इन्जीनियरिंग सेवा परीक्षा, 2009
Engineering Service Examination.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : O–FTF–J–DFB **Test Booklet Series**

A

Serial No. 16357

TEST BOOKLET

CIVIL ENGINEERING

Paper—II

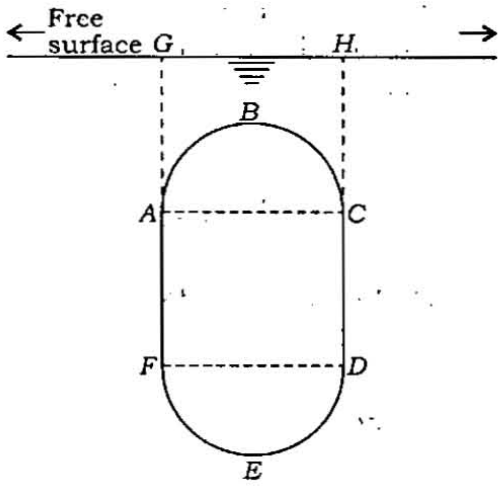
Time Allowed : Two Hours **Maximum Marks : 200**

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the responses to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

1.



Consider the above figure relating to buoyancy in water. What will be the downward force upon the top of the body *ABCDEF*?

(a) The weight of the liquid column *ABCHG*

(b) The weight of the liquid column *DEFGH*

(c) The weight of the liquid column *ABCHG* – the weight of the liquid column *DEFGH*

(d) The weight of the liquid column *ABCHG* + the weight of the liquid column *DEFGH*

2. Consider the following statements in respect of two-dimensional incompressible flow with velocity components u and v in x and y directions respectively :

1. The continuity equation is $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$
2. The acceleration in x-direction is $a_x = \frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}$
3. The condition of irrotationality is $\frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$
4. The equation of a streamline is $udy = -vdx$

Which of the above statements are correct?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1, 2 and 3

(d) 3 and 4

3. Consider the following :

1. Force on pipe bends and transitions
2. Jet propulsion
3. Flow velocities in open channel
4. Vortex flow

Which of the above admit employing the moment of momentum equation?

(a) 1 and 2 only

(b) 1, 2 and 3

(c) 1 and 3 only

(d) 2, 3 and 4

4. Consider the following statements :

1. Shear stress is maximum at the centre line.
2. Maximum velocity is 3/2 times the average velocity.
3. Discharge varies inversely with the coefficient of viscosity.
4. Slope of hydraulic gradient line increases linearly with the velocity of flow.

Which of the above statements are correct in connection with a steady laminar flow through a circular pipe?

(a) 1, 3 and 4

(b) 3 and 4 only

(c) 1 and 3 only

(d) 2 and 4

5. Consider the following statements :

Cavitation generally results from a combination of several influences

1. by reduction of pressure intensity below a limiting value
2. by increase in either elevation or the velocity of flow
3. by reduction of pressure load in the system
4. by decrease in the velocity of flow

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 and 4

6. Consider the following factors :

1. The change in the shape and size of the channel cross-section
2. The change in the slope of the channel
3. The presence of obstruction
4. The change in the frictional forces at the boundaries

Which of the above factors would cause a gradually varied flow?

(a) 1, 2, 3 and 4

(b) 1, 2 and 3 only

(c) 2 and 4 only

(d) 3 and 4 only

7. The power transmitted through a pipeline is maximum when the head lost due to friction in the pipe is equal to

(a) the total supply head

(b) half of the total supply head

(c) one-third of the total supply head

(d) one-fourth of the total supply head

8. Consider the following with respect to the application of the Navier-Stokes equations :

1. Laminar flow in circular pipes
2. Laminar flow between concentric rotating cylinders
3. Laminar unidirectional flow between stationary parallel plates
4. Laminar unidirectional flow between parallel plates having relative motion

Which of the above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

9. In a siphon system employed for carrying water from a reservoir *A* at a higher elevation to another reservoir *B* at lower elevation, both being separated by a higher hill, what will be the pressure at the 'Summit' (*S*)?

(a) Equal to the pressure at the water surface of reservoir *A*

(b) Higher than the pressure at the water surface of reservoir *A*

(c) Equal to the pressure at the water surface of reservoir *B*

(d) Less than the pressure at both *A* and *B* above

10. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I	*List–II*
A. Rehbock formula	1. Sutro weir
B. Francis formula	2. Rectangular suppressed weir
C. A special trapezoidal weir	3. Rectangular side-contracted weir
D. Linear proportional weir	4. Cippolletti weir

Code :

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

11. While selecting a centrifugal pump for your requirement of head and discharge on the basis of its performance characteristics, which one of the following criteria is to be adopted?

(a) Head, discharge and efficiency

(b) Head and discharge only

(c) Discharge only

(d) Head only

12. Consider the following statements :

The function of the impeller in a centrifugal pump is to

1. convert the pressure energy into hydraulic energy
2. convert the hydraulic energy into mechanical energy
3. convert the mechanical energy into hydraulic energy
4. transform most of the kinetic energies to pressure energy

Which of the above statements is/are correct?

(a) 1 only

(b) 3 only

(c) 1, 2 and 3

(d) 2, 3 and 4

13. A centrifugal pump gives maximum efficiency when its impeller blades are

(a) bent forward

(b) bent backward

(c) straight

(d) wave-shaped

14. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Component)	*List–II (Function)*
A. Spiral casing	1. To allow flow of water through it to produce a torque for the rotation of the runner
B. Stay ring	2. To direct the water on the runner at an appropriate angle
C. Guide vane	3. To distribute the flow over the periphery of the runner
D. Runner	4. To act as column helping to support the electrical generator above the turbine

Code :

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

15. By which one of the following, a small quantity of water may be lifted to a great height?

(a) Hydraulic ram

(b) Hydraulic crane

(c) Hydraulic lift

(d) Hydraulic coupling

16. What is 'Hydrological Cycle'?

(a) Processes involved in the transfer of moisture from sea to land

(b) Processes involved in the transfer of moisture from sea back to sea again

(c) Processes involved in the transfer of water from snowmelt in mountains to sea

(d) Processes involved in the transfer of moisture from sea to land and back to sea again

17. Consider the following with respect to a 'double-mass curve' :

1. Plot of accumulated rainfall with respect to two chronological orders
2. Plot for estimating multiple missing rainfall data
3. Plot for checking the consistency of the rainfall data
4. Plot of accumulated annual rainfall of a station vs. accumulated rainfall of a group of stations

Which of the above are correct?

(a) 1 and 3

(b) 2 and 3

(c) 3 and 4

(d) 1 and 4

18. Generally to estimate PMP, $P_m = 42 \cdot 16D^{0 \cdot 475}$ is used (P_m is maximum depth of precipitation, D = duration). What are the units of P_m and D in the equation?

(a) mm, sec

(b) cm, sec

(c) mm, hr

(d) cm, hr

19. A triangular direct runoff hydrograph due to a storm has a time base of 60 hr and a peak flow of 30 m^3 /s occurring at 20 hr from the start. If the catchment area is 300 km^2, what is the rainfall excess in the storm?

(a) 50 mm

(b) 20 mm

(c) 10·8 mm

(d) 8·3 mm

20. A 3 hr unit hydrograph U_1 of a catchment of area 235 km^2 is in the form of a triangle with peak discharge 30 m^3 /s. Another 3 hr unit hydrograph U_2 is also triangular in shape and has the same base width as U_1, but has a peak flow of 90 m^3 /s. What is the catchment area of U_2?

(a) 117·5 km^2

(b) 235 km^2

(c) 470 km^2

(d) 705 km^2

21. Consider the following chemical emulsions :

1. Methyl alcohol
2. Cetyl alcohol
3. Stearyl alcohol
4. Kerosene

Which of the above chemical emulsions is/are used to minimize the loss of water through the process of evaporation?

(a) 1 only

(b) 1 and 4

(c) 2 and 4

(d) 2 and 3

22. A catchment area of 60 ha has a runoff coefficient of 0·40. If a storm of intensity 3 cm/h and duration longer than the time of concentration occurs in the catchment, then what is the peak discharge?

(a) 2·0 m^3/s

(b) 3·5 m^3/s

(c) 4·5 m^3/s

(d) 2·5 m^3/s

23. The land use of an area and the corresponding runoff coefficients are as follows :

Sl. No.	*Land use*	*Area* (ha)	*Runoff coefficient*
1.	Roads	10	0·70
2.	Lawn	20	0·10
3.	Residential area	50	0·30
4.	Industrial area	20	0·80

What is the equivalent runoff coefficient?

(a) 0·15

(b) 0·36

(c) 0·40

(d) 0·51

24. The head on a sharp-crested rectangular weir of height 1·6 m and crest length 1·2 m was incorrectly observed to be 0·13 m when it was actually 0·15 m. What was the percentage error in the computed value of flow rate?

(a) 0·5%

(b) 1·0%

(c) 2·0%

(d) 1·5%

25. Consider the following with respect to measurement of stream flow during flood :

1. Timing of the travel of floats released in the stream
2. Use of weir formula for spillways provided on a dam
3. Calculation of flow through a contracted opening at a bridge
4. Using a current meter

Which of the above is/are reliable and accurate?

(a) 1

(b) 4 only

(c) 3 and 4

(d) 2 and 3

26. Under which one of the following categories is the river Ganga classified in the reach through UP and Bihar?

(a) Straight river

(b) Meandering river

(c) Braided river

(d) Deltaic river

27. Which of the following categories best describes the Hirakud reservoir?

(a) Reservoir for irrigation and power

(b) Reservoir for flood control, power and irrigation

(c) Reservoir for irrigation and water supply

(d) Reservoir for recreation and fishery

28. During a particular stage of the growth of a crop, consumptive use of water is 2·8 mm/day. If the amount of water available in the soil is 25% of 80 mm depth of water, what is the frequency of irrigation?

(a) 9 days

(b) 13 days

(c) 21 days

(d) 25 days

29. Consider the following statements :

Irrigation water has to be supplied to the crops when the moisture level falls

1. below field capacity
2. to wilting point
3. below wilting point

Which of the above statements is/are correct?

(a) 1

(b) 2 only

(c) 3 only

(d) 2 and 3

30. A groundwater basin consists of 10 km^2 area of plains. The maximum groundwater table fluctuation has been observed to be 1·5 m. Consider specific yield of the basin as 10%. What is the available groundwater storage in million cubic metres?

(a) 1·0

(b) 1·5

(c) 2·5

(d) 2·0

31. In a canal irrigation project, 76% of the culturable command area (CCA) remained without water during Kharif season; and 58% of CCA remained without water during Rabi season in a particular year. Rest of the areas got irrigated in each crop respectively. What is the intensity of irrigation for the project in that year?

(a) 134%

(b) 76%

(c) 66%

(d) 58%

32. What is the critical combination of vertical and horizontal earthquake accelerations to be considered for checking the stability of a gravity dam in reservoir full condition?

(a) Vertically upward and horizontally downstream

(b) Vertically upward and horizontally upstream

(c) Vertically downward and horizontally upstream

(d) Vertically downward and horizontally downstream

33. What is the height of wave which is likely to be generated by a wind of 80 km/hr in a reservoir having a fetch of 50 km?

(a) 0·5 m

(b) 1·0 m

(c) 2·0 m

(d) 3·0 m

34. Consider the following statements :

1. Giving equal weightages to horizontal and vertical creeps for design of weir foundations is one of the drawbacks of Kennedy's theory.
2. Khosla's theory of design of foundations for weirs is based on potential theory.
3. Piping problem can be reduced by increasing the length of floor.
4. In Lane's weighted creep theory, horizontal creep is given less weightage compared to vertical creep.

Which of the above statements is/are correct?

(a) 1

(b) 2, 3 and 4

(c) 2 and 4 only

(d) 3 and 4 only

35. Consider the following statements related to undersluices provided in diversion weirs on permeable foundations :

1. They are fully gate-controlled and have crest at the same level as the weir crest when no silt excluders are provided.
2. They scour the silt deposited on the river bed in the pockets upstream of the canal head regulator.
3. It is not necessary to provide end pile line on the downstream end of the undersluice floor.
4. The discharge capacity of the undersluice is 10–15% of the maximum flood or two times the maximum discharge of the offtaking canal or maximum winter discharge, whichever is the highest.

Which of the above statements is/are correct?

(a) 1

(b) 2 and 4 only

(c) 2, 3 and 4

(d) 3 and 4 only

36. What is the most important design parameter used in designing a continuous flow rectangular sedimentation tank for removal of discrete particles?

(a) Length of the tank

(b) Surface overflow rate

(c) Depth of the tank

(d) Temperature of the water to be treated

37. Effluent from a wastewater treatment plant (flow rate = 8640 m^3/d, temperature = 25 °C) is discharged to a surface stream (flow rate = 1·2 m^3/s, temperature = 15 °C). What is the temperature of the stream after mixing?

(a) 10 °C

(b) 15·77 °C

(c) 20 °C

(d) 24·99 °C

38. Match List-I with List-II and select the correct answer using the code given below the Lists :

List–I (Type of impurity)	*List–II (Harm caused)*
A. Excess of nitrates	1. Brackish water
B. Excess of fluorides	2. Goiter
C. Lack of iodides	3. Fragile bones
D. Excess of chlorides	4. Blue babies

Code :

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

39. The concentration of OH^- ion in a water sample is measured as 17 mg/L at 25 °C. What is the pH of the water sample?

(a) 10

(b) 11

(c) 12

(d) 13

40. Which combination of surface water quality parameters will indicate sweep coagulation as the preferred mechanism of coagulation?

(a) High turbidity—low alkalinity

(b) High turbidity—high alkalinity

(c) Low turbidity—high alkalinity

(d) Low turbidity—low alkalinity

41. Which one of the following processes of water softening requires recarbonation?

(a) Lime-soda ash process

(b) Hydrogen-cation exchanger process

(c) Sodium-cation exchanger process

(d) Demineralization

42. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Water/Wastewater treatment)	*List–II (Operating problem)*
A. Trickling filter	1. Negative head
B. Activated sludge process	2. Fly-breeding
C. Rapid gravity filter	3. Sludge bulking
D. Anaerobic sludge digester	4. pH reduction

Code :

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

43. Consider the following treatment process units in a water treatment plant :

1. Coagulation
2. Disinfection
3. Sedimentation
4. Filtration

Which is the correct sequence of the process units in the water treatment plant?

(a) 2–4–3–1

(b) 1–4–3–2

(c) 2–3–4–1

(d) 1–3–4–2

44. Which one of the following tests of water/wastewater employs Erichrome Black T as an indicator?

(a) Hardness

(b) COD

(c) Residual chlorine

(d) DO

45. Which of the following pollutants are generally ***not*** removed in a sewage treatment plant?

(a) Inorganic suspended solids

(b) Dissolved organic solids

(c) Oil and grease

(d) Dissolved inorganic solids

46. What is the theoretical oxygen demand of 300 mg/L glucose solution?

(a) 300 mg/L

(b) 320 mg/L

(c) 350 mg/L

(d) 400 mg/L

47. Which one of the following types of samples is relevantly employed for the design of wastewater treatment plant?

(a) Grab sample

(b) Composite sample

(c) Integrated sample

(d) Any sample

48. A drain carrying sewage of BOD = 200 mg/L and flow rate of 50 m^3/s joins a river whose upstream BOD is 8 mg/L and flow rate is 500 m^3/s. Assume immediate and complete mixing of drain with the river. What is the estimated downstream BOD of the river flow?

(a) 20·4 mg/L

(b) 25·4 mg/L

(c) 104·4 mg/L

(d) 70·4 mg/L

49. A 12·5 mL sample of treated wastewater requires 187·5 mL of odor-free distilled water to reduce the odor to a level that is just perceptible. What is the threshold odor number (TON) for the wastewater sample?

(a) 0·07

(b) 1·07

(c) 15

(d) 16

50. Which one of the following parameters is ***not*** included in the routine characterization of solid waste for its physical composition?

(a) Moisture content

(b) Density

(c) Particle size analysis

(d) Energy value

51. Which one of the following toxic gases has physiological action as asphyxiant?

(a) SO_2

(b) NO_2

(c) Cl_2

(d) CO

52. Assuming annual travel for each vehicle to be 20000 km, what is the quantity of NO_x produced from 50000 vehicles with emission rate of 2·0 g/km/vehicle?

(a) 1800 tonnes

(b) 1900 tonnes

(c) 2000 tonnes

(d) 2100 tonnes

53. What are the air pollutants responsible for acid rain within and downwind areas of major industrial emissions?

(a) Hydrogen sulfide and oxides of nitrogen

(b) Sulfur dioxide and oxides of nitrogen

(c) Carbon dioxide and hydrogen sulfide

(d) Methane and hydrogen sulfide

54. Consider the following air pollutants :

1. NO_x
2. PAN
3. CO_2
4. CO

Which of the above air pollutants is/are present in an auto exhaust gas?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1, 3 and 4

55. Consider the following properties for clays X and Y :

Sl. No.	Properties	Clay X (%)	Clay Y (%)
1.	Liquid limit	42	56
2.	Plastic limit	20	34
3.	Natural water content	30	50

Which of the clays, X or Y, experiences larger settlement under identical loads; is more plastic; and is softer in consistency?

(a) X, Y and X

(b) Y, X and X

(c) Y, X and Y

(d) X, X and Y

56. A clay sample, originally 26 mm thick at a void ratio of 1·22, was subjected to a compressive load. After the clay sample was completely consolidated, its thickness was measured to be 24 mm. What is the final void ratio?

(a) 1·322

(b) 1·421

(c) 1·311

(d) 1·050

57. For a sandy soil with soil grains spherical in shape and uniform in size, what is the theoretical void ratio?

(a) 0·61

(b) 0·71

(c) 0·91

(d) 0·81

58. A soil has liquid limit = 35, plastic limit = 20, shrinkage limit = 10 and natural moisture content = 25%. What will be its liquidity index, plasticity index and shrinkage index?

(a) 0·67, 15 and 25

(b) 0·33, 15 and 10

(c) 0·67, 25 and 15

(d) 0·33, 20 and 15

59. A cohesive soil yields a maximum dry density of 16 kN/m^3 during a standard Proctor Compaction test. If the specific gravity is 2·65, what would be its void ratio?

(a) 0·552

(b) 0·624

(c) 0·712

(d) 0·583

60. Consider the following :

1. Increase in shear strength and bearing capacity
2. Increase in slope stability
3. Decrease in settlement of soil
4. Decrease in permeability

Which of the above with respect to compaction of soil is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2, 3 and 4

61. For a sheet pile wall constructed in a soil having effective grain size = 0·1 mm, the difference of the upstream and downstream water levels is 3 m. If the flow net drawn for the problem yields 2 as the ratio of number of head drops to number of flow channels, then what is the discharge in unit of $m^3/s/m$ length of sheet pile wall?

(a) $3{\cdot}0 \times 10^{-4}$

(b) $3{\cdot}0 \times 10^{-2}$

(c) $1{\cdot}5 \times 10^{-4}$

(d) $1{\cdot}5 \times 10^{-2}$

62. Consider the following statements :

1. Quicksand is a special variety of sand.
2. Quicksand is not a material but a hydraulic condition.
3. In nature, quicksand condition is observed usually in coarse silt or fine sand.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

63. In a 6 m thick stratum of fine sand having submerged density of 11 kN/m^3, quicksand condition occurred at a depth of 4·2 m of excavation. What is the depth of lowering of groundwater table required for making an excavation 5 m deep? Take density of water as 10 kN/m^3.

(a) 3·85 m *(b)* 1·68 m

(c) 1·1 m *(d)* 0·897 m

64. Consider the following statements :

1. Permeability of a soil decreases as the effective stress acting on the soil increases.
2. The presence of organic matter in the soil increases its permeability.
3. Entrapped air decreases the permeability of a soil.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

65. A 1 m thick layer of saturated clay, drained at both faces, settles by 10 cm in one year. If a thin layer of pervious soil is introduced in the middle of this layer, then what will be the period during which the settlement of 10 cm will be completed?

(a) 4 years

(b) 0·5 year

(c) 0·25 year

(d) 2 years

66. Which one of the following conditions is valid in case of unconfined compression test in comparison to triaxial test?

(a) Minor principal stress = 0

(b) Minor principal stress = 0·5 × major principal stress

(c) Minor principal stress = major principal stress

(d) Major principal stress = 3 × minor principal stress

67. In an unconfined compression test on stiff clay, if the failure plane made an angle of 52° to the horizontal, what would be the angle of shearing resistance?

(a) 16° *(b)* 14°

(c) 12° *(d)* 13°

68. On which of the following soils is the standard penetration test useful?

1. Cohesionless soils
2. Medium clays
3. Gravelly soils
4. Very stiff clays

Select the correct answer using the code given below :

Code :

(a) 1 only

(b) 1 and 3

(c) 1 and 2

(d) 3 and 4

69. Consider the following statements :

1. Standard penetration test (SPT) is conducted by pushing a cone into soil at the rate of 2 cm/s.
2. Standard penetration test results are unreliable in deposits containing large number of boulders.
3. Dutch cone is a static penetrometer.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 3 only

70. What is the intensity of active earth pressure at a depth of 10·0 m in dry sand with an angle of shearing resistance of 30° and unit weight of 18 kN/m^3?

(a) 50 kN/m^3

(b) 60 kN/m^3

(c) 70 kN/m^3

(d) 80 kN/m^3

71. When a vertical face excavation was made in a clayey silt, having density of 20 kN/m^3, it failed at a depth of excavation of 4 m. What is the cohesive strength (in kN/m^2) of the soil, if its angle of internal friction was 30° ?

(a) 23·1 *(b)* 20·0

(c) 11·6 *(d)* 10·2

72. If an SPT test gave the average blow count of 32 in fine sand below water table, then what is the corrected value of blow count?

(a) 22·1 *(b)* 23·5

(c) 24·2 *(d)* 24·8

73. Consider the following statements :

1. The soil obtained from wash boring is a representative sample.
2. Recovery ratio will be high during drilling in sound rock.
3. Hollow stem augers are sometimes used to drill holes in silty sand.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 3 only

74. The standard penetration resistance value obtained in a deep deposit of sand at a depth of 6·0 m was 28. The unit weight of sand is 18·0 kN/m^3. What is the corrected value of number of blows for overburden pressure?

(a) 60 *(b)* 57

(c) 59 *(d)* 55

75. The net ultimate bearing capacity of a purely cohesive soil

(a) depends on the width of the footing and is independent of the depth of the footing

(b) depends on the width as well as the depth of the footing

(c) depends on the depth, but is independent of the width, of the footing

(d) is independent of both the width and the depth of the footing

76. A soil has a low allowable bearing capacity. The soil deposit contains compressible loess. A foundation is to be provided for a structure carrying a heavy load. Which one of the following foundation types is to be adopted?

(a) Strap footing

(b) Continuous footing

(c) Raft foundation

(d) Combined spread foundation

77. Consider the following statements :

Increasing width of footing results in

1. increase in settlement of a consolidating clay layer
2. increase in bearing capacity of sandy soils
3. decrease in bearing capacity of clays

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

78. Consider the following statements with respect to an anchored sheet pile wall :

1. Failure occurs due to bulging.
2. Failure occurs due to rotation.
3. Large yield is observed above the anchor rod.
4. Large yield is observed below the anchor rod and above the dredge line.

Which of the above statements is/are correct?

(a) 1 only

(b) 2 and 3

(c) 1 and 4

(d) 3 and 4

79. Consider the following statements :

1. Underreamed piles are precast piles with one or more underreams in each pile.
2. The ratio of pile shaft size to bulb size in an underreamed pile may be 0·33 to 0·50.
3. In a multibulb underreamed pile, the load-carrying capacity is a function of the area of cross-section of the lowest bulb.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

80. Consider the following statements :

1. Underreamed piles are designed as bearing piles.
2. In multiple-bulb underreamed piles, the bulbs are spaced at 1·5 to 2·0 times the diameter of the underream, the centre of the first underream being at a minimum depth of 1·75 m.
3. The length of traditional underreamed pile ranges from 3 m to 4 m.

Which of the above statements is/are correct?

(a) 2 and 3

(b) 1 and 2

(c) 2 only

(d) 1 and 3

81. Consider the following clay minerals :

1. Kaolinite
2. Montmorillonite
3. Illite

What is the correct sequence in an increasing order of their plasticity index?

(a) 1–2–3

(b) 3–2–1

(c) 1–3–2

(d) 3–1–2

82. Which one of the following conditions requires geodetic surveying?

(a) Horizontal curve ranging

(b) Vertical curve ranging

(c) Survey of a country

(d) Reconnaissance survey

83. Which of the following coordinate systems is the most convenient way to specify the position of the star on celestial sphere?

(a) Latitude and longitude

(b) Altitude and azimuth

(c) Declination and right ascension

(d) Declination and hour angle

84. Consider the following equipments :

1. Tacheometer
2. Odometer
3. Passometer
4. Perambulator

Which of the above equipments can be employed for measurement of horizontal distance?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2, 3 and 4

85. Consider the following statements :

In surveying operations, the word 'reciprocal' can be associated with

1. ranging
2. levelling
3. contouring

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

86. Which of the following sights will be applicable for a change point?

(a) Back sight

(b) Intermediate sight and fore sight

(c) Fore sight

(d) Back sight and fore sight

87. The whole circle bearings of lines *OP* and *OQ* are 18°15′ and 335°45′ respectively. What is the value of the included angle *QOP*?

(a) 307°30′

(b) 42°30′

(c) 354°00′

(d) 177°00′

88. Which one of the following linear methods of setting out a circular curve needs reference of the centre of the curve?

(a) Offset from chord produced

(b) Radial offset

(c) Perpendicular offset

(d) Successive bisection of arcs

89. Consider the following statements :

Reciprocal levelling is a method of levelling adopted when

1. the difference of levels between two points at a considerable distance apart is to be determined with great precision
2. it is not possible to set up the level midway between two points as in the case of a deep valley or a river
3. error due to improper centering of level is to be eliminated

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

90. Consider the following statements :

Errors eliminated by taking both face observations are those due to

1. horizontal axis not being perpendicular to the vertical axis
2. non-parallelism of the axis of telescope level and line of collimation
3. imperfect adjustment of vertical circle vernier

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

91. If everyone of the three angles of a triangle has a probable error of ± 1″, then what will be the probable error in the sum of the so-measured internal angles of the triangle?

(a) ± 1″

(b) ± 3″

(c) ± 9″

(d) $\pm\sqrt{3''}$

92. How many sidereal days are there in a solar year?

(a) 365·2840

(b) 366·2422

(c) 360·2500

(d) 365·0000

93. Consider the following statements :

A sidereal year can be defined as the time interval

1. between two successive transits of the sun through the meridian of any of the fixed stars
2. between two successive vernal equinoxes
3. between two successive passages of the sun through perigee

Which of the above statements is/are correct?

(a) 3 only

(b) 1 and 2

(c) 2 and 3

(d) 1 only

94. Which one of the following methods of computing area assumes that the short lengths of the boundary between the ordinates are parabolic arcs?

(a) Average ordinate rule

(b) Middle ordinate rule

(c) Simpson's rule

(d) Trapezoidal rule

95. Which one of the following errors is more severe in plane-table surveying?

(a) Defective sighting

(b) Defective orientation

(c) Movement of board between sights

(d) Non-horizontality of board when points sighted are at large differences of their elevation

96. Which one of the following tests is performed in the laboratory to determine the extent of weathering of aggregates for roadworks?

(a) Soundness test

(b) Crushing test

(c) Impact test

(d) Abrasion test

97. Which one of the following geometric features requires the magnitudes of weaving angle and weaving distance for its design?

(a) Rotary design

(b) Right-angle intersection

(c) Roundabout

(d) Grade-separated junction

98. Which one of the following methods is used in the design of rigid pavements?

(a) CBR method

(b) Group index method

(c) Westergaard's method

(d) McLeod's method

99. In which one of the following yards, are reception, sorting and dispatch of railway wagons done?

(a) Loco yard

(b) Marshalling yard

(c) Goods yard

(d) Passenger yard

100. Which one of the following is ***not*** a desirable property of the subgrade soil as a highway material?

(a) Stability

(b) Ease of compaction

(c) Good drainage

(d) Bitumen adhesion

101. Hot bitumen is sprayed over freshly constructed bituminous surface followed by spreading of 6·3 mm coarse aggregates and rolled. Which one of the following is indicated by this type of construction?

(a) Surface dressing

(b) Gravel-bitumen mix

(c) Liquid seal coat

(d) Seal coat

102. Radius of relative stiffness of cement concrete pavement does ***not*** depend upon which one of the following?

(a) Modulus of subgrade reaction

(b) Wheel load

(c) Modulus of elasticity of cement concrete

(d) Poisson's ratio of concrete

103. For conditions obtaining in India, at which location in a cement concrete pavement will the combined stresses due to traffic wheel load and temperature have to be critically checked during design?

(a) Corner

(b) Corner and interior

(c) Corner and edge

(d) Corner, edge and interior

104. Which one of the following sets of factors is related to design of thickness rigid pavement by Westergaard method?

(a) CBR value and stiffness index of soil

(b) Deflection factor and traffic index

(c) Swelling index and bulk modulus

(d) Radius of relative stiffness and modulus of subgrade reaction

105. Consider the following in relation to group index of soil :

1. Liquid limit
2. Sandy loam
3. Plasticity index
4. Percent passing 75 microns sieve

Which of the above is/are used for estimating the group index?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1, 3 and 4

106. Which set of traffic studies is needed for functional design as well as for 'highway capacity' design?

(a) Origin and destination studies

(b) Parking and accident studies

(c) Speed and volume studies

(d) Axle load studies

107. Which one of the following traffic survey schemes is most relevant when deciding on locating major 'routes' in a city?

(a) Traffic volume survey

(b) Origin and destination survey

(c) Speed survey

(d) Traffic capacity survey

108. Which one of the following equipments is useful in determining spot speed in traffic engineering?

(a) Endoscope

(b) Periscope

(c) Radar

(d) Tachometer

Directions :

Each of the following **twelve (12)** items consists of two statements, one labelled as 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

Code :

(a) Both A and R are individually true and R is the correct explanation of A

(b) Both A and R are individually true but R is ***not*** the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

109. Assertion (A) :

If a cylindrical body is placed in a fluid stream and is rotated, then a lift force is produced on the body.

Reason (R) :

Rotation of the cylinder disturbs the symmetrical pattern which in turn alters the pressure distribution on the body.

110. Assertion (A) :

The drag force on a sphere is more in laminar flow than in turbulent flow.

Reason (R) :

C_D of a sphere is more in laminar flow than in turbulent flow.

111. Assertion (A) :

Total energy of flow decreases in the direction of flow.

Reason (R) :

The specific energy may decrease, increase or remain constant.

112. Assertion (A) :

For a hydraulically efficient channel, the hydraulic radius is equal to half the depth of flow.

Reason (R) :

A hydraulically efficient channel has the minimum perimeter for a given area of flow.

113. Assertion (A) :

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

Reason (R) :

Catabolism converts part of the food into waste products.

114. Assertion (A) :

The solution of a three-point problem in plane-table surveying is aided by Lehmann's rules.

Reason (R) :

The application of Lehmann's rules reduces the triangle of error and is a controlled trial-and-error technique.

115. Assertion (A) :

Remote sensing is mostly quantitative in nature.

Reason (R) :

Remote sensing involves the subjective interpretation of the imagery.

116. Assertion (A) :

In water-bound macadam construction, grade I has better load dispersion characteristics as compared to grade III aggregates.

Reason (R) :

The plasticity index of the binding material should be less than 6%.

117. Assertion (A) :

Dowel bars are provided at expansion joints and sometimes also at contraction joints in cement concrete slabs.

Reason (R) :

Longitudinal joints in cement concrete pavements are constructed with tie bars.

118. Assertion (A) :

When a turnout is taken off from a curved track, it is called gauntlet track.

Reason (R) :

When a turnout from a curved track turns away in the opposite direction, the curves are said to be of contrary flexure.

119. Assertion (A) :

In case of airports, the innermost portion of approach zone, where any obstruction is to be critically viewed, is known as the clear zone.

Reason (R) :

The area of airport, other than the approach zone, which is used for turning of aircrafts, is called the turning zone.

120. Assertion (A) :

Helipads are usually located in close proximity to traffic-generating areas.

Reason (R) :

A helicopter cannot ascend or descend exactly vertically.

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

★ ★ ★