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**T.B.C. : VBY-S-CVL**

10786921

Serial

**Test Booklet Series**

## A

# TEST BOOKLET

# CIVIL ENGINEERING

*Time Allowed : Three Hours*                                    *Maximum Marks : 300*

## 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. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.

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 **150** 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.**

    (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. Which of the following statements are wholly correct regarding broken-brick aggregate useable in concretes ?

    1.   Broken-brick aggregate is obtained by crushing waste bricks; and it has a density varying between $1000 \text{ kg/m}^3 - 1200 \text{ kg/m}^3$.

    2.   Such aggregate is usable in concrete for foundation in light buildings, floorings and walkways.

    3.   Such aggregate may also be used in light-weight reinforced concrete floors.

    (a)   1 and 2 only

    (b)   2 and 3 only

    (c)   1 and 3 only

    (d)   1, 2 and 3

2. In handling air-entraining admixtures the beneficial amount of entrained air depends upon certain factors like

    1.   Type and quantity of air-entraining agent

    2.   Water-cement ratio of the mix

    3.   Strength of aggregates

    4.   Extent of compaction of concrete

    (a)   1, 2 and 3 only

    (b)   1, 2 and 4 only

    (c)   1, 3 and 4 only

    (d)   1, 2, 3 and 4

3. Which one of the following statements is *not* correct with respect to fly ash ?

    (a)   As part replacement of cement in the range of 15% – 30%, fly ash reduces the strength in the initial period, but once the Pozzolanic process sets in, higher strength can be obtained.

    (b)   Fly ash as a part replacement of sand has a beneficial effect on strength even at early age.

    (c)   Fly ash as a part replacement of sand is economical.

    (d)   A simultaneous replacement of cement and fine aggregates enables the strength at a specified age to be equalled depending upon the water content.

4. Which one of the following statements is *not* correct with respect to the properties of cement ?

    (a)   Highly reactive Pozzolanas enhance the early age strength of the composite cement.

    (b)   Pozzolanic activity refines pore structure which decreases electrolytic resistance of concrete.

    (c)   The expansion due to alkali-silica reaction can be controlled by replacement of as high as 60% of OPC with high-calcium Pozzolana.

    (d)   Such high amounts of replacement cements result in higher accelerated carbonation depths compared to pure use of OPC only.

5. Hydration of which compound is responsible for increase in strength of cement in later age ?

    (a)   Tri-calcium Aluminate ($C_3A$)

    (b)   Tetra-calcium Aluminoferrite ($C_4AF$)

    (c)   Tri-calcium Silicate ($C_3S$)

    (d)   Di-calcium Silicate ($C_2S$)

6. The creep strain of cement attains its terminal value by

    (a)   1 year

    (b)   2 years

    (c)   5 years

    (d)   6 months

7. Which of the following methods will help in reducing segregation in concrete ?

    1. Not using vibrator to spread the concrete

    2. Reducing the continued vibration

    3. Improving the cohesion of a lean dry mix through addition of a further small quantity of water

    (a) 1, 2 and 3

    (b) 1 and 2 only

    (c) 1 and 3 only

    (d) 2 and 3 only

8. On an average, in a 125 mm slump, the concrete may lose about (in first one hour)

    (a) 15 mm of slump

    (b) 25 mm of slump

    (c) 40 mm of slump

    (d) 50 mm of slump

9. Permeability in concrete is studied towards providing for, or guarding against, which of the following features ?

    1. The penetration by materials in solution may adversely affect the durability of concrete; moreover, aggressive liquids 'attack' the concrete.

    2. In case of reinforced concrete, ingress of moisture and air will result in corrosion of steel leading to an increase in volume of steel, resulting in cracking and spalling of the concrete cover.

    3. The moisture penetration depends on permeability and if the concrete can become saturated with water it is less vulnerable to frost action.

    (a) 1, 2 and 3

    (b) 1 and 2 only

    (c) 1 and 3 only

    (d) 2 and 3 only

10. Poisson's ratio of concrete $\mu$ can be determined using the formula

    (a) $\left(\dfrac{V}{2nL}\right) = \dfrac{(1-\mu)}{(1-2\mu)(1-\mu)}$

    (b) $\left(\dfrac{V}{2nL}\right) = \dfrac{(1+\mu)}{(1-2\mu)(1-\mu)}$

    (c) $\left(\dfrac{V^2}{2nL}\right) = \dfrac{(1-\mu)}{(1-2\mu)(1+\mu)}$

    (d) $\left(\dfrac{V^2}{2nL}\right) = \dfrac{(1-\mu^2)}{(1-2\mu)(1+\mu)}$

    where

    V is pulse velocity, in mm/s,

    n is resonant frequency of longitudinal vibration, in Hz,

    L is distance between transducers, in mm.

11. Which one of the following methods/techniques will be used for placing of concrete in dewatered 'Caissons or Coffer' dams ?

    (a) Tremie method

    (b) Placing in bags

    (c) Prepacked concrete

    (d) In-the-dry practice

12. The minimum cement content (kg/m³) for a pre-specified strength of concrete (using standard notations) premised on 'free water-cement ratio' will be as

    (a) $1 - \dfrac{C}{1000S_C} - \dfrac{W}{1000}$

    (b) $\dfrac{\text{Water Content}}{\text{Water Cement ratio}}$

    (c) Water Content × Water Cement ratio

    (d) $\dfrac{100\,F}{C-F}$

13. A bar specimen of 36 mm diameter is subjected to a pull of 90 kN during a tension test. The extension on a gauge length of 200 mm is measured to be 0·089 mm and the change in diameter to be 0·0046 mm. The Poisson's ratio will be

(a)   0·287

(b)   0·265

(c)   0·253

(d)   0·241

14. A steel rod 15 m long is at a temperature of 15°C. The values of $\alpha = 12 \times 10^{-6}$/°C and $E = 200$ GN/m$^2$ are adopted. When the temperature is raised to 65°C, what is the free expansion of the length; and if this expansion of the rod is fully prevented, what is the temperature stress produced ?

(a)   5 mm and 120 MN/m$^2$

(b)   9 mm and 120 MN/m$^2$

(c)   5 mm and 150 MN/m$^2$

(d)   9 mm and 150 MN/m$^2$

15. A bar of uniform rectangular section of area A is subjected to an axial tensile load P; its Young's modulus is E and its Poisson's ratio is $\frac{1}{m}$. Its volumetric strain $e_v$, is

(a)   $\frac{P}{AE}\left(1 + \frac{3}{m}\right)$

(b)   $\frac{P}{AE}\left(1 + \frac{2}{m}\right)$

(c)   $\frac{P}{AE}\left(1 - \frac{2}{m}\right)$

(d)   $\frac{P}{AE}\left(1 - \frac{1}{2m}\right)$

16. The normal stresses on two mutually perpendicular planes are 140 N/mm$^2$ (Tensile) and 70 N/mm$^2$ (Tensile). If the maximum shear stress is 45 N/mm$^2$, the shear stress on these planes will be nearly

(a)   20·9 N/mm$^2$

(h)   24·6 N/mm$^2$

(c)   28·3 N/mm$^2$

(d)   32·0 N/mm$^2$

17. The normal stresses on the two mutually perpendicular planes at a point are 120 MPa (Tensile) and 60 MPa (Tensile). If the shear stress across these planes is 30 MPa, the principal stresses will be nearly

(a)   124 MPa (Tensile) and 24 MPa (Compressive)

(b)   132 MPa (Tensile) and 24 MPa (Compressive)

(c)   124 MPa (Tensile) and 48 MPa (Tensile)

(d)   132 MPa (Tensile) and 48 MPa (Tensile)

18. At a point in a material, the stresses acting on two planes at right angles to each other are : $\sigma_x = 120$ MPa and $\sigma_y = -200$ MPa and $\tau_{xy} = -80$ MPa. The maximum shear stress on the element will be nearly

(a)   142 MPa

(b)   155 MPa

(c)   167 MPa

(d)   179 MPa

19. The principal stresses in the wall of a container are 40 MN/mm$^2$ and 80 MN/mm$^2$. The normal makes an angle of 30° with a direction of maximum principal stress. The resultant stresses (in magnitude) in the plane will be nearly
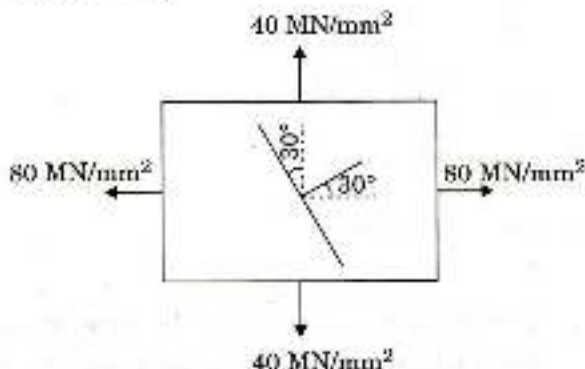


(a) 84 MN/mm$^2$

(b) 72 MN/mm$^2$

(c) 64 MN/mm$^2$

(d) 58 MN/mm$^2$

20. The change in shearing force between two points on the beam is equal to the area of

(a) Loading diagram between the two points

(b) Shear force diagram between the two points

(c) Bending moment diagram between the two points

(d) M/EI diagram between the two points

21. Which one of the following statements specifies shear flow ?

(a) Flow of shear force along the beam

(b) It is the product of the shear stress at any level and the corresponding width b (of the section)

(c) Unbalanced force on any side of given section divided by area of section

(d) The deformation at any level due to sudden variation in shear stress

22. Which one of the following statements is correct for the rotating shafts transmitting power ?

(a) Lower the frequency of shaft lower will be the torque

(b) Higher the frequency of shaft lower will be the torque

(c) Frequency of the shaft does not influence the torque

(d) Higher the frequency of shaft higher will be the torque

23. The maximum shear stress induced in a solid circular shaft of diameter 15 cm, when the shaft transmits 150 kW power at 180 rpm, will be

(a) 16 N/mm$^2$

(b) 14 N/mm$^2$

(c) 12 N/mm$^2$

(d) 10 N/mm$^2$

24. A closely coiled helical spring made of 10 mm diameter steel wire has 15 coils of 100 mm mean diameter. The spring is subjected to an axial load of 100 N. For a modulus of rigidity of $8.16 \times 10^4$ N/mm$^2$, the stiffness of the spring will be nearly

(a) 5·9 N/mm

(b) 6·8 N/mm

(c) 7·7 N/mm

(d) 8·8 N/mm

25. The shear-force diagram of a beam is shown in the figure.
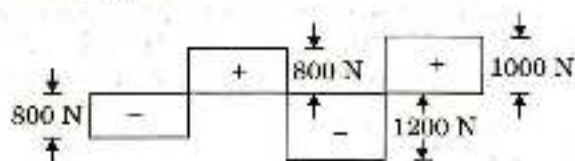


The total of the vertically downward loads on the beam is

(a) 2600 N

(b) 3000 N

(c) 3400 N

(d) 3800 N

26. A beam of triangular cross-section is subjected to a shear force of 50 kN. The base width of the section is 250 mm and the height is 200 mm. The beam is placed with its base horizontal. The shear stress at neutral axis will be nearly

(a) $2 \cdot 2 \text{ N/mm}^2$

(b) $2 \cdot 7 \text{ N/mm}^2$

(c) $3 \cdot 2 \text{ N/mm}^2$

(d) $3 \cdot 7 \text{ N/mm}^2$

27. A timber beam, 100 mm wide and 150 mm deep, supports a UDL over a span of 2 m. If the safe stresses are not to exceed 28 MPa in bending and 2 MPa in shear, the maximum load that the beam can support is

(a) 16 kN/m

(b) 20 kN/m

(c) 24 kN/m

(d) 28 kN/m

28. A 1·5 m long column has a circular cross-section of 50 mm diameter. Consider Rankine's formula with values of $f_c = 560 \text{ N/mm}^2$, $\alpha = \dfrac{1}{1600}$ for pinned ends and factor of safety of 3. If one end of the column is fixed and the other end is free, the safe load will be

(a) 9948 N

(b) 9906 N

(c) 9864 N

(d) 9822 N

29. A continuous beam with uniform flexural rigidity is shown in the figure.
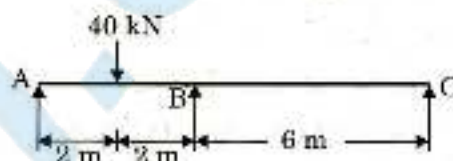


The moment at B is

(a) 18 kNm

(b) 16 kNm

(c) 14 kNm

(d) 12 kNm

30. The maximum shear stress across a circular section is

(a) $\left(\dfrac{4}{3}\right)$ Average shear stress

(b) $\left(\dfrac{3}{2}\right)$ Average shear stress

(c) $\left(\dfrac{5}{4}\right)$ Average shear stress

(d) $\left(\dfrac{9}{5}\right)$ Average shear stress

31. Which of the following statements are correct in respect of temperature effect on a load-carrying three-hinged arch ?

1. No stresses are produced in a three-hinged arch due to temperature change alone.
2. There is a decrease in horizontal thrust due to rise in temperature.
3. There is an increase in horizontal thrust due to rise in temperature.
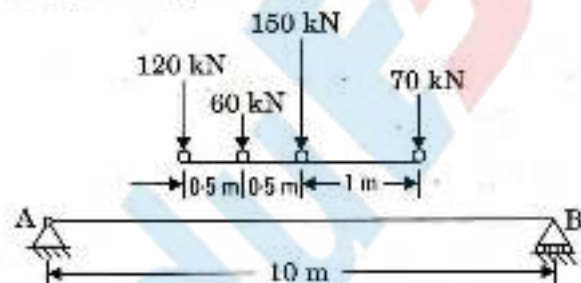
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 only
(d) 3 only

32. Consider the frame as shown in the figure.
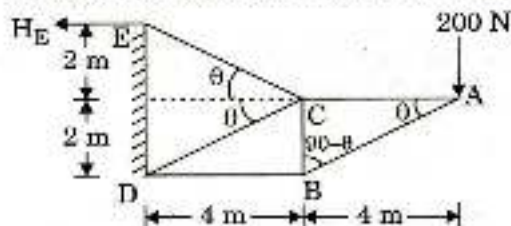


The magnitude of the horizontal support reaction at E is

(a) 400 kN
(b) 300 kN
(c) 250 kN
(d) 200 kN

33. The load system in the figure moves from left to right on a girder of span 10 m.



The maximum bending moment for the girder is nearly

(a) 820 kNm
(b) 847 kNm
(c) 874 kNm
(d) 890 kNm

34. Two wheel loads 80 kN and 200 kN respectively spaced 2 m apart, move on a girder of span 16 m. Any wheel load can lead the other. The maximum negative shear force at a section 4 m from the left end will be

(a) − 50 kN
(b) − 60 kN
(c) − 70 kN
(d) − 80 kN

35. The maximum possible span for a cable supported at the ends at the same level (assuming it to be in a parabolic profile) allowing a central dip of $\frac{1}{10}$ of the span with permissible stress of 150 N/mm$^2$ (where the steel weighs 78,000 N/m$^3$) will be nearly

(a) 1270 m
(b) 1330 m
(c) 1388 m
(d) 1450 m

36. A three-hinged arch has a span of 30 m and a rise of 10 m. The arch carries UDL of 60 kN/m on the left half of its span. It also carries two concentrated loads of 160 kN and 100 kN at 5 m and 10 m from the right end. The horizontal thrust will be nearly

(a) 446 kN
(b) 436 kN
(c) 428 kN
(d) 418 kN

37. An unstable vibratory motion due to combined bending and torsion which occurs in flexible plate like structures is called

(a) Galloping
(b) Ovalling
(c) Flutter
(d) Oscillation

38. A propped cantilever beam of span $l$ and constant plastic moment capacity $M_p$ carries a concentrated load at mid-span. The load at collapse will be

(a) $\dfrac{2 M_p}{l}$

(b) $\dfrac{4 M_p}{l}$

(c) $\dfrac{6 M_p}{l}$

(d) $\dfrac{8 M_p}{l}$

39. A steel plate is subjected to tension. The tensile force is applied over a width 'a' whereas the gross width of the plate is 'b'. The dispersion of the force from the point of application is at about $30°$ with the axis and extends to a maximum width of 12 times the thickness t of the plate. The effective width which comes into action will be

(a) $2a + 12t$

(b) $a + 12t$

(c) $a + 24t$

(d) $2a + 24t$

40. A wind brace is to be provided between two columns spaced at 5 m, at an inclination of $30°$ with the horizontal, to resist a tension of 320 kN developed by a wind force. The effective area required will be nearly (considering 150 N/m$^2$ as a relevant factor)

(a) $1670 \text{ mm}^2$

(b) $1640 \text{ mm}^2$

(c) $1600 \text{ mm}^2$

(d) $1570 \text{ mm}^2$

41. A beam column for a non-sway column in a building frame is subjected to a factored axial load of 500 kN, factored moment at bottom of column of 45 kNm. For ISHB 200, the values are A = 4750 mm$^2$, $\gamma_y = 45\cdot1$, h = 200 mm, b = 200 mm, $b_f = 9$ mm and the effective length is $0\cdot8$ L. Its buckling load will be

(a) 910 kN

(b) 930 kN

(c) 950 kN

(d) 980 kN

42. Which of the following assumptions are correct for ideal beam behaviour?

1. The compression flange of the beam is restrained from moving laterally.
2. The tension flange of the beam is restrained from moving laterally.
3. Any form of local buckling is prevented.

(a) 2 and 3 only

(b) 1 and 3 only

(c) 1 only

(d) 3 only

43. In which one of the following industrial roofing contexts, is the loading carried by the combination of pure flexure and flexure due to shear induced by the relative deformation between the ends of the top and bottom chord members?

(a) Vierendeel girders

(b) Scissors girders

(c) Lenticular girders

(d) Mansard girders

44. Bearing stiffeners are provided

(a) At the ends of plate girders

(b) At the ends of plate girder and on both faces of the web

(c) At the ends of plate girder and only on one face of the web

(d) At the points of concentrated loads, to protect the web from the direct compressive loads

**45.** If the cost of purlins/unit area is p and the cost of roof covering/unit area is r, then cost of trusses/unit area *t* for an economical spacing of the roof trusses will be

(a) p + r

(b) 2p + r

(c) p + 2r

(d) 2p − 2r

**46.** A welded plate girder of span 25 m is laterally restrained throughout its length. It has to carry a load of 80 kN/m over the whole span besides its weight. If K = 200 and $f_y$ = 250 MPa, the thickness of web will be nearly
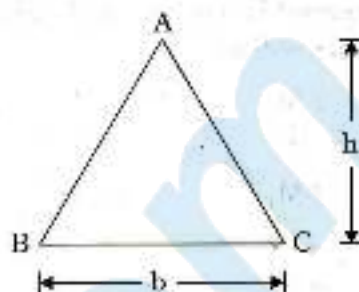
(a) 10 mm

(b) 14 mm

(c) 16 mm

(d) 20 mm

**47.** A propped cantilever ABCD is loaded as shown in figure. If it is of uniform cross-section, the collapse load of the beam will be nearly
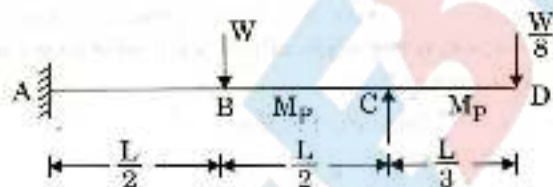


(a) $6.5 \dfrac{M_P}{L}$

(b) $5.6 \dfrac{M_P}{L}$

(c) $4.7 \dfrac{M_P}{L}$

(d) $3.8 \dfrac{M_P}{L}$

**48.** Consider a triangular section with base b and height h as shown in the figure.



The shape factor will be nearly

(a) 2·3

(b) 3·2

(c) 4·1

(d) 5·0

**49.** Fatigue in RCC beams will *not* be a problem if the number of cycles is less than

(a) 20,000

(b) 25,000

(c) 30,000

(d) 35,000

**50.** The desired characteristic strength of a mix is 20 N/mm². The standard deviation is 4 N/mm² for 150 mm size of concrete cubes; and K = 1·645. The average strength of the cubes will be nearly

(a) 38·2 N/mm²

(b) 32·4 N/mm²

(c) 26·6 N/mm²

(d) 22·8 N/mm²

**51.** A circular column is subjected to an un-factored load of 1600 kN. The effective length of the column is 3·5 m, the concrete is M 25, and the value of $\rho_g = \dfrac{A_{SC}}{A_g} = 2\%$ for Fe 415 steel. The design diameter of the column will be nearly

(a) 446 mm

(b) 432 mm

(c) 424 mm

(d) 410 mm

52. A strut is made of a circular bar, 5 m long and pin-jointed at both ends. When freely supported the bar gives a mid-span deflection of 10 mm under a load of 80 N at the centre. The critical load will be

(a) 8485 N

(b) 8340 N

(c) 8225 N

(d) 8110 N

53. The recommended imposed load on staircase in residential buildings as per IS 875 is

(a) $5\cdot0$ kN/m$^2$

(b) $3\cdot0$ kN/m$^2$

(c) $1\cdot5$ kN/m$^2$

(d) $1\cdot3$ kN/step

54. A 230 mm brick masonry wall is to be provided with a reinforced concrete footing on site having soil with safe bearing capacity of 125 kN/m$^2$, unit weight of $17\cdot5$ kN/m$^3$ and angle of shearing resistance of 30°. The depth of footing will be nearly

(a) $0\cdot8$ m

(b) $0\cdot7$ m

(c) $0\cdot6$ m

(d) $0\cdot5$ m

55. A rectangular beam 200 mm wide has an effective depth of 350 mm. It is subjected to a bending moment of 24,000 Nm. The permissible stresses are c = 5 N/mm$^2$, t = 140 N/mm$^2$; and m is 18. The required area of tensile reinforcement will be

(a) 688 mm$^2$

(b) 778 mm$^2$

(c) 864 mm$^2$

(d) 954 mm$^2$

56. Which of the following statements are correct with reference to ensuring minimum shrinkage of prestressed concrete ?

1. The water-cement ratio and proportion of cement paste should be kept minimum to reduce shrinkage.

2. Aggregates of larger size, well graded for minimum void, need a smaller amount of cement paste, and attendant shrinkage will be smaller.

3. Harder and denser aggregates of low water absorptions and high modulus of elasticity will exhibit small shrinkage.

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

57. During earthquakes, the corner and edge columns may be subjected to

(a) Uniaxial bending

(b) Biaxial bending

(c) Combined biaxial bending and torsion

(d) Combined biaxial bending and tension

58. The minimum number of bars required in a rectangular column for an earthquake resistant design, is

(a) 4

(b) 6

(c) 8

(d) 10

59. The permissible or allowable compressive stress $f_{ac}$ of brick masonry does *not* depend on

(a) Type and strength of bricks

(b) Efflorescence of bricks

(c) Strength of mortar

(d) Slenderness ratio

60. A masonry dam 8 m high, $1\cdot5$ m wide at the top and 5 m wide at the base retains water to a depth of $7\cdot5$ m, the water face of the dam being vertical. If the weight of water is $9\cdot81$ kN/m$^3$, weight of masonry is 22 kN/m$^3$, the maximum intensity of stress developed at the base will be nearly

(a) 196 kN/m$^2$

(b) 182 kN/m$^2$

(c) 160 kN/m$^2$

(d) 148 kN/m$^2$

**61.** A front-end loader on a given job moves a load of 1·5 m³ of loose soil in one cycle consisting of loading-lifting-travelling-unloading-return trip-and-ready for next loading. If each cycle time is 1·2 minutes, the actual output will be

(a) 75 m³/hour

(b) 70 m³/hour

(c) 65 m³/hour

(d) 60 m³/hour

**62.** Which of the following techniques belong to 'Project Time Plan' ?

1. Critical path method
2. Precedence network analysis
3. Line of balance technique
4. Linear programme chart

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

**63.** A construction equipment has an initial cost of ₹ 2,00,000 and salvage value of ₹ 50,000 at the end of an economic life of 5 years. The rate of straight-line depreciation and total depreciation will be

(a) 0·1 and ₹ 1,50,000

(b) 0·2 and ₹ 1,50,000

(c) 0·1 and ₹ 1,00,000

(d) 0·2 and ₹ 1,00,000

**64.** Consider the following assembly with different operations :
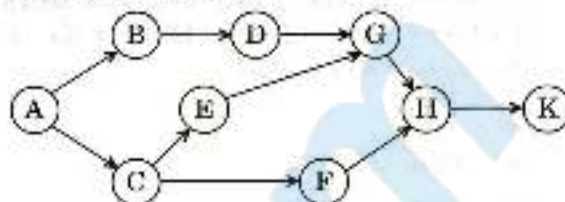


| Operation | Standard time, minutes |
|-----------|------------------------|
| A | 60 |
| B | 65 |
| C | 29 |
| D | 37 |
| E | 28 |
| F | 63 |
| G | 36 |
| H | 126 |
| K | 64 |

There are 250 working days in a year to produce 4000 units in a year. The minimum number of work stations required will be

(a) 13

(b) 12

(c) 11

(d) 10

**65.** Flattening and smoothing the road surface by scrapping is called

(a) Compaction

(b) Consolidation

(c) Grading

(d) Ditch digging

**66.** The amount of time by which the start of the activity may be delayed without interfering with the start of any succeeding activity is called

(a) Activity float

(b) Free float

(c) Total float

(d) Interfering float

**67.** A crew consisting of two carpenters and one helper can fix 10 m² of a slab form work in 8 hours and the hourly labour rate of a carpenter is ₹ 85 and for a helper is ₹ 69·50. An average hourly rate per worker of the crew will be nearly

(a) ₹ 90

(b) ₹ 80

(c) ₹ 70

(d) ₹ 60

**68.** A project with the production cost of ₹ 100 crores, has 20,000 man-months as direct labour, of which 60% is non-productive time. The labour cost as estimated while tendering is 20% of project cost. If 15% of the wastage resulting from non-productive time is eliminated by using improved methods, the resulting saving in labour cost will be

(a) 14·5%

(b) 18·5%

(c) 22·5%

(d) 26·5%

**69.** Consider the following data :

Work is carried out by a contractor employing labour with 25% overtime per day

Working for 5 days a week

Contractor peak manpower is 40 per day

Build-up period is 20%

Rundown period is 10%

Total effort in standard man days is 1200

The duration of work by Trapezoidal manpower distribution pattern will be

(a) 5·5 weeks

(b) 6·5 weeks

(c) 7·5 weeks

(d) 8·5 weeks

**70.** A systematic measurement and evaluation of the way in which an organization manages its health and safety programme against a series of specific and attainable standards is called

(a) Safety inspection

(b) Safety audit

(c) Safety plan

(d) Safety committee

**71.** On a construction project, the contractor, on an average, employed 100 workers with 50 hours working per week. The project lasted for 35 weeks and, during this period, 14 disabling injuries occurred. The injury-frequency rate will be (based on one lakh of man hours worked)

(a) 5

(b) 6

(c) 7

(d) 8

**72.** The graphical representations wherein long duration jobs are broken down to key segmental elements, wherein events are shown in chronological order without attention to logical sequencing, and wherein interdependencies between the events is not highlighted, is referred to as

(a) CPM

(b) Milestone chart

(c) GANTT chart

(d) PERT

73. A ship weighs 127 MN. On filling the ship's boats on one side with water weighing 600 kN with the mean distance of the boats from the centre line of the ship being 10 m, the angle of displacement of the plumb line is 2°16'. The metacentric height will be nearly

(Take sin 2°16' = 0·04, cos 2°16' = 0·9992 and tan 2°16' = 0·04)

(a) 1·73 m

(b) 1·42 m

(c) 1·18 m

(d) 0·87 m

74. For frictionless adiabatic flow of compressive fluid, the Bernoulli's equation with usual notations is

(a) $\dfrac{k}{k-1}\dfrac{p_1}{w_1} + \dfrac{v_1^2}{2g} + z_1 = \dfrac{k}{k-1}\dfrac{p_2}{w_2} + \dfrac{v_2^2}{2g} + z_2 + h_L.$

(b) $\dfrac{k}{k-1}\dfrac{p_1}{w_1} + \dfrac{v_1^2}{2g} + z_1 = \dfrac{k}{k-1}\dfrac{p_2}{w_2} + \dfrac{v_2^2}{2g} + z_2$

(c) $\dfrac{p_1}{w_1} + \dfrac{v_1^2}{2g} + z_1 + H_m = \dfrac{p_2}{w_2} + \dfrac{v_2^2}{2g} + z_2$

(d) $\dfrac{k}{k-1}\dfrac{p_1}{w_1} + \dfrac{v_1^2}{2g} + z_1 + H_m = \dfrac{p_2}{w_2} + \dfrac{v_2^2}{2g} + z_2 + h_L$

75. The phenomenon of generation of lift by rotating an object placed in a free stream is known as

(a) Coanda effect

(b) Magnus effect

(c) Scale effect

(d) Buoyancy effect

76. Which of the following assumptions is/are made in the analysis of hydraulic jump ?

1. It is assumed that before and after jump formation the flow is essentially two-dimensional and that the pressure distribution is hydrostatic.

2. The length of the jump is small so that the losses due to friction on the channel floor are small and hence neglected.

3. The channel floor is horizontal or the slope is so gentle that the weight component of the water mass comprising the jump is very high.

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

77. Water is to be pumped out of a deep well under a total head of 95 m. A number of identical pumps of design speed 1000 rpm and specific speed 900 rpm with a rated capacity of 150 l/s are available. The number of pumps required will be

(a) 1

(b) 3

(c) 5

(d) 7

78. Consider the following data from a test on Pelton wheel :

Head at the base of the nozzle = 32 m

Discharge of the nozzle = 0·18 m³/s

Area of the jet = 7500 mm²

Power available at the shaft = 44 kW

Mechanical efficiency = 94%

The power lost in the nozzle will be nearly

(a) 3·9 kW

(b) 4·7 kW

(c) 3·5 kW

(d) 2·3 kW

79. A certain hydropower plant utilizes the flow as it occurs, without any provision for storage. It is premised that a defined minimum dry weather flow is available. Such a plant is classified as

   (a) Diverted-flow plant

   (b) Pooled storage plant

   (c) Base-load plant

   (d) Run-of-river plant

80. Two turbo-generators, each of capacity 25,000 kW, have been installed at a hydel power station. The load on the hydel plant varies from 15,000 kW to 40,000 kW. The total installed plant capacity and the load factor are nearly

   (a) 40,000 kW and 68·8%

   (b) 50,000 kW and 68·8%

   (c) 40,000 kW and 62·3%

   (d) 50,000 kW and 62·3%

81. An airfoil is a streamlined body as shown in the figure below. Because of the streamlining of the body, the separation occurs only at the extreme rear of the body, resulting in
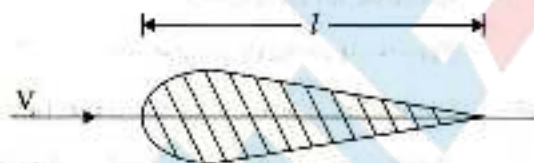


   (a) A very high pressure drag

   (b) A small wake and consequently small pressure drag

   (c) A moderate pressure drag

   (d) No pressure drag

82. A plate 0·025 mm distant from a fixed plate moves at 60 cm/s and requires a force of 0·2 kgf/m$^2$ to maintain this speed. The dynamic viscosity of the fluid between the plates will be nearly

   (a) $9·2 \times 10^{-10}$ kgfs/cm$^2$

   (b) $8·3 \times 10^{-10}$ kgfs/cm$^2$

   (c) $7·4 \times 10^{-10}$ kgfs/cm$^2$

   (d) $6·5 \times 10^{-10}$ kgfs/cm$^2$

83. Which of the following are component parts for an oil pressure governor in modern turbines ?

   1. Servomotor, known as relay cylinder

   2. Oil sump

   3. Oil pump which is driven by belt connected to turbine main shaft

   4. Draft tube

   (a) 1, 2 and 3 only

   (b) 1, 2 and 4 only

   (c) 1, 3 and 4 only

   (d) 2, 3 and 4 only

84. A double-acting reciprocating pump having piston area 0·1 m$^2$ has a stroke 0·30 m long. The pump is discharging 2·4 m$^3$ of water per minute at 45 rpm through a height of 10 m. The slip of the pump and power required to drive the pump will be nearly

   (a) 0·005 m$^3$/s and 4·8 kW

   (b) 0·003 m$^3$/s and 4·8 kW

   (c) 0·005 m$^3$/s and 4·4 kW

   (d) 0·003 m$^3$/s and 4·4 kW

85. In intensity-duration analysis by Sherman, the intensity of rainfall $i$ is represented as

(a) $\dfrac{b^n}{(t+a)}$

(b) $\dfrac{a^n}{(t+b)^n}$

(c) $\dfrac{(a+t)^n}{b}$

(d) $\dfrac{a}{(t+b)^n}$

where $t$ is time and $a, b, n$ are constants for the area.

86. Which one of the following points should be kept in mind while selecting the site for a rain gauge station ?
    (a) The site where a rain gauge is set up should be close to a meteorological observatory.
    (b) The rain gauge should be on the top of a hill.
    (c) A fence, if erected to protect the rain gauge from cattle etc. should be located within twice the height of the fence.
    (d) The distance between the rain gauge and the nearest object should be at least twice the height of the object.

87. Which of the following statements relates to a retarding reservoir ?
    1. There are no gates at the outlets and hence the possibility of human error in reservoir operation is eliminated.
    2. The high cost of gate installation and also its operation is saved.
    3. An automatic regulation may cause coincidence of flood crest farther downstream where two or more channels taking off from retarding reservoirs join together.
    (a) 1, 2 and 3
    (b) 1 and 2 only
    (c) 1 and 3 only
    (d) 2 and 3 only

88. The coefficient of transmissibility T for a confined aquifer can be determined by a pumping-out test together with other relevant observations. The applicable formula is (where $Q$ = Discharge, and $\Delta S$ = Difference in drawdowns in two wells )

(a) $\dfrac{Q}{2 \cdot 72 \, \Delta S}$

(b) $\dfrac{Q}{1 \cdot 72 \, \sqrt{\Delta S}}$

(c) $\dfrac{Q}{2 \cdot 72} \, \Delta S$

(d) $\dfrac{Q}{2 \cdot 72} \, \sqrt{\Delta S}$

89. The volume of water below the minimum pool level in a reservoir is known as
    (a) Useful storage
    (b) Surcharge storage
    (c) Dead storage
    (d) Bank storage

90. Depending upon the source from which the water is drawn, flow irrigation can be sub-divided into
    1. River canal irrigation
    2. Reservoir or tank irrigation
    3. Combined storage and lift irrigation
    4. Combined storage and diversion irrigation

    Which of the above designations are relevant ?
    (a) 1, 2 and 3 only
    (b) 1, 2 and 4 only
    (c) 1, 3 and 4 only
    (d) 2, 3 and 4 only

91. Consider the following data

Root zone depth = 2 m

Existing water content = 5%

Dry density of soil = 15 kN/m$^3$

Water applied to the soil = 500 m$^3$

Water loss due to evaporation and deep percolation = 10%

Area of plot = 1000 m$^2$

The field capacity of the soil will be nearly

(a) 16·8%
(b) 17·7%
(c) 18·8%
(d) 19·7%

92. Consider the following data for irrigation water:

|   | Concentration | Milli-equivalents per litre |
|---|---|---|
| 1 | Na$^+$ | 24 |
| 2 | Ca$^{++}$ | 3·6 |
| 3 | Mg$^{++}$ | 2 |

The Sodium-Absorption Ratio (SAR) is nearly

(a) 13·1
(b) 14·3
(c) 15·5
(d) 16·7

93. Consider the following statements with respect to weir under discussion :

1. Its design corresponds to soft sandy foundation.
2. The difference in weir crest and downstream river bed may not exceed 3 m.
3. When water passes over it, the longitudinal location of the formation of a hydraulic jump is variable.

This weir is of the type

(a) Vertical drop weir
(b) Masonry or concrete sloping weir
(c) Dry stone slope weir
(d) Parabolic weir

94. Consider the following data while designing an expansion transition for a canal by Mitra's method :

Length of flume = 16 m

Width of throat = 9 m

Width of canal = 15 m

If $B_x$ is the width at any distance x from the flumed section, the values of $B_x$ at x = 8 m and at x = 16 m are nearly

(a) 10·8 m and 15 m
(b) 11·3 m and 15 m
(c) 10·8 m and 13 m
(d) 11·3 m and 13 m

95. Consider the following data for a drain :

L = 50 m, a = 10 m, h = 10·3 m, and

k = 1 × 10$^{-5}$ m/s

If the drains carry 1% of average annual rainfall in 24 hrs, the average annual rainfall for which this system has been designed will be

(a) 78 cm
(b) 84 cm
(c) 90 cm
(d) 96 cm

96. The purpose of constructing a 'Groyne' is to

(a) Expand a river channel to improve its depth
(b) Encourage meandering
(c) Train the flow along a certain course
(d) Reduce the silting in the river bed

97. Which one of the following compounds of nitrogen, when in excessive amounts in water, contributes to the illness known as infant methemoglobinemia ?

(a) Ammoniacal nitrogen
(b) Albuminoid nitrogen
(c) Nitrite
(d) Nitrate

**98.** Consider the following data regarding a theoretical profile of a dam :

Permissible value of compressible stress $\sigma$ = 350 tonnes/$m^2$

Specific gravity of concrete $s$ = 2·4

Uplift coefficient $c$ = 0·6 m

The value of $\gamma$ = 1

The height and base width will be nearly

(a) 125 m and 63 m

(b) 175 m and 63 m

(c) 125 m and 93 m

(d) 175 m and 93 m

**99.** Chlorine usage in the treatment of 25,000 $m^3$/day of water has been 9 kg/day. The residual chlorine after 10 minutes contact is 0·2 mg/$l$. The chlorine demand of water would be nearly

(a) 0·28 mg/$l$

(b) 0·22 mg/$l$

(c) 0·16 mg/$l$

(d) 0·12 mg/$l$

**100.** The demand of water is 150 litres/head/day in a city of one lakh population. The factor of safety is taken as 1·5, detention time as 4 h and overflow rate as 20,000 litres/day/$m^2$. The area of 3 m deep plain sedimentation tank as per surface loading consideration will be

(a) 1025 $m^2$

(b) 1075 $m^2$

(c) 1125 $m^2$

(d) 1175 $m^2$

**101.** The rain intensity over 54 hectares of land is 50 mm/h, 30% of area consists of roof surfaces with runoff rate as 0·9, 30% is open field with runoff rate of 0·2 and remaining 40% is road network with runoff rate of 0·4. The storm water flow will be nearly

(a) 2·6 $m^3$/s

(b) 3·7 $m^3$/s

(c) 4·8 $m^3$/s

(d) 5·9 $m^3$/s

**102.** Critical dissolved oxygen (D.O.) deficit occurs in which one of the following zones of pollution of 'oxygen sag curve' in case of self-purification of natural streams ?

(a) Zone of recovery

(b) Zone of active decomposition

(c) Zone of degradation

(d) Zone of clear water

**103.** The MLSS concentration in an aeration tank is 2000 mg/$l$ and the sludge volume after 30 minutes of settling in a 1000 m$l$ graduated cylinder is 176 m$l$. The value of sludge density index (SDI) will be nearly

(a) 3·34 g/m$l$

(b) 2·22 g/m$l$

(c) 1·14 g/m$l$

(d) 0·26 g/m$l$

**104.** Which one of the following gases is the principal by-product of anaerobic decomposition of the organic content in waste water ?

(a) Carbon monoxide

(b) Ammonia

(c) Hydrogen sulphide

(d) Methane

**105.** Consider the following statements with reference to the mixing of industrial waste water with domestic waste water :

1. The industrial waste water can be mixed with domestic water when it has higher BOD.

2. The industrial waste water can be mixed with domestic water when the pH value of industrial waste water is highly alkaline.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

106. The waste water from a factory having a pH of 10, contains KOH only. For waste water discharge is 80 $m^3$/day. The total quantity of KOH per day will be nearly

(a) 4·5 kg/day

(b) 5·4 kg/day

(c) 6·3 kg/day

(d) 7·2 kg/day

107. Fanning type of plume behaviour takes place when

(a) Super-adiabatic lapse rate prevails with light to moderate wind speed

(b) Extreme inversion conditions exist in the presence of light wind

(c) There exists a strong super-adiabatic lapse rate above a surface of inversion

(d) Plume is caught between two inversion layers

108. A thermal power plant burns coal at the rate of 8 t/h. The coal has sulphur content of 4·5%. The rate of emission of $SO_2$ will be

(a) 180 g/s

(b) 200 g/s

(c) 220 g/s

(d) 240 g/s

109. The property of clays by virtue of which they regain, if left alone for a time, a part of the strength lost due to remoulding at unaltered moisture content, is known as

(a) Thixotropy

(b) Sensitivity

(c) Consistency

(d) Activity

110. The plastic limit and liquid limit of a soil are 30% and 42% respectively. The percentage volume change from liquid limit to dry state is 35% of the dry volume. Similarly the percentage volume change from plastic limit to dry state is 22% of the dry volume. The shrinkage ratio will be nearly

(a) 4·2

(b) 3·1

(c) 2·2

(d) 1·1

111. The ratio of a given volume change in a soil, expressed as percentage of the dry volume, to the corresponding change in water content is called

(a) Specific gravity of soil solids

(b) Mass-specific gravity of soils

(c) Shrinkage ratio of soils

(d) Density ratio of soils

112. A masonry dam is founded on pervious sand. A factor of safety of 4 is required against boiling. For the sand, n = 45% and $G_s$ = 2·65. The maximum permissible upward hydraulic gradient will be nearly

(a) 0·18

(b) 0·23

(c) 0·28

(d) 0·33

113. The representative liquid limit and plastic limit values of a saturated consolidated clay deposit are 60% and 30%, respectively. The saturated unit weight of the soil is 19 kN/$m^3$. The water table is at 8 m below ground level. At a depth of 10 m from the ground surface, the undrained shear strength of the soil will be nearly

(a) 37·7 kN/$m^2$

(b) 33·5 kN/$m^2$

(c) 29·3 kN/$m^2$

(d) 25·1 kN/$m^2$

114. A 6 m high retaining wall with a vertical back has a backfill of silty sand with a slope of 10° for the backfill. With values of $K_H = 760$ kg/m²/m and $K_V = 100$ kg/m²/m, the total active earth pressure will approximately be

(a) 128 kN/m

(b) 134 kN/m

(c) 138 kN/m

(d) 142 kN/m

115. The vertical stress at any point at a radial distance r and at depth z as determined by using Boussinesq's influence factor $K_B$ and Westergaard's influence factor $K_W$ would be almost same for $\left(\dfrac{r}{z}\right)$ ratios equal to or greater than

(a) 2·0

(b) 1·8

(c) 1·5

(d) 1·2

116. A strip footing 2 m in width, with its base at a depth of 1·5 m below ground surface, rests on a saturated clay soil with $\gamma_{sat} = 20$ kN/m³; $c_u = 40$ kN/m²; $\phi_u = 0$; $c' = 10$ kN/m²; and $\phi' = 20°$. The natural water table is at 1 m depth below ground level. As per IS : 6403 – 1981, the ultimate bearing capacity of this footing will be

(taking the relevant $N_c$ as 5·14)

(a) 327 kN/m²

(b) 285 kN/m²

(c) 253 kN/m²

(d) 231 kN/m²

117. The settlement due to secondary compression is predominant in

(a) Granular soils

(b) Inorganic clays

(c) Organic clays

(d) Very fine sand and silts

118. A raft foundation 10 m wide and 12 m long is to be constructed in a clayey soil having shear strength of 12 kN/m². Unit weight of soil is 16 kN/m³. The ground surface carries a surcharge of 20 kN/m²; the factor of safety is 1·2 and the value of $N_c = 5·7$. The safe depth of foundation will be nearly

(a) 8·2 m

(b) 7·3 m

(c) 6·4 m

(d) 5·5 m

119. The skin frictional resistance of a pile driven in sand does *not* depend on

(a) Lateral earth pressure coefficient

(b) Angle of friction between pile and soil

(c) Pile material

(d) Total stress analysis

120. An excavation is made with a vertical face in a clay soil which has $C_u = 50$ kN/m², $\gamma_t = 18$ kN/m³ and $s_n = 0·261$. The maximum depth of a stable excavation will be nearly

(a) 10·6 m

(b) 12·4 m

(c) 14·2 m

(d) 16·0 m

121. Reconnaissance survey for determining feasibility and estimation of scheme falls under the classification based on the

(a) Nature of the field of survey

(b) Object of surveying

(c) Instruments used

(d) Method employed

122. A survey line BAC crosses a river, A and C being on the near and distant banks respectively. Standing at D, a point 50 m measured perpendicularly to AB from A, the bearings of C and B are 320° and 230° respectively, AB being 25 m. The width of the river will be

(a) 80 m

(b) 90 m

(c) 100 m

(d) 110 m

123. In plane surveying where a graduated staff is observed either with horizontal line of sight or inclined line of sight, the effect of refraction is to

(a) Increase the staff reading

(b) Decrease the staff reading

(c) Neither increase nor decrease the staff reading

(d) Duplicate the staff reading

124. A sidereal day is the average time taken by

(a) The Earth to move around the Sun once

(b) The Moon to move around the Earth once

(c) The first point of Aries to cross the same meridian successively

(d) The Earth to move around its own axis once

125. In triangulation, in order to control the accumulation of errors of length and azimuth subsidiary bases are selected. At certain stations, the astronomical observations for azimuth and longitude are also made. These stations are called

(a) Transportation stations

(b) Bowditch stations

(c) Universe stations

(d) Laplace stations

126. A vertical photograph is taken at an altitude of 1200 m 'above mean sea level' (a.m.s.l.) of a terrain lying at an elevation of 80 m a.m.s.l. The focal length of camera is 15 cm. The scale of the photograph will be nearly

(a) 1 : 8376

(b) 1 : 7467

(c) 1 : 6558

(d) 1 : 5649

127. Aerial photographs are required to be taken to cover an area of 150 km². The longitudinal and side overlaps are to be 60% and 30% respectively. The scale of photograph is 1 cm = 100 m; and the size of each photograph is 20 cm × 20 cm. The minimum required number of photographs will be

(a) 170

(b) 158

(c) 146

(d) 134

**128.** Which one of the following conditions is *not* correct with respect to the transition curve ?

(a) It should be tangential to the straight approaches at the two ends.

(b) It should meet the circular curve tangentially.

(c) Its curvature will necessarily be non-zero at the point of take-off from the straight approaches.

(d) The rate of increase of curvature along the transition reach should match with the increase of cant.

**129.** A circular curve has a long chord of 80 m and a versed sine of 4 m. The height and ordinate at a distance of 30 m from the mid-ordinate will be nearly

(a) 3·06 m

(b) 2·72 m

(c) 2·24 m

(d) 1·76 m

**130.** Two parallel railway lines are to be connected by a reverse curve, each section having the same radius. If the lines are 12 m apart and the maximum distance between tangent points measured parallel to the straights is 48 m, then the maximum allowable radius will be

(a) 51·1 m

(b) 52·3 m

(c) 53·5 m

(d) 54·7 m

**131.** In an old map, a line AB was drawn to a magnetic bearing of 5°30', the magnetic declination at the time being 1° East. If the present magnetic declination is 8°30' East, the line should be set to a magnetic bearing of

(a) 358°

(b) 2°

(c) 6°30'

(d) 357°

**132.** An unconformity is

(a) A surface of erosion or non-deposition as detected in a sequence of rocks

(b) A layer of boulders and pebbles in a sequence of rocks

(c) A layer of clay or shale in an igneous mass

(d) A type of joint especially associated with folded and faulted rocks

**133.** Consider two cars approaching from the opposite directions at 90 km/h and 60 km/h. If the reaction time is 2·5 s, coefficient of friction is 0·7 and brake efficiency is 50% in both the cases, the minimum sight distance required to avoid a head-on collision will be nearly

(a) 154 m

(b) 188 m

(c) 212 m

(d) 236 m

134. What is the extra widening required (as nearest magnitude) for a pavement of 7 m width on a horizontal curve of radius 200 m, if the longest wheel of vehicle expected on the road is 6·5 m and the design speed is 65 km/h ?

(a) 0·3 m

(b) 0·5 m

(c) 0·7 m

(d) 0·9 m

135. A vehicle moving at 40 km/h speed was stopped by applying brake and the length of the skid mark was 12·2 m. If the average skid resistance of the pavement is 0·70, the brake efficiency of the test vehicle will be nearly

(a) 80%

(b) 74%

(c) 68%

(d) 62%

136. The main drawback of automatic counters-cum-classifiers, used for traffic volume studies, is that it is not yet possible to classify and record

(a) Vehicle type

(b) Axle spacing

(c) Axle load

(d) Speed

137. Which one of the following is *not* a part of 'speed and delay' studies ?

(a) Floating car method

(b) Vehicle number method

(c) Interview technique

(d) License number method

138. Consider the following data with respect to the design of flexible pavement :

Design wheel load = 4200 kg

Tyre pressure = 6·0 kg/cm$^2$

Elastic modulus = 150 kg/cm$^2$

Permissible deflection = 0·25 cm

(take $\pi^{1/2} = 1\cdot77$, $\pi^{-1/2} = 0\cdot564$, $\frac{1}{\pi} = 0\cdot318$, and $\pi^2 = 9\cdot87$)

The total thickness of flexible pavement for a single layer elastic theory will be nearly

(a) 42 cm

(b) 47 cm

(c) 51 cm

(d) 56 cm

139. The minimum possible grade that can be provided in a tunnel and its approaches with providing adequately for proper drainage is

(a) 0·1%

(b) 0·2%

(c) 0·3%

(d) 0·4%

**140.** The section of the tunnel adopted perfectly in lieu of ease of construction and maintenance in hard rock tunnels, where the risk of roof failure or collapse caused by external pressure from water, or from loose or unstable soil conditions on tunnel lining is practically non-existent, is

(a) Circular section

(b) Segmental roof section

(c) Horse-shoe section

(d) Egg-shaped section

**141.** Which one of the following methods is adopted for tunneling in soft soils ?

(a) Pilot tunnel method

(b) Drift method

(c) Needle beam method

(d) Heading and benching method

**142.** Which one of the following features does **not** pertain to Littoral drift ?

(a) It depends on length of wave

(b) It is the process of erosion of deposition by waves

(c) Waves caused by prevailing wind, stir up and move sand particles

(d) Wind tends to carry drifting sand in a zigzag way

**143.** Consider the following data for designing a taxiway for operating Boeing 707 – 320 aeroplane :

Wheel base = 17·70 m

Tread of main loading gear = 6·62 m

Turning speed = 40 km/h

Coefficient of friction between tyres and pavement surface = 0·13

The turning radius of the taxiway will be

(a) 98·5 m

(b) 94·5 m

(c) 89·5 m

(d) 86·5 m

**144.** Which one of the following instances of performance of aircraft is **not** considered for determining basic runway length ?

(a) Normal landing case

(b) Normal take-off case

(c) Engine failure case

(d) Emergency landing case

Directions : Each of the next **six (06)** items consists of two statements, one labeled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine the two statements carefully and select the answers to these six items using the codes given below :

**Codes :**

(a) Both Statement (I) and Statement (II) are individually true, and Statement (II) is the correct explanation of Statement (I).

(b) Both Statement (I) and Statement (II) are individually true, but Statement (II) is **not** the correct explanation of Statement (I).

(c) Statement (I) is true, but Statement (II) is false.

(d) Statement (I) is false, but Statement (II) is true.

**145.** *Statement (I) :*

Expansive cement is used in repair work for opened up joints.

*Statement (II) :*

Expansive cement expands while hardening.

**146.** *Statement (I) :*

Plastic hinges are developed when stress at every point is equal to yield stress.

*Statement (II) :*

Plastic hinges are formed at sections subjected to the greatest curvature.

**147.** *Statement (I) :*

If degree of fixity at supports is leasened, the maximum hogging moment at the ends will decrease.

*Statement (II) :*

If degree of fixity at supports is leasened, the maximum sagging moment at mid-span decreases.

**148.** *Statement (I) :*

Torsion reinforcement is provided at (and near) corners in a two-way slab which is simply supported on both edges meeting at the corner.

*Statement (II) :*

The area of reinforcement in each of the layers shall be three-quarters of the area required for maximum mid-span moment in the slab.

**149.** *Statement (I) :*

The inclination of the resultant stress with normal can exceed the angle of repose (adopting old terminology).

*Statement (II) :*

The ratio of the difference between greatest and least intensities of pressure to their sum cannot exceed the sine of the angle of repose (adopting old terminology).

**150.** *Statement (I) :*

Alum works in slightly alkaline range.

*Statement (II) :*

At higher temperatures, viscosity of water (resistance to settling) decreases and flocs settle better.