are used for estimating the group index?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1, 3 and 4

106. Which set of traffic studies is needed for functional design as well as for 'highway capacity' design?

(a) Origin and destination studies

(b) Parking and accident studies

(c) Speed and volume studies

(d) Axle load studies

107. Which one of the following traffic survey schemes is most relevant when deciding on locating major 'routes' in a city?

(a) Traffic volume survey

(b) Origin and destination survey

(c) Speed survey

(d) Traffic capacity survey

108. Which one of the following equipments is useful in determining spot speed in traffic engineering?

(a) Endoscope

(b) Periscope

(c) Radar

(d) Tachometer

Each of the following **twelve (12)** items consists of two statements, one labelled as '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 code given below :

Code :

(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

109. Assertion (A) :

If a cylindrical body is placed in a fluid stream and is rotated, then a lift force is produced on the body.

Reason (R) :

Rotation of the cylinder disturbs the symmetrical pattern which in turn alters the pressure distribution on the body.

110. Assertion (A) :

The drag force on a sphere is more in laminar flow than in turbulent flow.

Reason (R) :

C_D of a sphere is more in laminar flow than in turbulent flow.

111. Assertion (A) :

Total energy of flow decreases in the direction of flow.

Reason (R) :

The specific energy may decrease, increase or remain constant.

112. Assertion (A) :

For a hydraulically efficient channel, the hydraulic radius is equal to half the depth of flow.

Reason (R) :

A hydraulically efficient channel has the minimum perimeter for a given area of flow.

113. Assertion (A) :

The rate of biomass production will be always lower than the rate of food utilization in a biological system having a mixed culture of microorganism.

Reason (R) :

Catabolism converts part of the food into waste products.

114. Assertion (A) :

The solution of a three-point problem in plane-table surveying is aided by Lehmann's rules.

Reason (R) :

The application of Lehmann's rules reduces the triangle of error and is a controlled trial-and-error technique.

115. Assertion (A) :

Remote sensing is mostly quantitative in nature.

Reason (R) :

Remote sensing involves the subjective interpretation of the imagery.

116. Assertion (A) :

In water-bound macadam construction, grade I has better load dispersion characteristics as compared to grade III aggregates.

Reason (R) :

The plasticity index of the binding material should be less than 6%.

117. Assertion (A) :

Dowel bars are provided at expansion joints and sometimes also at contraction joints in cement concrete slabs.

Reason (R) :

Longitudinal joints in cement concrete pavements are constructed with tie bars.

118. Assertion (A) :

When a turnout is taken off from a curved track, it is called gauntlet track.

Reason (R) :

When a turnout from a curved track turns away in the opposite direction, the curves are said to be of contrary flexure.

119. Assertion (A) :

In case of airports, the innermost portion of approach zone, where any obstruction is to be critically viewed, is known as the clear zone.

Reason (R) :

The area of airport, other than the approach zone, which is used for turning of aircrafts, is called the turning zone.

120. Assertion (A) :

Helipads are usually located in close proximity to traffic-generating areas.

Reason (R) :

A helicopter cannot ascend or descend exactly vertically.

IES 2009 Solutions
Civil Engineering (Paper-I)

Q. No.	A	B	C	D
1.	c	c		a
2.	b	b		d
3.	b	c		c
4.	d	d		d
5.	a	b		a
6.		d		a
7.	c	d		b
8.	c	a		☐
9.	c	c		☐
10.	d	b		a
11.	c	c		☐
12.	a	c		b
13.	c	b		d
14.	b	b		d
15.	c	a		☐
16.	d	d		c
17.	c	a		b
18.	b	c		b
19.	d	b		c
20.	b	d		b
21.	c	b		c
22.	b	a		b
23.	c	d		a
24.	d	c		
25.	d	b		a
26.				c
27.	d	c		d
28.	b	a		b
29.	c	d		d
30.	b	a		d

Q. No.	A	B	C	D
31.	c	c		c
32.	b	c		b
33.	c	c		b
34.	d	b		d
35.	b	a		a
36.	d	b		c
37.	d	b		c
38.	a	d		c
39.	c	a		c
40.	b	d		d
41.	c	c		c
42.	c	☐		c
43.	b	a		d
44.	b	b		c
45.	a	d		d
46.	d	d		d
47.	c	b		c
48.	b	c		b
49.	b	c		d
50.	d	b		b
51.	b	d		c
52.	a	a		b
53.	d	a		c
54.	c	d		a
55.	b	b		d
56.	c	c		d
57.	c	d		d
58.	a	c		b
59.	d	b		c
60.	a	d		b

Q. No.	A	B	C	D
61.	c	a		c
62.	c	d		b
63.	c	c		b
64.	b	d		d
65.	a	a		d
66.	b	a		d
67.	d	c		d
68.	d	☐		a
69.	a	c		c
70.	d	a		b
71.	c	☐		c
72.	c	b		c
73.	a	d		b
74.	b	d		b
75.	d	☐		a
76.	d	c		d
77.	b	b		a
78.	c	b		c
79.	c	c		b
80.	b	b		d
81.	d	c		b
82.	a	☐		a
83.	a	a		d
84.	d	a		c
85.	b	a		b
86.	c	c		c
87.	d	d		c
88.	c	b		a
89.	b	d		d
90.	d	d		a

Q. No.	A	B	C	D
91.	a	c		c
92.	d	b		c
93.	c	b		c
94.	d	d		b
95.	a	e		d
96.	a	☐		b
97.	b	c		b
98.	☐	c		d
99.	☐	c		a
100.	a	d		d
101.	☐	c		c
102.	b	a		
103.	d	c		a
104.	d	b		b
105.	☐	c		d
106.	c	d		d
107.	b	c		b
108.	b	b		c
109.	c	d		c
110.	b	b		b
111.	c	c		d
112.	☐	b		a
113.	a	c		a
114.	a	d		d
115.	a	d		b
116.	c	d		c
117.	d	d		d
118.	b	b		c
119.	d	c		b
120.	d	b		d

IES 2009 Solutions
Civil Engineering (Paper-II)

Q. No.	A	B	C	D
1.	a	c		d
2.	a	d		b
3.	d	c		b
4.	b	b		c
5.	b	b		b
6.	a	b		d
7.	c	b		a
8.	d	c		c
9.	d	b		b
10.	d	b		d
11.	a	a		a
12.	b	b		b
13.	b	d		d
14.	c	a		a
15.	a	d		a
16.	d	b		a
17.	c	a		b
18.	d	b		a
19.	c	d		a
20.	d	d		d
21.	d	d		b
22.	a	c		d
23.	c	b		a
24.	c	d		a
25.	b	c		d
26.	a	b		a
27.	b	c		b
28.	c	b		d
29.	a	b		b
30.	b	d		d

Q. No.	A	B	C	D
31.	c	c		a
32.	d	c		a
33.	c	□		d
34.	b	d		b
35.	b	c		b
36.	b	a		a
37.	b	b		c
38.	c	a		d
39.	b	c		d
40.	b	b		d
41.	a	c		d
42.	b	b		a
43.	d	c		a
44.	a	d		a
45.	d	c		d
46.	b	c		d
47.	b	c		c
48.	b	c		d
49.	c	c		c
50.	d	d		d
51.	d	c		d
52.	c	c		a
53.	b	b		c
54.	d	d		g
55.	c	b		b
56.	d	d		b
57.	c	b		b
58.	b	b		c
59.	b	b		a
60.	d	a		b

Q. No.	A	B	C	D
61.	c	d		c
62.	c	b		d
63.	□	b		c
64.	d	c		c
65.	c	b		c
66.	a	c		b
67.	b	b		b
68.	a	c		c
69.	b	b		b
70.	b	d		b
71.	c	a		a
72.	b	b		b
73.	c	d		d
74.	d	d		a
75.	d	d		d
76.	c	a		b
77.	b	b		a
78.	c	a		b
79.	c	a		d
80.	d	d		d
81.	c	b		d
82.	c	a		c
83.	b	a		b
84.	d	a		d
85.	b	d		c
86.	d	d		d
87.	b	b		c
88.	b	d		b
89.	b	b		b
90.	a	d		d

Q. No.	A	B	C	D
91.	d	a		c
92.	b	a		c
93.	b	d		c
94.	c	b		d
95.	b	b		c
96.	d	a		a
97.	a	c		b
98.	c	d		a
99.	b	d		c
100.	d	d		b
101.	a	a		c
102.	b	b		b
103.	d	b		c
104.	d	c		d
105.	d	a		d
106.	a	d		c
107.	b	c		b
108.	a	d		c
109.	a	c		c
110.	d	d		d
111.	b	d		c
112.	a	a		c
113.	a	c		c
114.	a	c		d
115.	d	b		b
116.	d	b		d
117.	b	b		b
118.	d	c		b
119.	b	a		b
120.	d	b		a