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Previous Year Paper
(Civil) 22 Jan 2023 Paper II

PAPER CODE	PAPER – II	Question Booklet Number
22122	**CIVIL ENGINEERING** (English)	**237658**

Question Booklet Number 237658

EEA-1222

Duration : 150 Minutes   **Max. Marks : 300**

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అభ్యర్థులకు సూచనలు

1. ప్రశ్నా పత్రం యొక్క సీల్ ను తెరిచే ముందు దాని పైన ముద్రించి ఉన్న పేపర్ కోడ్ ను మీ హాల్‌టికెట్‌లో ముద్రించబడిన ఆ సెషన్‌కు సంబంధించిన పేపర్ కోడ్‌తో సరిపోల్చుకోండి. ఒక వేళ ఆ రెండూ ఒక దానికొకటి భిన్నంగా ఉన్నచో ఆ విషయాన్ని ఇన్విజిలేటర్ దృష్టికి వెంటనే తీసుకెళ్ళి సరైన పేపర్ కోడ్ ఉన్న ప్రశ్న పత్రాన్ని అడిగి తీసుకోండి.

2. ప్రశ్నా పత్రాన్ని తెరచిన వెంటనే అందులోని 150 ప్రశ్నలు వాటికిచ్చిన ఆప్షన్లు అన్నీ సరిగ్గా ముద్రింపబడ్డాయో లేదో జాగ్రత్తగా పరిశీలించండి.

3. క్వశ్చన్ బుక్‌లెట్ నంబర్‌ను జాగ్రత్తగా పరిశీలించండి.

4. సమాధానాలను గుర్తించడానికి ప్రత్యేకంగా OMR సమాధాన పత్రాన్ని ఇవ్వడం జరుగుతుంది. అందులో హాల్‌టికెట్ నంబరు, క్వశ్చన్ బుక్‌లెట్ నంబర్, పేపర్ కోడ్, అభ్యర్థి సంతకం, ఇన్విజిలేటర్ సంతకాలకు సంబంధించిన వివరాలు నింపడానికి గడులు కేటాయింపబడి ఉంటాయి. గడులను నింపటానికి సీల్/నలువు (బ్లూ/బ్లాక్) బాల్ పాయింట్ పెన్నులను మాత్రమే ఉపయోగించాలి.

5. ప్రశ్న పత్రంలో కానీ, OMR సమాధాన పత్రంలో కానీ ఏవైనా లోపాలుంటే వాటిని మార్చవలసిందిగా వెంటనే ఇన్విజిలేటర్‌ను కోరవచ్చు.

6. సమాధాన పత్రాలను ఆప్టికల్ మార్క్ స్కానర్ వర్క్షా పద్ధతిలో మూల్యాంకనం చేస్తారు. కాబట్టి దానిపైన ఉన్న వృత్తాలను (జవాబులకు సంబంధించిన వృత్తాలతో సహా) నింపటానికి బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్నులను మాత్రమే ఉపయోగించాలి. పెన్సిల్ లేదా ఇంకు పెన్ను లేదా జెల్ పెన్నులతో బబ్లింగ్ చేయడం వర్క్షాలో అనుమతించబడదు. OMR పత్రంలో అభ్యర్థి తప్పులు రాసిన/దిద్దిన యెడల దానిని మార్చి ఇంకొకటి ఎట్టి పరిస్థితుల్లో ఇవ్వటం జరగదు.

7. ప్రశ్నా పత్రం పై క్వశ్చన్ బుక్‌లెట్ నంబర్ ముద్రింపబడి ఉంటుంది. ఇది ప్రశ్నా పత్రం కవర్ పేజీ పై కుడి మూలన ముద్రింపబడి ఉంటుంది. ఈ క్వశ్చన్ బుక్‌లెట్ నంబర్‌ను మీ సమాధాన పత్రం యొక్క సైడ్– 1 లో దానికి కేటాయించబడిన స్థలంలో బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్నుతో జాగ్రత్తగా నింపాలి.

1. Which of the following statements cannot be used to describe free flow speed (u_f) of a traffic stream ?

   (1) u_f is the speed when flow is negligible

   (2) u_f is the speed at which flow is maximum and density is optimum

   (3) u_f is affected by geometry of the road

   (4) u_f is the speed when density is negligible

2. What is the far end moment for a beam element of length L due to a settlement of δ at the near end ? The beam has the modulus of elasticity and moment of inertia as E and I, respectively.

   (1) $\dfrac{4EI\delta}{L^2}$ clockwise

   (2) $\dfrac{6EI\delta}{L^2}$ anti-clockwise

   (3) $\dfrac{6EI\delta}{L^2}$ clockwise

   (4) $\dfrac{4EI\delta}{L^2}$ anti-clockwise

3. For sand beds, the Darcy's law would be valid if the Reynold's number defined by R = ud50/v is less than

   (1) 0.2

   (2) 1000

   (3) 10

   (4) 1

4. Which method of Quarrying is suitable for costly, soft and stratified rocks ?

   (1) Excavating

   (2) Heating

   (3) Blasting

   (4) Wedging

5. A beam is prestressed by a straight tendon carrying a prestressing load P at an eccentricity e towards the bottom direction of the beam. Which match is the correct one for the beam ?

   A. Direct stress contribution to resultant stress at the top fibre due to prestressing force

   i. Minimum

   B. Stress contribution to resultant stress at the bottom fibre due to live load

   ii. Subtractive

   C. Maximum stress due to eccentricity

   iii. Additive

   D. Resultant stress at the bottom fibre

   iv. Bottom

   (1) A-iii, B-i, C-iv, D-ii

   (2) A-iv, B-ii, C-i, D-iii

   (3) A-iii, B-ii, C-iv, D-i

   (4) A-ii, B-i, C-iv, D-iii

6. If the Froude number of hydraulic jump is 5.5 it can be classified as

   (1) an oscillating jump

   (2) a steady jump

   (3) a strong jump

   (4) a weak jump

7. The estimated value of the property at the end of its life period, without being dismantled is called as

   (1) Salvage value

   (2) Book value

   (3) Scrap value

   (4) Market value

8. Which of the following statements is/are correct for a plane stress isotropic material problem ?

A. Three stress components can exist at a point.

B. Six stress components can exist at a point.

C. Three principal stresses can exist at a point.

D. Two principal stresses can exist at a point.

(1) A and C only   (2) A and D only

(3) D only   (4) B and D only

9. A beam is designed using M20 grade concrete and Fe415 is used for the tension reinforcement. If the diameter of the main steel is 12 mm, what is the minimum value of the development length (L_d) in mm to be provided in the support section ?

(1) 300   (2) 470

(3) 564   (4) 260

10. The field capacity of a certain soil is 20% and the specific gravity is 1.6. Before applying irrigation water, a wet sample of soil was taken and its mass was found as 150 gm after oven drying its mass was 136 g. Determine the depth of water that must be applied to irrigate the soil to a depth of 0.9 m.

(1) 90 mm   (2) 180 mm

(3) 140 mm   (4) 210 mm

11. Le-Chateliers Apparatus is used to measure the unsoundness of cement caused due to the presence of

(1) Unburnt lime (CaO)

(2) Unburnt lime (CaO) and unburnt magnesia (MgO) both

(3) Calcium sulphate ($CaSO_4$)

(4) Unburnt magnesia (MgO)

12. The specific gravity of particles of a sand is 2.64 and their porosity is 45% in loose state. The critical hydraulic gradient will be

(1) 0.66   (2) 0.947

(3) 0.901   (4) 0.747

13. Consider the following sets of derivatives for a prismatic beam.

A. Shear force   i. $\dfrac{d^2y}{dx^2}$

B. Loading intensity   ii. $\dfrac{d^3y}{dx^3}$

C. Bending moment   iii. $\dfrac{d^4y}{dx^4}$

D. Slope   iv. $\dfrac{dy}{dx}$

Which combination is the correct combination ?

(1) A-iv, B-i, C-ii, D-iii

(2) A-ii, B-iii, C-i, D-iv

(3) A-ii, B-i, C-iv, D-iii

(4) A-ii, B-i, C-iii, D-iv

14. The actual velocity of water flowing in a medium is observed as 0.30 m/s. The porosity of the medium is 0.40. The Darcy's velocity is

(1) 0.12 m/s

(2) 1.2 m/s

(3) 0.133 m/s

(4) 0.075 m/s

5

P.T.O.

15. A steady, incompressible flow is given by $u = 2x^2 + y^2$ and $v = -4xy$. What is the convective acceleration along x-direction at point (1, 2) ?
    (1) + 24 units
    (2) − 8 units
    (3) − 24 units
    (4) + 8 units

16. Match the name of stone in List 1 with the use of that stone in List 2 :

List – 1	List – 2
A. Granite	i. Ornamental work
B. Limestone	ii. Bridges
C. Marble	iii. Production of cement
D. Slate	iv. Flooring

    (1) A-iii, B-ii, C-i, D-iv
    (2) A-ii, B-iv, C-i, D-iii
    (3) A-iii, B-iv, C-i, D-ii
    (4) A-ii, B-iii, C-i, D-iv

17. The maximum number of vehicles observed in any five-minute period during the peak hour is 150. If the total flow in the peak hour is 1200 vehicles, the five-minute peak hour factor (round off to 2 decimal places) is
    (1) 0.67
    (2) 0.45
    (3) 0.52
    (4) 0.78

18. In a model experiment with weir, if the dimension of the model weir are reduced by a factor k, the flow rate through the model weir is the following fraction of the flow rate through the prototype
    (1) $k^{5/2}$ (2) $k^{3/2}$
    (3) 1   (4) k^2

19. Which of the following statements is/are correct for Maxwell's law of deflection ?
    A. The work done by a set of external forces F_m acting through displacements δ_{mn} produced by another set of forces F_n is equal to the work done by the set of forces F_n acting through displacements δ_{nm} produced by forces F_m. m and n are different set of points of a structure.
    B. The defection at any point δ_{nm} due to the force F_m is equal to the deflection at the other point δ_{mn} due to the force F_n. m and n are two different points of a structure.
    C. The slope at any point θ_{nm} due to the force F_m is equal to the slope at the other point θ_{mn} due to the force F_n. m and n are two different points of a structure.
    D. The moment at any point M_{nm} due to the force F_m is equal to the moment at the other point M_{mn} due to the force F_n. m and n are two different points of a structure.

    (1) A and D only   (2) C only
    (3) A and B only   (4) B only

20. The type of surveying in which the curvature of the earth is considered is called
    (1) Preliminary surveying
    (2) Plane surveying
    (3) Geodetic surveying
    (4) Topographical surveying

21. The initial depth of hydraulic jump in a rectangular channel is 0.2 m and the sequent depth ratio is 10. The length of the jump is about
    (1) 4 m   (2) 20 m
    (3) 12 m   (4) 6 m

22. Which of the following pairs are NOT correctly matched ?
    (1) PERT – Probabilistic approach
    (2) CPM – Float concept
    (3) PERT – Three-time estimate
   (4) PERT – Activity-oriented network model

23. In a Lacey's regime channel, the discharge is 100 m^3/s and the silt factor is 1 : 1. The regime longitudinal slope is about
    (1) 1/5100
    (2) 1/4100
    (3) 1/7100
    (4) 1/6140

24. Calculate the area in square meters enclosed between the survey line, the irregular boundary line, and the first and last offsets by Simpson's rule. The perpendicular offsets were taken at 20 m intervals from a survey line to an irregular boundary line: 2.35, 6.50, 5.40, 6.65, 7.85, 6.2, 2.35, 6.5, 5.65
    (1) 800
    (2) 950
    (3) 900
    (4) 850

25. What is the distribution factor for the CB element at point C in the beam given below ?

    50 kN   20 kN
    A   B   C   D
         I   2I   I
    2 m   3 m   3 m   2 m   2 m
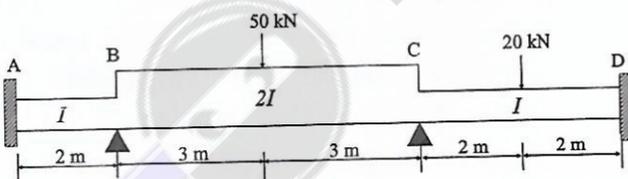
    (1) 0.50
    (2) 0.62
    (3) 0.40
    (4) 0.57

26. Convert the circle bearing of 211°54′ to quadrantal bearing.
    (1) S 31° 54′ W
    (2) N 31° 54′ W
    (3) N 31° 54′ E
    (4) S 31° 54′ E

27. The 3-hr UH of a basin can be approximated as a triangle with a base period of 20 hour and peak coordinate of 300 m^3/s. The area of the basin is
    (1) 540 km^2
    (2) 6000 km^2
    (3) 300 km^2
    (4) 1080 km^2

28. Consider the following statement with respect to cements :
    A. Vinsol resin or vegetable fats and oils and fatty acids are ground with ordinary cement to air entraining cement.
    B. Extra rapid hardening cement is prepared by adding 2% of calcium chloride.
    Identify the correct statement.
    (1) Statement B is true and A is false
    (2) Both A and B are true
    (3) Both A and B are false
    (4) Statement B is false and A is true

29. On a section of a highway the speed-density relationship is linear and is given by $v = 100 - \frac{5}{6}k$; where v is in km/h and k is in veh/km. The capacity (in veh/h) of this section of the highway would be
    A. Free flow speed is 100 kmph and jam density is 120 veh/km
    B. Maximum flow rate is 3000 veh/h and critical density is 60 veh/km
    C. Maximum flow rate is 6000 veh/h and critical density is 120 kmph
    D. Free flow speed is 120 kmph and jam density is 100 veh/km

    Which of the above statement is/are correct ?
    (1) A and C only
    (2) A and B only
    (3) D and C only
    (4) B and D only

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30. Which of the following statements is/are correct while analyzing an indeterminate structure ?

A. The force method requires to satisfy equilibrium condition.

B. The force method requires to satisfy compatibility condition.

C. The displacement method requires to satisfy force-displacement for a structure.

D. The displacement method requires to satisfy compatibility condition.

(1) B and C only
(2) D only
(3) B only
(4) A and C only

31. A fluid of jet of cross section Area A and velocity V strikes a flat plate moving with a velocity u. The fluid mass striking it per second is

(1) ρAV
(2) ρAu
(3) $\rho A(u - V)$
(4) $\rho A(V - u)$

32. In long and short wall method of estimation, the length of long wall is the centre to centre distance between the walls and

(1) breadth of the wall on each side
(2) half the breadth of the wall on one side
(3) breadth of wall only on one side
(4) half breadth of wall on each side

33. At a rated capacity of 44 cumecs, centrifugal pump develops 36 m of head when operating at 1450 rpm. The specific speed of the pump is

(1) 65.44
(2) 100.44
(3) 1654.44
(4) 654.44

34. Calculate the coefficient of permeability in m/sec, if the coefficient of consolidation and volume changes are 4.8 mm²/min and 1.02×10^{-3} m²/kN.

(1) 4.8×10^{-8}
(2) 4.8×10^{-10}
(3) 8.0×10^{-10}
(4) 8.0×10^{-9}

35. The resistance of stones against the grinding action under traffic is measured by

(1) Abrasion test
(2) Crushing strength test
(3) Hardness test
(4) Attrition test

36. A circular dug well in fine sand region has a yield of 15 l/s under a depression head of 4 m. Assuming specific capacity per unit area as 0.8/h, the bottom diameter of the dug well is

(1) 2.65 m
(2) 3.5 m
(3) 1.7 m
(4) 4.64 m

37. A steel pipe of length 3 m has outer and inner diameters of 150 mm and 125 mm, respectively. The pipe was held fixed at both ends and the pipe temperature was 20°C when fixed. During the use, cold fluid moves through the pipe. As a result, the uniform temperature of the pipe becomes −15°C. What will be the force on the fixed joint neglecting gravitational forces ? The coefficient of linear expansion and the modulus of elasticity for the pipe are 10×10^{-6}/°C and 200 GPa respectively.

(1) 120.31 π kN
(2) 130.31 π kN
(3) 125.31 π kN
(4) 110.31 π kN

38. A hydraulic jump occurs when there is a break in grade from a
   (1) Mild slope to steep slope
   (2) Mild slope to milder slope
   (3) Steep slope to steeper slope
   (4) Steep slope to mild slope

39. Match the kinematic indeterminacy of the following structures neglecting axial strain.

   A. One span beam fixed at both ends — i. 5
   B. Two span continuous beam hinged at all supports — ii. 24
   C. Five span continuous beam with fixed at one end and rollers at other supports — iii. 0
   D. One bay one storey space frame fixed at all supports — iv. 3

   (1) A-iv, B-iii, C-i, D-ii
   (2) A-iv, B-i, C-iii, D-ii
   (3) A-iii, B-i, C-iv, D-ii
   (4) A-iii, B-iv, C-i, D-ii

40. Cube rate estimate is _____ as compared to the plinth area estimate.
   (1) equally accurate   (2) similar
   (3) more accurate   (4) less accurate

41. A compacted fill was 8m thick has its void ratio as 1.2. The fill was loaded on surface by constructing an embankment covering a large area of fill. Some days after the embankment was constructed measurements of fill indicated an average void ratio of 0.8. Estimate compression of fill.
   (1) 2.5   (2) 2.45
   (3) 1.35   (4) 1.45

42. A prismatic circular bar is situated in the x-y-z coordinate system with the length L measured in the x direction. We measure the shear stress at a radius ρ from the center and the shear modulus of elasticity is G. The polar moment of inertia of the bar is J. What is the strain energy for the member when subjected to torsion T ?

   (1) $\int_L \dfrac{T^2}{2GJ}\left[\int\int \rho^2 dy\, dz\right] dx$

   (2) $\int\int\int \dfrac{T^2}{2GJ} dx\, dy\, dz$

   (3) $\int\int\int \dfrac{T^2}{2GJ^2} dx\, dy\, dz$

   (4) $\int_L \dfrac{T^2}{2GJ^2}\left[\int\int \rho^2 dy\, dz\right] dx$

43. A vehicle has a wheel base of 6.0 m. What is the off-tracking in metres while negotiating a curve path with a mean radius of 60 m ?
   (1) 0.50   (2) 0.30
   (3) 0.60   (4) 0.15

44. Arrange the steps of production of cement in chronological order.

   A. blending the materials in the correct proportions
   B. grinding the clinker and gypsum
   C. crushing and grinding the raw materials
   D. burning the prepared mix in a kiln

   (1) A, D, B, C
   (2) A, C, D, B
   (3) A, B, C, D
   (4) C, A, D, B

45. The silt factor f as used by Lacey's in his regime theory was adjusted to be equal to 1 for silt in an alluvium region. What is the median size of the alluvium soil?

(1) 0.28 mm   (2) 2.8 mm

(3) 3.2 mm   (4) 0.32 mm

46. In channel routing using the Muskingum method, the value of the routing coefficients C_0 and C_1 are estimated as -0.3 and 0.6 respectively. The value of the C_2 is

(1) 0.3   (2) -0.5

(3) 0.4   (4) 0.7

47. Admixtures used to produce high strength concrete and reduce the water-cement ratio of concrete are called

(1) Air entraining admixtures

(2) Superplasticizers

(3) Accelerators

(4) Retarders

48. A road is being designed for a speed of 100 km/hr on a horizontal curve with a super elevation of 7%. If the coefficient of side friction is 0.15, the minimum radius of the curve (in m) required for safe vehicular movement is

(1) 144.8   (2) 357.9

(3) 178.9   (4) 202.1

49. Analysis of data on maximum one day rainfall depth at Hyderabad showed that a depth of 300 mm had a return period of 80 years. The probability of a one-day rainfall depth equal to or greater than 300 mm at Hyderabad occurring at least once is 80 years is

(1) 0.314   (2) 0.0125

(3) 0.125   (4) 0.341

50. A theodolite is placed at P and a 5 m long vertical staff is held at Q. The depression angle made at reading 3.5 m marking on staff is 7°15′. The horizontal distance between P and Q is 2500 m. The height of instrument at P is 1.5 m and reduced level of point P is 980.450 m. Using curvature correction and refraction correction determine the RL of point Q (in m).

(1) 660.830   (2) 975.450

(3) 660.410   (4) 976.950

51. Cavitation in fluid flow occurs when

(1) the total energy suddenly increases

(2) the velocity head reduces to zero

(3) the pressure of flow decreases to a value close to its vapour pressure

(4) the total energy suddenly decreases

52. For an isotropic material, which of the following statements is/are correct ?

A. The properties are same at all the points throughout the material, but different properties can be there in three directions at a point.

B. The properties at a point are same in three different directions.

C. The property in two directions is same, but it is different in one direction at a point.

D. The properties are same at all the points throughout the material, and same properties observed in all three directions at a point.

(1) A and B only

(2) A and D only

(3) C and D only

(4) B and D only

53. In steady flow through a pipe the density, velocity and area of a section are 3 kg/m³, 8m/s and 0.5m² respectively. The velocity at another section having area of 1m² and density of 4 kg/m³ will be

(1) 2 m/s   (2) 1 m/s

(3) 4 m/s   (4) 3 m/s

54. In which type of contract, measurement of executed items are NOT required to keep ?

(1) Percentage Rate Contract

(2) Lump-Sum Contract

(3) Cost Plus Contract

(4) Item-Rate Contract

55. The coefficient of average rolling friction of a road is f_r and its grade is + G%. If the grade of this road is doubled, what will be the percentage change in the braking distance (for the design vehicle to come to a stop) measured along the horizontal (assume all other parameters are kept unchanged) ?

(1) $\dfrac{2f_r}{f_r + 0.01\,G} \times 100$

(2) $\dfrac{0.02\,G}{f_r + 0.01\,G} \times 100$

(3) $\dfrac{f_r}{f_r + 0.02\,G} \times 100$

(4) $\dfrac{0.01\,G}{f_r + 0.02\,G} \times 100$

56. The total float can be expressed as

A. latest start time – earliest start time

B. latest finish time – earliest finish time

Identify the correct statement.

(1) Statement B is true and A is false

(2) Both A and B are true

(3) Both A and B are false

(4) Statement B is false and A is true

57. A 1.25 m layer of soil having the porosity 0.35 and specific gravity 2.65 is subjected to an upward seepage head of 1.85 m. What depth of coarse sand would be required above the existing soil to provide a factor of safety of 2 against piping ? Assume that coarse sand has the same porosity and specific gravity as the soil and there is negligible head loss in sand.

(1) 1.25   (2) 4.4

(3) 2.2   (4) 2.7

58. Consider the following statements related to a horizontal venturimeter.

A. The velocity of flow in the main pipe is greater and the pressure is lesser than that at the throat section.

B. The velocity of flow in the main pipe is lower and the pressure is larger than that at the throat section.

C. The pressure difference between the main pipe and throat section is positive.

D. The pressure difference between the main pipe and throat section is negative.

Which of these statements are NOT correct ?

(1) A and D only

(2) C and D only

(3) B and D only

(4) A and B only

59. A water tank supported by a ring foundation having outer diameter of 8 m and thickness of 1m carries a uniform load intensity of 200 kN/m². The vertical stress (in kN/m²) caused by the water tank at a depth of 4 m below the center of foundation is

(1) 15.8 kN/m²   (2) 51.4 kN/m²

(3) 10 kN/m²   (4) 31.7 kN/m²

60. Consider the following statements :
   A. Efflorescence is the appearance of white powder on the surface of bricks.
   B. Efflorescence is caused by the presence of chalk in the brick earth.
   C. Moderate efflorescence – covering upto 50% area of the brick.
   D. Moderate efflorescence – covering less than 10% area of brick.
   Which of the above statements is/are correct ?
   (1) A and B
   (2) B and C
   (3) B and D
   (4) A and C

61. The depth of scour according to Lacey's formula in a river represents the depth below the
   (1) maximum flood level in the river
   (2) maximum depth of scour in the channel
   (3) 1.2 m above the flood level
   (4) bed level of the river

62. A pitot tube is an instrument for measuring
   (1) Pressure of flow
   (2) Total energy
   (3) Velocity of flow
   (4) Discharge of fluid

63. Match the following for a body under plane stress condition.

A. Distance of the center of the Mohr's circle from origin of coordinates	i.	Difference between normal stresses divided by 2
B. The diameter of the Mohr's circle	ii.	Shear stress
C. Distance of maximum normal stress from the center of Mohr's circle	iii.	Average normal stress
D. Vertical direction of the Mohr's circle	iv.	Difference between major principal stresses

   (1) A-iii, B-iv, C-ii, D-i
   (2) A-iv, B-i, C-iii, D-ii
   (3) A-iii, B-iv, C-i, D-ii
   (4) A-iv, B-iii, C-i, D-ii

64. If the formation level of a highway has a uniform gradient for a particular length and the ground is also having a longitudinal slope, the earthwork cannot be calculated by
   (1) Mid-section formula
   (2) Central line method
   (3) Prismoidal formula
   (4) Trapezoidal formula

65. If duty is 1500 hec/cumec and base period of 150 days for an irrigated crop, the delta of the crop will be
   (1) 86.4 cm
   (2) 0.864 mm
   (3) 86.4 mm
   (4) 864 cm

66. Match the shear force diagrams for the beams with different loadings.

   (1) A-i, B- ii, C-iv, D-iii
   (2) A- i, B-iii, C-iv, D-ii
   (3) A-ii, B-iii, C-iv, D-i
   (4) A-ii, B-iii, C-i, D-iv

67. The momentum correction factor is used to correct for
   (1) change in pressure
   (2) non-uniform distribution of velocities at inlet and outlet sections
   (3) change in total energy
   (4) change in mass rate of flow

68. Consider the following :

A. Honeycombing — i. Rise of water to surface of freshly placed concrete

B. Bleeding — ii. Separation of concrete constituent materials due to gravity

C. Thermal shrinkage — iii. Hollow spaces and cavities left in concrete mass

D. Segregation — iv. Volume reduction of concrete due to temperature variation

Choose the option in which given pairs are correctly matched.

(1) A-i, B-iv, C-ii, D-iii
(2) A-ii, B-i, C-iv, D-iii
(3) A-iii, B-i, C-iv, D-ii
(4) A-iii, B-iv, C-i, D-ii

69. In a 1 : 50 model of stilling basin filled with water, energy dissipation in model is 0.5 kW. The corresponding energy dissipation in prototype for same fluid will be

(1) 1.25 MW
(2) 441.94 MW
(3) 321.5 MW
(4) 62.5 MW

70. The bending moment, modulus of elasticity and the moment of inertia of a beam are given by M, E and I, respectively. According to elastic beam theory, what is the radius of curvature ?

(1) $\frac{M}{EI}$
(2) EI
(3) $\frac{1}{EI}$
(4) $\frac{EI}{M}$

71. A vertical cut is made in saturated clay with $c = 30$ kN/m^2, phi = 0° and $\gamma = 20$ kN/m^3. What is the theoretical depth to which clay can be excavated without side collapse ?

(1) 1.4 m
(2) 6 m
(3) 2.8 m
(4) 12 m

72. Compressive strength of concrete mainly depends upon

(1) Grading of aggregate
(2) Quantity of aggregate
(3) Water-cement ratio
(4) Quantity of cement

73. Which of the following pairs is/are incorrect ?

A. Castigliano's theorem — Deflection
B. Flexibility method — Consistent displacement method
C. Stiffness method — Degree of static indeterminacy
D. Betti's law — Reciprocal deflection

(1) C only
(2) A and B only
(3) D and B only
(4) C and D only

74. The frequency distribution of duration of an individual activity takes the shape of _____ as per the PERT analysis.

(1) Normal distribution
(2) Beta distribution
(3) Log-Normal distribution
(4) Gamma distribution

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P.T.O.

75. dy/dx is negative in the following GVF profiles

(1) M1, S2, A2
(2) A3, A2, M2
(3) M2, A2, H2
(4) M2, A2, S3

76. Consider the following statements from IS 800 : 2007

A. The maximum value of the effective slenderness ratio of compression flange of a beam against lateral torsional buckling is 300.

B. The partial safety factor for the combination of dead load, live load, crane load and wind load under the limit state of serviceability is 1.0.

C. The partial safety factor for the resistance of members to buckling is 1.25.

D. The design strength for bolted connections due to block shear failure requires only net areas.

Which of the above-mentioned statements is/are correct ?

(1) A and C only
(2) B and C only
(3) A and B only
(4) B and D only

77. The average spacing between vehicles in a traffic stream is 20 m, then the density (in veh/km) of the stream is

(1) 120
(2) 80
(3) 50
(4) 20

78. Convective precipitation is caused when

(1) rising of moist air due to surface heating

(2) when air mass pass over the mountain region and gets cooled

(3) when the cooler air mass forms wedge and lifts the warm air mass

(4) there is a frontal mechanism

79. The correct arrangement of different voids of concrete according to their size is

(1) entrapped voids > entrained voids > capillary voids > gel voids

(2) entrapped voids > entrained voids > gel voids > capillary voids

(3) capillary voids > entrapped voids > entrained voids > gel voids

(4) entrained voids > entrapped voids > capillary voids > gel voids

80. A two-dimensional water jet strikes a fixed two-dimensional plate and splits into two streams such that the ratio of discharge is 3. The angle of water jet striking normal to a plates is

(1) 45°
(2) 30°
(3) 60°
(4) 75°

81. The St. Venant Equations for unsteady open channel flow are

(1) continuity and momentum equations

(2) energy and continuity equations

(3) momentum and energy equations

(4) momentum in two different forms

82. What is the correct increasing order of the following materials with respect to their Poisson's ratio?

A. Magnesium alloys

B. Cast iron

C. Aluminum alloys

D. Nickel

(1) D, B, A, C
(2) A, C, B, D
(3) B, D, C, A
(4) C, A, B, D

83. Premature stiffening of cement pastes due to conversion of hemihydrate ($CaSO_4 \cdot H_2O$) or anhydrite ($CaSO_4$) to gypsum can be eliminated by

(1) Reducing C_3A content of cement

(2) Adding accelerating admixtures to concrete

(3) Continuous mixing or by reworking

(4) Reducing gypsum content of cement

84. While aligning the hill road with a rolling gradient of 7 percent, a horizontal curve of radius 100 m is encountered. What is the compensated gradient in percentage as per IRC ?

(1) 5.5

(2) 6.0

(3) 5.7

(4) 6.25

85. A syphon aqueduct is provided when

(1) the canal bed level is well below the flood level of the drain

(2) the canal bed level is above the flood level of the drain

(3) the drain bed level is well below FSL of the canal

(4) the canal bed level lies between the bed level and HFL of the drain

86. For a plane strain problem, the number of non-zero stress components will be

(1) 2

(2) 1

(3) 4

(4) 3

87. A surveyor measured the distance between two points on a plan drawn to a scale of 1 cm = 100 m and the result was 333 m. Later, however, he discovered that he used a scale of 1 cm = 25 m. Find the true scale distance between the points.

(1) 666

(2) 999

(3) 1665

(4) 1332

88. For a long pipe carrying liquid from one reservoir to another, at the exit section of the pipe, the energy grade line will

(1) meet the liquid surface

(2) lie at a distance ($v^2/2g$) below the liquid surface

(3) lie at a distance ($v^2/4g$) below the liquid surface

(4) lie at a distance ($v^2/2g$) above the liquid surface

89. If the plate load test shows settlement of plate as 15 mm, for a 400 mm wide plate then how much more settlement a footing of width 1.2 m will have for a clayey soil compared to sandy soil ?

(1) 74.4 mm

(2) 12.4 mm

(3) 15.6 mm

(4) 45.6 mm

90. According to IS 10262:2019, the relationship between target mean compressive strength (f_t) and characteristic compressive strength (f_{ck}) of concrete is

(1) $f_t = f_{ck} + 1.05 \times$ standard deviation

(2) $f_t = f_{ck} + 1.25 \times$ standard deviation

(3) $f_t = f_{ck} + 0.65 \times$ standard deviation

(4) $f_t = f_{ck} + 1.65 \times$ standard deviation

91. Consider the following statements from IS 456 : 2000 code
    A. The standard deviation for M 15 concrete is 4.0 N/mm² in case of concrete mix.
    B. A minimum 2 samples should be tested for 15 m³ of concrete.
    C. Basic value of span to effective depth ratio for a cantilever beam up to 10 m is 7.
    D. Design bond stress for M35 concrete in limit state method for plain bars in tension is1.5 N/mm².

    Which of the above mentioned statements is/are incorrect ?
    (1) A and B only
    (2) B and D only
    (3) A and D only
    (4) B and C only

92. A linear relationship is observed between speed and density on a certain section of a highway. The free flow speed is observed to be 100 km per hour and the jam density is estimated as 120 vehicles per km length. Based on the above relationship, the maximum flow expected on this section and the speed at the maximum flow will be respectively
    (1) 6000 vehicles per hour and 100 km per hour
    (2) 6000 vehicles per hour and 50 km per hour
    (3) 3000 vehicles per hour and 100 km per hour
    (4) 3000 vehicles per hour and 50 km per hour

93. For a beam element, the bending moment, modulus of elasticity and the moment of inertia are given by M , E and I, respectively. What is the flexural rigidity of the beam element ?
    (1) $\frac{M}{EI}$
    (2) $\frac{EI}{M}$
    (3) $\frac{1}{EI}$
    (4) EI

94. The separation of the boundary layer takes place when the pressure gradient is
    (1) Negative
    (2) Constant
    (3) Zero
    (4) Positive

95. The manometer shown in the given figure, connects two pipes carrying oil and water then
    (1) If $S_1 < S_2$ the pressure in the pipes are equal
    (2) Insufficient data to compare
    (3) If $S_1 < S_2$ the pressure in the water pipe is higher
    (4) If $S_1 < S_2$ the pressure in oil pipe is higher

    where S_1 and S_2 are Specific Gravity of oil and water respectively.
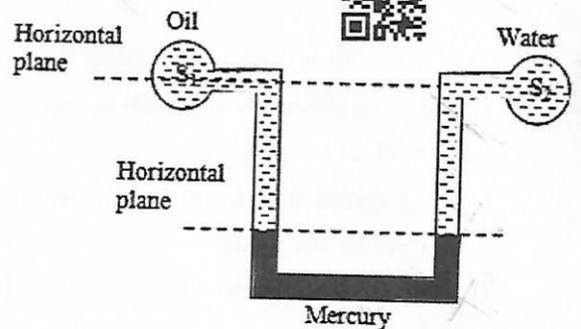
96. A tube well commands 20 hectares of land under rice. When the well is discharging at a constant rate, the water level in the well drops to 120.2 m. The level of highest land is 129 m. The duty of rise is 800 ha/cumec on the field. For the pump efficiency of 60%, input power of the pump is
    (1) 4.32 Kw
    (2) 3.59 Kw
    (3) 4.56 Kw
    (4) 4.82 Kw

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97. Arrange the steps of preparation of brick earth in chronological order :
    A. Unsoiling
    B. Cleaning
    C. Digging
    D. Blending
    E. Weathering
    F. Tempering
    (1) A, B, C, D, E, F
    (2) A, C, B, D, E, F
    (3) A, F, B, E, D, C
    (4) A, C, B, E, D, F

98. Consider the following statements :
    A. Running speed is higher than journey speed
    B. Journey speed includes delays
    C. Journey speed is the average speed maintained by a vehicle over a given course while vehicle is in motion
    D. Running speed is known as the overall travel speed.
    Which one of the above statements is/are correct ?
    (1) C and D only
    (2) A and D only
    (3) A and B only
    (4) B and C only

99. The survey carried out to delineate natural features such as hills, rivers, forests and man made features, such as towns, villages, buildings, roads, transmission lines and canals is classified as
    (1) Land survey
    (2) Topographic survey
    (3) Geological survey
    (4) Engineering survey

100. Write the correct decreasing order with respect to the number of stress components for the following case.
    A. An axially loaded member
    B. Plane strain problem
    C. Plane stress problem
    D. A single point of a three-dimensional structure
    (1) D, B, C, A
    (2) C, D, B, A
    (3) B, D, C, A
    (4) D, C, B, A

101. A 300 mm plate with a thickness of 6 mm of grade Fe 410 is used as a tension member, as shown in the figure. The plate is connected to a 12 mm thick gusset plate using 20 mm diameter bolts of grade 4.6. The distances between the bolts are the same as the ones mentioned in the figure. What is the effective net area for the tension member ?
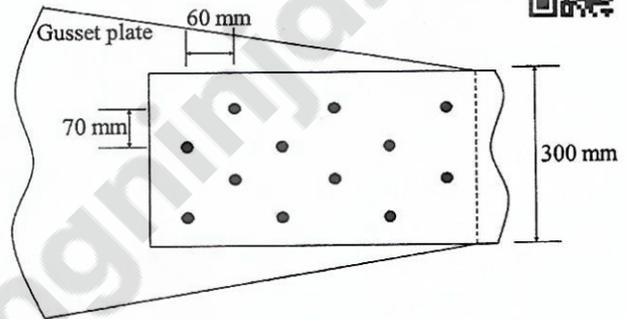
    (1) 1536.00 mm^2
    (2) 1473.24 mm^2
    (3) 1481.14 mm^2
    (4) 1503.43 mm^2

102. Match the following :

| A. Tacheometry | i. Angular Surveying |
B. Contouring	ii. Horizontal and Vertical angles
C. Levelling	iii. Bearing
D. Theodolite	iv. Equal elevation
E. Compass	v. Elevation

    (1) A-i, B-iv, C-v, D-ii, E-iii
    (2) A-ii, B-v, C-iv, D-iii, E-i
    (3) A-iii, B-i, C-ii, D-v, E-iv
    (4) A-ii, B-iii, C-i, D-iv, E-v

103. Match the following.

A.	Cautionary sign	i.	Downward equilateral triangle
B.	Indication sign	ii.	Octagonal
C.	Yield sign	iii.	Upward equilateral triangle
D.	Prohibitory sign	iv.	Rectangular
E.	Stop sign	v.	Circular

(1) A-i, B-ii, C-iii, D-iv, E-v
(2) A-v, B-iv, C-ii, D-i, E-iii
(3) A-ii, B-i, C-v, D-iii, E-iv
(4) A-iii, B-iv, C-i, D-v, E-ii

104. A dry sand specimen failed in a traxial test when the major and minor principal stresses were respectively $900 \, kN/m^2$ and $250 \, kN/m^2$. If same specimen is tested in direct shear test under a normal stress of $100 \, kN/m^2$ shear stress will be equal to

(1) $68.5 \, kN/m^2$
(2) $575 \, kN/m^2$
(3) $550 \, kN/m^2$
(4) $650 \, kN/m^2$

105. Corrosion of reinforcement in concrete can be caused by the ingress of

(1) Sulphates and chlorides
(2) Carbon dioxide and alkalis
(3) Alkalis and sulphates
(4) Chlorides and carbon dioxide

106. Calculate the critical depth corresponding to a discharge of $8 m^3/s$ in a rectangular channel of width 4m. Take $g = 10 m/s^2$

(1) $(0.5)^{1/3}$m
(2) $(0.4)^{1/3}$m
(3) $(0.2)^{1/3}$ m
(4) $(0.8)^{1/3}$m

107. A precast concrete pile of size $50 \, cm \times 50 \, cm$ is to be driven into clay strata whose unconfined compressive strength is $220 \, kN/m^2$ and adhesion factor = 0.6. The length of the pile required to carry safe working load of 450 kN with factor of safety of 2.5 is

(1) 6.647 m
(2) 10.23 m
(3) 2 m
(4) 3.3 m

108. What is the anchorage length of d diameter Fe 415 bars in M30 concrete column in compression ? Assume $\sigma_s = 0.75 f_y$.

(1) 41.50d
(2) 51.87d
(3) 32.42d
(4) 25.94d

109. The weight of water to be added in kN per m^3 to make the soil saturated (with specific gravity = 2.7) having moisture content = 20% and void ratio = 0.72 is

(1) 1.025
(2) 0.51
(3) 9.81
(4) 10.025

110. A point load of 500 KN applied on the surface of thick layer of saturated clay. Using Boussinesq's elastic analysis the estimated vertical stress at a depth of 3 m and a radial distance of 2 m from the point of application of load is

(1) 6.7 kPa
(2) 2.3 kPa
(3) 5.5 kPa
(4) 10.58 kPa

111. Consider the following statements :

A. The pH value of water for making concrete should be more than 8.5 to produce corrosion-resistant concrete.

B. The presence of sugar causes retardation in the setting of concrete.

C. Entertained air voids reduce resistance against freeze-thaw deterioration.

D. Chlorides should be less than $0.6 \, kg/m^3$ in the water used for construction of reinforced concrete.

Which of the above statements is/are correct ?

(1) A and B
(2) B and C
(3) B and D
(4) A and C

112. What is the plastic moment for the frame as shown in the figure ? All members of the frame have the same plastic moment capacity M_p.
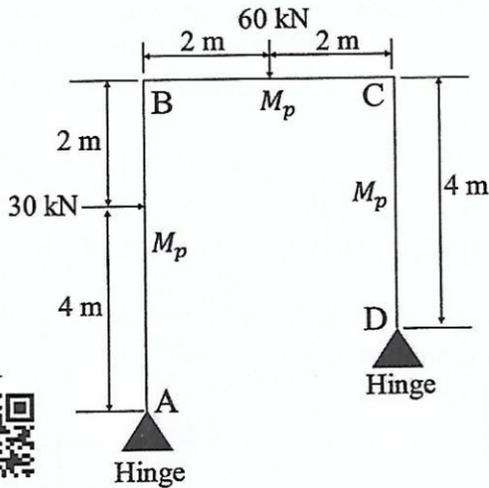
(1) 53.33 kNm   (2) 36.92 kNm

(3) 48 kNm   (4) 63.33 kNm

113. The extra widening required for a three-lane national highway at a horizontal curve of 900 m radius, considering a wheel base of 6 m and a design speed of 100 kmph is

(1) 0.41   (2) 0.61

(3) 0.51   (4) 0.31

114. A 24 hr rainfall of 50 cm magnitude at a station located in hilly terrains has a return period of 50 years. The probability of having 3 succeeding years in which rainfall is greater than or equal to 50 cm is

(1) 8×10^{-4} (2) 8×10^{-6}

(3) 6×10^{-6} (4) 4×10^{-6}

115. For a three-dimensional problem, the stress components altogether is a tensor of order

(1) 0   (2) 3

(3) 2   (4) 1

116. The observed bearings of a traverse are given below :

Line	Bearing	Line	Bearing
PQ	45°15′	QP	225°15′
QR	107°15′	RQ	286°15′
RS	202°30′	SR	21°30′
ST	320°45′	TS	141°45′

The stations(s) most likely to be affected by the local attraction is/are

(1) Only R   (2) Q and R

(3) R and S   (4) Only S

117. Find out the length of transition curve for a broad-gauge curve of 3 degrees having a cant of 12 cm. The maximum permissible speed on the curve is 100 km/hr and the allowable cant deficiency is 85 mm.

(1) 86.40   (2) 89.40

(3) 87.60   (4) 62.04

118. M20 grade of concrete is approximately

(1) 1 : 1.5 : 3   (2) 1 : 4 : 8

(3) 1 : 1.5 : 2   (4) 1 : 2 : 4

119. If in a gradually varied flow dy/dx is positive, then dE/dx is equal to

(1) $S_o - S_f$ (2) $S_o(1 - F^2)$

(3) $S_o - S_f - dy/dx$ (4) $S_f - S_o$

120. A retaining wall, 8m high with a smooth vertical back, retains a clay backfill with $C' = 15$ kN/m², $\varnothing' = 15°$ and $\gamma = 18$ kN/m³. Assume that the tension cracks may develop to the full theoretical depth, the active thrust on the wall is

(1) 23 kN/m²   (2) 20 kN/m²

(3) 46 kN/m²   (4) 61.67 kN/m²

P.T.O.

121. Consider the following :

A. Earnest money deposit	i. Settlement of a dispute by the decision of third person
B. Security deposit	ii. Offer in writing to execute some specified works
C. Arbitration	iii. Deposited by the contractor to safeguard the interests of the owner in the event of improper performance of the contract
D. Tender	iv. Guarantee in the form of cash on the part of the contractor to keep open the offer for consideration

   Choose the option in which given pairs are correctly matched.
   (1) A-iv, B-iii, C-i, D-ii
   (2) A-ii, B-i, C-iv, D-iii
   (3) A-i, B-ii, C-iv, D-iii
   (4) A-iii, B-iv, C-i, D-ii

122. The diurnal variation is
   A. More at magnetic poles and less at equator
   B. Does not changes from year to year
   C. More in winter and less in summer
   D. More in day time and less in night time
   (1) A and D   (2) B and D
   (3) A and B   (4) B and C

123. An instantaneous unit hydrograph is a hydrograph of
   (1) unit duration and indefinitely small rainfall excess
   (2) instant runoff from a unit area of catchment
   (3) infinitely small duration and of unit rainfall excess
   (4) instant duration and infinite rainfall excess

124. Order the following structures with respect to their increasing static indeterminacy.
   A. A two-span continuous beam hinged at one end and rollers at the other supports.
   B. A two span continuous beam fixed at one end and rollers at the other supports.
   C. A fixed-fixed beam with two internal hinges.
   D. A one bay one storey fixed-fixed frame.
   (1) C, A, D, B   (2) C, A, B, D
   (3) C, B, D, A   (4) C, D, B, A

125. What is the kinematic indeterminacy of the frame shown in the figure ?
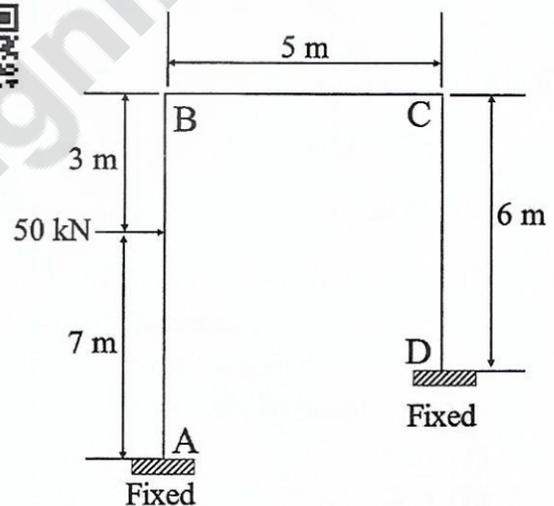
   (1) 2   (2) 4
   (3) 1   (4) 3

126. Isogonic line is line of
   (1) Positive declination
   (2) Negative declination
   (3) Same declination
   (4) Zero declination

127. What will be depth of d/s cutoff wall if maximum static head, length of floor and safe exit gradient is 2.4 m, 21.45 m and 1/5 respectively ?
   (1) 2.56 m   (2) 0.64 m
   (3) 1.28 m   (4) 0.9 m

128. For a pure shear problem with shear stress τ_{xy}, what would be the maximum principal stress ?

(1) $\dfrac{\tau_{xy}}{2}$

(2) τ_{xy}

(3) $\sqrt{\tau_{xy}}$

(4) $2\tau_{xy}$

129. A confined aquifer of thickness 5 m gives a steady discharge of 20 litre/sec through a well of 0.3 m radius. The height of water in the well dropped from 10 m to 8 m after pumping. What is the coefficient of permeability when the radius of influence is taken as 300 m ?

(1) 0.0001*(ln 1000/π)

(2) 0.001*(ln 1000/π)

(3) 0.011*(ln 1000/π)

(4) 0.101*(ln 1000/π)

130. A triangular section is hydraulically efficient when the vertex angle is

(1) 90°

(2) 75°

(3) 30°

(4) 120°

131. Consider the following statements.

A. Cumulative errors are more important than compensating errors

B. All cumulative errors are equally important

C. The more times a line is measured, the more likely the accidental errors to disappear from mean

D. Variation in temperature results in compensating error

Which of the above statements is/are correct ?

(1) A and B

(2) B and D

(3) A and C

(4) B and C

132. The length of a line measured with a 25 m chain was found to be 300 m. Calculate the true length of the line if the chain was 15 cm too long.

(1) 300.2

(2) 298.2

(3) 251.5

(4) 301.8

133. Match the type of work in List 1 with the use requirements from fresh concrete in List 2 :

List – 1

A. Road

B. Mass concrete

C. Heavy reinforced RCC section

D. RCC congested reinforcement

List – 2

i. high workability and semi fluid consistency

ii. very low workability and very dry consistency

iii. low workability and dry consistency

iv. medium workability and plastic consistency

(1) A-iii, B-ii, C-i, D-iv

(2) A-ii, B-iv, C-i, D-iii

(3) A-iii, B-iv, C-i, D-ii

(4) A-ii, B-iii, C-iv, D-i

134. A level instrument at a height of 1.350 m has been placed at a station having a Reduced Level (RL) of 102.365 m. The instrument reads −3.735 m on a levelling staff held at the bottom of a bridge deck. The RL (in m) of the bottom of the bridge deck is

(1) 104.75

(2) 116.72

(3) 107.45

(4) 99.98

135. While designing the abutments of a bridge, the lateral earth pressure to be considered is
    (1) Active earth pressure
    (2) At the rest pressure
    (3) At the bottom of the bridge
    (4) Passive earth pressure

136. For a catchment, the s-curve due to a rainfall intensity 1cm/h is given by $Q = 3 - (2 + t)\, t^{-2}$ where t is in hour, Q in m^3/s. At t = 1 hour, ordinate of instantaneous unit hydrograph will be
    (1) 5 m^3/s
    (2) 50 m^3/s
    (3) 3 m^3/s
    (4) 500 m^3/s

137. The inner dimensions of a room are 6 m × 5 m with 35 cm wall thickness. The total central line length of the room will be
    (1) 21.2 m
    (2) 25.0 m
    (3) 36.0 m
    (4) 23.4 m

138. A rectangular channel 2m wide carries a discharge of $10 m^3/s$ at a depth of 2m. Calculate the specific energy of the channel.
    (1) 1.8 m
    (2) 4.6 m
    (3) 2.3 m
    (4) 3.0 m

139. The design speed on a road is 72 kmph. Assuming the driver reaction time of 2.0 seconds and coefficient of friction of pavement surface as 0.30, the required stopping distance (in meters) for a two-lane two-way traffic is
    (1) 40.0
    (2) 43.30
    (3) 106.67
    (4) 96.6

140. The centre of buoyancy of a submerged body
    (1) Coincides with the center of gravity of body
    (2) It is always above the centroid of the displaced volume of liquid
    (3) It is always below the center of gravity of the body
    (4) Coincides with the centroid of displaced volume of fluid

141. Match the following errors in chaining.

A. Errors in reading the tape	i.	Cumulative + or −
B. Errors due to temperature	ii.	Cumulative +
C. Incorrect counting of tape lengths	iii.	Mistake
D. Bad ranging	iv.	Compensating ±
E. Variation in pull	v.	Blunder

    (1) A-v, B-ii, C-iii, D-iv, E-i
    (2) A-iv, B-iii, C-i, D-v, E-ii
    (3) A-iii, B-i, C-v, D-ii, E-iv
    (4) A-i, B-iv, C-ii, D-iii, E-v

142. For any material, the modulus of elasticity at a point can be given by E_x, E_y, E_z. Which of the following properties is true for a homogeneous material ?
    (1) $E_x = E_y = E_z$ at a point and $E_x \neq E_y \neq E_z$ at the other points throughout the material
    (2) $E_x = E_y \neq E_z$ at a point and $E_x = E_y = E_z$ at the other points throughout the material
    (3) $E_x \neq E_y \neq E_z$ at a point and $E_x = E_y = E_z$ at the other points throughout the material
    (4) $E_x \neq E_y \neq E_z$ at a point and the same property exists at all the points throughout the material

143. A surveyor was reading a level staff as 4.935 m. Later he found that the staff was 20 cm off the vertical through the bottom. Find the error of reading.
    (1) 4.735
    (2) 4.931
    (3) 4.939
    (4) 5.135

144. The saturated unit weight of sand in the bed of a pond 20 m deep is 20 kN/m³. Unit weight of water is 10 kN/m³. The effective stress at 4 m below bed level of pond is

  (1) 20 kN/m²   (2) 80 kN/m²

  (3) 60 kN/m²   (4) 40 kN/m²

145. Consider the following statement with respect to cements :

  A. Low heat cement is produced by reducing the amount of tricalcium aluminate and increasing the amount of dicalcium silicate.

  B. Rapid hardening cement is produced by decreasing the amount of tricalcium silicate.
  Identify the correct statement.

  (1) Statement B is true and A is false

  (2) Both A and B are true

  (3) Both A and B are false

  (4) Statement B is false and A is true

146. An oven dry soil sample of volume 250 cc weigh 430 g. If the specific gravity of solids is 2.70. What will be water content which willfully saturate the sample ?

  (1) 29.8%   (2) 73.1%

  (3) 19.6%   (4) 26.9%

147. In a particular season, the catchment was found to have a phi-index of 0.4 cm/h. If a rainfall of 2.4 cm occurs in that season at a uniform rate in a 8 hour storm, the resulting direct runoff depth on the catchment in cm will be

  (1) 0.8 cm   (2) 2.8 cm

  (3) 2 cm   (4) 0

148. Arrange the following in chronological order.

  A. Integration and regrouping
  B. Modified Guarantee system
  C. Old Guarantee system
 D. State construction and ownership
  E. Nationalization

  (1) A, C, B, D, E   (2) D, E, A, B, C

  (3) C, D, B, E, A   (4) E, D, B, A, C

149. The hydraulic radius of an efficient triangular section channel is

  (1) $2\sqrt{2}y$ (2) y

  (3) y/2   (4) $y/(2\sqrt{2})$

  Where, y is the depth of the water.

150. What is the critical buckling load for the column shown in the figure ? The modulus of elasticity and the moment of inertia of the column are given by E and I, respectively.

Fixed
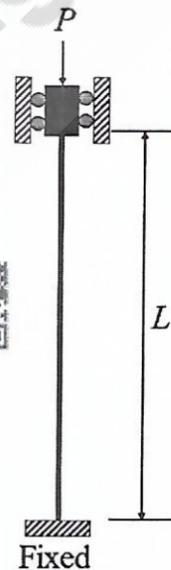
  (1) $\dfrac{\pi^2 EI}{L^2}$ (2) $\dfrac{4\pi^2 EI}{L^2}$

  (3) $\dfrac{2.046\pi^2 EI}{L^2}$ (4) $\dfrac{\pi^2 EI}{4L^2}$