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2020

TEST BOOKLET

TEST BOOKLET SERIES

Time allowed : 2 hours

Full marks : 200

Answer *all* the questions.

Questions are of equal value.

Serial No. **15181**Roll No.: Signature of the Candidate:

INSTRUCTIONS

Candidates should read the following instructions carefully before answering the questions:

1. This booklet consists of 16 pages including this front page, containing 100 questions. **Verify the Page Nos. and Test Booklet series on each page and bring at once to the Invigilator's notice any discrepancy.**
2. Answers will have to be given in the Special Answer-Sheet supplied for the purpose.
3. Before you proceed to mark in the Answer-Sheet in 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 in the Admit Card. **Do not fold the Answer-Sheet as this will result in error in your marks.**
4. All questions are of multiple-choice answer-type. You will find **four** probable answers (A), (B), (C) and (D) against each question. Find out which of the four answers appears to be correct or the best. Now darken the circle corresponding to the letter of the selected answer in the Answer-Sheet with **Black Ball Point Pen** as per instructions printed on the reverse of the Admit Card and in the Answer-Sheet.
5. One and only one circle is to be fully blackened for answer. Any spot in any other circle (multiple circle) or in wrong circle will be considered as wrong answer.
6. **There will be negative marking for wrong answer. $\frac{2}{3}$ mark will be deducted for each wrong answer.**
7. **There are blank pages at the end of this Booklet for Rough Work.**
8. **The Special Answer-Sheet should be handed over to the Invigilator before leaving the Examination Hall. You are permitted to take away the us** **oklet after completion of the examination.**

1. When a chain of designated length L and actual length L' is used for measuring a line, the true length of the line will be

- (A) $\frac{L}{L'} \times \text{measured length}$
- (B) $\frac{L'}{L} \times \text{measured length}$
- (C) $(L' - L) \times \text{measured length}$
- (D) $(L - L') \times \text{measured length}$

2. Continuity equation in a pipe flow is based on the principle of conservation of

- (A) mass
- (B) energy
- (C) momentum
- (D) None of the above

3. What will be the coefficient of passive earth pressure, at a depth of 8m in cohesion less soil with an angle of internal friction of 30° when the water rises to the ground level?

- (A) 4
- (B) 5
- (C) 3
- (D) 1

4. When a bar is subjected to a decrease of temperature and its deformation is prevented, the stress induced in the bar is

- (A) Tensile stress
- (B) Compressive stress
- (C) Shear stress
- (D) Thermal stress

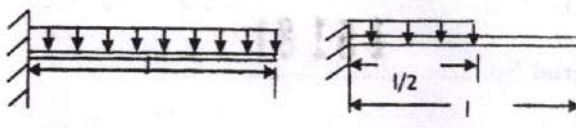
5. A reflux valve is also known as

- (A) safety valve
- (B) scour valve
- (C) air valve
- (D) check valve

6. Theoretically, the best cross-section for a lined canal is

- (A) semicircular
- (B) triangular
- (C) trapezoidal
- (D) egg shaped

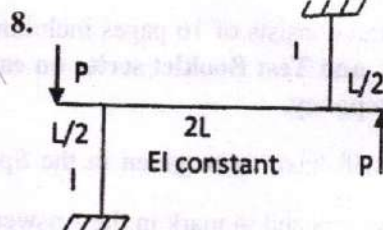
7. Two cantilever beams A and B are shown in Fig. The ratio of maximum deflection of beam A to the beam B is



(a) Beam A

(b) Beam B

- (A) $8/7$
- (B) $16/7$
- (C) $32/7$
- (D) $48/7$



8. The rigid jointed frame ($EI = \text{Constant}$) shown will

- (A) sway to right
- (B) sway to left
- (C) No sway
- (D) None of the above

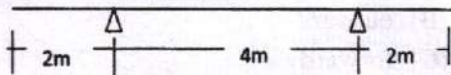
9. Damage due to Alkali aggregate reaction in concrete structure is mainly due to the presence of

- (A) cement with high alkali + reactive aggregate
- (B) cement with high alkali + moisture
- (C) cement with high alkali + aggregate + moisture
- (D) cement with high alkali + reactive aggregate + moisture

10. A cantilever column is subjected to an axial load. If a linear spring of stiffness 'K' is attached to the column laterally connected at the free end, the critical buckling load will

- (A) increase
- (B) decrease
- (C) remain unchanged
- (D) depending on the value of 'K' may increase or decrease

11. A beam is loaded is subjected to udl load w kN/m throughout the whole length of 8 m. Find the bending moment (kNm) at the centre.



- (A) $2w$ (sagging)
- (B) w (sagging)
- (C) zero
- (D) w (hogging)

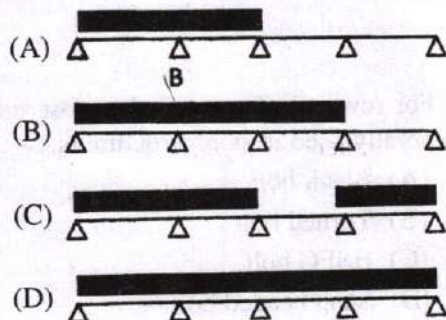
12. Ordinary rails are made of

- (A) mild steel
- (B) cast iron
- (C) wrought iron
- (D) high carbon steel

13. A sand having fineness modulus of 3 is regarded as

- (A) fine
- (B) medium
- (C) coarse
- (D) unusable

14. In a four span continuous beam of equal span, to determine the maximum hogging bending moment at support B (next to end support from left) the position of live load should be



15. The PCU (Passenger Car Unit) value for car on an urban road is

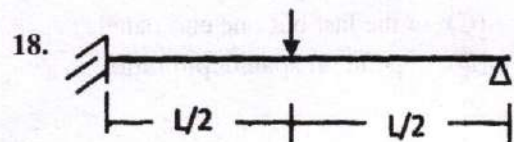
- (A) 0.5
- (B) 1.0
- (C) 3.0
- (D) 4.0

16. For a saturated cohesive soil, a tri-axial test yields the angle of internal friction is zero. The conducted test is called

- (A) Consolidated drain test.
- (B) Consolidated un-drained test.
- (C) Unconfined compression test.
- (D) Unconsolidated un-drained test.

17. Find the equivalent permeability for flow in perpendicular to three layers of soils placed one by one having depth Z_1 , Z_2 and Z_3 and the corresponding permeability of K_1 , K_2 and K_3 .

- (A) $(Z_1 + Z_2 + Z_3) / [Z_1/K_1 + Z_2/K_2 + Z_3/K_3]$
- (B) $(K_1.Z_1 + K_2.Z_2 + K_3.Z_3) / (Z_1 + Z_2 + Z_3)$
- (C) $[Z_1/K_1 + Z_2/K_2 + Z_3/K_3] / (Z_1 + Z_2 + Z_3)$
- (D) $(Z_1 + Z_2 + Z_3) / (K_1.Z_1 + K_2.Z_2 + K_3.Z_3)$



A propped cantilever beam of span L is subjected to central concentrated load P as shown. Find the maximum collapse load P for the beam having plastic moment capacity of M_p as shown

- (A) $2M_p/L$
- (B) $4M_p/L$
- (C) $6M_p/L$
- (D) $8M_p/L$

19. The expansion of Portland Cement is caused by

- (A) voids
- (B) iron oxide
- (C) free silica
- (D) free lime

20. The point on the Earth's surface directly above the point where an earthquake originates is called

- (A) Focus
- (B) Hypocentre
- (C) Epicentre
- (D) Gust point

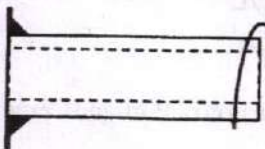
21. With the decrease in lateral stiffness of a regular typical building, the design horizontal seismic coefficient will

- (A) increase.
- (B) decrease.
- (C) depends on the height.
- (D) depends on base dimensions.

22. In a steel roof trusses, bracings should be provided at top chord level,

- (A) in the central panels.
- (B) in the end panels.
- (C) in the last but one end panel.
- (D) depend on span/depth ratio.

23. A tube of outer diameter 150mm is connected to a plate by welding all round as shown. The strength of the weld as per IS 800-2017 is 500 N/mm in limit state method of design. Find the maximum torsional moment can be applied so that the weld will not fail. Take Partial Load factor = 1.5.



- (A) 5.625π kNm
- (B) 3.75π kNm
- (C) 5.625 kNm
- (D) 3.75 kNm

24. A differential manometer is used to measure

- (A) atmospheric pressure.
- (B) pressure in pipes and channels.
- (C) pressure in venturimeter.
- (D) difference of pressures between two points in a pipe.

25. When a vehicle traces a horizontal curve, it is subjected to centrifugal force in _____ direction.

- (A) inward
- (B) outward
- (C) forward
- (D) backward

26. For lack of fit problems in a truss, the truss is at least statically,

- (A) determinate both externally as well as internally.
- (B) indeterminate internally.
- (C) indeterminate externally.
- (D) None of the above.

27. The range of projectile is maximum, when the angle of projection is

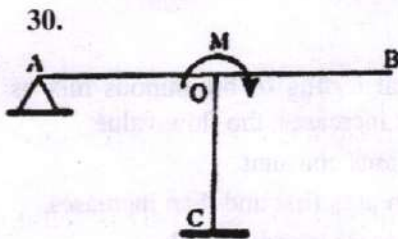
- (A) 30°
- (B) 45°
- (C) 60°
- (D) 90°

28. For reversal of stresses the most suitable bolt generally used in steel structure is

- (A) Black bolt
- (B) Turned bolt
- (C) HSFG bolt
- (D) Snap headed bolt

29. The main circular ring beam in a typical intze type overhead water tank supported on columns located in the form of circle symmetrically is subjected to

- (A) shear force and bending moment at the column support.
- (B) shear force, bending moment and torsional moment at the column support.
- (C) shear force and bending moment at the mid span between two column supports.
- (D) shear force, bending moment and torsional moment at the mid span between two column support.



The frame consists of member AO, OB and OC of equal length and equal EI. The magnitude of bending moment at C will be

- (A) $8M/7$
- (B) $4M/7$
- (C) $M/6$
- (D) $M/8$

31. Creep strain is due to

- (A) Dead load only
- (B) Live load only
- (C) Cyclic load only
- (D) Independent of load

32. The maximum dose of plasticiser and superplasticiser for concrete, in general, restricted to

- (A) 0.5 and 1.0 respectively
- (B) 1.0 and 1.5 respectively
- (C) 0.5 and 2.0 respectively
- (D) 1.0 and 2.0 respectively

33. Curvature correction to a staff reading in differential levelling is

- (A) always subtractive
- (B) always zero
- (C) always additive
- (D) always dependent on latitude

34. In limit state method of design, which is not a correct load combination as per IS456-2000 (DL = dead load, LL = live load, WL = wind load, SL = seismic load)?

- (A) $1.5 \text{ DL} + 1.5 \text{ LL}$
- (B) $1.5 \text{ DL} + 1.5 \text{ SL}$
- (C) $0.9 \text{ DL} + 1.5 \text{ SL}$
- (D) $1.5 \text{ DL} + 1.0 \text{ SL}$

35. Find the development length of reinforcing steel of diameter d in compression for M30 grade concrete and Fe 500 grade TMT bars (Bond strength for plain bars under tension in limit state = 1.5 MPa)

- (A) $30 d$
- (B) $36 d$
- (C) $45 d$
- (D) $50 d$

36. For TMT (Thermo Mechanical Treatment) reinforcing steel bars of grade Fe 500, choose the correct statement.

- (A) Yield stress = 500 MPa
- (B) 0.2% proof stress = 500 MPa
- (C) Ultimate tensile strength = 500 MPa
- (D) Breaking strength = 500 MPa

37. The centre to centre distance between the parallel bars for distribution steel required for shrinkage and temperature effect in a slab should not be more than (d = effective depth of slab) as per IS456-2000.

- (A) $3d$ or 300mm whichever is smaller
- (B) $3d$ or 450mm whichever is smaller
- (C) $5d$ or 300mm whichever is smaller
- (D) $5d$ or 450mm whichever is smaller

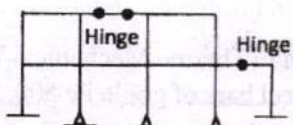
38. A symmetrical footing resting on linear isotropic elastic soil is provided to transfer the concentric load from column. Assume that the footing is perfectly rigid. The distribution of pressure at the footing will be

- (A) maximum at the edge and minimum at the centre.
- (B) maximum at the centre and minimum at the edge.
- (C) uniform distribution.
- (D) depending on the depth of foundation.

39. The presence of hydrogen sulphide in water causes

- (A) softening
- (B) alkalinity
- (C) acidity
- (D) bad state

40. Static indeterminacy of this frame with 3 internal hinges and 3 hinged supports apart from 2 fixed supports, is



- (A) 12
- (B) 13
- (C) 14
- (D) 15

41. Why the curing period of concrete with PPC is more than that OPC?

- (A) In PPC secondary reaction starts after hydration.
- (B) In PPC primary hydration starts at later stage after adding water.
- (C) In PPC cement particle are coarser than OPC.
- (D) In PPC gypsum addition is more than OPC.

42. For three-dimensional movement of a weight in a construction site, which one of the following machinery is most suitable?

- (A) Chain hoist
- (B) Winch
- (C) Crane
- (D) Jack

43. Soil to be used for earthen road should have liquid limit less than

- (A) 5%
- (B) 15%
- (C) 25%
- (D) 35%

44. In marshal testing of bituminous mix as bitumen content increases, the flow value

- (A) remains constant.
- (B) decreases first and then increases.
- (C) increases monotonically.
- (D) increases first and then decreases.

45. Consider the different unit process used in water treatment, Rapid Mixing (RM), Flocculation (F), Primary Sedimentation (PS), Secondary Sedimentation (SS), Chlorination (C), Rapid Sand Filter (RSF). The correct order of water treatment plant is

- (A) PS → RM → F → SS → RSF → C
- (B) PS → RSF → F → RM → SS → C
- (C) PS → F → RM → RSF → SS → C
- (D) PS → F → SS → RSF → RM → C

46. For a reinforced concrete section the shear stress diagram is

- (A) Parabolic
- (B) Circular
- (C) Parabolic above the neutral axis and Triangular below the neutral axis
- (D) Parabolic above the neutral axis and Rectangular below neutral axis

47. Find the maximum bending stress at the fixed end of a cantilever beam of span L subjected to vertical concentrated load P at the free end. The cross-section of the beam is a square section of each side " a " with its diagonal placed in vertical direction.

(A) $\frac{6\sqrt{2}PL}{a^3}$

(B) $\frac{6PL}{a^3}$

(C) $\frac{12\sqrt{2}PL}{a^3}$

(D) $\frac{12PL}{a^3}$

48. For a sample of dry cohesion-less soil with friction angle ϕ , the failure plane will be inclined to the major principal plane by an angle equal to

(A) ϕ

(B) 45°

(C) $45^\circ + \phi/2$

(D) $45^\circ - \phi/2$

49. The latitude and departure of a line AB is -75m and $+45.1\text{m}$. The whole circle bearing of the line AB

(A) 30 degree

(B) 150 degree

(C) 210 degree

(D) 330 degree

50. Which of the following sewage treatment method has inherent problem of odour, ponding and fly nuisance?

(A) Activated sludge process

(B) UASB process

(C) Trickling filters

(D) Stabilization ponds

51. The action of negative skin friction in a pile

(A) reduces the allowable load on pile.

(B) increases the ultimate load on the pile.

(C) maintains the working load on the pile.

(D) reduces the settlement of the pile.

52. Two dimensional stress at a point is given by (notations have their usual meaning)

$$\begin{bmatrix} \sigma_{xx} & \tau_{xy} \\ \tau_{yx} & \sigma_{yy} \end{bmatrix} = \begin{bmatrix} 100 & 30 \\ -30 & 20 \end{bmatrix} \text{MPa}$$

The maximum shear stress is given by

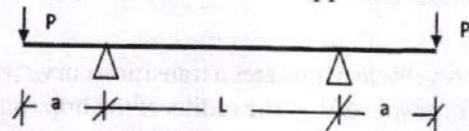
(A) 50 MPa

(B) 75 MPa

(C) 100 MPa

(D) 110 MPa

53. The shape of the deflected curve of the prismatic beam between the support as shown will



(A) be parabolic

(B) be circular

(C) be cubic parabola

(D) depend on a/L ratio

54. In natural water, the hardness is due the presence of

(A) Ca^{++} and Mn^{++}

(B) Na^+ and K^+

(C) Ca^{++} and Fe^{++}

(D) Ca^{++} and Mg^{++}

55. The three governing equations used in structural analysis are (i) Equilibrium equations (ii) Compatibility equations and (iii) Constitutive equations. In stiffness matrix method to solve a indeterminate structure, the set of equations used are

- (A) (i) and (ii)
- (B) (i) and (iii)
- (C) (ii) and (iii)
- (D) (i), (ii) and (iii)

56. Camber in highways is provided to take care of

- (A) Centrifugal force
- (B) Drainage
- (C) Off tracking
- (D) Sight distance

57. Find the secondary air pollutant among NO, SO₂, Shoot, O₃.

- (A) NO
- (B) SO₂
- (C) Shoot
- (D) O₃

58. A vehicle negotiates a transition curve with an uniform speed V. If the radius of the horizontal curve and the allowable jerk is R and J respectively, the minimum length of transition curve is

- (A) $R^3/(VJ)$
- (B) $J^3/(RV)$
- (C) V^2R/J
- (D) V^3R/J

59. Quick sand is a

- (A) moist sand containing small particles.
- (B) condition which occurs in coarse and sand.
- (C) condition in which a cohesionless soil loses all its strength because of upward flow of water.
- (D) None of the above

60. A compound column consists of two ISMB 300 sections connected with batten plates at their flanges. Find the critical distance between the two sections (centre to centre) for maximum load carrying capacity under compression. (For each ISMB, $I_{xx} = 8500 \text{ cm}^4$, $I_{yy} = 500 \text{ cm}^4$, $A = 50 \text{ cm}^2$)

- (A) $\sqrt{80} \text{ cm}$
- (B) $\sqrt{160} \text{ cm}$
- (C) $\sqrt{320} \text{ cm}$
- (D) $\sqrt{640} \text{ cm}$

61. The maximum value of compaction factor in concrete workability test is

- (A) 0.5
- (B) 1.0
- (C) 1.5
- (D) 2

62. Zero hardness of water is achieved by

- (A) Lime soda process.
- (B) Excess lime process.
- (C) Ion exchange treatment.
- (D) Excess lime and alum treatment.

63. At the location of a plastic hinge in a plastic analysis of a structure the

- (A) radius of curvature is infinite.
- (B) curvature is infinite.
- (C) moment is infinite.
- (D) flexible stress is infinite.

64. Lysimeter is used to measure

- (A) Infiltration
- (B) Evaporation
- (C) Evapotranspiration
- (D) Vapour pressure

65. When bitumen is added to soil, it mainly

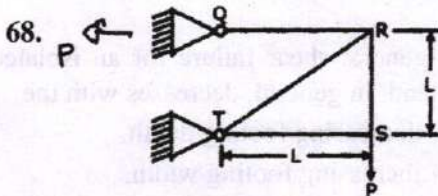
- (A) increases cohesion.
- (B) accelerate cohesion.
- (C) acts as a water proofing agent.
- (D) fills voids.

66. The unit in which both sedimentation and digestion process of sludge takes place simultaneously is

- (A) Skimming tank
- (B) Imhoff tank
- (C) Detritus tank
- (D) Digestion tank

67. Minimum edge distances in bolt connection specified by the code IS800-2007 should be maintained to avoid

- (A) rupture of plate.
- (B) shearing of plate.
- (C) bearing of plate.
- (D) tearing of plate.



Find the force in the member QR.

- (A) Zero
- (B) $P/\sqrt{2}$
- (C) P
- (D) $\sqrt{2}P$

69. Which test is not used for workability of concrete?

- (A) Flow test
- (B) Vee bee test
- (C) Compacting factor test
- (D) Air permeability test

70. A basic requirement of intersection at grade is

- (A) the relative angle of approach should be high.
- (B) it should clearly guide the driver.
- (C) the area of conflict should be small.
- (D) the relative speed should be high.

71. A critical path in a project management has

- (A) zero slack
- (B) minimum slack
- (C) maximum slack
- (D) infinite slack

72. An imaginary line along which bolts in an angle section are placed is known as

- (A) Rivet line
- (B) Back line
- (C) Gauge line
- (D) All of the above

73. Find the RL of the station R from the field book as shown:

Staff Station	BS	IS	FS	RL
P	1.655 m			100.000m
Q	-0.950 m		-1.500 m	
R			0.750 m	?

- (A) 103.355 m
- (B) 103.155 m
- (C) 101.455 m
- (D) 100.355 m

74. The super-elevation in road construction is

- (A) directly proportional to velocity of vehicles.
- (B) inversely proportional to velocity of vehicles.
- (C) directly proportional to velocity of pavement.
- (D) inversely proportional to velocity of pavement.

75. The bentonite is used in bored cast in situ pile construction, mainly

- (A) to make the soil soft for cutting.
- (B) to support the excavated part before concreting.
- (C) to set the concrete quickly.
- (D) to separate water to mix with wet concrete.

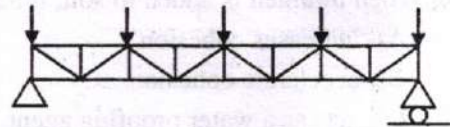
76. During the clear, cool night followed by a hot sunny day, the edges and corners of slab in rigid pavement will

- (A) wrap downward
- (B) warp upward
- (C) wrap upwards and downwards
- (D) wrap laterally

77. To produce corrosion resistant steel (CRS) bar which element is added?

- (A) Carbon
- (B) Phosphorus
- (C) Sulphur
- (D) Copper

78.



The simply supported truss of span $8L$ (8 segment of each length L) and height L is subjected to five concentrated load of each P . Find the maximum tensile in the bottom chords of the truss.

- (A) $2P$
- (B) $4P$
- (C) $6P$
- (D) $8P$

79. The minimum cement content in a concrete mix design for durable concrete depends on

- (A) exposure condition
- (B) grade of concrete
- (C) exposure condition + water cement ratio
- (D) exposure condition + grade of concrete

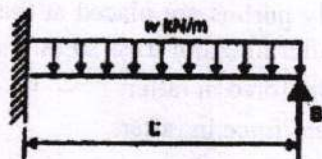
80. The general shear failure for an isolated footing in sand, in general, decreases with the

- (A) decreasing footing depth.
- (B) increasing footing width.
- (C) decreasing soil grain compressibility.
- (D) decreasing inter granular packing of sand.

81. When a simply supported pre-stressed concrete beam supports two concentrated loads, the cable in general follows which profile?

- (A) Straight.
- (B) Parabola.
- (C) Cubic parabola.
- (D) Trapezoidal.

82.



Find the reaction at B

- (A) $3wL/8$
- (B) $5wL/8$
- (C) $3wL/4$
- (D) $wL/4$

83. Reynold's number is the ratio of the inertia force to the

- (A) surface tension force
- (B) viscous force
- (C) gravity force
- (D) elastic force

84. What kind of structural system was used for the Howrah Bridge (Rabindra Setu) at Kolkata?

- (A) Simply supported span
- (B) Balanced cantilever
- (C) Cantilever with a suspended span
- (D) Cable stayed

85. Among the following, which crop has the highest value to delta?

- (A) Wheat
- (B) Vegetables
- (C) Rice
- (D) Cotton

86. Some of the nontoxic metal normally found in the natural water are

- (A) Arsenic, Lead, Mercury
- (B) Calcium, Sodium, Silver
- (C) Cadmium, Chromium, Copper
- (D) Iron, Manganese, Magnesium

87. A 1 hr. rainfall of 10 cm has return period of 50 years. Find the probability of 1 hr. rainfall of 10 cm or more in each of the two successive years is

- (A) 0.02
- (B) 0.04
- (C) 0.0002
- (D) 0.0004

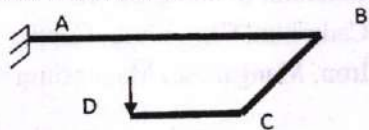
88. A simply supported prismatic beam subjected to transverse load UDL of w and axial compressive load P . Transverse Load vs. Vertical deflection (central) curve of the beam will be linear if

- (A) material is linear and $P > 0$.
- (B) material is linear and $P = 0$.
- (C) material is nonlinear and $P > 0$.
- (D) material is nonlinear and $P = 0$.

89. For a given discharge, the critical flow depth in an open channel flow depends on

- (A) channel geometry only.
- (B) channel geometry and bed slope.
- (C) channel geometry, bed slope and roughness.
- (D) channel geometry, bed slope, roughness and Reynold's no.

90. Find the bending moment at the middle of AB (length of $AB = L$, $BC = L/2$, $CD = L/2$) of the frame in horizontal plane subjected to vertical concentrated load P at D.



- (A) $PL/2$ (sagging)
- (B) $PL/2$ (hogging)
- (C) PL (hogging)
- (D) Zero

91. In a natural condition, a soil sample has a mass of 1.98 kg and volume 0.001 m^3 . After completely oven dried the mass becomes 1.8 kg. Find the degree of saturation (specific gravity = 2.7).

- (A) 0.54
- (B) 0.61
- (C) 0.65
- (D) 0.70

92. In a reservoir with uncontrolled spillways, the peak of the plotted outflow hydrograph

- (A) lies outside of the plotted inflow hydrograph.
- (B) lies on the recession part of the plotted inflow hydrograph.
- (C) lies on the peak of the plotted inflow hydrograph.
- (D) is higher than the peak of the plotted inflow hydrograph.

93. Aeration of water is done to remove

- (A) suspended impurities
- (B) colour
- (C) dissolved salts
- (D) dissolved gases

94. Generally purlins are placed at the nodal points of the rafter in a roof truss so as to avoid

- (A) axial force in rafter.
- (B) shear force in rafter.
- (C) deflection rafter.
- (D) bending moment rafter.

95. The minimum centre to centre distance between the pile of diameter 500mm in clay soil is

- (A) 2.0 m
- (B) 1.5 m
- (C) 1.0 m
- (D) 0.5 m

96. Two simply supported beams (A and B) are under same udl loading. The span of A is double of span B. The correct statement is

- (A) deflection of A = 2 × deflection of B
- (B) deflection of A = 4 × deflection of B
- (C) deflection of A = 8 × deflection of B
- (D) deflection of A = 16 × deflection of B

97. The shrinkage index in soil test is equal to

- (A) liquid limit + plastic limit
- (B) plastic limit – liquid limit
- (C) liquid limit – shrinkage limit
- (D) shrinkage limit – liquid limit

98. A thin cylindrical shell of diameter (d), length (l) and thickness (t) subjected to an internal pressure p . The longitudinal stress in the shell is

$$pdl = 2\sigma lt, \quad \sigma = \frac{pd}{2t}$$

- (A) pd/t
- (B) $pd/2t$
- (C) $pd/4t$
- (D) $pd/6t$

99. A plot between rainfall intensity versus time at a site is called as

- (A) hydrograph
- (B) mass curve
- (C) hyetograph
- (D) isohyet

100. Lacey's silt factor is written as

- (A) $f = 1.75 (d_m)^{1/2}$
- (B) $f = 0.01 (d_{mm})^{2/3}$
- (C) $f = 4.75 (d_{mm})^{1/6}$
- (D) $f = 1.76 (d_{mm})^{1/2}$

Space for Rough Work