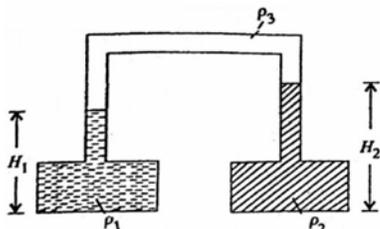


CIVIL ENGINEERING

(PAPER-II)

1.



Which one of the following expresses the difference in the pressure at the floors of the tank shown above in the figure?

- $(\rho_2 - \rho_1)gH_2$
- $(\rho_2 - \rho_1)gH_1$
- $p_1gH_1 + p_3gH_2 - p_2gH_2$
- $p_1gH_1 + p_3g(H_2 - H_1) - p_2gH_2$

Where ρ_1 , ρ_2 and ρ_3 are the densities of the different fluids.

2. A flat plate of 0.15m^2 is pulled at 20 cm/s relative to another plate, fixed at a distance of 0.02 cm from it with a fluid having $\mu = 0.0014\text{ Ns/m}^2$ separating them. What is the power required to maintain the motion?

- 0.014 W
- 0.021 W
- 0.035 W
- 0.042 W

3. Multi U-tube manometers with different fluids are used to measure

- Low pressures
- Medium pressures
- High pressures
- Very low pressures

4. A pilot-static tube, with a coefficient of 0.98 is used to measure the velocity of water in a pipe. The stagnation pressure recorded is 3 m and the static pressure is 0.5 m . What is the velocity of flow?

- 7.2 m/s
- 6.8 m/s
- 5.9 m/s

d. 5.2 m/s

5. Which one of the following assumptions in deriving the boundary layer equation of flow past a flat plate at zero incidence is not correct?

- Uniform flow = 0
- Outside boundary layer velocity is v_0 throughout
- The boundary layer thickness is very small compared to distance x
- Pressure remains constant throughout the flow both within and outside the boundary layer

6. Which one of the following gives the lift force F_L produced on a rotating circular cylinder per unit length in a uniform flow?

- $F_L = u\Gamma/\rho$
- $F_L = \rho u\Gamma$
- $F_L = u\Gamma/\rho$
- $F_L = \rho u/\Gamma$

Where u = free stream velocity ;

Γ = Circulation

ρ = density of the fluid

7. Drag force on a cylinder for turbulent flow compared to Laminar flow is

- Same
- More
- Less
- Very high

8. Match List – I with list – II and select the correct answer :

List-I

- Reynolds number
- Froude number
- Mach number
- Weber number

List-II

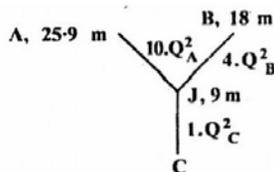
- Formation of liquid droplet

2. High speed flow of a gas
3. Flow in closed conduits
4. Sloping interface exists between fluids of different densities
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 4 | 2 | 1 |
| b. | 2 | 1 | 3 | 4 |
| c. | 3 | 1 | 2 | 4 |
| d. | 2 | 4 | 3 | 1 |
9. Match List-I with List — II and select the correct answer :
- List-I**
- A. Froude number
- B. Euler number
- C. Reynolds number
- D. Mach number
- List-II**
1. Related to inertia force & elastic force
2. Related to inertia force to viscous force
3. Related to inertia force to pressure force
4. Related to inertia force to gravity force
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 1 | 2 | 3 |
| b. | 2 | 3 | 4 | 1 |
| c. | 4 | 3 | 2 | 1 |
| d. | 2 | 1 | 4 | 3 |
10. Consider the following statements in respect of specific energy of flow in an open channel of fixed width :
1. There is only one specific energy curve for a given channel.
 2. Alternate depth are the depths of flow at which the specific energy is the same.
 3. Critical flow occurs when the specific energy is minimum.
- Which of the statements given above are correct ?
- a. Only 1 and 2
 - b. Only 1 and 3
 - c. Only 2 and 3
 - d. 1, 2 and 3
11. If the Froude number of flow in a rectangular channel at a depth of flow of y_0 is F_0 , then what is y/y_0 equal to ?
- a. $F_0^{1/3}$
 - b. $F_0^{2/3}$
 - c. $F_0^{3/2}$
 - d. $\frac{1}{\sqrt{F_0}}$
12. A hydraulically efficient trapezoidal section of open channel flow carries water at the optimal depth of 0.6 m. Chezy coefficient is 75 and bed slope is 1 m 250. What is the discharge through the channel?
- a. 1.44 m³/s
 - b. 1.62 m³/s
 - c. 1.92 m³/s
 - d. 2.24 m³/s
13. In the step methods (both direct and standard), the computations must
- a. Proceed downstream in subcritical flow
 - b. Proceed upstream in subcritical flow
 - c. Always proceed upstream
 - d. Always start at a control section
14. Which of the following equations are used for the derivation of the differential equation for water surface profile in open channel flow?
1. Continuity Equation
 2. Energy Equation
 3. Momentum Equation
- Select the correct answer using the code given below
- a. 1, 2 and 3
 - b. Only 1 and 3
 - c. Only 1 and 2
 - d. Only 2 and 3
15. In a wide rectangular channel if the normal depth is increased by 20%, then what is the approximate increase in discharge ?
- a. 25%
 - b. 30%
 - c. 35%
 - d. 40%

16. Which one of the following statements is not correct ?
- Water hammer is a phenomenon which occurs due to oscillation of water column away from the valve
 - Rigid water column theory specifies that water is incompressible and pipe material does not expand
 - Water hammer occurs under unsteady conditions of flow
 - Rigid water column theory is used less in practice as it does not reflect field situation

17. Which one of the following statements is not correct ?
- Solution of pipe network by Hardy Cross method is a trial and error solution
 - At a junction of pipes, total inflow is equal to the total outflow
 - Loss of head due to flow in a clockwise direction should be equal to loss of head in a counter clockwise direction
 - Hardy Cross method can be extended to open channel flow also

18.



Water flows into junction J from reservoirs A and B through connecting pipes, the head loss through these being, respectively $10 Q_A^2$ and $4 Q_B^2$. The water level elevations at the reservoirs at A and B are 25.9 m and 18 m, respectively. The inflow at J is discharged out at C into the atmosphere. The head loss through pipe JC is $1 Q_C^2$. The gauge pressure at J is 9 m. What is the residual gauge pressure of the outflow at C?

- 2.56 m
- 1.86 m
- 1.16 m
- 0.46 m

19. Which one of the following inferences is not drawn by studying performances curves of centrifugal pumps ?
- Discharge increases with speed
 - Power decreases with speed
 - Head increases with speed
 - Manometric head decreases with discharge

20. The centrifugal pump should be installed above the water level in the sump such that
- Its height is not more than 10.3 m at room temperature of liquid
 - Its height is not allowed to exceed 6.7 m
 - The negative pressure does not reach as low as the vapour pressure
 - The negative pressure is not allowed to develop in the impeller

21. Which one of the following statements is correct?
- Pumps operating in series boost the discharge whereas pumps operating in parallel boost the head
 - Pumps operating in parallel boost the discharge whereas pumps operating in series boost the head
 - In both the above cases there would be a boost in discharge only
 - In both the above cases there would be a boost in head only

22. Which one of the following statements is not correct ?
- Draft tubes decrease efficiency of a turbine
 - Wheels of a reaction turbine must always run full
 - When the load on a reaction turbine is decreased, the system reduces quantity of flow of water in an immersed flow reaction turbine and reduces the power produced.
 - Pelton wheels are impulse turbine

23. Match List — I with List — II and select the correct answer

List — I

- Pelton
- Kaplan

- C. Banki
D. Francis

List—II

1. Draft tube is used
2. Draft tube is not used
3. Operates under high head & low discharge
4. Operates under low head & high discharge

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

24. Which one of the following statements is not correct ?
- a. Storage and pondage can be obtained from flow duration curve
 - b. Primary or form power corresponds to maximum stream flow condition
 - c. Secondary power is occasionally called surplus power
 - d. Often, flash boards are put on dams to augment the pondage at low flow durations
25. In the selection of turbine by specific speed or head, which one of the following statements is not correct ?
- a. For specific speed 10—35, Kaplan turbines
 - b. For specific speed 60—300, Francis turbines
 - c. For head 50—1 50 m. Francis turbines
 - d. For head above 300 m, Pelton wheel
26. Recorded annual maximum 24—hour rainfall magnitudes at stations KTX are as under :

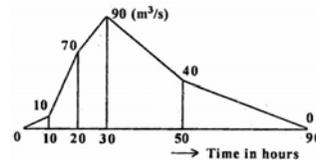
| Year | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|--------------|------|------|------|------|------|------|------|------|------|------|
| Rainfall, cm | 12.0 | 6.0 | 4.8 | 7.9 | 12.0 | 14.2 | 13.6 | 6.0 | 3.7 | 2.9 |

What is the return period, in years, for a 6.0 cm annual rainfall according to (i) Hazen formula; and (ii) Weibull formula respectively ?

- a. 10/7, 11/7
- b. 20/13, 22/13

- c. 5/3, 11/7
- d. 20/11, 11/6

27. Which one of the following is not a major type of storm precipitation?
- a. Frontal storm
 - b. Air mass storm
 - c. Orographic storm
 - d. Continental storm
- 28.



A DRH due to a storm over a basin has a time base of 90 hours with straight line portions of the hydrograph with flow rates of 0, 10, 70, 90, 40 and 0 m³/s at elapsed durations of 0, 10, 20, 30, 50 and 90 hours as indicated on the above diagram, respectively. The catchment area is 300 km². What is the rainfall excess in the storm ?

- a. 2.83 cm
- b. 3.46 cm
- c. 3.87 cm
- d. 4.02 cm

29. Double mass curves are used
- a. to check on the consistency of precipitation records
 - b. as basis for storm rainfall analysis
 - c. to determine average rainfall over an area
 - d. to indicate rainfall distribution
30. Penman's equation is based on
- a. Energy budgeting only
 - b. Energy budgeting and water budgeting
 - c. Energy budgeting and mass transfer
 - d. Water budgeting and mass transfer

31. The time of concentration at the outlet in an urban area catchment of 1.5 km² area with a run off coefficient of 0.42 is 28 minutes. The maximum depth of rainfall with a 50 year return period for this time of concentration is 48 mm. What is the peak flow rate at the outlet for this return period ?

- a. $12 \text{ m}^3/\text{s}$
- b. $14 \text{ m}^3/\text{s}$
- c. $16 \text{ m}^3/\text{s}$
- d. $18 \text{ m}^3/\text{s}$

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

List—I (Technique/Principle)

- A. ϕ —Index
- B. Slope—area method
- C. Flow duration curve
- D. Dilution technique

List—II (Purpose)

- 1. Dependable flow
- 2. Reservoir regulation
- 3. Steady stream discharge determination
- 4. Run—off volume
- 5. Unsteady stream discharge determination

| | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 5 | 1 | 4 |
| b. | 4 | 1 | 2 | 3 |
| c. | 3 | 1 | 2 | 4 |
| d. | 4 | 5 | 1 | 3 |

33. In the case of large rivers, a number of equidistant vertical sections of the total width of flow are indentified, for the purpose of finding by umerical integration, the total discharge on any day. On each section, the mean velocity is taken as the arithmetic average of two typical depths on that Section. Then the mean velocity is worked out for, that section.

Usually, the mean velocity on any section, corresponds to which one of the following?

- a. $\frac{V_{0.1d} + V_{0.9d}}{2}$
- b. $\frac{V_{0.2d} + V_{0.8d}}{2}$
- c. $\frac{V_{0.3d} + V_{0.7d}}{2}$
- d. $\frac{V_{0.4d} + V_{0.6d}}{2}$

(V represents the point velocity at the given section and the depth such as 0.1d, 0.2d etc.)

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

List—I

- A. Location
- B. Stability
- C. Variation of discharge
- D. Plan form

List—II

- 1. Perennial
- 2. Degrading
- 3. Tidal
- 4. Braided

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

35. The basic equation of flood routing through a reservoir can be modified for discrete successive intervals Δt by which one of the following ?

- a. $\left[\frac{l_1 + l_2}{2} \right] \Delta t + \left[S_1 + \frac{Q_1 \Delta t}{2} \right] = \left[S_2 + \frac{Q_2 \Delta t}{2} \right]$
- b. $\left[\frac{l_1 + l_2}{2} \right] \Delta t + \left[S_1 - \frac{Q_1 \Delta t}{2} \right] = \left[S_2 + \frac{Q_2 \Delta t}{2} \right]$
- c. $\left[\frac{l_1 + l_2}{2} \right] \Delta t + \left[S_1 + \frac{Q_1 \Delta t}{2} \right] = \left[S_2 - \frac{Q_2 \Delta t}{2} \right]$
- d. $\left[\frac{l_1 + l_2}{2} \right] \Delta t + \left[S_1 - \frac{Q_1 \Delta t}{2} \right] = \left[S_2 - \frac{Q_2 \Delta t}{2} \right]$

36. By using Gumbel's method, the flood discharge with a return period of 500 years at a particular township neighborhood was estimated as $18000 \text{ m}^3/\text{s}$ with a probable error of $2000 \text{ m}^3/\text{s}$. What are the 95% confidence probability limits of the 500-year flood at the location ?

- a. $16100 \text{ m}^3/\text{s}$ to $19900 \text{ m}^3/\text{s}$
- b. $17050 \text{ m}^3/\text{s}$ to $18950 \text{ m}^3/\text{s}$
- c. $14080 \text{ m}^3/\text{s}$ to $21920 \text{ m}^3/\text{s}$
- d. $13600 \text{ m}^3/\text{s}$ to $22400 \text{ m}^3/\text{s}$

37. Which type of fall can be generally used for a moderate discharge of 40—60 cumecs and low fall heights of 1 to 1.5 m?
- Vertical drop fall
 - Ogee fall
 - Glacis fall
 - Baffle fall
38. If the sensitivity of an irrigation module is 0.5, then what per cent variation in outlet discharge will be caused by 50 percent variation in canal water depth ?
- 100%
 - 50%
 - 25%
 - 12.5%
39. A 252 km² catchment area has a 6 hr U.II. which is a triangle with time base of 35 hours. What is the peak discharge of the DRI-I due to 5 cm effective rainfall in 6 hours from that catchment ?
- 45 cumecs
 - 115 cumecs
 - 200 cumecs
 - 256 cumecs
40. In a river carrying a discharge of 142 m³/s, the stage at a station A was 3.6 m and the water surface slope was 1 in 6000. If during a flood, the stage at A was 3.6 m and the water surface slope was 1 in 3000, what was the flood discharge (approximately)?
- 284 m³/s
 - 200 m³/s
 - 164 m
 - 96 m
41. The moisture tension for a soil is 8 atmospheres. The soil is then at
- Permanent wilting point
 - Field capacity
 - Optimum moisture content
 - Equivalent moisture
42. Consider the following terms relating to irrigation requirements:
- Consumptive irrigation requirement
 - Net irrigation requirement
 - Field irrigation requirement
4. Gross irrigation requirement
- For a given set up, which one of the following is the correct relation?
- $1 > 2 > 3 > 4$
 - $1 < 2 < 3 < 4$
 - $(1=2) < 3 < 4$
 - $1 < (2=3) < 4$
43. A drainage coefficient
- Decides the choice of the method of the drainage
 - Decides the kind of crop that can be grown on the land
 - Is the depth of water that can be removed from the drainage area in unit time
 - Is the flow of water from the soil into the tile laterals per unit time
44. Match List — I with List — II and select the correct answer (s = bed slope, q = discharge intensity, Q = Discharge) :
- List — I**
- Mean velocity in a Lacey regime channel
 - Mean velocity in a lined channel
 - Normal scour depth in an alluvial channel
 - Wilted perimeter of a Lacey regime channel
- List — II**
- $s^{1/2}$
 - $s^{1/3}$
 - $q^{2/3}$
 - $q^{-1/3}$
 - $Q^{1/2}$
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 2 | 5 | 3 | 1 |
| b. | 3 | 1 | 4 | 5 |
| c. | 2 | 1 | 3 | 5 |
| d. | 3 | 5 | 4 | 1 |
45. What type of cross drainage work is provided when the canal runs below the drain, with FS L of canal well below the bed of the drain?
- Aqueduct
 - Super passage

- c. Level crossing
d. Siphon acueduct
46. What is the equivalent calcium carbonate concentration of 110 mg/l of CaCl_2 ?
- 50 mg/l
 - 58.5 mg/l
 - 100 mg/l
 - 117 mg/l

47. Which of the following cations impart(s) pseudo—hardness to water?
- Calcium only
 - Magnesium only
 - Calcium and magnesium
 - Sodium

48. Which one of the following is the range of ozonosphere in atmosphere ?
- Troposphere to Stratosphere
 - Tropopause to Stratosphere
 - Tropopause to Mesosphere
 - Stratosphere to Mesosphere -

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

List—I (Equipment)

- Tintometer
- Nephelometer
- Imhoff cone
- Muffle furnace

List—II (Parameter)

- Temperature
- Colour
- Turbidity
- Settleable solids
- Volatile solids

| | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 3 | 1 | 5 |
| b. | 2 | 5 | 4 | 3 |
| c. | 4 | 5 | 1 | 3 |
| d. | 2 | 3 | 4 | 5 |

50. Which one of the following pairs is not correctly matched ?
- Coriolis : The effect of earth's rotation on wind effect direction and velocity

- PAN : Found during photo—chemical smog
- Cyclone : Employed for particulate matter removal
- Wind rose : Employed in forecast of pollutant dispersion in ambient air

51. A standard multiple—tube fermentation test was conducted on a sample of water. The results of the analysis for the confirmed test are given below :

| Sample Size (ml) | No. of positive results out of 5 tubes | No. of negative results out of 5 tubes |
|------------------|--|--|
| 10 | 4 | 1 |
| 1 | 2 | 3 |
| 0.1 | 1 | 4 |
| 0.01 | 0 | 5 |

MPN Index for combination of positive results when 5 tubes used per dilutions (10 ml, 1.0ml, 0.1 ml)

| Combination of positives | MPN Index per 100 ml | Combination of positives | MPN Index per 100 ml |
|--------------------------|----------------------|--------------------------|----------------------|
| 5-4-3 | 280 | 4-2-1 | 26 |
| 4-3-1 | 33 | 2-1-0 | 7 |

Using the above MPN Index table, what is the most probable number (MPN) of the sample ?

- 280
 - 33
 - 26
 - 70
52. Chlorides from water are removed by
- Lime soda process
 - Reverse osmosis
 - Cation exchange process
 - Chemical coagulation
53. Chlorination with Cl_2 produces hypochlorous acid (HOCl), which may further dissociate as hypochlorite ion (OCl^-) depending upon pH of the water. The reaction is represented as
- $$\text{HOCl} \rightleftharpoons \text{H}^+ + \text{OCl}^- \quad (k = 2.5 \times 10^{-8} \text{ moles/l at } 20^\circ\text{C}).$$

- What is the fraction of HOCl in the water at pH 7.0 ?
- 0.95
 - 0.80
 - 0.20
 - 0.05
54. In which treatment unit is “Schmutzdecke” formed?
- Sedimentation tank
 - Rapid sand filter
 - Coagulation tank
 - Slow sand filter
55. Which one of the following chemicals is employed for dechlorination of water?
- Sodium sulphite
 - Sodium bicarbonate
 - Calcium carbonate
 - Hydrogen peroxide
56. Which one of the following is the correct sequence of slow sand filter (SSF), rapid sand filter (RSF), dual media filter (DMF) and mixed media filter (MMF) in the decreasing order of their filtration rates ?
- MMF DMF > RSF > SSF
 - DMF > RSF > SSF > MMF
 - RSF > SSF > MMF DMF
 - SSF > MMF DMF > RSF
57. After which of the following water treatment units, the turbidity is maximum ?
- Chlorination
 - Primary sedimentation
 - Flocculation basin
 - Secondary sedimentation
58. In context of water polluted, with sewage, what does BOD signify ?
- Biological oxygen demand
 - Bacteriological oxygen demand
 - Biochemical oxygen demand
 - Biology of degradation
59. What is the most common cause of acidity in water ?
- Carbon monoxide
 - Nitrogen
 - Hydrogen
 - Carbon dioxide
60. If total hardness & alkalinity of a water sample are 200 mg/l as CaCO₃ and 260 mg/l as CaCO₃ respectively, what are the values of carbonate hardness and non-carbonate hardness?
- 200 mg/l and zero
 - Zero and 60 mg/l
 - Zero and 200 mg/l
 - 60 mg/l and zero
61. Match List — I with List — II and select the correct answer using the code given below the Lists:
- List — I (Process/Bacteria)**
- Anabolism
 - Autotrophs
 - Catabolism
 - Heterotrophs
- List — II (Energy/Material)**
- Providing energy for the synthesis of new cells and maintenance of other cell functions
 - Obtaining energy and material for growth from organic sources
 - Providing the material necessary for cell growth
 - Obtaining energy and material for growth from inorganic sources
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 4 | 3 | 2 |
| b. | 3 | 2 | 1 | 4 |
| c. | 1 | 2 | 3 | 4 |
| d. | 3 | 4 | 1 | 2 |
62. Consider the following clay minerals
- Kaolinite
 - Illite
 - Montmorillonite
- Which one of the following is the correct sequence of the minerals given above in the increasing order of their grain size?
- 3—2—1
 - 1—3—2
 - 1—2—3
 - 3—1—2
63. Consider the following statements

1. Mica is a clay mineral
2. Rock dust particles, even of clay size are non—plastic
3. A particle of Kaolinite is electrically charged

Which of the statements given above are correct ?

- a. 1, 2 and 3
- b. Only 1 and 2
- c. Only 2 and 3
- d. Only 1 and 3

64. Which one of the following relation gives the value of degree of saturation s , in terms of unit weight γ , water content w (as ratio) and specific gravity of soil solids G_s , γ_w is unit weight of water?

$$a. s = \frac{w}{(\gamma / \gamma_w)(1+w) - 1 / G_s}$$

$$b. s = \frac{w}{(\gamma / \gamma_w)(1+w) + 1 / G_s}$$

$$c. s = \frac{w}{(\gamma_w / \gamma)(1+w) + 1 / G_s}$$

$$d. s = \frac{w}{(\gamma_w / \gamma)(1+w) - 1 / G_s}$$

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

List-I

- A. Smooth wheel rollers
- B. Sheep foot rollers
- C. Pneumatic tyred rollers
- D. Rammers

List-II

1. Most suitable for compacting cohesive soils
2. Most suited for compacting coarse grained soils
3. Used for compacting soils in confined places
4. Suitable for both cohesion- less & cohesive soils

- | | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 3 | 2 | 1 |
| b. | 2 | 1 | 4 | 3 |

- | | | | | |
|----|---|---|---|---|
| c. | 4 | 1 | 2 | 3 |
| d. | 2 | 3 | 4 | 1 |

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

List - I (Type of Soil)

- A. Wet clays and silts
- B. Crushed rock
- C. Fills soils
- D. Sands

List-II (Compaction Equipment)

1. Smooth wheel rollers
2. Vibrators
3. Pneumatic tyred rollers
4. Grid rollers

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

67. A soil mass under seepage has a downward flow of water. Which of the following statements are correct with regard to stresses at any point in the soil mass ?

1. Effective stress is decreased by an amount equal to the seepage force
2. Effective stress is increased by an amount equal to the seepage force
3. Total stress will change
4. Total stress will be unaltered

Select the correct answer using the code given below

- a. 1 and 3
- b. 2 and 3
- c. 1 and 4
- d. 2 and 4

68. In a consolidation test void ratio decreased from 0.80 to 0.70 when the load was changed from 40 kN/m² to 80 kN/m². What is the compression index ?

- a. 0.14
- b. 0.16
- c. 0.33
- d. 0.66

69. In a consolidation test the sample tested has height H ; water content is w ; specific gravity of solids G . After increasing the loading by an increment Δp , the height decrease is ΔH Which one of the following expresses the corresponding change in void ratio Δe ?

a. $\Delta e = \frac{\Delta H}{H(1+wG)}$

b. $\Delta e = \frac{\Delta H(1+wG)}{H}$

c. $\Delta e = \frac{H(1+wG)}{\Delta H}$

d. $\Delta e = \frac{H}{\Delta H(1+wG)}$

70. Consider the following statements

1. A sand with its void ratio higher than its critical void ratio increases in volume when sheared.
2. A sand with its void ratio less than its critical void ratio increases in volume when sheared.
3. For a sand at critical void ratio, the volume change during shear is minimum.

Which of the statements given above are correct ?

- a. 1, 2 and 3
- b. Only 1 and 2
- c. Only 2 and 3
- d. Only 1 and 3

71. Consider the following statements about the shearing resistance as a function of effective stress

1. Effective stress on the failure plane governs the shearing resistance and not the total stress.
2. Two soils equally dense, consolidated to same effective stress will show different shear resistance with drainage and undrained condition.
3. The post peak drop off in shearing resistance is less pronounced in over consolidated clays and more in normally consolidated clays at same effective stress.

Which of the statements given above are correct?

- a. 1, 2 and 3
- b. Only 1 and 3
- c. Only 1 and 2
- d. Only 2 and 3

72. Consider the following statements:

1. Stress path is a locus of stress points developed by stress changes in the soil and can be obtained from Mohr's Stress Circle.
2. Stress path can be used to determine the intensity of stress at a point due to the application of uniformly applied circular loaded area.
3. Stress path has a value in giving insight into probable soil response - particularly if a part of the previous history stress path can be reproduced.

Which of the statements given above are correct?

- a. 1, 2 and 3
- b. Only 1 and 2
- c. Only 2 and 3
- d. Only 1 and 3

73. A point load of 650 kN is applied on the surface of a thick layer of clay. Using Boussinesq's elastic analysis, what is approximate value of the estimated vertical stress at a depth 2 m and a radial distance of 1.0 m from the point of application of load?

- a. 55 kN/m²
- b. 44 kN/m²
- c. 41 kN/m²
- d. 37 kN/m²

74. In a braced vertical excavation of 5 m height and 250 m width in a cohesive soil having undrained cohesion equal to 20 kN/m² and bulk unit weight of 20 kN/m³, what is the factor of safety against heave failure at its base ?

- a. 1.0
- b. 1.20
- c. 1.40
- d. 2.0

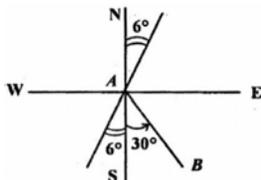
75. During a sampling operation, the drive sampler is advanced 600 mm and the length of the sample recovered is 525 mm. What is the recovery ratio of the sample?
- 0.125
 - 0.140
 - 0.875
 - 0.143
76. A sampling tube with a cutting edge is used for extracting the samples. The sampling tube has the following dimensions:
 Inner diameter of cutting edge = D_c . Outer diameter of cutting edge = D_w . Inner diameter of the sampling tube = D_s . Outer diameter of the sampling tube = D_t .
 What is the area ratio A_r of the sampling tube?
- $A_r = \frac{D_w^2 - D_c^2}{D_c^2} \times 100\%$
 - $A_r = \frac{D_t^2 - D_c^2}{D_c^2} \times 100\%$
 - $A_r = \frac{D_t^2 - D_w^2}{D_w^2} \times 100\%$
 - $A_r = \frac{D_t^2 - D_s^2}{D_s^2} \times 100\%$
77. Match List — I with List — II and select the correct answer using the code given below the Lists
- List-I (Type of Foundations)**
- Spread footings
 - Underreamed piles
 - Raft foundation
 - Deep foundation
- List-II (Suitability)**
- Soft clay for 20 m followed by hard rock stratum
 - Upto 3 m black cotton soil followed by medium dense sand
 - Compact sand deposit extending to great depth
 - Loose sand extending to great depth
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 4 | 1 | 3 | 2 |
| b. | 3 | 2 | 4 | 1 |
- c. 4 2 3 1
 d. 3 1 4 2
78. Consider the following statements
- The proportioning of a footing is more often governed by its bearing capacity.
 - Friction piles are also called 'floating piles.'
- Which of the statements given above is/are correct ?
- Only 1
 - Only 2
 - Both 1 and 2
 - Neither 1 nor 2
79. A test plate 30 cm square, settles by 12 mm under a load of 4.5 kN in a sandy soil. By how much will a footing 2m x 2m subjected to a load of 200 kN settle by ?
- 36.3 mm
 - 20.87 mm
 - 75.75 mm
 - 1815 mm
80. Consider the following statements
- Initial load tests and routine tests are carried out on test piles and working piles, respectively.
 - A cyclic load test is performed to determine a pile's skin resistance and base resistance separately.
 - In a pile load test, the safe load is taken as half the final load at which the settlement equals 10% of pile diameter.
- Which of the statements given above are correct ?
- 1, 2 and 3
 - Only 1 and 2
 - Only 2 and 3
 - Only 1 and 3
81. Which one of the following verniers is employed in Abney Level?
- Retrograde vernier
 - Double vernier
 - Double folded vernier
 - Extended vernier
82. What is the angle between two plane mirrors of an optical square ?

- a. 30^0
 b. 60^0
 c. 45^0
 d. 90^0
83. Which of the following figures are equal to one acre?
 1. 43560 sq. ft.
 2. 40 gunthas
 3. 10 sq. Gunter's chain
 4. 4850 sq. yds.

Select the correct answer using the code given below

- a. 1, 2 and 3
 b. 2, 3 and 4
 c. 1, 2 and 4
 d. 1, 3 and 4
84. What is the slope correction for a length of 30.0 m along gradient of 1 in 20?
 a. 3.75 cm
 b. 0.375 cm
 c. 37.5 cm
 d. 0.0375 cm

85.



The magnetic bearing of a line AB is S 30° E. If the declination is 6° West, then what is the true bearing ?

- a. S 36° E
 b. N 36° W
 c. S 24° E
 d. N 24° W
86. A 30 m metric chain is found to be 10 cm too short throughout a measurement. If the distance measured is recorded as 300 m, what is the actual distance ?
 a. 300.1 m
 b. 301.0 m
 c. 299.0 m
 d. 310.0 m
87. Diurnal variation is greater

- a. In winter than in summer
 b. At smaller latitudes than at higher latitudes
 c. At magnetic equator points
 d. In summer than in winter

88. What is the angle of intersection of a contour and a ridge line?
 a. 30°
 b. 0°
 c. 180°
 d. 90°

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

List-I

- A. Adjustment of surveying instruments
 B. Bowditch rule
 C. Triangulation
 D. Bessel's method

List-II

1. Bringing the various fixed parts of the instruments into proper relations with one another
 2. Solution of three point problem
 3. Measuring all the angles and base line
 4. Balancing the latitudes and departures

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

90. A level when set up 25 m from peg A and 50 m from peg B reads 2.847 m on staff held on A and 3.462 m on staff held on B, keeping bubble at its centre while reading. If the reduced levels of A and B are 283.665 m and 284.295 m respectively, what is the collimation error per 100.0 m?
 a. 0.015m
 b. 0.30m
 c. 0.045m
 d. 0.060m

91. For air borne application and materialization of GPS receiver and easy construction, which is the most frequently used antenna ?

- a. Microstrip
b. Micropole
c. Spiral helix
d. Choke ring
92. What is the minimum length of a transition curve for a design speed of 80 kmph in a horizontal curve of 240 m radius?
a. 32 m
b. 42 m
c. 52 m
d. 72 m
93. A runway is located 450 m above the mean sea level. If the aeroplane reference field is 1800 m, what is the approximate corrected runway length for elevation ?
a. 1849 m
b. 1889 m
c. 1987 m
d. 2013 m
94. Match List — I with List — II and select the correct answer using the code given below the Lists :
- List-I (Type of Binder)**
A. 80/100 Penetration grade bitumen
B. 85/25 Blownbitumen
C. MC—70 Cutback
D. RT-5 Road tar
- List-II (Use)**
1. Mastic—assphalt
2. Bituminous roads
3. Grouting works
4. Prime-coat
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 4 | 1 | 2 |
| b. | 2 | 1 | 4 | 3 |
| c. | 3 | 1 | 4 | 2 |
| d. | 2 | 4 | 1 | 3 |
95. What are the standards for testing of road macadam in Aggregate Impact Test ?
a. 14 kg wt, 38 cm drop, 15 blows
b. 14 kg wt, 35 cm drop, 20 blows
c. 18 kg wt, 35 cm drop, 15 blows
d. 18 kg wt, 30 cm drop, 20 blows
96. Which one of the following is the set of physical requirements of coarse aggregates for construction of WBM roads as per IRC recommendation?
- | | LAV(%) | AIV(%) | Fl (%) |
|----|--------|--------|--------|
| a. | <50 | <40 | <15 |
| b. | <50 | <30 | <15 |
| c. | <40 | <30 | <20 |
| d. | <40 | <30 | <15 |
97. On a road the free speed was 65 kmph and the space headway at jam density was 625 m. What is the maximum flow which could be expected on this road?
a. 2600 vph
b. 1625 vph
c. 1300 vph
d. 406 vph
98. A mucking operation is to be carried out by hauling trucks of 6 m³ capacity. Further,
1. Volume of muck per blast = 60 m³
2. Time allotted for mucking is 60 minutes with operating efficiency = 50 minute per hour.
3. Effective cycle time of hauling truck 25 mm.
What is the number of hauling trucks required for mucking?
a. 2
b. 4
c. 5
d. 6
99. Match List — I with List — II and select the correct answer using the code given below the Lists :
- List-I (Signal)**
A. Outer signal
B. Starter signal
C. Repeater signal
D. Disc signal
- List-II (Function)**
1. Departure signal
2. Reception signal
3. Shunting signal
4. Coacting signal

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

100. What is the value of the steepest gradient to be provided on a 2 degree curve for B.G. line having ruling gradient of 1 in 200?

- 1 in 238 (b)
- 1 in 227
- 1 in 202
- 1 in 198

101. The ruling gradient on B.G. section of railway is 1 in 150 and a 4° curve is also there on it. What is the allowable ruling gradient?

- 1 in 146
- 1 in 154
- 1 in 196
- 1 in 232

102. For design of a runway length, match List—I with List—II and select the correct answer using the code given below the Lists:

List - I (Factor)

- Standard basic length
- Elevation
- Temperature
- Effective gradient

List - II (Correction)

- 7% for every 303 metres
- 0.5%
- 20% for each 1% gradient
- Depends upon aircraft and obtained from ICAO Standard Tables

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

103. If M_i = Proportion of i th type of aircraft in the mix, T_i = "Gate occupancy time" of the i th type of aircraft. G = Number of gates

(considering that all the available gates can be used by all aircrafts).

Which one of the following equations gives the ultimate gate capacity C ?

$$a. C = \frac{\sum_{i=1}^n G \times M_i}{\sum_{i=1}^n T_i}$$

$$b. C = \frac{G \times 60}{\sum_{i=1}^n M_i T_i}$$

$$c. C = \sum_{i=1}^n \left(\frac{M_i}{G} \right) \times T_i$$

$$d. C = \frac{G}{\sum_{i=1}^n M_i \times T_i}$$

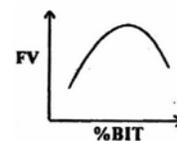
104. The total correction percentage for altitude and temperature, in calculating the runway length from basic runway length, normally does not exceed

- 7
- 14
- 28
- 35

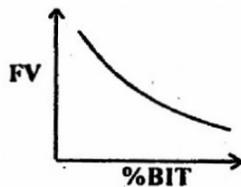
105. The present population of a community is 28000 with an average water demand of 150 lpcd. The existing water treatment plant has a design capacity of 6000 m³/d. It is expected that the population will increase to 48000 during the next 20 years. What is the number of years from now when the plant will reach its design capacity assuming an arithmetic rate of population growth ?

- 86 years
- 120 years
- 150 years
- 165 years

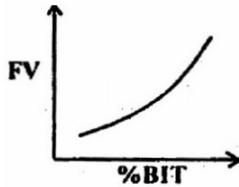
106. Which one of the following diagrams illustrates the relationship between flow value (FV) and percentage bitumen (%BIT)?



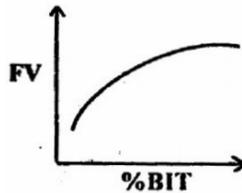
a.



b.



c.



d.

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

List – I (Method of Design for Flexible Pavement)

- A. Group Index Method
- B. CBR Method
- C. US Navy Method
- D. Asphalt Institute Method

List – II (Principle)

1. Semi—theoretical
2. Quasi—rational
3. Empirical method using soil classification test
4. Empirical method using soil strength test

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

108. What ratio do the versines of a circular curve when measured at the quarter point of a full chord and, when measured at the same point on half chord bear?
- a. 100 : 1
 - b. 60 : 1
 - c. 3 : 1
 - d. 1 : 1

109. The design speed of a highway is 80 km/hr and the radius of circular curve is 150 m in plain topography. Which one of the following is the minimum length of transition curve?

- a. 115 m
- b. 85 m
- c. 65 m
- d. 43 m

110. A rising gradient of 1 in 50 meets a falling gradient of 1 in 30. Which one of the following is the length of vertical curve if the stopping sight distance is 120 m ?

- a. 174 m
- b. 158 m
- c. 140 m
- d. 120 m

111. A 4-hour unit hydrograph of a basin can be approximated as a triangle with a base period of 48 hours and peak ordinate of $300\text{m}^3/\text{s}$. What is the area of the catchment basin ?

- a. 7776 km^2
- b. 5184 km^2
- c. 2592 km^2
- d. 1294 km^2

112. Hardness to water is caused by the presence of calcium (Ca^{+2}) and magnesium (Mg^{+2}) ions. Which are the least soluble forms of calcium and magnesium at normal water temperature?

- a. CaCl_2 and MgCO_3
- b. $\text{Ca}(\text{HCO}_3)_2$ and MgCl_2
- c. $\text{Ca}(\text{OH})_2$ and $\text{Mg}(\text{HCO}_3)_2$
- d. CaCO_3 and $\text{Mg}(\text{OH})_2$

113. Assertion (A) : Boundary layer theory is applicable only in the vicinity of the leading edge of the plate.

Reason (R) : Boundary layer theory is based on the assumption that its thickness is small when compared to other linear dimensions.

- 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
114. Assertion (A) : It takes longer to drain a reservoir with a long vertical pipe taken down from its bottom discharging into atmosphere than with an orifice at the bottom.
- Reason (R) : The relative height of the water surface elevation in the reservoir compensates for the friction loss in the pipe besides the entry and exit losses in the pipe.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
115. Assertion (A) : The unit hydrograph cannot be applied for areas less than 5000 sq. km.
- Reason (R) The run—off hydrograph reflects the physiographic factors of a catchment.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
116. Assertion (A) : The USBR type 11 stilling basin length requirement is less than that in type III basin for similar design conditions.
- Reason (R) : Energy dissipation is primarily accomplished by hydraulic jump in USBR type II stilling basin.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
117. Assertion (A) : Flocculating particles settle in curved path in a long rectangular sedimentation tank designed for a constant flow rate.
- Reason (R) : The downward settling velocities of particles as well as their respective horizontal velocities remain constant during their stay in the tank.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
118. Assertion (A) : Large weir overflow rates will result in excessive velocities at the outlet of a settling basin.
- Reason (R) : These excessive velocities will extend backward into the settling zone, causing particles and flocs which would otherwise be removed as sludge to be drawn into the outlet.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
119. Assertion (A) : The state of earth pressure at rest is the state of equilibrium with zero strain condition.
- Reason (R) : In rest condition neither the wall nor the soil moves.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true
120. Assertion (A) : The super elevation provided on a curve of a railway track is less than the equilibrium cant.
- Reason (R) : Subject to a maximum value depending on speed and gauge, cant deficiency is allowed and therefore actual cant provided is less than the equilibrium cant.
- Both A and R are individually true and R is the correct explanation of A
 - Both A and R are individually true but R is not the correct explanation of A
 - A is true but R is false
 - A is false but R is true