

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

Booklet Serial No.

006241

Test Booklet Series

TEST BOOKLET  
ASSISTANT ENGINEER CIVIL

A

Written Test - 2022

(28)

Time Allowed: Two Hours

Maximum Marks: 120

**INSTRUCTIONS**

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET **DOES NOT** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer /Response Sheet. Any omission/discrepancy will render the Response Sheet liable for rejection.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside.   
**DO NOT write anything else** on the Test Booklet.
4. This Test booklet contains 120 items (questions). Each item comprises of four responses (answers). You will select the response which you want to mark on the Answer Sheet/Response 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 /Response Sheet provided. See directions in the Response Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer /Response Sheet, the response to various items in the Test Booklet, you have to fill in some particulars in the Answer /Response Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Response Sheet and the examination has concluded, you should hand over to the Invigilator **only the Answer /Response Sheet**. You are permitted to take away with you the Test Booklet and **Candidate's Copy of the Response Sheet**.
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 THE CANDIDATE IN THE WRITTEN TEST (OBJECTIVE TYPE QUESTIONS. 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, (0.25) 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 for 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 TOLD TO DO SO

(28) (A)/2022

[P.T.O.]

008541

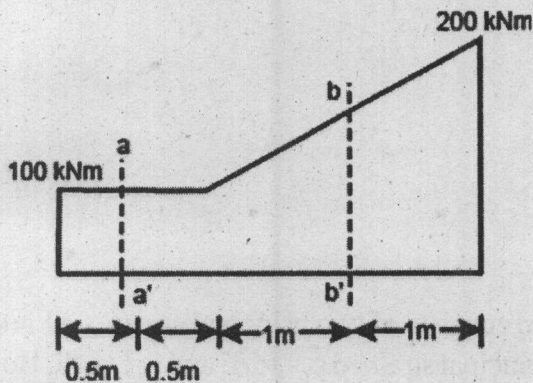


1. What is the relation between slope ( $\theta$ ) and load (W) in the simply supported beam?

- A)  $\theta = WL^2/24EI$
- B)  $\theta = WL^3/24EI$
- C)  $\theta = WL^3/6EI$
- D)  $\theta = WL^2/6EI$

2. The bending moment diagram for a beam is given below. The shear force at sections aa' and bb' respectively are of the magnitude

- A) 50, zero kN
- B) 150, Zero kN
- C) 100, 150 kN
- D) zero, 50 kN



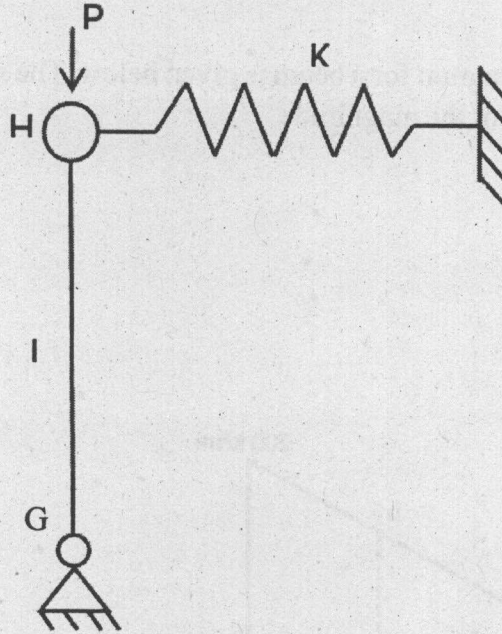
3. The moment of inertia of a square of side(a) about an axis through its centre of gravity is

- A)  $a^4/4$
- B)  $a^4/8$
- C)  $a^4/12$
- D)  $a^4/36$

4. Find the correct match of the shape of BMD (Bending Moment Diagram) for various loadings in a cantilever beam:

Loading	BMD
A) Moment	Parabola
B) Concentrated load	Triangle
C) Uniformly distributed load	Rectangle
D) Linearly varying load	Triangle

5. A rigid bar GH of length  $L$  is supported by a hinge and a spring of stiffness  $K$  as shown in the Fig. below. The buckling load  $P_{cr}$ , for the bar will be:
- A)  $0.5 KL$   
 B)  $0.8 KL$   
 C)  $1.0 KL$   
 D)  $1.2 KL$

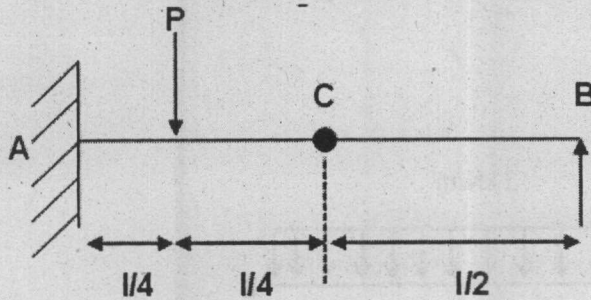


6. **Assertion (A):** A plane stress system consists of two principal stresses  $\sigma_1$  and  $\sigma_2$  and a plane strain system consists of two principal strains  $\epsilon_1 = \sigma_1/E$  and  $\epsilon_2 = \sigma_2/E$ . Both systems are identical.
- Reason (R):** Stress is proportional to strain.
- A) Both A and R are true and R is not the correct explanation of A  
 B) Both A and R are true and R is the correct explanation of A  
 C) A is true but R is false  
 D) A is false but R is true
7. A rectangular beam of width 150 mm is subjected to maximum shear force of 40 kN. The corresponding maximum shear stress in the cross section is  $4 \text{ N/mm}^2$ . The depth of the beam should be:
- A) 150 mm  
 B) 225 mm  
 C) 100 mm  
 D) 200 mm



8. For the propped cantilever shown in the figure below, a hinge is provided at C. A and B are at the same level. What is the force reaction at the fixed end A?

- A)  $4P/3$
- B)  $3P/4$
- C)  $P/2$
- D)  $P$



9. A T-section is used as a simply supported beam with uniform loading. The maximum bending stresses for a given load will occur at the:

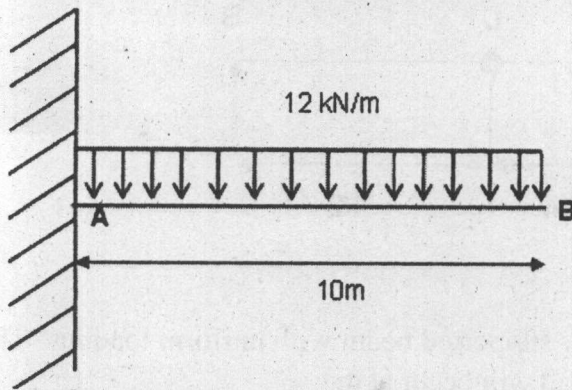
- A) Top of the section
- B) C.G of the section
- C) Mid-point of the depth of section
- D) Bottom of the section

10. Which of the following zone is true in shear span?

- A) Shear force is constant
- B) Shear force is zero
- C) Bending moment is constant
- D) Bending moment is zero

11. The deflection at pt. B in the figure below is:

- A)  $\frac{5 \times 10^3}{EI}$  kNm<sup>3</sup>
- B)  $\frac{7.5 \times 10^3}{EI}$  kNm<sup>3</sup>
- C)  $\frac{10 \times 10^3}{EI}$  kNm<sup>3</sup>
- D)  $\frac{15 \times 10^3}{EI}$  kNm<sup>3</sup>



12. A mild steel structural section is an unsymmetrical I-section, with the greater width at the top and the smaller width at the bottom. The overall depth of the beam is 300 mm, and the flange stresses at the top and the bottom of the beam are 150 N/mm<sup>2</sup>, respectively. What is the height of the neutral axis of the beam from its bottom?

- A) 125 mm
- B) 50 mm
- C) 75 mm
- D) 100 mm

13. Consider the following statements:

**Assertion (A):** The concept of strain energy can be implemented to analyze a statically indeterminate structure.

**Reason (R):** Strain energy of a structure has a direct relation with slopes only of these statements

- A) Both A and R are true and R is the correct explanation of A.
- B) Both A and R are 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.



14. Match the following type of structure and statical indeterminacy having the notation with its usual meanings:

**List - I**

- a. Plane frame  
b. Space Frames

**List - II**

- 1)  $6m + r - 3n$   
2)  $6m + r - 6n$   
3)  $3m + r - 3n$

**Codes:**

- |    | a | b |
|----|---|---|
| A) | 1 | 2 |
| B) | 3 | 2 |
| C) | 2 | 1 |
| D) | 2 | 3 |

15. Consider the following statements:

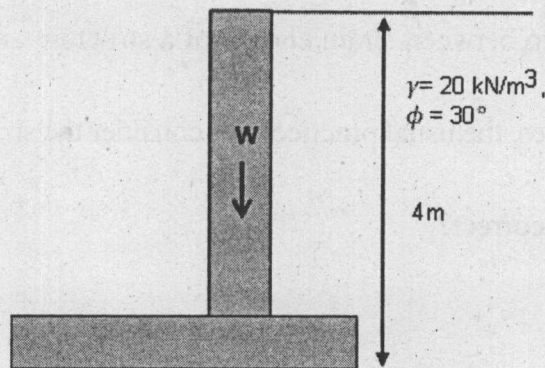
There is a direct relationship between strain energy of a structure and the slopes and deflection caused in it.

In the analysis of rigid frames, the usual practice is to consider the strain energy due to flexural only.

Which of these options are correct?

- A) Only A is correct  
B) Only B is correct  
C) Both are correct  
D) Both are wrong
16. An axially loaded column, not machined for full bearing, the fastenings connecting the column to the base plates through gussets are to be designed for
- A) 100% of the load on the column  
B) 50% of the load on the column  
C) 25% of the load on the column  
D) Respective erection conditions only
17. According to IS 456:2000 the value shear coefficient for the continuous beam at end support for fixed dead and imposed load is:
- A) 0.5  
B) 0.4  
C) 0.2  
D) 0.3

18. In plate girder bearing plate are provided to
- Increase the bearing capacity of the flange
  - Decrease the effective depth of web
  - Transfer the load from the top flange to the bottom flange
  - Prevent buckling of web
19. According to IS 456:2000 the final deflection limit due to all loads including the effect of temperature, creep and shrinkage measured from as cast level in floors, roofs and horizontal members is:
- Span/300
  - Span/250
  - Span/350
  - Span/400
20. Determine the factor of safety for sliding for the cantilever retaining wall shown in the figure below. Given  $W = 150$  kN and coefficient of sliding friction ( $\mu$ )=0.5.
- 1.41
  - 1
  - 1.2
  - 2.8125



21. Determine the maximum positive bending moment after 20% redistribution of the end moment in the fixed end beam shown in figure below:

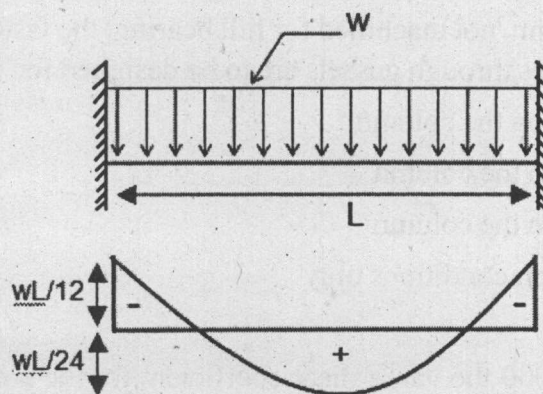


Fig: Initial bending moment diagram before moment redistribution

- $0.05 WL$
- $0.5 WL$
- $0.0583 WL$
- $0.125 WL$

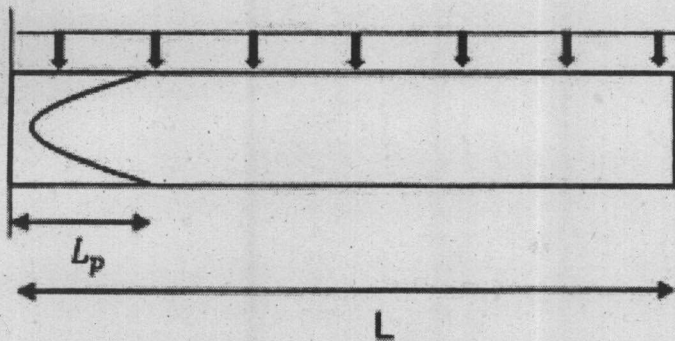


22. In an industrial steel building, the primary method of resisting lateral loads parallel to the ridge is through the use of
- A) Purlins
  - B) Bracings
  - C) Truss
  - D) Column

23. According to IS456:2000 the pitch of the lateral ties should not exceed:
- A) Least lateral dimension of the compression member.
  - B) Sixteen times the smallest diameter of the longitudinal reinforcement bar to be tied.
  - C) 300mm.
  - D) All of the above.

24. A cantilever beam of length  $L$  and a cross-section with shape factor  $s$  supported a distributed load as shown in figure

The length  $L_p$  of the plastic zone, when the maximum bending moment, equals the plastic moment  $M_p$ , given by

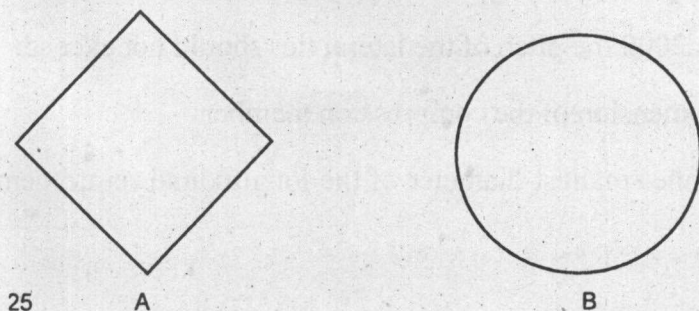


- A)  $(L_p/L) = (1/s)$
- B)  $(L_p/L) = 1 - (1/\sqrt{s})$
- C)  $(L_p/L) = 1 - (1/s)$
- D) None

25. According to IS456:2000 the recommended value of effective height of the of compression member effectively held in position and restrained against rotation at one end, and at other end restrained against rotation but not held in position:

- A) L
- B) 1.5 L
- C) 0.8 L
- D) 1.2 L

26. Choose correct option for shape factor of given cross section A and B are



25

A

B

- A) 2.343 and 1.7 respectively
- B) 1.7 and 2.343 respectively
- C) 2 and 1.7 respectively
- D) 1.7 and 2 respectively

27. The spacing of stirrups for minimum shear reinforcement is given by the expression:

- A)  $\frac{0.8\sigma_y A_0}{0.45b}$
- B)  $\frac{0.85\sigma_y A_0}{0.4bd}$
- C)  $\frac{0.87\sigma_y A_0}{0.5b}$
- D)  $\frac{0.87\sigma_y A_0}{0.4b}$

28. Consider the following definitions

1. Collapse load/Service load
2. (Collapse load/Service load) -1
3. (Ultimate stress/Permissible stress)
4. (Ultimate stress/Permissible stress)-1

Those which relate to 'margin of safety' would include

- A) 1 and 3
- B) 1 alone
- C) 2 and 4
- D) 3 alone



29. As per IS456:2000, the value of creep coefficient at 1 year age of loading is:
- A) 1.1
  - B) 1.2
  - C) 1.6
  - D) 2.2
30. The use of concordant cables in prestressed continuous beam induces
- A) Initial support reactions
  - B) Excess deflection
  - C) Excess cracking
  - D) No initial support reactions
31. If an oil of dynamic viscosity  $0.9 \text{ N-s/m}^2$  is flowing over a flat plate with velocity distribution given by the equation  $u = 3.6 + 0.5y - y^2$  (where  $y$  is the vertical distance from the plate surface), then shear stress at  $0.2 \text{ m}$  from the plate surface comes out to be?
- A)  $1.8 \text{ N/m}^2$
  - B)  $0.9 \text{ N/m}^2$
  - C)  $0.09 \text{ N/m}^2$
  - D)  $2.25 \text{ N/m}^2$
32. A water jet of diameter  $50 \text{ mm}$  has excess pressure value of  $7.5 \text{ N/m}^2$ . Then surface tension acting on the jet is equal to:
- A)  $0.023 \text{ N/m}$
  - B)  $0.047 \text{ N/m}$
  - C)  $0.187 \text{ N/m}$
  - D)  $0.036 \text{ N/m}$
33. Which of the following fluids given below are non-Newtonian in nature?
- 1. Toothpaste
  - 2. Water
  - 3. Human Blood
  - 4. Diesel
- A) 1 and 3
  - B) 1, 3 and 4
  - C) 3 and 4
  - D) 1, 2, 3 and 4

34. A metal gate ( $6 \times 6$ ) m is holding back an oil (Relative density = 0.6) on one side with free surface at its top. Calculate the value of the moment of the force exerted by the oil with respect to the bottom edge of the gate and choose the correct option from the below (If  $z$  is the specific weight of water):
- A)  $216 z$
  - B)  $129.6 z$
  - C)  $72 z$
  - D)  $36 z$
35. The equation explaining the velocity potential function for a fluid flow is given as  $9x^2 + 4y^2 + 3x + 4y - 7$ , calculate the value of velocity at (0,0):
- A) 5 units
  - B) 7 units
  - C) 13 units
  - D) -7 units
36. Select the combination of heads which defines the piezometric head correctly:
- 1. Datum Head
  - 2. Total Head
  - 3. Velocity Head
  - 4. Pressure Head
- A) 1 and 4
  - B) 2 and 4
  - C) 1,3 and 4
  - D) 1,2 and 4
37. While analyzing the movement of air mass inside a tornado, which type of fluid flow is there?
- A) Free vortex flow
  - B) Forced vortex flow
  - C) Forced vortex flow at the core while free vortex flow at the outside
  - D) Free vortex at the center while forced vortex at the outside
38. Select the incorrect statement from the following:
- A) Nature of flow is unsteady during water hammer effect.
  - B) Rigid water column theory does not reflect field situations.
  - C) Rigid water column theory assumes that pipe does not expand during fluid flow.
  - D) Water hammer occurs due to oscillation of water column away from the valve.



39. Arrange the following turbines/wheels in decreasing order of specific speed:
1. Kaplan Turbine
  2. Pelton wheel with single jet
  3. Pelton wheel with multiple jet
  4. Francis Turbine
- A) 3, 2, 1, 4  
B) 1, 4, 3, 2  
C) 4, 3, 2, 1  
D) 4, 1, 3, 2
40. In case of a submerged body, if the location of the center of gravity of body is below the center of buoyancy of displaced liquid, then the body can be termed as in:
- A) Neutral condition  
B) Stable Equilibrium  
C) Unstable Equilibrium  
D) None of the above
41. Two identical pipes of same length A and B are connecting two reservoirs with different water levels. Both pipes are in parallel while the diameter of pipe A is 3 times than that of pipe B. Calculate the ratio of discharge obtained from pipe A than that of pipe B?
- A) 3.33  
B) 15.59  
C) 6.39  
D) 3
42. Choose the flow condition when the pressure gradient in the direction of flow is equal to the rate of change in shear stress with respect to distance normal to the flow direction?
- A) Laminar flow through parallel plates  
B) Turbulent flow in spillway  
C) Laminar flow in pipes  
D) Flow through siphons
43. While solving a dimensional similarity problem if the viscous and surface tension effects are ignored and only gravitational force is given more importance then what will be the value of discharge ratio? (Where  $L_r$  is length scale ratio)
- A)  $L_r^{1/2}$   
B)  $L_r^{5/2}$   
C)  $L_r^{3/2}$   
D)  $L_r^{1/3}$

44. A hydroelectric project is to be constructed at a hilly site where the flow condition is low throughout the year, but the available head is high, which one of the following turbines will be suitable for the project?
- A) Pelton turbine
  - B) Francis turbine
  - C) Kaplan turbine
  - D) Propellor turbine
45. Consider an open channel flow whose model is to be prepared on the scale of 1:9. If the discharge in the prototype is found to be 1458 m<sup>3</sup>/s, then the discharge value in the model would be (ignore the surface tension and viscous effects)?
- A) 6 m<sup>3</sup>/s
  - B) 162 m<sup>3</sup>/s
  - C) 81 m<sup>3</sup>/s
  - D) 9 m<sup>3</sup>/s
46. If the void ratio of soil is 1. What is the degree of saturation at 40 % water content, given G=2.5.
- A) 60%
  - B) 40%
  - C) 100%
  - D) 20%
47. Which of the following statement is incorrect?
- I) Soil is saturated at shrinkage limit
  - II) Upon drying the soil below shrinkage limit, the total volume remains constant
  - III) Core cutter method is used to determine insitu dry density and field moisture content
  - IV) Core cutter method is most suitable in sandy cohesionless soil
- A) I
  - B) III
  - C) II
  - D) IV
48. The hydraulic conductivity of a soil is  $2 \times 10^{-7}$  cm/s. The viscosity of water at 25°C is  $0.1 \times 10^{-4}$  g.s/cm<sup>2</sup>. Calculate the absolute permeability of soil in cm<sup>2</sup>
- A)  $2 \times 10^{-12}$
  - B)  $5 \times 10^{-12}$
  - C)  $0.7 \times 10^{-11}$
  - D)  $9 \times 10^{-11}$



49. The void ratio of a sample is 0.5 and the degree of saturation is 60 %. What is the bulk unit weight of soil? Given  $G=2.7$ ,  $w=10$  KN/m<sup>3</sup>
- A) 10 kN/m<sup>3</sup>
  - B) 20 kN/m<sup>3</sup>
  - C) 15 kN/m<sup>3</sup>
  - D) 17.7 kN/m<sup>3</sup>
50. In standard proctor test, a cohesive soil yields a bulk density of 2 g/cc at a water content of 15 %. The maximum dry density in g/cc is.
- A) 1.74
  - B) 2.05
  - C) 1.51
  - D) 1.95
51. As per Unified Soil Classification System SC stand for
- A) Clayey sand
  - B) Silty clay
  - C) Clayey silt
  - D) Sandy clay
52. At a point in saturated soil mass, the total stress and pore water pressure is obtained as 200 kN/m<sup>2</sup> and 100 kN/m<sup>2</sup>. The shear strength of soil is 80 kN/m<sup>2</sup> and the effective friction angle is 30°. Determine the effective cohesion ( $\tan 30^\circ=0.577$ )
- A) 22.3
  - B) 33.33
  - C) 50
  - D) 47.7
53. A 6 m high retaining wall retains dry sandy backfill of angle of internal friction 30° and unit weight 20 kN/m<sup>3</sup>. Assuming that wall is prevented from yielding, the active horizontal thrust on the wall is
- A) 80 kN/m
  - B) 45 kN/m
  - C) 60 kN/m
  - D) 120 kN/m

54. A precast concrete pile is driven with a 60 kN hammer falling through a height of 1 m with an efficiency of 0.5. The set value is 4 mm per blow and the combined compression of pile, cushion and ground is 6 mm. The ultimate resistance of pile as per modified Hiley formula is.

- A) 4285.7 kN
- B) 6282.5 kN
- C) 8939.6 kN
- D) 7231.5 kN

55. Choose the incorrect assumption in Rankine's earth pressure theory

- I) Soil is in a state of plastic equilibrium
  - II) Rupture surface is planar
  - III) It takes into account the roughness of wall
  - IV) None of the above
- A) III
  - B) IV
  - C) I
  - D) II

56. Choose the incorrect statement

- I) Pole is the origin of planes
  - II) Two planes that are at right angles to each other on which the shear stress is zero is called principal planes
  - III) Mohr circle for any point in soil sample subjected to a hydrostatic pressure ( $\sigma$ ) is a point at a distance from the origin
  - IV) Field test used to determine the undrained shear strength of soft clay is plate load test
- A) I
  - B) III
  - C) IV
  - D) II

57. Match the following

**List -1**

- a) Regain of strength with time
- b) Loss of strength due to cyclic loading
- c) Expansive behavior of sand upon shearing
- d) Effective pressure becomes zero in earth dam

**List -2**

- 1) Liquefaction
- 2) Dilation
- 3) Thixotropy
- 4) Piping

**Codes:**

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



58. Compaction by vibratory roller is best suited for compaction in

- A) Dry sand
- B) Moist silty sand
- C) Highly compressive clay
- D) Highly compressible silt

59. According to Darcys law for flow through porous media, the velocity is proportional to

- A) Cohesion
- B) Hydraulic gradient
- C) Angle of internal friction
- D) Specific gravity

60. Match the following

**List-1**

- a) Shear strength of soil
- b) Liquid limit
- c) Gradation
- d) Permeability

**List-2**

- 1) Casagrande apparatus
- 2) Constant head permeability test
- 3) Triaxial apparatus
- 4) Sieve analysis

**Codes:**

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

61. The major cement oxides are

- A)  $\text{CaO}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{SiO}_2$
- B)  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$ ,  $\text{MgO}$  and  $\text{SO}_3$
- C)  $\text{CaO}$  and  $\text{SiO}_2$
- D)  $\text{CaO}$  and  $\text{MgO}$

62. The durability of concrete

- A) Is governed by its strength
- B) Is governed by its porosity and chemical composition
- C) A and B
- D) None of the above

63. Which one of the following statements is correct?
- A) Adding 5% to 6% of moisture by weight increases the volume of dry sand from 18% to 38%
  - B) Volume of fully saturated sand is equal to that of dry sand
  - C) The bulking of fine sand is more than that of coarse sand
  - D) None of the above
64. Consider the following equipment:
- 1) Drag line
  - 2) Power shovel
  - 3) Hoe
  - 4) Crawler dozer
- Which of the above may be used for excavation of materials and loading them into trucks?
- A) 2 and 3 only
  - B) 2, 3 and 4
  - C) 1 only
  - D) 1, 2 and 3
65. The minimum grade of concrete specified for RC elements exposed to sea water is
- A) M25
  - B) M30
  - C) M35
  - D) M40
66. The probability distribution taken to represent the completion time in PERT analysis
- A) Beta distribution
  - B) Log-normal distribution
  - C) Normal distribution
  - D) Gamma distribution
67. Sinking fund method is useful in
- A) Scrap value
  - B) Depreciation
  - C) Obsolescence
  - D) Liquidation
68. The total mass of moving unit Vicat's apparatus is
- A)  $100 + 1$  g
  - B)  $200 + 1$  g
  - C)  $300 + 1$  g
  - D)  $500 + 1$  g



69. The coefficient of linear expansion of granite is in the range of that of
- A) Glass
  - B) Bamboo
  - C) Mild steel
  - D) High carbon steel
70. What is the impact of the large percentage of mica in sand?
- A) It increases the strength of concrete or mortar
  - B) It reduces the strength of concrete or mortar
  - C) It has no effect on the strength of concrete or mortar
  - D) Marginally enhances the strength of concrete or mortar
71. When a masonry wall is known as a shear wall?
- A) If the earthquake load is in plane
  - B) If the earthquake load is out of plane
  - C) If it is unreinforced
  - D) If it is placed as infill to the frame
72. The permissible range of fly ash constituent in PPC as per IS 1489 (part-1) is
- A) 5%-10%
  - B) 10%-20%
  - C) 15%-35%
  - D) 25%-50%
73. As per IS 456 – 2000, what is the pH of potable water?
- A) Less than 6
  - B) Between 6 to 9
  - C) Not less than 6
  - D) Not less than 6.5
74. Copper slag can be used
- A) For producing slag cement
  - B) For producing pozzolana cement
  - C) As performance improver in OPC
  - D) As set retarder

75. According to IS 456 2000, silica fume is usually used in proportion of \_\_\_ to \_\_\_ % of the cement content of a concrete mix
- A) 2,4
  - B) 5,10
  - C) 15,20
  - D) 1,2
76. The principles of surveying are.
- I) Working from part to whole
  - II) Location of relative position of a point with reference from one point and one direction
  - III) Location of a point by measurement from two points of reference
  - IV) Working from whole to part
- Which of the above-mentioned options are correct?
- A) I & II
  - B) I & III
  - C) II & IV
  - D) III & IV
77. The magnetic bearing of a line PQ is  $S35^{\circ}24'W$ . Calculate the true bearing if declination is  $5^{\circ}10'$ .
- A)  $S40^{\circ}34'E$
  - B)  $S30^{\circ}14'E$
  - C)  $S40^{\circ}34'W$
  - D)  $S30^{\circ}26'W$
78. The incorrect statement among the following is
- A) The direction of magnetic meridian is variable
  - B) The direction of true meridian is invariable
  - C) The magnetic bearing of line varies with time
  - D) Magnetic meridian through various stations is not parallel but converge at poles



79. Two points A and B are 1720m apart across a wide river. The following reciprocal levels are taken with one level:

Calculate the true difference of level between A and B.

Table		
Level	Readings on	
	A	B
A	3.165	3.810
B	0.810	2.365

- A) 1.1m  
 B) 1.9m  
 C) 1.5m  
 D) 0.9m

80. Two objects P and Q are on opposite banks of a river. The following observations were taken in reciprocal leveling:

Table		
Level	Readings on	
	A	B
P	1.400	3.500
Q	0.600	2.200

RL of P is 200m and RL of Q is nearly.

- A) 199.3 m  
 B) 200.0 m  
 C) 201.7 m  
 D) 198.2 m
81. What is the volume of an 18 m deep tank with rectangular shaped top 10 m × 4 m and bottom 6 m × 2 m with prismoidal formula?
- A) 216 m<sup>3</sup>  
 B) 156 m<sup>3</sup>  
 C) 228 m<sup>3</sup>  
 D) 360 m<sup>3</sup>
82. Identify the methods used for locating the 'plane table stations' from the mentioned methods below.
- I. Radiation II. Intersection III. Traversing IV. Resection
- A) I and II  
 B) II and III  
 C) III and IV  
 D) I and IV

83. Match List I (Phenomenon) with List II (Method of survey) and select the correct answer.

**List-I**

- a) Crab and Drift
- b) Stadia intercept
- c) Culmination and elongation
- d) Baseline measurement

**List-II**

- 1. Triangulation
- 2. Astronomical survey
- 3. Aerial photogrammetry
- 4. Tacheometric survey

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

84. The 'Golden quadrilateral' project developed under NHDP (National Highway Development Projects), now managed by NHAI connects following cities in phase I.

- A) Mumbai-Chennai-Kolkata-Delhi
- B) Mumbai-Bangalore-Silchar-Delhi
- C) Porbandar-Chennai-Kolkata-Srinagar
- D) Porbandar-Bangalore-Silchar-Delhi

85. Bump indicator is used to measure.

- A) Unevenness of pavement surface
- B) Roughness of pavement surface
- C) Evaluate stability of soil subgrade
- D) All of the above

86. While designing a hill road with a ruling gradient of 5%, if a sharp horizontal curve of 70 m radius is encountered, the compensated gradient at the curve as per IRC specification should be?

- A) 3.58 %
- B) 3.93 %
- C) 4 %
- D) 4.5 %

87. What is intermediate sight distance (ISD), if the breaking distance and lag distance for a vehicle are 42 m and 45.5 m respectively on single lane two-way traffic road?

- A) 175 m
- B) 87.5 m
- C) 129.5 m
- D) 350 m



88. What is the restricted speed in km/h for vehicles travelling on curve of radius 100 m, with surface having coefficient of friction 0.15 when no super-elevation is provided.
- A)  $\sqrt{1500}$
  - B)  $\sqrt{1905}$
  - C)  $\sqrt{1471}$
  - D)  $\sqrt{1705}$
89. The ideal form of curve for transition curve is
- A) Circular
  - B) Parabolic
  - C) Spiral
  - D) Lemniscate
90. What is the shift (in m), for the BG track situated on circular curve with radius 200 m and 120 m length of transition curve?
- A) 3.33 m
  - B) 1.67 m
  - C) 3 m
  - D) 2.54 m
91. If the actual vapour pressure for a fluid at  $T = 20^\circ \text{C}$  is equal to 1800 Pa, and its saturation vapour pressure is equal to 2400 Pa. Calculate its corresponding relative humidity?
- A) 70%
  - B) 75%
  - C) 80%
  - D) 65%
92. There is uniform flow in a 100-ft wide rectangular channel with bed slope 0.03% and Manning's  $n$  is 0.015. If the depth is 10 ft, calculate the velocity?
- A) 7 ft/s
  - B) 10 ft/s
  - C) 5 ft/s
  - D) 14 ft/s

93. The normal annual rainfall at rain gauge stations A, B, C and D in a catchment are 60, 70, 80 and 90 cm respectively. In the year 2020, the station A was inoperative and the stations B, C and D recorded annual precipitations of 80, 85 and 90 cm respectively. Estimate the rainfall at station A in that year using the normal ratio method?
- A) 60 cm
  - B) 64.1 cm
  - C) 61.8 cm
  - D) 68.1 cm
94. Which one of the following is the correct definition for "Probable Maximum Flood"?
- A) Design flood used for the specific purpose of designing the spillway of a storm structure.
  - B) The flood that would result from a severe combination of meteorological and hydrological factors that are reasonably applicable to the region. Extremely rare combinations of factors are excluded.
  - C) The maximum discharge that can be passed over a hydraulic structure without any damage or serious threat to the stability of the structure.
  - D) The extreme flood that is physically possible in a region as a result of severe most combinations, including rare combinations of meteorological and hydrological factors.
95. A bridge has an expected life of 30 years and is designed for a flood magnitude of return period 80 years. What is the risk of this hydrologic design?
- A) 21.4%
  - B) 22.4%
  - C) 31.4%
  - D) 41.4%
96. If in clayey soil the available moisture drops by 20% from Field Capacity (100%), the value of (Actual Evapotranspiration)/ (Potential Evapotranspiration) will be approximately equal to?
- A) 1
  - B) 0.5
  - C) 0.25
  - D) 0



97. In an unconfined aquifer of  $4 \text{ km}^2$  area, the water table initially was at an elevation of 110m, but due to natural recharge in wet season, its level rose to 112m. A volume of  $2 \text{ Mm}^3$  of water was then pumped out, causing the water table to fall to 109m. Assuming the water table in the entire aquifer to respond in a similar way, estimate the specific yield of the aquifer?
- A) 0.317
  - B) 0.250
  - C) 0.167
  - D) 0.114
98. If the field capacity is 21.5 %, permanent wilting point is 11 % and the depth of the surface layer is 0.15m. Calculate the Total Evaporable Water?
- A) 14 mm
  - B) 16 mm
  - C) 20 mm
  - D) 24 mm
99. The field capacity and permanent wilting point for a given 1 m root-zone soil are 35 and 10 per cent, respectively. At a given time, the soil moisture in the given soil is 20 per cent when a farmer irrigates the soil with 250 mm depth of water. Assuming bulk specific gravity of the soil as 1.28, determine the amount of water wasted from the consideration of irrigation.
- A) 23.2%
  - B) 21.2%
  - C) 19.4%
  - D) 18.2%
100. Using the Blaney-Criddle formula, estimate the monthly consumptive use (mm) of water for sugarcane, for the month of June where, mean monthly temperature =  $33.5^\circ\text{C}$ , monthly crop coefficient = 24.13 and percent sunshine hours = 9.41?
- A) 209.58 mm
  - B) 220.34 mm
  - C) 200.48 mm
  - D) 223.34 mm

101. A well with a radius of 0.4 m, including gravel envelope and developed zone, completely penetrates an unconfined aquifer with  $K = 30$  m/day and initial water table at 30 m above the bottom of the aquifer. The well is pumped so that the water level in the well remains at 22 m above the bottom of the aquifer. Assuming that pumping has essentially no effect on water table height at 400 m from the well, determine the steady-state well discharge. Neglect well losses. [ $\ln(1000) = 6.9$ ]
- A) - 5072.93 m<sup>3</sup>/day
  - B) - 5672.93 m<sup>3</sup>/day
  - C) - 4672.93 m<sup>3</sup>/day
  - D) - 4084.93 m<sup>3</sup>/day
102. The first watering given to the plant when it is only few centimetres high is called.....?
- A) Paleo watering
  - B) Delta watering
  - C) Kor watering
  - D) Duty watering
103. Which of the following river training works runs parallel (nearly so) to the river flow?
- A) Spurs
  - B) Groynes
  - C) Transverse dikes
  - D) Levees
104. Orographic precipitation occurs when?
- A) The moist air masses may get lifted up to higher altitudes due to the presence of mountain barriers and consequently undergo cooling, condensation and precipitation.
  - B) A packet of air which is warmer than the surrounding air due to localised heating rises because of its lesser density and air from cooler surroundings flows to take up its place.
  - C) A packet of air which is colder than the surrounding air due to localised cooling rises because of its lesser density and air from hotter surroundings flows to take up its place.
  - D) None of the above



105. As per the Indian Standard (IS: 4987-1968), what is the recommended density of rain gauge stations in regions where average elevation is 1000m?

- A) 1 station per 520 km<sup>2</sup>
- B) 1 station per 260-390 km<sup>2</sup>
- C) 1 station per 130 km<sup>2</sup>
- D) 1 station per 80 km<sup>2</sup>

106. If the average daily consumption of a locality is 1,000m<sup>3</sup>, the maximum daily consumption will be

- A) 1000 m<sup>3</sup>
- B) 1500 m<sup>3</sup>
- C) 1800 m<sup>3</sup>
- D) 2700 m<sup>3</sup>

107. The quantity of coagulant required for coagulation of water decreases with

- i) Increase in turbidity of water
- ii) Decrease in turbidity of water
- iii) Increase in temperature of water
- iv) Decrease in temperature of water

The correct answer is

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

108. Initial DO = 6 mg/litre, Final DO = 1 mg/litre, Dilution to 2%. The BOD of the given sewage sample is

- A) 25 mg/litre
- B) 10 mg/litre
- C) 1 mg/litre
- D) 250 mg/litre

109. Match List-I with List-II

**List-I**

- a. Steel pipe
- b. Concrete pipe
- c. Asbestos cement pipe
- d. Vitrified clay

**List-II**

- 1. Highly resistant to corrosion but can break easily
- 2. Virtually corrosion resistant
- 3. Sulfide corrosion
- 4. Electrolyte corrosion

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

110. The design parameter for flocculation is given by a dimensionless number  $Gt$ , where  $G$  is the velocity gradient and  $t$  is the detention time. The most preferred combination of  $G$  and  $t$  to produce larger and lighter flocs is

- A) Large  $G$  values with short  $t$
- B) Large  $G$  values with long  $t$
- C) Smaller  $G$  values with long  $t$
- D) Small  $G$  values with short  $t$

111. The chlorine demand of a water sample was found to be 0.3 mg/litre. The amount of bleaching powder containing 30% available chlorine to be added to treat 1000 litre of such a water sample is:

- A) 1000 mg
- B) 900 mg
- C) 10000 mg
- D) 90 mg

112. Which of the following is incorrectly matched?

- i) Interception trap - The last trap provided in a house drainage system
  - ii) Gully Trap – Generally used to admit sullage from the floors of room, bathrooms and kitchen to the sullage pipe
  - iii) Nahani trap - provided outside the building to connect waste pipe to the external sewage line
  - iv) Q-trap - prevents transmission of unfavorable odors from the washroom to the living area
- A) i and ii
  - B) ii and iii
  - C) i and iii
  - D) iii and iv



113. Fresh sludge has moisture content of 99%, after thickening its moisture content is reduced to 96%. The reduced volume of sludge is

- A) 75%
- B) 25%
- C) 5%
- D) 3%

114. Match the following

**List-I (Environmental effect)**

**List-II (Air pollutant)**

- |  |                       |
|--|-----------------------|
| a) Problems with breathing experienced by living things        | 1. Carbon monoxide    |
| b) Interaction of chemicals with blood's hemoglobin            | 2. Particulate matter |
| c) Reduced vision and increased exposure to airborne allergens | 3. Nitrogen oxides    |
| d) Photochemical smog in atmosphere                            | 4. Sulphur oxide      |

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

115. **Assertion (A):** Slow sand filters are less efficient in the removal of bacteria than rapid sand filter.

**Reason (R):** The sand used in slow sand filter is finer than in the rapid sand filters.

- A) Both A and R are true and R is the correct explanation of A
- B) Both A and R are true but R is not a correct explanation of A
- C) A is true but R is false
- D) A is false but R is true

116. Removal of phosphorus from the waste water can be done by

- A) Chlorine addition
- B) Rapid sand filter
- C) Ferric chloride addition
- D) Carbon absorption

117. When more than two sewers join in a manhole?

- A) Their tops should be at the same level
- B) Their centres should be at the same level
- C) Their bottoms should be at the same level
- D) They can be either way

118. The design discharge for the separate and combined sewer system shall be taken as

- A)  $3 \times \text{DWF, Rainfall} + 2 \text{ DWF}$
- B)  $6 \times \text{DWF, Rainfall} + 2 \text{ DWF}$
- C)  $3 \times \text{DWF, Rainfall} + 6 \text{ DWF}$
- D)  $6 \times \text{DWF, Rainfall} + 6 \text{ DWF}$

119. The various treatment processes in a water treatment plant are listed below:

1. Filtration 2. Chlorination 3. Sedimentation 4. Coagulation 5. Flocculation

The correct sequence of processes in water treatment is

- A) 1, 2, 3, 4, 5
- B) 4, 5, 3, 1, 2
- C) 2, 3, 1, 5, 4
- D) 1, 2, 5, 3, 4

120. **Assertion (A):** Compressed natural gas (CNG) is natural gas under pressure and mainly composed of methane.

**Reason (R):** One of the advantages of using CNG as a fuel in automobiles is that it requires very less space for storage as compared to that of petrol or diesel.

- A) Both A and R are true and R is the correct explanation of A
- B) Both A and R are true but R is not a correct explanation of A
- C) A is true but R is false
- D) A is false but R is true



# ROUGH WORK

(28) (A)

(31)

[P.T.O.]

# ROUGH WORK

(28) (A)

(32)

CONFIDENTIAL  
S  
CONFIDENTIAL