OSSC JE
(Civil)
Previous Year Paper
03 Sept, 2023

Script: English

SVA-2022

DO NOT OPEN THE SEAL OF THE QUESTION BOOKLET UNTIL YOU ARE ASKED TO DO SO

Question Booklet Series Code: **C** Question Booklet Series No: **101575**

Time Allowed: **180 Minutes** Total Questions: **100** Maximum Marks:**200**

There shall be negative marking **@ 0.50 marks** per question for wrong/multiple answers

Before answering any question, check the booklet, that it contains **12 pages** and no page is missing, mutilated or repeated. In case of defect, get it replaced immediately.

INSTRUCTIONS FOR CANDIDATES

1. Fill in the OMR answer sheet, mentioning the Roll No. and other data as required in the place(s) indicated therein. Darken the appropriate circles in **blue or black ball point pen only**. Do not write any name / surname or put any symbol, sign, slogan, prayer or any mark of identification in the OMR answer sheet. Do not tamper with the bar-code or any other portion of the OMR answer sheet. **Any such act is liable to render the answer sheet unfit for evaluation.**
2. Correcting fluid, eraser, blade, books, textual material, script notes / loose paper, calculator, document, slide rules, log tables / electronic watches, smart watch, cell phone, pager, other electrical/ electronic devices etc, are not allowed inside the examination hall. In case the candidate is found to be in possession of any of the above, he / she shall be **expelled from the examination without any enquiry** as to whether the same was / were used by the candidate or not.
3. A machine will read the coded information furnished by you in the OMR Answer Sheet. If the information so furnished by you is incomplete or different from what you have given in the application form, **you shall be awarded Zero mark.**
4. Answer must be given by completely darkening one of the four circles / ovals representing the most appropriate answer given on the Answer Sheet corresponding to the relevant question. For answers not shown by properly darkening in **black / blue ball point pen**, no marks shall be awarded.
5. **No Rough work should be done on the OMR Answer Sheet**, Space for rough work has been provided in the Question Booklet itself.
6. After the examination is over, candidates must ensure to fold the OMR Answer Sheet at the perforation and separate the Original Copy and Candidate's Copy of the Two Part OMR Answer Sheet in the presence of the Invigilator and handover the Original Copy to the Invigilator. The Candidate's Copy of the OMR Answer sheet may be taken by the candidate. **Failure to hand over the original copy of the OMR Answer Sheet to the Invigilator before leaving the examination hall / room shall make the candidate liable for penal action.**
7. Candidates may take with them the respective question-booklet after the examination is over.
8. Failure to comply with or violation of any of the above instructions shall be considered as adopting unfair means and action as deemed proper shall be taken.

SEAL

1. The vertical component of pressure force on a submerged curved surface is equal to

a) its horizontal component
b) the force on a vertical projection of the curved surface
c) the product of the pressure at the centroid and surface area
d) the weight of liquid supported by the curved surface

2. The ratio of water stored in the root zone to the water delivered to the field is known as

a) water application efficiency
b) water storage efficiency
c) water use efficiency
d) water distribution efficiency

3. For a given centrifugal pump (where N is speed, Q is discharge, H is head and P is power)

a) $H \alpha 1/N^2$
b) $P \alpha N^5$
c) $Q \alpha N^2$
d) $Q \alpha N$

4. The inflection point on the recession limb of a hydrograph indicates the end of

a) the direct runoff
b) the base flow
c) the rainfall
d) the interflow

5. In a submerged orifice flow the head of water on one side is H_1 and the other side is H_2. The discharge through the orifice is proportional to

a) $H_1 - H_2$
b) $H_1^{1/2} - H_2^{1/2}$
c) $(H_1/H_2)^{1/2}$
d) $(H_1 - H_2)^{1/2}$

6. In the case of weirs on permeable foundations, the d/s pile is provided

a) to reduce the uplift pressure on floor
b) to prevent undermining
c) to increase the vertical creep
d) Both a and b

7. The length of a line measured with a 30-meter chain was found to be 300 meters. After survey, it was observed that the chain is 15 cm too short. Therefore, the true length of the chain is _____

a) 301.5 meters
b) 298.5 meters
c) 299.5 meters
d) 300.5 meters

8. Which of the following is a personal mistake?

a) Variation in temperature
b) Sag in Chain
c) Variation in Pull
d) Misreading

9. Identify the correct combination of chain, chain length and length of each link of chain:

i. Metric chain, 100 feet, I feet
ii. Gunter's chain, 66 feet, 0.6 feet
iii. Revenue chain, 33 feet, 2 1/16 feet
iv. Engineer's chain, 20m, 0.2m

a) i and ii only
b) ii and iii only
c) iii and iv only
d) i and iv only

10. A line drawn through point of same declination is called as _____

a) Isogonic line
b) Isobar
c) Contour
d) Agonic line

11. What is the magnetic declination at a place if the magnetic bearing of the sun at noon is 355°30'

a) 4°30' E
b) 4°30' W
c) 5°30' E
d) 5°30' W

12. Plumb bob is used _____

a) To measure angles
b) To measure distances
c) To determine vertical alignment
d) To determine horizontal alignment

13. A levelling instrument is set up at Point A. The staff reading on a benchmark at Point B is 2.45 m. The staff reading at Point A is 1.23 m. What is the height difference between Point A and Point B?

a) 3.68m
b) 1.22m
c) 1.24m
d) 1.28m

14. Which levelling error occurs due to the bending of light rays as they pass through the Earth's atmosphere?

a) Curvature error
b) Collimation error
c) Refraction error
d) Parallax error

15. If the cross slope of terrain is between 10% to 25% the terrain may be classified as:

a) Rolling Terrain
b) Steep Terrain
c) Mountainous Terrain
d) Plane Terrain

16. If the ruling gradient is 1 in 20 and there is also a horizontal curve of radius 76 m, then the compensated grade should be:

a) 3.0%
b) 4.0%
c) 5.0%
d) 5.5%

17. Identify the correct statement from the following.

a) Traffic volume should always be more than traffic capacity
b) Traffic capacity should always be more than traffic volume.
c) Spot speed is the average speed of a vehicle at a specified section.
d) 85th percentile speed is more than 98th percentile speed.

18. Which of the following represents hardest grade of bitumen?

a) 100/120
b) 80/100
c) 30/40
d) 60/70

19. Granular bases are used in pavements to:

a) Increase the load-carrying capacity.
b) Prevent mud pumping in concrete pavements.
c) Prevent volume change in the subgrade.
d) All of the above

20. The order of engineering surveys for road alignment is as follows:

a) Reconnaissance, Detailed Study and Preliminary study and Map study
b) Reconnaissance, Map study, Detailed Study and Preliminary study
c) Preliminary study Map study, Reconnaissance, and Detailed Study
d) Map Study, Reconnaissance, Preliminary study, and Detailed Study

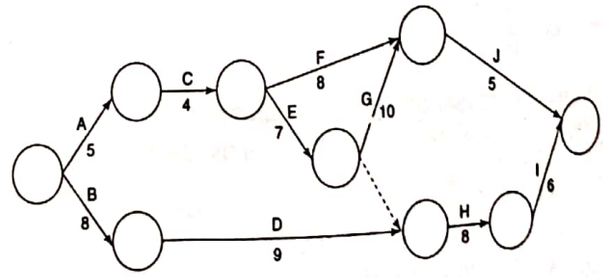
21. As per the IRC, the thickness of single compacted wet mix macadam shall not be less than:

a) 50mm
b) 75mm
c) 80mm
d) 100mm

22. The guidelines for the design of highway flexible pavements as per the Indian Road Congress is:

a) IRC 37-2012
b) IRC 37-2015
c) IRC 37-2018
d) IRC 37-2022

23. The critical duration of the network diagram given below is:



a) 25
b) 31
c) 42

d) 28

24. The ratio of current assets to current liabilities is known as:

a) Liquidity ratio
b) Current ratio
c) Acid-Test (or Quick) ratio
d) Debts ratio

25. Minimum thickness of a fillet weld is

a) 5mm
b) 3mm
c) 2mm
d) 4mm

26. What is the partial safety for material strength when resistance governed by yielding is as per IS:800-2007?

a) 1.1
b) 1.2
c) 1.3
d) 1.4

27. In compression members, the distance between the centres of any two adjacent fasteners shall not exceed (where t is the thickness of thinner plate)

a) 12t or 200mm
b) 16t or 200mm
c) 32t or 300mm
d) 22t or 300mm

28. The shape factor for a rectangular beam of width 'b' and depth 'd' is:

a) 1.5
b) 2.0
c) 2.5
d) 3.0

29. The maximum value of effective slenderness ratio of tension member as per IS:800 is:

a) 150
b) 250
c) 300
d) 400

30. At points and crossings, the total number of sleepers for 1 in 12 turnouts in Broad Gauge is

a) 51.0
b) 62.0
c) 60.0
d) 70.0

31. Sleeper density in India is normally kept as

a) M+1 to M+8
b) M+5 to M+2
c) M+5 to M+5
d) M+2 to M+7

32. For ballast supply on B.G., the maximum permitted aggregate abrasion value is

a) 20%
b) 30%
c) 40%
d) 50%

33. Standard size of wooden sleeper for Broad Gauge track is

a) 180x20x11 cm
b) 275x25x13 cm
c) 225x23x15 cm
d) 250x26x12 cm

34. The extra clearance on horizontal cures overthrows for BG and MG bogie lengths are.

a) 27230/R and 23510/R
b) 27330/R and 23512/R
c) 27430/R and 23514/R
d) 27330/R and 23516/R

35. Slab bridges are used to maximum the span of

a) 2m
b) 6m
c) 9m
d) 12m

36. Which of the following pairs are correctly matched?

1. Lime soda process ↔ Softening
2. Nalgonda technique ↔ Fluoride removal.
3. Aeration ↔ Coagulation
4. Ozonation ↔ Disinfection.

Select the correct answer using the codes given below: Codes:

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

37. Which one of the following statements is TRUE regarding polymers?

a) Alum is frequently used along with an anionic polymer when dewatering anaerobically digested sludge using a belt press.
b) Cationic polymers are high-molecular-weight organic compounds carrying a negative charge.
c) A dry polymer is always a better choice for application in centrifuges than any liquid polymer solution.
d) Because of its viscosity, a Manniche polymer may be difficult to pump.

38. Corrosion in water mains results in:

1. Reduction in life of the pipe
2. Adds colour to water
3. Adds taste and odour
4. Causes diseases

Identify correct choice.

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

39. To control growth of algae in a reservoir:

a) bleaching power is added
b) lime is added
c) copper sulphate is added
d) alum is added

40. Self-cleansing velocity is:

a) the minimum velocity of flow required to maintain a certain amount of solids in the flow
b) the maximum velocity of flow required to maintain a certain amount of solids in the flow
c) such flow velocity as would be sufficient to avoid settlement of solids in the sewer.
d) Such flow velocity as would be sufficient to ensure that sewage does not remain in the sewer.

41. The following units are included in a sewage treatment plant.

1. Screening
2. Grit removal
3. Secondary sedimentation
4. Aeration
5. Primary sedimentation

The correct sequence of these units is:

a) 1,2,3,4,5
b) 1,2,5,4,3
c) 2,1,4,5,3
d) 2,1,4,3,5

42. Which one of the following pairs is NOT correctly matched?

a) Activated sludge ↔ aeration
b) Trickling filters ↔ attached growth system
c) Oxidation ditch ↔ algae
d) Channel grit chamber ↔ proportional weir

43. If 2 % diluted wastewater sample incubated at 20 degrees centigrade resulted in DO depletion of 8 mg/l, BOD of the sample is:

a) 200 mg/l
b) 300 mg/l
c) 400 mg/l
d) 100 mg/l

44. Sewage sickness relates to:

a) toxicity of sewage interfering with response to treatment
b) destruction of aquatic flora and fauna due to gross pollution of receiving bodies of water by sewage.
c) Reduction in the waste purifying capacity of the soil
d) Clogging of pores in soil due to excessive application of sewage to

land, obstruction of aeration and leading to septic conditions.

45. The correct Prismoidal formula for volume is

a) D [first area + last area + 4 ∑even areas+ 2 ∑odd areas]/3
b) D [first area + last area + 4 ∑even areas+ 2 ∑odd areas]/6
c) D [first area + last area + 2 ∑even areas+ 4 ∑odd areas]/3
d) D [first area + last area + 2 ∑even areas+ 4 ∑odd areas]/6

46. Match the following

Nomenclature	Definition
(i) Work Value	**(p)** expenditure on incidental, establishment, and travel charges
(ii) Actual cost	**(q)** Estimate for contingencies, work establishment, tool & plants
(iii) Administrative approval	**(r)** Formal acceptance for incurring an expenditure on work

a) i-q; ii-p; iii-r
b) i-p; ii-r; iii-q
c) i-q; ii-r; iii-p
d) i-p; ii-q; iii-r

47. Charged establishment is the amount of expenditure incurred on

a) Incidental expenses
b) engaging additional staff
c) tool & Plants
d) Contingencies

48. Consider the following data for concrete with mild exposure

Water-cement ratio = 0.50; Water = 191.6 litre. The required cement content will be

a) 561 kg/m3
b) 472 kg/m3
c) 383 kg/m3
d) 294 kg/m3

49. The stadia intercept on the staff is 2.5 m and the tacheometric constant (k) is 100. Then, the horizontal distance between the instrument and the staff is _____

a) 25m
b) 250m
c) 2.5m
d) 0.25m

50. _____ curve is preferred for connecting two tangents with a gradual change in direction?

a) Spiral Curve
b) Circular Curve
c) Parabolic Curve
d) Transition Curve

51. Parallax is _____

a) The process of capturing images using a drone
b) The difference in apparent position of an object when viewed from different angles
c) A unit of measurement for photographs
d) A type of camera lens

52. If the expected time for completion of a project is 10 days with a standard deviation of 2 days, the expected time of completion of the project with 99.9% probability is

a) 4 days
b) 6 days
c) 10 days
d) 16 days

53. In a CPM network, the activity is non critical if:

a) EST = LST & EFT = LFT
b) EST < LST & EFT < LFT
c) EST > LST & EFT > LFT
d) EST < LST & EFT > LFT

54. In critical path method of construction planning, free float can be

1. greater than total float

2. greater than independent float

3. equal to total float

4. less than independent float.

Of these statements,

a) only 1 and 4 are correct
b) only 2 and 3 are correct
c) only 1 and 4 are correct
d) only 1 and 2 are correct

55. A four-wheel truck or whose operating weight is 12000 kg, is pulled along a road having a rising slope of 2% at a uniform speed. Assume grade resistance factor = 10 kg/tonne. The tension in the tow cable is 720 kg. Then, the rolling resistance of the road will be:

a) 25 kg/tonne
b) 35 kg/tonne
c) 40kg/tonne
d) 30 kg/tonne

56. A machine is purchased for ₹10,000,00 and has an estimated life of 10 years. The salvage value at the end of 10 years is ₹1,50,000. The book value of the machine at the end of 5 years using general straight-line method of evaluation of depreciation is:

a) ₹ 4.75 Lakhs
b) ₹ 5.75 Lakhs
c) ₹ 6.50 Lakhs
d) ₹ 8.50 Lakhs

57. 800 units of certain item of stock are needed over each year period. If the unit cost is 400 and the cost of each order is 150, the carrying cost is 1.5%. Then the Economic Order Quantity (EOQ) is:

a) 120
b) 160
c) 200
d) 240

58. Match the list of earthworks excavating equipment with the suitable use cases listed in table below:

List 1	List 2
(A) Bulldozer	1. To dig trenches, footings or basement where the precise control of depth is required
(B) Backhoe	2. To excavate the earth from a canal and deposit on nearby banks
(C) Clamshell	3. For clearing and scrubbing of worksite
(D) Dragline	4. To rehaul loose or excavated material from one place to another place

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

59. A scraper is to haul earth from a pit to fill 0.4 km away. If it is working under average-fixed-time conditions of 2.2 minutes, with an average haul speed of 7 kmph, with operating factor of 0.8, the number of cycles which can effectively be performed per hour is nearly:

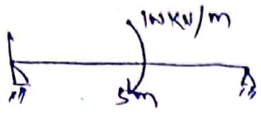
a) 5.4
b) 6.4
c) 8.5
d) 9.6

60. Walls of a room with dimension 10 m × 10 m × 4 m need to be constructed using offsite prefabrication technique. Assuming the wall thickness 150 mm. The truck used for the transportation of the prefabricated components from the manufacturing unit to the construction site is of volume 15 m^3 with the dimension of carriage 4 m (Length) × 3 m (width) × 3m (height). Fix the dimension of the prefab wall components in a way that it takes minimum _____ number of cycles by the loading truck for achieving the least transportation cost.

a) 12 number of cycles
b) 13 number of cycles
c) 14 number of cycles
d) 15 number of cycles

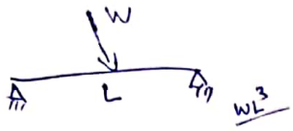
61. A simply supported beam of span '5m' has a moment '100kN-m' acting at mid span. The reaction at each support is:

a) 20kN
b) 25kN
c) 10kN
d) 15kN



62. A simply supported beam of span 'L' is subjected to a point load 'W' at the centre. What is the deflection at the centre?

a) $WL^3/4EI$
b) $WL^3/28EI$
c) $WL^3/48EI$
d) $WL^2/8EI$



63. Columns of given length, cross section and material, have different values of crippling loads, for different end conditions. The strongest column is one whose:

a) Both ends are hinged
b) Both ends are fixed
c) One end is free and the other is fixed
d) One end is fixed and the other is hinged.

64. An element from a strained material is subjected to 50MPa and 100Mpa (both tensile) in two mutually perpendicular directions. Then, the Major principal stress is:

a) 200MPa
b) 100Mpa
c) 150Mpa
d) 400Mpa

65. The ratio of maximum shear stress to average shear stress in a circular section is:

a) 1/2
b) 2/3
c) 3/2
d) 4/3

66. A clay sample has:

- gravel = 2%,
- sand = 58%,
- fines = 40%,
- LL = 38%,
- PL = 15%,
- SL = 13% &
- natural water content = 18%.

The consistency index of the clay sample is:

a) 1.33
b) 2.53
c) 1.15
d) 0.87

67. A soil has 80% degree of saturation. Its air content will be:

a) 0.80
b) 1.8
c) 0.20
d) 0.40

68. A dry sand sample in a triaxial test gave $\varnothing = 32^0$ under cell pressure of 100 kPa. The deviator stress at failure is:

a) 100 kPa
b) 225 kPa
c) 325 kPa
d) 53 kPa

69. Sieve analysis on a dry soil sample of mass 1000 g showed that 980 g & 270 g of soil pass through a 4.75 mm and 0.075 mm sieve respectively. The LL = 40% & PL = 18%. The soil classification as per IS system is:

a) SC
b) ML
c) CL
d) SM

70. Which of the following statement is incorrect?

a) Effective stress is a mathematical parameter
b) Effective stress has no physical meaning
c) Effective stress is the intergranular contact stress
d) Effective stress cannot be directly measured but can be calculated

71. Which of the following statements is incorrect?

a) Under quicksand conditions, total stress can be zero
b) Soil particles can move under quicksand condition
c) Quicksand is related to upward seepage
d) Quicksand condition is remote in cohesive soils

72. A clay bed under a footing load is subjected to 4 cm settlement in 4 years under 1-way drainage & the total settlement is estimated to be 11 cm. The total settlement of this clay bed under 2-way drainage would be:

a) 8 cm
b) 22 cm
c) 11 cm
d) 4 cm

73. A flow net may be utilized for the determination of:

a) Exit gradient & Seepage
b) Hydraulic pressure
c) Seepage Pressure
d) All of these

74. The intensity of active earth pressure at a depth of 10 meters in dry cohesionless sand with an internal angle of friction of 30^0 and with a weight of 1.8 t/m^3, is:

a) 5 t/m^2
b) 6 t/m^2
c) 7 t/m^2
d) 8 t/m^2

75. The rise of the water table will influence the bearing capacity of the foundation resting on sand, due to the:

a) Decrease in angle of internal friction
b) Increase in angle of internal friction
c) Decrease in the unit weight of soil
d) Increase in the unit weight of soil

76. The generally acceptable nominal size of aggregates for reinforced concrete is:

a) 10 mm
b) 15 mm
c) 20 mm
d) 25 mm

77. The pH value of water to be used in concrete shall generally be:

a) not more than 7
b) not less than 6
c) not less than 5
d) not more than 6

78. The mortar in which both cement and lime are used as binding materials, is called:

a) cement mortar
b) lime mortar
c) fire resistant mortar
d) gauged mortar

79. Granite, which is mainly composed of quartz and feldspar particles, is obtained from:

a) Metamorphic Rocks
b) Igneous Rocks
c) Sedimentary Rocks
d) All of the above

80. The minimum amount of Clay and Silt required in a good brick earth is:

a) 25%
b) 30%
c) 50%
d) 75%

81. The high strength of rapid hardening cement at early stage, is due to its:

a) finer grinding
b) burning at high temperature
c) increased lime cement
d) higher content of tricalcium

82. the detail dimensions of each section of a half-sectional plan of an RCC slab culvert with right angled wing walls is given below. What is the total quantity of earthwork in excavation per meter span?

Section	Length (m) for each section	Breadth (m) for each section	Height/Depth (m) for each section
Abutments	5.10	0.70	0.60
Wing Walls	1.20	0.70	0.60

a) 2.646 cu. m.
b) 5.252 cu. m.
c) 6.300 cu. m.
d) 8.316 cu. m.

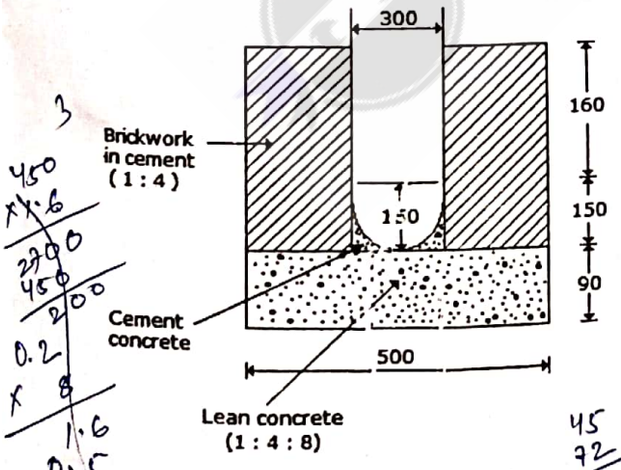
83. If B is the width of formation, d is the height of the embankment, side slope is S:1, for a highway with no transverse slope, then the area of cross-section is given by

a) Bd+Sd
b) Bd+Sd^2
c) Bd- Sd^2
d) (Bd+ Sd^2)/2

84. Due to change in price level, a revised estimate is prepared, if the sanctioned estimate exceeds:

a) 3%
b) 5%
c) 10%
d) 20%

85. The cost of the earthwork in excavation for the surface drain of the cross-section as shown below, for a length of 8m at the rate of Rs. 450 per cu. m., is:

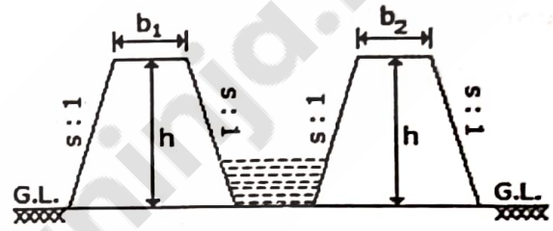


a) Rs. 90/-
b) Rs. 270/-
c) Rs. 450/-
d) Rs. 720/-

86. The detention period in a septic tank is generally assumed as:

a) 30 Minutes
b) 15 Minutes
c) 10 Minutes
d) 5 Minutes

87. The cross-section area of the embankment of a canal considered in calculation of earthwork for 'fully in embankment' case is given by:



a) [(b$_1$+b$_2$) h+sh^2]/2
b) (b$_1$+b$_2$) h+sh^2
c) (b$_1$+b$_2$) h+2sh^2
d) (b$_1$+b$_2$) h+[sh^2/2]

88. For 30° cranked or bent-up bar, the inclined length of the crank is given by:

a) 2d
b) 1.73d
c) 0.9d
d) 1.42d

89. While designing a rectangular septic tank for 50 users considering 0.08 cu. m. per user and depth of water as 1.2m along, what would be the length of the tank if the length of the tank is considered as 4 times the width of the tank?

a) 0.83m
b) 1.66m
c) 3.32m
d) 4.15m

90. In the design of flexible pavement, the C.B.R. value of the soils and the equivalent load of vehicles are considered for:

a) Fixing the grade of bitumen concrete used for paving
b) Fixing the thickness of the pavement crust
c) Fixing the slope of the pavement curb
d) Fixing the total width of the pavement

91. Anti-siphonage pipe is connected to:

a) Main soil pipe
b) Bottom of P-Trap of W.C.
c) Top of P-Trap of W.C.
d) Side of Water Closet

92. Which one of the following areas in India is a hotspot of biodiversity?

a) Sundarbans
b) Eastern ghats
c) Western ghats
d) Gangetic plain

93. Eutrophication of water bodies is caused by the:

a) discharge of toxic substances
b) excessive discharge of nutrients
c) excessive discharge of suspended solids
d) excessive discharge of chlorides

94. Partial safety factor for steel in limit state of collapse flexure is:

a) 1.20
b) 1.15
c) 1.50
d) 1.31

95. If a simply supported reinforced concrete beam having a clear span of 4m and an effective depth 400m is resting on the supports 230mm wide, the effective span of the beam is:

a) 4.0m
b) 4.4m
c) 4.23m
d) 4.5m

96. The effective length of a column that is held in position and restrained against rotation at one end but not held in position nor restrained against rotation at the other end is (Where 'L' is unsupported length of column):

a) 2L
b) L/2
c) 3L
d) L

97. In the working stress method, the permissible stress in bond for plain bars in tension and for M20 grade concrete is:

a) 1.20MPa
b) 1.00MPa
c) 0.70MPa
d) 0.80MPa

98. The minimum percentage of reinforcement in slabs, if HYSD bars (Fe 415) are used, is:

a) 1.0% of the gross cross-sectional area.
b) 0.15% of the gross cross-sectional area.
c) 0.12% of the gross cross-sectional area.
d) 1.5% of the gross cross-sectional area.

99. The difference in pressure head, measured by a mercury water differential manometer for a 20 cm difference of mercury level will be (specific gravity of oil is 0.8):

a) 2.72 m of oil
b) 2.52 m of oil
c) 3.20 m of oil
d) 2.0 m of oil

100. Each term in Bernoulli's equation represents:

a) energy per unit mass
b) energy per unit volume
c) mass per unit energy
d) energy per unit weight

Space For Rough Work

SEAL