ENGINEERING SERVICES
EXAMINATION- (P) 2017

Eng. Exam (P) = 2017

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T.B.C. : MKA-S-CEN

Test Booklet Series

Serial 106725

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 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.

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1. Consider the following statements :

1. IS 3583 refers to Burnt Clay Paving Bricks.
2. IS 5779 refers to Burnt Clay Soling Bricks.
3. IS 3952 refers to Burnt Clay Hollow Bricks.
4. IS 2222 refers to Burnt Clay Lay Bricks.

Which of the above statements are correct ?

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

2. Consider the following statements :

1. A high aggregate impact value indicates strong aggregates.
2. A low aggregate crushing value indicates high crushing strength of aggregates.
3. Aggregates having elongation index values greater than 15% are generally considered suitable for pavement construction.
4. Flakiness index of aggregates should not be less than 25% for use in road construction.

Which of the above statements are correct ?

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

3. Consider the following statements regarding refractory bricks in furnaces :

1. The furnace is fired at temperatures more than 1700°C.
2. Silica content in the soil should be less than 40%.
3. Water absorption of bricks should not exceed 10%.
4. Chrome bricks are known as basic bricks.

Which of the above statements are correct ?

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

4. Consider the following statements about lime :

1. Calcination of limestone results in quick lime.
2. Lime produced from pure variety of chalk is hydraulic lime.
3. Hydrated lime is obtained by treating quick lime with water.

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

5. Consider the following statements :

1. If more water is added to concrete for increasing its workability, it results into concrete of low strength.
2. No slump is an indication of a good workable concrete.
3. Higher the slump of concrete, lower will be its workability.
4. Workability of concrete is affected by water content as well as water-cement ratio.

Which of the above statements are correct ?

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

6. Pozzolana used as an admixture in concrete has the following advantages :

1. It improves workability with lesser amount of water.
2. It increases the heat of hydration and so lets the concrete set quickly.
3. It increases the resistance of concrete to attack by salts and sulphates.
4. It leaches out calcium hydroxide.

Select the correct answer using the codes given below :

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

7. Consider the following particulars in respect of a concrete mix design :

	Weight	*Specific Gravity*
Cement	400 kg/m^3	3·2
Fine aggregates	–	2·5
Coarse aggregates	1040 kg/m^3	2·6
Water	200 kg/m^3	1·0

What shall be the weight of the Fine aggregates ?

(a) 520 kg/m^3
(b) 570 kg/m^3
(c) 690 kg/m^3
(d) 1000 kg/m^3

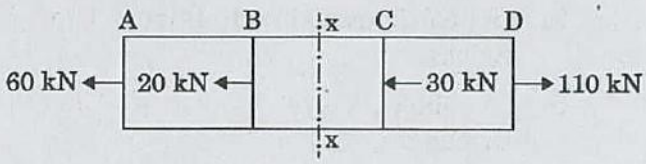
8. Consider the following statements regarding Cyclopean Concrete :

1. Size of aggregate is more than 150 mm.
2. Size of aggregate is less than 150 mm.
3. High slump.
4. High temperature rise due to heat of hydration.

Which of the above statements are correct ?

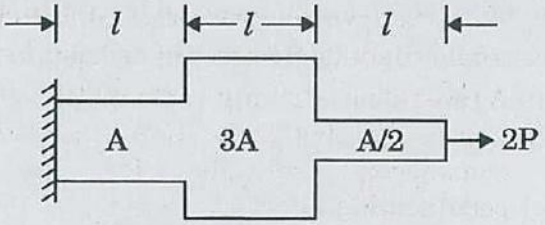
(a) 1 and 3 only
(b) 1 and 4 only
(c) 2 and 3 only
(d) 2 and 4 only

9. What is the stress at the section x – x for the bar ABCD with uniform cross-section 1000 mm^2 ?



(a) 20 N/mm^2 (Tensile)
(b) 30 N/mm^2 (Compressive)
(c) 80 N/mm^2 (Tensile)
(d) 50 N/mm^2 (Compressive)

10. The total elongation of the structural element (fixed at one end, free at the other end, and of varying cross-section) as shown in the figure, when subjected to load 2P at the free end is



(a) $6{\cdot}66\,\frac{P\,l}{AE}$
(b) $5{\cdot}55\,\frac{P\,l}{AE}$
(c) $4{\cdot}44\,\frac{P\,l}{AE}$
(d) $3{\cdot}33\,\frac{P\,l}{AE}$

11. A chain, working a crane, has sectional area of 625 mm^2 and transmits a load of 10 kN. When the load is being lowered at a uniform rate of 40 m/min, the chain gets jammed suddenly at which time the length of the chain unwound is 10 m. Assuming E = 200 GPa, the stress induced in the chain due to this sudden jamming is

(a) 100·6 N/mm^2
(b) 120·4 N/mm^2
(c) 140·2 N/mm^2
(d) 160·0 N/mm^2

12. A simply supported beam of span l and flexural rigidity EI carries a unit load at its mid-span. The strain energy at this condition in the beam due to bending is

(a) $\frac{l^3}{48\,EI}$

(b) $\frac{l^3}{96\,EI}$

(c) $\frac{l^3}{192\,EI}$

(d) $\frac{l^3}{16\,EI}$

13. In mild steel specimens subjected to tensile test cycle, the elastic limit in tension is raised and the elastic limit in compression is lowered. This is called

(a) Annealing effect

(b) Bauschinger effect

(c) Strain rate effect

(d) Fatigue effect

14. A solid uniform metal bar of diameter D mm and length l mm hangs vertically from its upper end. The density of the material is ρ N/mm^3 and its modulus of elasticity is E N/mm^2. The total extension of the rod due to its own weight would be

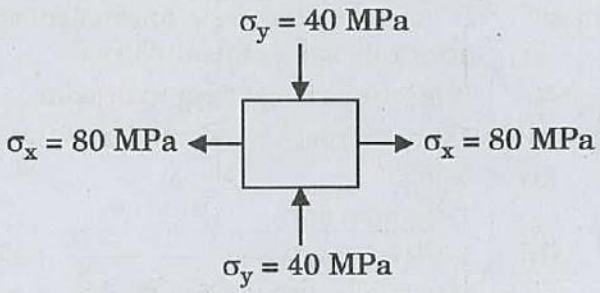
(a) $\frac{\rho l^2}{2\,E}$

(b) $\frac{\rho l}{2\,E}$

(c) $\frac{\rho l}{4\,E}$

(d) $\frac{\rho l^2}{4\,E}$

15. The state of stress at a certain point in a stressed body is as shown in the figure. Normal stress in x-direction is 80 MPa (Tensile) and in y-direction is 40 MPa (Compressive). The radius of the Mohr's circle for this state of stress will be



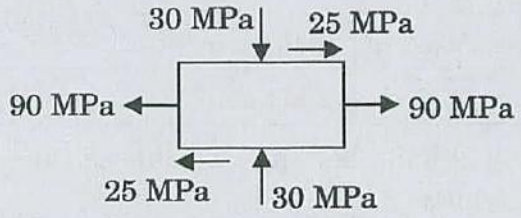
(a) 60 MPa

(b) 40 MPa

(c) 20 MPa

(d) 10 MPa

16. For the state of stress shown in the figure, the maximum and minimum principal stresses (taking tensile stress as +, and compressive stress as –) will be



(a) 95 MPa and (– 35) MPa

(b) 60 MPa and 30 MPa

(c) 95 MPa and (– 30) MPa

(d) 60 MPa and 35 MPa

17. Consider the following statements :

1. The shear stress distribution across the section of a circular shaft subjected to twisting varies parabolically.
2. The shear stress at the centre of a circular shaft under twisting moment is zero.
3. The shear stress at the extreme fibres of a circular shaft under twisting moment is maximum.

Which of the above statements is/are correct ?

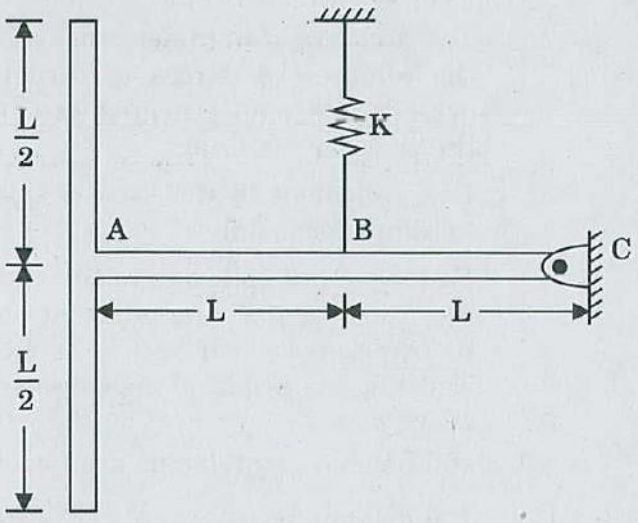
(a) 1, 2 and 3

(b) 1 only

(c) 2 only

(d) 3 only

18. A uniform T-shaped arm of weight W, pinned about a horizontal point C, is supported by a vertical spring of stiffness K. The extension of the spring is



(a) $\frac{3\,W}{4\,K}$

(b) $\frac{4\,W}{3\,K}$

(c) $\frac{3\,K}{4\,W}$

(d) $\frac{4\,K}{3\,W}$

19. The span of a cantilever beam is 2 m. The cross-section of the beam is a hollow square with external sides 100 mm; and its $I = 4 \times 10^5$ mm^4. The safe bending stress for the beam material is 100 N/mm^2. The safe concentrated load at the free end would be

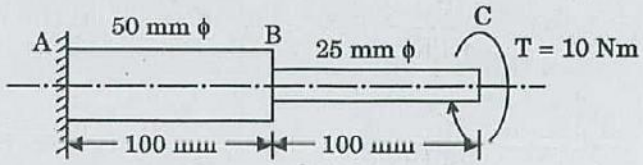
(a) 100 N

(b) 200 N

(c) 300 N

(d) 400 N

20. A stepped steel shaft is subjected to a clockwise torque of 10 Nm at its free end. Shear modulus of steel is 80 GPa. The strain energy stored in the shaft is



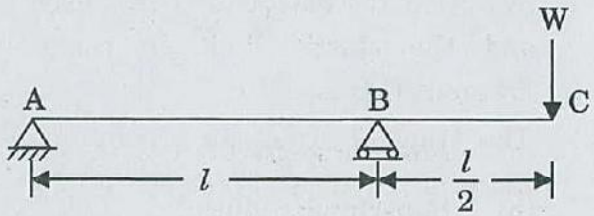
(a) 1·73 Nmm

(b) 2·52 Nmm

(c) 3·46 Nmm

(d) 4·12 Nmm

21. An overhanging beam of uniform EI is loaded as shown below. The deflection at the free end is



(a) $\frac{W\,l^3}{81\,EI}$

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

(c) $\frac{W\,l^3}{27\,EI}$

(d) $\frac{2\,W\,l^3}{27\,EI}$

22. The principal stresses at a point in a stressed material are $\sigma_1 = 200$ N/mm^2, $\sigma_2 = 150$ N/mm^2, and $\sigma_3 = 200$ N/mm^2. $E = 210$ kN/mm^2 and $\mu = 0{\cdot}3$. The volumetric strain will be

(a) $8{\cdot}954 \times 10^{-4}$

(b) $8{\cdot}954 \times 10^{-2}$

(c) $6{\cdot}54 \times 10^{-3}$

(d) $6{\cdot}54 \times 10^{-4}$

23. A mild steel bar, circular in cross-section, tapers from 40 mm diameter to 20 mm diameter over its length of 800 mm. It is subjected to an axial pull of 20 kN. $E = 2 \times 10^5$ N/mm^2. The increase in the length of the rod will be

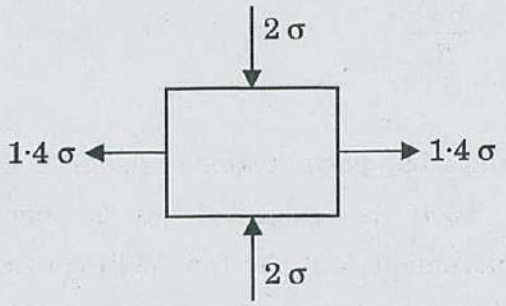
(a) $\frac{1}{10\pi}$ mm

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

(c) $\frac{4}{5\pi}$ mm

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

24. The state of stress at a point in an elastic material, with yield stress of 200 MPa in simple tension, and Poisson's ratio 0·3, is as shown in the figure.



The permissible value of σ by maximum strain theory is

(a) 75 MPa

(b) 100 MPa

(c) 150 MPa

(d) 200 MPa

25. Consider the following statements in respect of arched construction made of voussoirs :

1. The superimposed load is transferred to the sidewalls only by the strength of cohesion of the mortar between the voussoirs.
2. The arch may fail under crushing when the compressive stress or thrust in it exceeds the safe crushing strength of the voussoir material.
3. Every element in the arch is subjected to compression only.
4. Failure of the arch due to the sliding of any voussoir past the adjacent one due to transverse shear can be avoided by reducing the height of the voussoirs.

Which of the above statements are correct ?

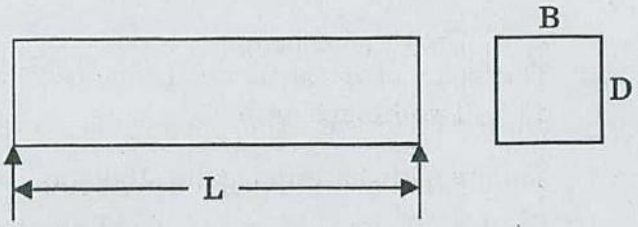
(a) 1 and 4 only

(b) 1 and 3 only

(c) 2 and 4 only

(d) 2 and 3 only

26. A homogeneous prismatic simply supported beam is subjected to a point load F. The load can be placed anywhere along the span of the beam. The very maximum flexural stress developed in the beam is



(a) $\frac{3\,FL}{2BD^2}$

(b) $\frac{3\,FL}{4BD^2}$

(c) $\frac{2\,FL}{3BD^2}$

(d) $\frac{4\,FL}{3BD^2}$

27. The ratio $\left(\frac{s}{t}\right)$ of, (s) stiffness of a beam (of constant EI) at the near end when the far end is hinged, to (t) the stiffness of the same beam at the near end when the far end is fixed, is

(a) $\frac{1}{2}$

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

(c) $\frac{1}{1}$

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

28. Which of the following are examples of indeterminate structures ?

1. Fixed beam
2. Continuous beam
3. Two-hinged arch
4. Beam overhanging on both sides

Select the correct answer using the codes given below :

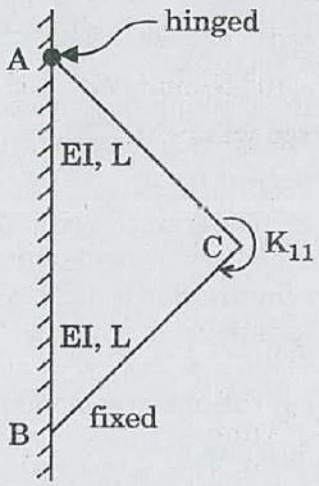
(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 1, 3 and 4 only

(d) 2, 3 and 4 only

29. The rotational stiffness coefficient indicated as K_{11} for the frame with details as shown is



(a) $\frac{9\,EI}{L}$

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

(c) $\frac{7\,EI}{L}$

(d) $\frac{6\,EI}{L}$

30. A single-bay portal frame of height h fixed at the base is subjected to a horizontal displacement Δ at the top. With constant EI, the base moment developed is proportional to

(a) $\frac{1}{h}$

(b) $\frac{1}{h^2}$

(c) $\frac{1}{h^3}$

(d) $\frac{1}{h^4}$

31. Consider the following statements :

1. When the number of members (n) and joints (j) are such that the equation $n = (2j - 3)$ is satisfied, the framed structure is said to be a perfect structure.
2. In a redundant frame, the number of members is less than that required for a perfect frame.
3. If, in a framed structure, the number of members provided is more than that required for a perfect frame, it is called as a deficient frame.

Which of the above statements is/are correct ?

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

32. A cantilever beam, 3 m long, carries a uniformly distributed load over the entire length. If the slope at the free end is 1°, the deflection at the free end is

(a) 49·27 mm
(b) 39·27 mm
(c) 30·27 mm
(d) 20·27 mm

33. The maximum bending moment at a given section, in which a train of wheel loads moves, occurs when the average load on the left segment is

1. Equal to the average load on the right segment.
2. More than the average load on the right segment.
3. Less than the average load on the right segment.

Select the correct answer using the codes given below :

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

34. A single degree of freedom system of mass 22 kg and stiffness 17 kN/m vibrates freely. If damping in the system is 2%, the cyclic frequency and the damped circular frequency, respectively, are nearly

(a) 4·4 Hz and 0·88 rad/sec
(b) 0·88 Hz and 27·8 rad/sec
(c) 4·4 Hz and 27·8 rad/sec
(d) 0·88 Hz and 0·88 rad/sec

35. A cable of insignificant weight, 18 m long, is supported at its two ends, 16 m apart, at the same level. The cable supports at its mid-reach a load of 120 N. The tension in the cable is nearly

(a) 136 N
(b) 131 N
(c) 126 N
(d) 121 N

36. The design strength of a tension member is governed by

1. Rupture at a critical section
2. Yielding of gross area
3. Block shear of end region

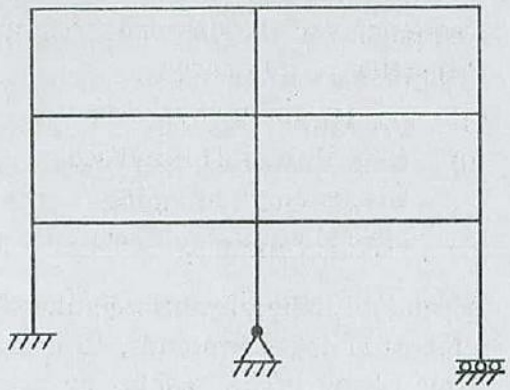
Select the correct answer using the codes given below :

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

37. Two parallel rails are running on railway sleepers. The centre-to-centre distance between the rails is 'b' with the sleepers projecting by an amount 'a' at each end beyond the rails. When the train passes over the rails, the reaction exerted by the ground can be taken as uniformly distributed over the sleeper. The ratio $\frac{b}{a}$ for the condition that the maximum bending moment is as small as possible is

(a) 2·83
(b) 2·90
(c) 2·50
(d) 3·00

38. The kinetic indeterminacy of the structure shown in the figure is equal to



(a) 14

(b) 15

(c) 16

(d) 17

39. A beam-column is alternately bent either (1) in single curvature, or (2) in double curvature. The secondary moments induced are to be compared. These are indicated SM_1 and SM_2 as per the conditions (1) and (2) respectively

(a) $SM_1 > SM_2$

(b) $SM_1 < SM_2$

(c) $SM_1 = SM_2$

(d) Cannot be ascertained

40. Gantry girders can be designed

1. As laterally supported beams.
2. As laterally unsupported beams.
3. By using channel sections.

Select the correct answer using the codes given below :

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

41. A three-hinged parabolic arch ABC has a span of 20 m and a central rise of 4·0 m. The arch has hinges at the ends and at the crown. A train of two point loads of 20 kN and 10 kN, 5 m apart, crosses this arch from left to right, with the 20 kN load leading. The maximum thrust induced at the supports is

(a) 25·0 kN

(b) 28·13 kN

(c) 31·25 kN

(d) 32·81 kN

42. According to IS : 875 Part 3, the design wind speed acting on industrial roof is estimated based on the basic wind speed by multiplying it by factors K_1, K_2 and K_3, where K_1 is called

(a) Terrain height factor

(b) Structure size factor

(c) Topography factor

(d) Risk coefficient

43. Consider the following two statements regarding Bearing stiffeners provided at the location of a concentrated load :

1. Bearing stiffeners have to resist bearing and buckling loads.
2. Bearing area and the area resisting buckling load are the same.

Which of the above statements is/are correct ?

(a) 2 only

(b) 1 only

(c) Both 1 and 2

(d) Neither 1 nor 2

44. In a plate girder, the web plate is connected to the flange plates by fillet welding. The size of the fillet welds is designed to safely resist

(a) The bending stresses in the flange

(b) The vertical shear force at the section

(c) The horizontal shear force between the flanges and the web plate

(d) The forces causing buckling in the web

45. For a rectangular cross-section, when the extreme fibre strain was ε_y, the yield moment capacity is M_y. What would be the value of the resisting moment when the extreme fibre strain is $2\varepsilon_y$?

(a) $1{\cdot}000\ M_y$

(b) $1{\cdot}250\ M_y$

(c) $1{\cdot}375\ M_y$

(d) $1{\cdot}550\ M_y$

46. A certain R.C. short column with 300 mm square cross-section is made of M 20 grade concrete and has 4 numbers, 20 mm diameter, longitudinal bars of Fe 415 grade steel. It is under the action of a concentric axial compressive load. Ignoring the reduction in the area of concrete due to the steel bars, the ultimate axial load carrying capacity of the column as by the relevant code is

(a) 1069 kN

(b) 1198 kN

(c) 1548 kN

(d) 1659 kN

47. A rectangular beam is of size 230 mm × 350 mm (effective depth). The factored shear force acting at a section is 80 kN. If the permissible shear stress in concrete is 0·25 MPa, the design shear force is nearly

(a) 100 kN

(b) 80 kN

(c) 60 kN

(d) 20 kN

48. In a combined footing for two columns carrying unequal loads, the maximum hogging moment occurs at

(a) The inside face of the heavier column

(b) A section equidistant from both the columns

(c) A section subjected to maximum shear force

(d) A section subjected to zero shear force

49. Consider the following statements :

1. The minimum steel requirements of slabs are based on considerations of shrinkage and temperature effects alone, and not on strength.
2. Providing excessive reinforcement in beams can result in congestion, thereby adversely affecting the proper placement and compaction of concrete.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

50. A T-beam becomes identical to a rectangular beam with width equal to its flange width when the neutral axis is

(a) Through the geometrical centre of the beam

(b) At the junction of the rib and the flange

(c) Below the slab

(d) Within the flange

51. Consider the following statements in the light of IS : 456 - 2000 :

1. There is an upper limit on the nominal shear stress in beams (even with shear reinforcement) due to the possibility of crushing of concrete in diagonal compression.
2. A rectangular concrete slab whose length is equal to its width may not be a two-way slab for certain definable support conditions.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

52. A simply supported prestressed concrete beam is of 25 m span. The initial stress is 1000 MPa. The slip in the jack during tensioning has been 2 mm. If E_s = 200 GPa, the loss of prestress due to anchorage slip is

(a) 16%

(b) 12%

(c) 10%

(d) 1·6%

53. Which of the following measures are relevantly considered for earthquake loading and lateral stability of tall buildings ?

1. Minimizing gravity loads
2. Adding masses at floor levels
3. Ensuring ductility at the locations of maximum moments
4. Providing shear walls
5. Providing basement

Select the correct answer using the codes given below :

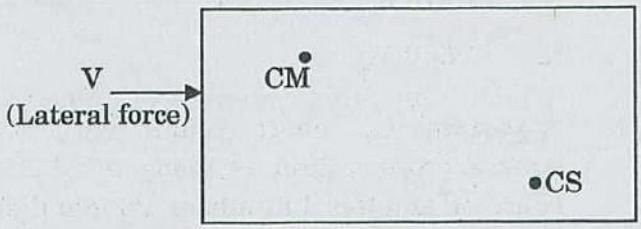
(a) 1, 2 and 5 only

(b) 1, 2 and 4 only

(c) 1, 3 and 4 only

(d) 3, 4 and 5 only

54. The figure shows the plan view of a single-storey masonry shear wall building with rigid roof diaphragm. The traces of locations of the centre of mass (CM) and the centre of stiffness (CS) are as shown. Neglecting accidental eccentricity, the direction of the twisting moment on the diaphragm, for the lateral force direction shown, is



(a) Clockwise

(b) Anticlockwise

(c) Opposite to the direction of lateral force

(d) None of the above

55. Which of the following statements is/are correct for a non-critical activity ?

1. It demands very special attention and action.
2. One can do with normal attention to this activity with some leeway for action.

Select the correct answer using the codes given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

56. Consider the following statements regarding tendering for a civil work :

1. Earnest money deposit (EMD) is a prerequisite to tender for a work.
2. It is not essential to call for the contractor's credentials when a tender is invited.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

57. Consider the following statements regarding quality control :

1. It refers to absolute conformity to specifications.
2. It may not vouch against overspending.
3. It may unknowingly resort to overdesign in the hope of risk minimization.
4. It is intended to reduce maintenance costs.

Which of the above statements are correct ?

(a) 1 and 3 only

(b) 2 and 3 only

(c) 2 and 4 only

(d) 1 and 4 only

58. Which of the following statements are correct ?

1. Depression of mercury in a capillary tube is dependent on density and surface tension.
2. Modelling of flow-induced drag on a ship is done invoking both of Froude number and Reynolds number.
3. Flow of a fluid in a narrow pipe is relatable to both Reynolds number and Cauchy number.
4. Formation and collapse of a soap bubble is analyzed through employing surface tension and external pressure.
5. Flow over the downstream slope of an ogee spillway can be affected by surface tension.

Select the correct answer using the codes given below :

(a) 1, 2 and 4 only

(b) 1, 3 and 5 only

(c) 2, 3 and 4 only

(d) 3, 4 and 5 only

59. Which of the following factors are non-dimensional ?

1. C in Chezy's equation
2. 11·6 as a measure of the sub-layer
3. $\frac{H}{N^2D^2}$ employed in comparing performance of pumps
4. $\frac{Q^2}{D^5}$ employed in computations in pipe networks
5. $\frac{U}{\sqrt{gL}}$ used in estimating wave-making drag

Select the correct answer using the codes given below :

(a) 2 and 5 only

(b) 2, 4 and 5 only

(c) 1 and 5 only

(d) 1, 3 and 4 only

60. An ocean liner, 240 m long and 24 m wide, displaces 654 MN of sea-water (ρ = 1025 kgf/m^3). The second moment of inertia of the water plane about its fore-aft axis is $\frac{2}{3}$ of that of the circumscribing rectangle. The position of the centre of buoyancy is 2·30 m below the centre of gravity. How high is the metacentre above the centre of buoyancy (to the nearest cm) ?

(a) 49 cm

(b) 53 cm

(c) 58 cm

(d) 65 cm

61. A fluid flow field is given by

$$U = 2xyi + yzj - \left(2yz + \frac{z^2}{2}\right)k.$$

1. The flow is viscous.
2. The flow is steady.
3. The flow is incompressible.
4. The magnitude of the total velocity vector at a point (1, 4, 3) is nearest to 27 units.

Which of the above statements are correct ?

(a) 1 and 3 only

(b) 1 and 4 only

(c) 2 and 3 only

(d) 2 and 4 only

62. Consider the following statements regarding flow net :

1. It helps determine the quantity of seepage.
2. It helps determine the upward lift below a hydraulic structure.
3. It is applicable to rotational flow only.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

63. Hydraulic jump forms in a horizontal rectangular channel carrying a unit discharge of 1·019 m^3/sec/m at a depth of 101·9 mm. This jump is classified as

(a) Weak jump

(b) Oscillating jump

(c) Steady jump

(d) Strong jump

64. A man, 65 kg, descends to the ground with the help of a parachute, 18 kg. The parachute is hemispherical in shape, 2 m diameter. Density of air can be taken as 0·00125 g/cm^3 and its kinematic viscosity as 0·15 stoke. What is the terminal velocity of the parachute ?

(Take C_D – 1 5 and g – 1000 cm/sec^2)

(a) 16·6 m/sec

(b) 15·8 m/sec

(c) 15·0 m/sec

(d) 14·1 m/sec

65. In a wide rectangular channel, the normal depth is increased by 20%. This would mean an increase in the discharge of the channel nearly by

(a) 20%

(b) 26%

(c) 36%

(d) 56%

66. At a sluice gate across a rectangular channel, the upstream flow conditions are : depth of 2·0 m; velocity of flow of 1·25 m/sec. The flow conditions at the vena contracta just downstream of the gate can be taken as : depth of 0·44 m; velocity of flow of 5·68 m/sec. What is the total thrust on the gate on its upstream face (to the nearest 10 units) ?

(a) 770 kgf

(b) 800 kgf

(c) 825 kgf

(d) 870 kgf

67. A centrifugal pump has an impeller of 30 cm diameter and runs at 1000 rpm giving best efficiency. It delivered 1·2 m^3/minute against a head of 25 m. What is its non-dimensional specific speed (based on flow expressed in *l*.p.s.) ? Take $\sqrt{9{\cdot}81} = 3{\cdot}132$; and $\sqrt{\sqrt{9{\cdot}81}} = 1{\cdot}77$.

(a) 55

(b) 63

(c) 72

(d) 80

68. Consider the following statements regarding a turbine :

1. Specific speed plays an important role in the selection of the type of turbine.
2. An increase in specific speed of the turbine is accompanied by higher maximum efficiency.
3. The runner of too high specific speed with high available head increases the cost of the turbine on account of the high mechanical strength required.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

69. In a hydraulic machine, the moment of momentum of water is reduced by 15915 N.m, when the machine is rotating at 600 rpm. The power developed is

(a) 1000 kW

(b) 1500 kW

(c) 2000 kW

(d) 2500 kW

70. Consider the following statements in connection with hydraulic turbines :

1. The Kaplan turbine is a radial flow turbine in which the guide vane angles as well as the runner vane angles are adjustable.
2. Francis and Kaplan turbines are provided with draft tubes which carry water from exit of runner to tailwater to increase the gross head across the turbine.
3. The parts of turbines susceptible to cavitation are the guide vanes and runner vanes — drastically reducing the turbine efficiency.
4. The specific speed of a 4-jet Pelton turbine will be 28 if the specific speed of a single-jet Pelton turbine is 14.

Which of the above statements are correct ?

(a) 2 and 3 only

(b) 1 and 3 only

(c) 1 and 4 only

(d) 2 and 4 only

71. Consider the following statements :

1. Surge tanks are not substitutes for forebays.
2. Pumped storage power plants are a boon to power generation.
3. Water hammer in penstocks is not dangerous.
4. Kaplan turbines are used in low head power plants.

Which of the above statements are correct ?

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

72. In the standard SCS-CN method of modelling runoff due to daily rainfall, if CN = 75, the runoff magnitude for a one-day rainfall of 100 mm is nearly

(a) 17 mm
(b) 31 mm
(c) 41 mm
(d) 57 mm

73. Consider the following statements concerning precipitation :

1. The Isohyetal map method of determining the average precipitation is considered to be better than the Thiessen method.
2. There is no possibility of damaging the storms because of cloud seeding activity.
3. Water that percolates through the soil emerges as the dry weather flow in streams.

Which of the above statements are correct ?

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

74. An 8-hour storm with incremental rainfall during each successive hour is tabulated herewith. What will be the correction to total runoff when, whereas the actual φ index was 0·5 cm/hour, a wrong magnitude of 0·6 cm/hour was adopted in computing the total runoff ?

Time from start (hour)	Incremental rainfall in each hour (cm)
1	0·4
2	0·8
3	1·2
4	0·9
5	1·8
6	1·0
7	0·3
8	0·8

(a) + 1·0 cm
(b) + 0·9 cm
(c) + 0·8 cm
(d) + 0·6 cm

75. The probability of a 10-year flood to occur at least once in the next 4 years is

(a) 45%
(b) 35%
(c) 30%
(d) 20%

76. Tortuosity of a meandering river is the ratio of

(a) Meander length to width of the meander
(b) Meander length to width of the river
(c) Curved length along the river to the direct axial length of the river
(d) Direct axial length of the river to the curved length along the river

77. Consider the following statements in respect of ground water aquifers :

1. Specific storage is specific capacity per unit depth of the aquifer.
2. Specific capacity is storage coefficient per unit aquifer depth.
3. Specific capacity is a constant for a given well.
4. For one-dimensional flow in a confined aquifer between two water bodies, the piezometric head line in the aquifer is a straight line.

Which of the above statements are correct ?

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

78. An extended layer of soil with homogeneous rounded grains has 10% of the material finer than 0·07 mm. The constant to be adopted to determine its permeability has been recommended as 750. What is its permeability ?

(a) 2·583 m/day
(b) 2·857 m/day
(c) 3·244 m/day
(d) 3·675 m/day

79. Consider the following statements in connection with soil-water-crop relationship :

1. Water utilization by plants is mainly from capillary water.
2. The amount of irrigation water required to meet the evapotranspiration needs of the crop during its full growth duration is its consumptive irrigation requirement.
3. The depth of water required to bring the soil-moisture level of a given soil up to its field capacity is called hygroscopic water.
4. With continuous increase in quantity of water applied, the yield of most crops increases up to a certain limit and then is expected to be constant.

Which of the above statements are correct ?

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

80. Consider the following statements regarding design of channel by Lacey and Kennedy :

1. The theoretical concept of silt transportation is the same in both the theories.
2. Lacey improved upon Kennedy's formula.
3. There are no defects in either the theories of Lacey or of Kennedy.

Which of the above statements are correct ?

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

81. Consider the following statements in respect of dams :

1. In a gravity dam, a grout curtain is provided near the toe to reduce the exit gradient.
2. A drainage gallery with its drainage pipe system provided in a gravity dam reduces the uplift pressure at all levels below the upstream water level.
3. An earthquake acceleration of 0·1 g acting vertically downward causes a decrease of 10% in the unit weight of concrete and of water in a gravity dam.
4. The Tehri dam is a gravity dam.

Which of the above statements are correct ?

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

82. Objectives for river training are

1. High flood discharge may pass safely through the reach.
2. Sediment load (including bed and suspended load) may be transported efficiently.
3. By making the river course unstable whereby to increase bank erosion.

Select the correct answer using the codes given below :

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

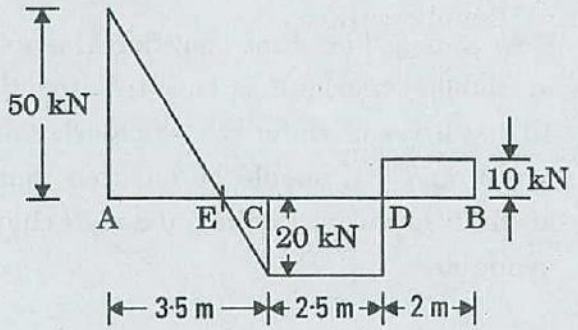
83. Consider the following statements regarding coagulant aids :

1. They are employed when temperature is low as they then accelerate the process of coagulation.
2. They are employed when flocs are small and water is coloured.
3. With their use, water purification capacity of the plant is increased.
4. Most widely used materials are oxidants, absorbents, weighing agents, activated carbon and polyelectrolytes.

Which of the above statements are correct ?

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

84. Consider the following statements with regards to the shear force diagram for the beam ABCD :



1. The beam ABCD is an overhanging beam having supports at A and D only.
2. The beam carries a point load of 20 kN at C.
3. The beam carries a concentrated load of 10 kN at the end B.
4. The beam is an overhanging beam having supports at C and D only.
5. The beam carries a uniformly distributed load of 70 kN over the left hand portion AC only.

Which of the above statements are correct ?

(a) 1, 2 and 3 only
(b) 1, 3 and 5 only
(c) 2, 3 and 4 only
(d) 2, 4 and 5 only

85. A good disinfectant

1. Should be persistent enough to prevent regrowth of organisms in the distribution system.
2. Must be toxic to micro-organisms at concentrations well above the toxic thresholds of humans and higher animals.
3. Should have a fast rate of kill of micro-organisms.

Select the correct answer using the codes given below :

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

86. How much bleaching powder (having 20% available chlorine) is needed to disinfect 10,000 litres of water whose chlorine demand is 1·0 mg/*l* ? It should be ensured that, after about 1 hour contact time, 0·2 mg/*l* chlorine is available.

(a) 30 g
(b) 40 g
(c) 48 g
(d) 68 g

87. The approximate value of BHP of a pump to supply 1 m^3/s water to a town at RL 400 m from a source, whose water level is at RL 320 m, would be

(a) 940
(b) 1000
(c) 1070
(d) 1120

88. Consider the following statements regarding removal of impurities from water :

1. Settleable solids are removed by filtration.
2. Volatile solids are removed through sedimentation.
3. Dissolved solids are removed through reverse osmosis.
4. Colloidal solids are removed by coagulation.

Which of the above statements are correct ?

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

89. Consider the following statements regarding contact stabilization process :

1. Primary settling tank is not required in some cases.
2. BOD removal occurs in two stages.
3. Aeration volume requirements are approximately 50% of those of a conventional — or tapered — aeration plant.
4. Returned sludge is aerated for 30 min to 90 min in sludge aeration tank.

Which of the above statements are correct ?

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

90. Consider the following statements regarding pyrolysis :

1. It is an irreversible chemical change brought about by the action of heat in oxygen-free atmosphere.
2. Range of temperature is 500°C to 1000°C.
3. Internal heating causes organic matter to decompose physically and chemically rather than burn.
4. It is a highly exothermic process.

Which of the above statements are correct ?

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

91. Consider the following statements regarding air pollution :

1. The pollutant caused by incomplete combustion of organic matter is carbon monoxide.
2. Depletion of ozone in outer atmosphere may trigger skin cancer.
3. Acid rains are caused by SO_2 and NO_x.
4. The permissible standard for SO_2 in air for residential areas in India is 80 $\mu g/m^3$.

Which of the above statements are correct ?

(a) 1, 2, 3 and 4

(b) 1, 3 and 4 only

(c) 2 and 4 only

(d) 1, 2 and 3 only

92. Consider the following statements :

1. Illite is the mineral largely responsible for the swelling and shrinkage behaviour of clayey soils.
2. A differential free swell value of 55% indicates a soil with low degree of expansiveness.
3. Higher the plasticity index of a soil, greater its swelling potential.
4. A low shrinkage limit of a soil indicates possibility of swelling at low water content.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 4 only

(d) 3 and 4 only

93. Consider the following effects as indicative of complete saturation of a soil sample :

1. Pore water pressure is positive.
2. Volume of water to volume of voids is equal to 1.
3. Relative density is equal to 1.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

94. Consider the following statements :

1. Secondary consolidation of soil follows Terzaghi's one-dimensional theory of consolidation.
2. Consolidation is a function of total stress.
3. Even after complete dissipation of excess pore pressure, the soil undergoes a little more consolidation.

Which of the above statements is/are correct ?

(a) 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 only

95. An undrained triaxial compression test is carried out on a saturated clay sample under a cell pressure of 50 kN/m^2. The sample failed at a deviator stress of 100 kN/m^2. The cohesion of this clay sample would be

(a) 25 kN/m^2

(b) 50 kN/m^2

(c) 75 kN/m^2

(d) 100 kN/m^2

96. Consider the following statements regarding permeability of soils :

1. Permeability of coarse grained soil is inversely proportional to the specific surface at a given porosity.
2. Direct measurement of permeability of a soil specimen at any stage of loading in oedometer test can be made only in fixed-ring type oedometer.
3. The permeability of an aquifer increases with decrease in temperature of water moving through it.

Which of the above statements are correct ?

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

97. Which of the following statements are correct ?

1. Stress Isobar can be prepared using Boussinesq's stress distribution theory.
2. Equivalent point load method yields accurate results.
3. Newmark's method relates the vertical stress with the help of influence chart.
4. Westergaard's method helps in determination of stress distribution for layered soils.

Select the correct answer using the codes given below :

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

98. Consider the following statements :

1. Functions of reinforcement in reinforced soil and in reinforced concrete are comparable.
2. The design of a geotextile reinforced wall is similar in principle to that of a reinforced earth wall.

Which of the above statements is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

99. Consider the following statements :

1. Immediate settlement takes place as soon as the load is placed.
2. Secondary settlement is significant in the case of organic soil.
3. Secondary settlement is estimated based on the 'void ratio versus time curve' for a particular load under consolidation test.

Which of the above statements are correct ?

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

100. In a plate load test on a soil, at a particular magnitude of the settlement, it was observed that the bearing pressure beneath the footing is 100 kN/m^2 and the perimeter shear is 25 kN/m^2. Correspondingly, the load capacity of a 2 m square footing at the same settlement will be

(a) 200 kN
(b) 300 kN
(c) 400 kN
(d) 600 kN

101. Consider the following statements :

1. According to Terzaghi, a foundation is shallow if its depth is equal to or less than its width.
2. Spread footing, strap footing and raft footing are types of shallow foundations.
3. Combined footing may be trapezoidal if the two columns carry unequal loads; and rectangular if both columns carry equal loads.
4. For water tanks, providing raft foundations will avoid unequal settlements.

Which of the above statements are correct ?

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 1, 2 and 4 only

(d) 3 and 4 only

102. Consider the following statements :

1. A braced cofferdam is used in shallow trench excavation as well as in deep excavation exceeding 6 m in depth.
2. Cofferdams, braced or un-braced, are temporary structures either on land or in water bodies.
3. When sheet piling is used for retaining soil, or soil and water, without any bracing, it is called a bulkhead.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

103. Consider the following statements :

1. The maximum shear stress is one half of the normal stress in the case of uniaxial stress field.
2. In a biaxial stress field, acted upon by normal stresses unaccompanied by shear stresses, the maximum shear stress is any one of the normal stresses.
3. The Mohr's stress circle will be tangential to the vertical axis in the case of uniaxial stress field.

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

104. A line PQ in an old map had magnetic bearing of N 57° E when the local magnetic declination was 2° E. If the magnetic declination is now 4° W, what will be the magnetic bearing of the line PQ now ?

(a) N 52° W

(b) N 63° E

(c) N 54° E

(d) N 52° E

105. Consider the following characteristics of contours :

1. A uniform slope is indicated when contour lines are uniformly spaced.
2. Contour lines cannot end anywhere but can close on themselves.
3. A set of closed contours indicates a depression or a summit, according to the lower or higher values being respectively inward.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1, 2 and 3

(c) 1 and 3 only

(d) 2 and 3 only

106. The type of levelling operations carried out for laying a railway track are

1. Longitudinal levelling (L.S.)
2. Fly levelling
3. Barometric levelling
4. Cross-sectioning

Select the correct answer using the codes given below :

(a) 1, 2 and 3 only

(b) 1, 3 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2 and 4 only

107. Two reservoirs maintain a constant difference of water levels of 11·25 m and are connected by a 10 cm diameter pipeline of 294·3 m length. The total of all head losses, by friction, valve losses, bend losses, inlet and exit losses, and velocity head can be taken as $98{\cdot}1\ v^2/2g$ (in m) where v is the flow velocity through the pipe (in m/sec). Assuming that the valve at the downstream end is suddenly opened so that there is no pressure wave, what will be the time taken for the velocity of flow in the pipe to attain 95% of the steady terminal velocity ? Take $\frac{1}{9{\cdot}81} = 0{\cdot}102$.

(a) $2{\cdot}25 \log_e 19$

(b) $2 \log_e 19$

(c) $2{\cdot}25 \log_e 39$

(d) $2 \log_e 39$

108. Cleavage is a mode of folding :

1. It is a process wherein all internal movements are along shear planes which do not change their position during the entire process.
2. It is a process wherein all internal movements are along shear planes which change their position during the process.
3. The process involves dilation in the vertical direction.
4. The process involves compression in a lateral direction.

Which of the above statements are correct ?

(a) 1, 2 and 3 only

(b) 1, 3 and 4 only

(c) 1, 2 and 4 only

(d) 2, 3 and 4 only

109. Consider the following statements concerning engineering geology :

1. Dams on sedimentary impervious strata dipping upstream will be unsafe.
2. In general, igneous rocks are hard and are suitable for construction of large hydraulic structures.
3. Construction of a major dam must be preceded by thorough geotechnical investigations.
4. Construction of dams is never indicated in any active zone of seismicity.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 4 only

(c) 2 and 3 only

(d) 3 and 4 only

110. For an unconfined aquifer, the specific yield is 20%, specific retention is 15%, and permeability is 35 m/day. Consider the following statements :

1. The porosity of the aquifer is 35%.
2. The transmissibility is 35 m^2/day.
3. The volume of water lost from storage per metre drop in the water table per 100 km^2 area of the aquifer is 20 million m^3.

Which of the above statements are correct ?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

111. The concentration of chloride ions in a water sample is estimated by titration with

(a) Sodium thiosulphate reagent using ferrion as an indicator

(b) Ferrous ammonium sulphate reagent using soluble starch as an indicator

(c) Silver nitrate reagent using potassium chromate as an indicator

(d) Silver nitrate reagent using potassium dichromate as an indicator

112. In revised CBR design method recommended by the IRC for the design of flexible pavement, the total thickness depends upon

(a) Only the CBR value of the soil

(b) The CBR value of the soil and magnitude of wheel load

(c) The CBR value of the soil and cumulative standard axle loads

(d) The CBR value of the soil and number of commercial vehicles passing per day

113. The following purposes served by a transition curve in a highway alignment include :

1. Gradual introduction of the centrifugal force on moving vehicles from zero on the straight alignment to a constant final value on the circular curve.
2. Enabling the gradual introduction of superelevation on the roadway.

Select the correct answer using the codes given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

114. The type of signalling system in which it is possible to vary the length of cycle, cycle division and the time schedule at each signal point is called

(a) Simultaneous system

(b) Alternate system

(c) Simple progressive system

(d) Flexible progressive system

115. Consider the following statements regarding pavements :

1. Rigid pavements are more suitable than flexible pavements for stage construction.
2. Rigid pavements are more affected by temperature variations than flexible pavements.
3. In a flexible pavement, any deformation in the top layers is transferred to underlaid layers; but, in rigid pavements, there is slab or beam action due to which any deformation is only in the top layer of the concrete slab.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

116. Consider the following statements concerning railways :

1. A level stretch equal to the maximum train length is to be provided between the gradient reaches where a rising gradient is followed by a falling gradient.
2. Vertical curves in railway tracks are not set out as parabolas.
3. Diamond crossings can be laid on curves also.
4. Curves should be avoided at the top level segment of bridges.

Which of the above statements are correct ?

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

117. Which of the following options increase the sensitivity of a bubble tube ?

1. Using a liquid of greater surface tension
2. Increasing the diameter of the tube
3. Increasing the length of the tube
4. Decreasing the diameter of the tube

Select the correct answer using the codes given below :

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

118. Consider the following statements in the context of capillary pressure in soils :

1. Pore water pressure is negative in capillary zone.
2. Water is in tension in capillary zone.
3. Capillary pressure is more in coarse grained soils.

Which of the above statements are correct ?

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

119. Consider the following statements :

For a rigid footing placed at the ground surface on sand, the contact pressure

1. is maximum at the edges.
2. is zero at the edges.
3. distribution is parabolic.
4. is uniform throughout the base of the footing.

Which of the above statements are correct ?

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

120. Consider the following statements as suggestive of the bearing capacity of soil :

1. The maximum net loading intensity at which neither the soil fails in shear nor is there excessive settlement detrimental to the structure.
2. The maximum net pressure which the soil can carry without shear failure.
3. The net ultimate bearing capacity of the soil divided by a factor of safety.

Which of the above statements is/are correct ?

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

Directions : *Each of the next* ***Thirty (30)*** *items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these 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

121. *Statement (I) :*

'Compreg' timbers have higher specific gravity of up to 1·30 and are stronger than other timbers.

Statement (II) :

Impregnation of resins and special curing methods are adopted to develop 'Compreg' timbers.

122. *Statement (I) :*

Deccan trap (basalt) is used in the foundations of blast furnaces.

Statement (II) :

Deccan trap has high compressive strength more than 150 N/mm^2.

123. *Statement (I) :*

Contemporarily, even in high-rise buildings, ordinary brick is being replaced by glass blocks for load-bearing walls.

Statement (II) :

Bricks have high thermal conductivity and are not heat insulators.

124. *Statement (I) :*

In recent practice, sponge iron replaces pig iron in large foundries.

Statement (II) :

Sponge iron can be produced in small plants using non-coking coal.

125. *Statement (I) :*

The fundamental storage equation through a river reach considers that the total inflow is balanced by total outflow plus the change in storage in the reach over the routing period as has been considered.

Statement (II) :

To be adaptable for actual computations, the storage equation is recast in the form

$$\frac{1}{2}(I_1 + I_2)\,t + (S_1 - \frac{1}{2}D_1\,t) = (S_2 + \frac{1}{2}D_2\,t),$$

where suffixes 1 and 2 denote values at start and end respectively, of the routing interval t, the I's and D's denote, respectively, the inflow and outflow at the respective points of time and the S's denote the storage in the reach at the respective point of time.

126. *Statement (I) :*

Hollow shafts are preferred in propeller shafts of airplanes.

Statement (II) :

Use of hollow shafts affords considerable reduction in the weight of the shaft for equal performance.

127. *Statement (I) :*

Foam glass is extensively used in air-conditioning units.

Statement (II) :

Foam glass is termite proof and non-combustible.

128. *Statement (I) :*

Slope-deflection method is a displacement method of analysis.

Statement (II) :

Forces are the basic unknowns in the slope-deflection method.

129. *Statement (I) :*

Hiring and firing is a poor substitute for proper selection and proper training of labourers.

Statement (II) :

Bad training facilities for new employees cause them to be discharged during or at the end of the probationary period.

130. *Statement (I) :*

When flow through a pipeline is measured through fixing a venturimeter, the computed flow will not be sensitive to the alignment of the centre line of the set-up — horizontal or sloping, up or down, along the flow direction.

Statement (II) :

The difference in the readings on the manometer limbs is by itself always adjusted for the ratio of the densities of the two liquids — the manometer liquid and the liquid whose flow rate is being measured — in the development of the formula for computing the discharge.

131. *Statement (I) :*

Collin's method for the determination of the unit hydrograph for a multi-period storm considers residuals as attributable to the unit graph of the period of the largest rain.

Statement (II) :

Collin's method is *ab initio* premised on the Bernard method where a unit graph is necessarily to be proportional to the net rain.

132. *Statement (I) :*

Tiny quantities of over 30 rare gases would warm the atmosphere over the Earth more rapidly than CO_2.

Statement (II) :

A single molecule of some CFCs, methane and nitrous oxide absorbs as much heat as 15,000 molecules, 25 molecules and 230 molecules of CO_2, respectively.

133. *Statement (I) :*

The invert of the lower (outgoing) larger size sewer is depressed suitably so as to match with the crowns of the upper (incoming) and the smaller size sewers.

Statement (II) :

It ensures that the smaller sewer runs full by backwater effect from the larger sewer even if the larger sewer does not run full.

134. *Statement (I) :*

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

Statement (II) :

Catabolism converts part of the food into waste products.

135. *Statement (I) :*

In the computations of velocity triangles, or the torque of well-encased roto-dynamic flow machines, whether of outward, or inward, flow type, the tangential component of velocity at the smaller radius flow section can be almost neglected.

Statement (II) :

This follows from the very concept of 'outward', or 'inward', flow — to a large extent — in visualizing the working features of the machine.

136. *Statement (I) :*

At shrinkage limit, the soil is fully saturated.

Statement (II) :

Montmorillonite clay minerals are non-expansive.

137. *Statement (I) :*

Cohesion and angle of internal friction are shear strength parameters of soils.

Statement (II) :

Cohesion is zero for pure sand and angle of internal friction is zero for pure clay.

138. *Statement (I) :*

Fine-grained soils are difficult to drain.

Statement (II) :

Capillary forces act on pore water.

139. *Statement (I) :*

Saturated fine, as well as medium, sands of uniform particle size are most susceptible to liquefaction.

Statement (II) :

Fine particles reduce the permeability which is a prime factor for liquefaction.

140. *Statement (I) :*

Reciprocal levelling is adopted to decide the difference of level between two points, a considerable distance apart, with great precision.

Statement (II) :

Reciprocal levelling eliminates errors due to curvature, refraction and collimation.

141. *Statement (I) :*

Curvature correction must be applied when the sights are long.

Statement (II) :

Line of collimation is not a level line but is tangential to the level line.

142. *Statement (I) :*

All old systems of surveying can be completely replaced by remote sensing system basing on INSAT data.

Statement (II) :

Reference data in-situ is essential in interpreting satellite imageries.

143. *Statement (I) :*

Mud bricks can be completely replaced by Fly ash lime-Gypsum (Fal-G) bricks in building.

Statement (II) :

Useful fertile soil is used in manufacturing mud bricks, causing high CO_2 release in the atmosphere.

144. *Statement (I) :*

Softening of clear groundwater should be carried out immediately after collection by pumping out, or from springs.

Statement (II) :

Iron and manganese precipitates can foul the exchange medium surface if oxidation occurs in, or prior to, the ion-exchange phase.

145. *Statement (I) :*

Consolidation is the process of expulsion of pore water by applying steady load for a long time.

Statement (II) :

Volume change occurs immediately after the action of the load in case of consolidation tests.

146. *Statement (I) :*

The stresses and strains in a soil mass depend on the stress-deformation characteristics, anisotropy and non-homogeneity of the soil and also on the boundary conditions.

Statement (II) :

Boussinesq's theory of stress distribution in soils deals with layered soils only.

147. *Statement (I) :*

When a loop rating curve is prepared at a gauging station when a flood wave passes, the maximum discharge occurs earlier than the maximum stage.

Statement (II) :

When a flood wave passes through a reach, during rising stages, some water may get into depressions on the floodplains of the river and, may be, only part of this spill returns to the channel runoff when flood levels recede.

148. *Statement (I) :*

The Muskingum method of routing a flood through a river reach is not a simple recast of the storage equation

$$I = D + \frac{d}{dt}(S).$$

Statement (II) :

The Muskingum method first develops trial storage loops considering contributions from both inflow and outflow and also the algebraic difference between them.

149. *Statement (I) :*

Incrustation of sand occurs in rapid sand filter when water softened by lime-soda is fed in for filtration.

Statement (II) :

The sand gets coated with precipitates of $Ca(OH)_2$ and $Mg(OH)_2$ generated during softening of water by lime-soda process which leads to incrustation of sand.

150. *Statement (I) :*

Dilution of the wastewater sample with organic-free, oxygen-saturated water is necessary to measure 5-day 20°C BOD values greater than 7 mg/*l*.

Statement (II) :

Saturation concentration of oxygen in water at 20°C is approximately 9 mg/*l*.

SPACE FOR ROUGH WORK

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