

CIVIL ENGINEERING

(PAPER-II)

1. The load carrying capacity of an individually friction pile is 200 kN. What is the total load carrying capacity of a group of 9 such piles with group efficiency factor of 0.8?
- 1800 kN
 - 1640 kN
 - 1440 kN
 - 900 kN
2. Consider the following statements:
- The standard penetration test is a reliable method for measuring the relative density of granular soils.
 - For a sand having the same relative density, N-values remain the same at all depths.
 - For a sand having the same relative density, N-values are different at different depths.
- Which of the statements given above is/are correct?
- 1, 2 and 3
 - 1 and 2
 - only 3
 - 1 and 3
3. Which one of the following states of field compaction of sand deposit truly represents the corrected standard penetration test value: N (corrected) = 27?
- Loose
 - Medium dense
 - Dense
 - Very dense
4. In case of footing on the surface or shallow depth is very dense sand, which one of the following types of failure is likely to occur?
- Punching shear failure
 - Local shear failure
 - General shear failure
 - Any of the above three
5. The bearing capacity factors N_c , N_q and N_{γ} are functions of:
- Width and depth of footing
 - Density of soil
 - Cohesion of soil
 - Angle of internal friction of soil
6. Match List I (Type of Soil) with List II (Suitable Foundation) and select the correct answer using the code given below the Lists :
- List I**
- Strong soil in surface layer
 - Weak surface layer followed by rock at shallow depth below ground
 - Swelling soil in surface layer extending upto a few meters below ground level
 - Weak heterogeneous surface soil layer
- List II**
- Raft foundation
 - Isolated footings
 - End bearing pile
 - Under-reamed piles
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 1 | 4 | 3 | 2 |
| b. | 2 | 3 | 4 | 1 |
| c. | 1 | 3 | 4 | 2 |
| d. | 2 | 4 | 3 | 1 |
7. Match List I (Type of Exploration) with List II (Soil Profile) and select the correct answer using the code given below the Lists :
- List I**
- Diamond core drilling
 - Uncased wash boring
 - Open pit excavation
 - Cased boring
- List II**
- Medium strong cohesive soils

2. Rocky formation
3. Soft cohesive soils and cohesionless soils. Exploration upto relatively larger depths
4. Exploration upto a shallow depth below ground level

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

8. Consider the following statements:

1. A recovery ratio of less than 1 implies that the soil has compressed.
2. A recovery ratio greater than 1 implies that the soil has swelled.
3. A recovery ratio of less than 1 implies that the soil has swelled.
4. A recovery ratio greater than 1 implies that the soil has compressed.

Which of the following statements given above is/are correct?

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

9. The wall friction of the retaining wall

- a. Decreases active earth pressure but increases passive earth pressure
- b. Decreases passive earth pressure but increases active earth pressure
- c. Decreases both active and passive earth pressures
- d. Increases both active and passive earth pressures

10. Stresses obtained from Boussinesq's theory are considered reasonably satisfactory in foundation engineering because:

- a. They represent stress distribution in inhomogeneous soil below loaded area
- b. They account for anisotropy of soil properly
- c. They give due regard to plastic behaviour of soils, particularly of settlement analysis

- d. They consider elastic soil medium, and the intensity of allowable stresses below foundations in most cases are quit small and justify elastic solutions

11. Consider the following statements:

1. Obtaining reliable properties of soil is very important in geotechnical engineering. Chunk samples obtained from the field are the best for this purpose.
2. Chunk samples may easily be obtained at all depths below ground level and for all types of soils.
3. Undisturbed soil samples are enclosed in rugged containers. As such, they do not get disturbed easily during transportation and handling.

Which of the statements given above is/are correct?

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

12. Which one of the following is the appropriate triaxial test to assess the immediate stability of an unloading problem, such as an excavation of a clay slope?

- a. UU test
- b. CU test
- c. CD test
- d. Unconsolidated drained test

13. Well-graded dense saturated sands have high shear strength because:

- a. Such sands have, a better grade (superior type) of sand grains resulting in higher strength
- b. Such sands have lower water content, which increases shear strength
- c. Such sands have better interlocking of grains, higher inter-particle contacts and higher inter-particle frictional resistance resulting in higher strength
- d. Presence of water in such sands induces capillary pressure generating higher inter-granular stresses, which generate apparent cohesion and hence higher shear strength

14. A footing is resting on a fully saturated clayey strata. For checking the initial stability shear parameters are used from which one of the following?
- Consolidated non-drained test
 - Unconsolidated drained test
 - Unconsolidated non-drained test
 - Unconsolidated non-drained test with pore pressure measurement
15. How high should a helicopter pilot rise at a point A just to see the horizon at point B, if the distance AD is 40 km?
- 101.75 m
 - 110.50 m
 - 107.75 m
 - 105.50 m
16. Which one of the following represents a circumpolar star?
- Upper culmination above horizon, lower culmination below horizon
 - Both upper and lower culminations below horizon
 - Both upper and lower culminations above horizon
 - Altitude at upper culmination is minimum
17. In an aerial photogrammetric survey, if the exposure interval is 20 seconds to cover ground distance of 1000 m between exposures, what would be the ground speed of the aircraft?
- 90 km/hour
 - 120 km/hour
 - 150 km/hour
 - 180 km/hour
18. Match List I (Phenomenon) with List II (Method of Survey) and select the correct answer using the code given below the lists.
- List I
- Crab and drift
 - Stadia intercept
 - Culmination and elongation
 - Baseline measurement
- List II
- Triangulation
 - Astronomical survey
3. Aerial photogrammetry
4. Tachometric survey
- | | A | B | C | D |
|----|---|---|---|---|
| a. | 3 | 1 | 2 | 4 |
| b. | 2 | 4 | 3 | 1 |
| c. | 3 | 4 | 2 | 1 |
| d. | 2 | 1 | 3 | 4 |
19. Which one of the following pairs is not correctly matched?
- Declination : Horizontal angle between magnetic meridian & true meridian
 - Bowditch's rule : Employed to adjust closing error of closed traverse
 - Deflection angle : Measured in case of open traverse instead of measuring included angle
 - Reconnaissance : Employed for detailed survey and precise survey
20. What is the volume of a 6 m deep tank having rectangular shaped top 6 m x 4 m and bottom 4 m x 2 m (computed through the use of prismoidal formula)?
- 96 m³
 - 94 m³
 - 92 m³
 - 90 m³
21. If two triangulation signals of 6.75 m height each, are to be just visible over ground mutually, what is the maximum distance between their locations on the ground surface?
- 10 km
 - 20 km
 - 30 km
 - 40 km
22. What is the actual ground area covered by a 20 cm x 20 cm size vertical aerial photograph, at an average scale of 1 cm = 200 m having 60% forward overlap and 30% side overlap?
- 1.92 km²
 - 4.48 km²
 - 6.72 km²
 - 2.88 km²
23. Assertion (A) : A turn-out is a combination of points and crossings, which enable a

branch line to take off from another main line railway track.

Reason (R) : Turn-outs are in great use in railway marshalling yards.

- 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

24. Assertion (A) : A small quantity of ammonia is added to water before carrying out disinfection using chlorine.

Reason (R) : Chloramines are persistent disinfectants, which provide continued protection against re-growth of microorganisms in a water distribution system.

- 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

25. Assertion (A) : Composting is the most commonly used process for the decomposition of the organic components of municipal solid wastes.

Reason (R) : Bangalore method is a common anaerobic method used for biological conversion of organic components of municipal solid wastes.

- 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

26. Assertion (A) : The bearing capacity of a footing always gets affected by the location of ground water table.

Reason (R) : Water in soil affects the shear strength parameters as well as the unit weight.

- 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

27. Assertion (A) : Basement walls and bridge abutments are usually designed for earth pressure at rest.

Reason (R) : These are usually not restrained by the floor slab and by the deck structure at their bases.

- 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

28. Assertion (A) : The clay core of an earth dam is usually compacted on the wet side of OMC.

Reason (R) : Compaction on the wet side of OMC reduces permeability and prevents cracking in core.

- 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

29. Assertion (A) : At the critical state of flow, the specific force is a minimum for the given discharge.

Reason (R) : For a minimum value of specific force the first derivative of force with respect to depth should be unity.

- 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

30. Assertion (A) : The earth pressure at rest is greater than active pressure but less than passive earth pressure.

Reason (R) : When the wall moves away from backfill from the rest condition, the mobilisation of the internal resistance of soil occurs; on the other hand, if the wall moves towards the fill, the shearing resistance builds up.

- 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
31. Which type of light energy is effectively absorbed by CO_2 in the lower boundary of the troposphere?
 a. X-rays
 b. UV-rays
 c. Visible light
 d. Infra-red rays
32. Which one of the following is the correct sound intensity expression with usual notations?
 a. $\text{dB} = 10 \log_{10}(I/I_0)^2$
 b. $\text{dB} = 10 \log_{10}(I/I_0)$
 c. $\text{dB} = 10 \log_{10}(I - I_0)^2$
 d. $\text{dB} = 10 \log_{10}(I - I_0)$
33. What type of noise can be abated by providing lining on walls and ceiling with sound absorbing material?
 a. Source noise
 b. Reflection noise
 c. Structural noise
 d. Direct air-borne noise
34. In which type of lakes, does a perfect ecological equilibrium among the producers, decomposers and consumer groups of organisms exist?
 a. Senescent lakes
 b. Mesotrophic lakes
 c. Oligotrophic lakes
 d. Eutrophic lakes
35. Match List I (Type of Impurity) with List II (Effect) and select the correct answer using the code given below the Lists
- List I**
- Carbonates and bicarbonates of Ca and Mg
 - Carbonates and bicarbonates of Sodium
 - Sulphates and chlorides of Ca and Mg
 - Oxides of iron and manganese
- List II**
- permanent hardness
 - Temporary hardness

3. Alkanity and softness

4. Colour and taste

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

36. Match List I (Equation/Law) with List II (Related Application) and select the correct answer using the code given below the Lists

List I

- Chicks law
- Darcy-Weisbach equation
- Stoke's equation
- Garnen-Reynolds equation

List II

- Discrete particle settling
- Head loss in a pipe
- Head loss in filters
- Rate of bacterial kill

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

37. A flash mixer of 2.0 m^3 , with a velocity gradient of mixing mechanism equal to $600/\text{s}$, and fluid absolute viscosity of $1.0 \times 10^{-3} \text{ N s/m}^2$ is continuously operated. What is the power input per unit volume?
 a. 360 W
 b. 720 W
 c. 1440 W
 d. 300 W

38. Consider the following statements:

In water supply distribution network,

- the grid-iron system requires more length of pipe lines and larger number of cut-off valves.
- the design of the grid-iron system is difficult but economical.
- employing a grid-iron system, the dead ends are completely eliminated.

4. employing a grid-iron system permits more water to be diverted towards the affected point from various directions.

Which of the statements given above are correct?

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

39. A municipal sewage has BOD_5 of 200 mg/l. It is proposed to treat it and dispose off into a marine environment. For what minimum efficiency should the sewage treatment plant be designed?

- a. 85%
- b. 60%
- c. 50%
- d. 33.67%

40. Which one of the following types of settling phenomenon can be analysed by the classic sedimentation laws of Newton and Stokes?

- a. Discrete settling
- b. Flocculent settling
- c. Hindered settling
- d. Compression settling

41. Match List I ('Treatment Process') with List II (Related Terms) and select the correct answer using the code given below the Lists

List I

- A. Lagoons
- B. Trickling filter
- C. Oxidation pond
- D. Activated sludge process

List II

- 1. Attached growth system
- 2. Algae-bacteria symbiotic relationship
- 3. Extended aeration
- 4. Low cost treatment method

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

42. A summit curve is formed at the intersection of a 3% upgrade and a 5% downgrade. What is the length of the summit curve in order to provide a stopping distance of 128 m?

- a. 271 m
- b. 298 m
- c. 322 m
- d. 340 m

43. Match List I (Study) with List II (Purpose) and select the correct answer using the code given below the Lists

List I

- A. Primary road system
- B. Economic studies
- C. Engineering studies
- D. Road use studies

List II

- 1. Population distribution
- 2. Freeways
- 3. Traffic volume
- 4. Topographic details

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

44. Consider the following statements:

- 1. Mastic asphalt is a mixture of hard grade bitumen or blown bitumen, minerals filler and fine aggregates.
- 2. % of binder content in the mastic asphalt is 17.20 percent by weight of the aggregates.

Which of the statements given above is/are correct?

- a. 1 only
- b. 2 only
- c. Both 1 and 2
- d. Neither 1 nor 2

45. Match List I (Traffic Survey) with List II (Method) and select the correct answer using the code given below the Lists :

List I

- A. Spot speed
- B. Traffic volume

- C. O-D survey
D. Parking survey

List II

1. By video tape
2. By road side interview
3. By Doppler radar
4. By pneumatic tube

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

46. Match List I (Unit) with List H (Purpose) and select the correct answer using the code given below the Lists :

List I

- A. Clover leaf interchange
B. Traffic studies
C. Rotary island
D. Road junction approach sign

List II

1. Informatory sign
2. Traffic control device
3. Traffic flow characteristics
4. Grade-separation

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

47. Which one of the following is the correct expression for the versine(h) of a curve?

- a. $h = \frac{l^2}{2r}$
b. $h = \frac{l^2}{4r}$
c. $h = \frac{l^2}{8r}$
d. $h = \frac{l^2}{r}$

(Where l = length of rail on the curve portion and r = radius of curvature)

48. A 6 hour storm has 6 cm of rainfall and the resulting runoff was 3 cm. If ϕ = index

remains at the same value, which one of the following is the runoff due to 12 cm of rainfall in 9 hours in the catchment?

- a. 4.5 cm
b. 6.0 cm
c. 7.5 cm
d. 9.0 cm

49. Which one of the following statements is correct?

A forebay in a hydel system is provided at the junction of:

- a. the power channel and the tail race channel
b. the tail race channel and the penstock
c. the penstock and the turbine
d. the power channel and the penstock

50. A catchment has an area of 150 hectares and a runoff/rainfall ratio of 0.40. If due to 10 cm rainfall over the catchment, a stream flow at the catchment outlet lasts for 6 hours, what is the average stream flow in the period?

- a. 60,000 m³/hour
b. 100 m³/minute
c. 3.5 m³/s
d. 1.33 m³/s

51. The area between the two isohyets 45 cm and 55 cm is 100 km², and that between 55 cm and 65 cm is 150 km². What is the average depth of annual precipitation over the basin of 250 km²?

- a. 50 cm
b. 52 cm
c. 56 cm
d. 60 cm

52. Viewing watershed as a system, which one of the following assumptions is made in the unit graph theory?

- a. Non-linearity
b. Both linearity and time, variance
c. Both time invariance and non-linearity
d. Both linearity and time invariance

53. Which one of the following flood routing methods involves the concepts of wedge and prism storages?

- a. Coefficient method
b. Muskingum method

- c. Pul's method
- d. Lag method

54. The base width of a soil gravity dam is 25 m, the material of the dam has a specific gravity of 2.56 and the dam is designed as an elementary profile ignoring uplift. What is the approximate allowable height of the dam?
- a. 64 m
 - b. 40 m
 - c. 164 m
 - d. 80 m

55. Match List I (Relative Position of Canal and Drainage Channel) with List II (Type of Cross Drainage Work) and select the correct answer using the code given below the Lists :

List I

- A. Canal taken above the drainage channel at its grade
- B. Drainage channel taken above the canal at its bed slope
- C. Canal taken below the drainage channel
- D. Drainage channel taken below the canal

List II

- 1. Cansal siphon
- 2. Drainage siphon
- 3. Aqueduct
- 4. Super passage

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

56. A clay sample has a void ratio of 0.54 in dry state. The specific gravity of soil solids is 2.7. What is the shrinkage limit of the soil?
- a. 8.5%
 - b. 10.0%
 - c. 17.0%
 - d. 20.0%

57. Match List I (Equipment) with List II (Purpose) and select the correct answer using the code given below the Lists :

List I

- A. Sheep foot roller
- B. Frog hammer
- C. Vibratory roller

List II

- 1. To densify cohesionless soils to relatively larger depths
- 2. To compact lumpy cohesive soil fills
- 3. To compact soils at corners and places which bigger rollers cannot access
- 4. To compact cohesionless soils of shallow depth

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

58. Match List I (Unit) with List II (Purpose) and select the correct answer using the code given below the Lists :

List I

- A. Graded filter
- B. Lime treatment
- C. Impervious clay core
- D. Curtain grouting

List II

- 1. To reduce seepage of water through body of earth dam
- 2. To reduce water seepage through foundation below dam
- 3. To stabilize black cotton soils
- 4. To drain water without losing fines from the soil

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

59. A soil deposit has three layers having same thickness each but the permeabilities of the layers are in the ratio of 1 : 2 : 4 from top to bottom. What is the ratio of average permeability in the horizontal direction to that in the vertical direction?

- a. 7 : 2

- b. 14 : 6
c. 28 : 24
d. 49 : 36
60. If the time required for 60% consolidation of a remoulded soil sample of clay with single drainage is t , then what is the time required to consolidate the same sample of clay with the same degree of consolidation but with double drainage?
a. $4t$
b. $2t$
c. $t/2$
d. $t/4$
61. If Δp is increment of pressure on a normally consolidated saturated soil mass, as per Terzaghi's theory at the instant of application of pressure increment i.e. when time $t = 0$, what is the pore pressure developed in the soil mass?
a. Zero
b. Very much less than Δp
c. Equal to Δp
d. Greater than Δp
62. Which one of the following is the best method for locating sounding to estimate the dredged material from the harbours?
a. Two angles from shore
b. Two angles from boat
c. One angle from shore and other from the boat
d. Fixed intersecting ranges
63. Which one of the following gives the number of gate position in an airport?
a. $\frac{\text{Capacity of runway}}{\text{average gate occupancy time}}$
b. $\frac{\text{Capacity of apron}}{60 \times 2}$ number of aircraft movements
c. $\frac{\text{Capacity of taxiway}}{60 \times 2}$ average gate occupancy time
d. $\frac{\text{Capacity of holding apron}}{2}$ average gate occupancy time

64. Match List I (Unit) with List II (Purpose) and select the correct answer using the code given below the Lists:

List I

- A. Width and length of safety area of airport
B. Engine failure case
C. Location of exit taxiways
D. Grading of airport size

List II

1. Basic runway length
2. Runway geometric design
3. Airport drainage
4. Runway capacity

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

65. Which of the following are requirements for the design of a transition curve for a highway system?

1. Rate of change of grade
2. Rate of change of radial acceleration
3. Rate of change of super elevation
4. Rate of change of curvature

Select the correct answer using the code given below:

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

66. California Bearing Ratio (CBR) is a:

- a. Measure of soil strength
b. Method of soil identification
c. Measure to indicate the relative strengths of paving materials
d. Measure of shear strength under lateral confinement

67. Which of the following factors have to be considered for the design of the flexible pavement for a highway?

1. Design wheel load
2. Strength of pavement component material
3. Expansion joints

4. Climatic factors

Select the correct answer using the code given below:

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

68. What is the curve resistance for a 50 tonnes train on a BG track on a 4° curve?

- a. 0.05 tonne
- b. 0.06 tonne
- c. 0.08 tonne
- d. 0.01 tonne

69. Why are moorings provided?

- a. For anchoring of ships
- b. For towing the ships to the sea
- c. For repair of ships
- d. For washing of ships and ship boards

70. What is the use of a station pointer?

- a. For making soundings in water bodies
- b. For plotting of soundings in harbour area
- c. For marking sunken shipping hazards
- d. For making tidal observations

71. Consider the following statements:

1. Dock is a marine structure for mooring up vessels, loading and unloading of passengers and/or cargo.
2. Dry dock is generally used only for carrying out repairs, inspections and painting.
3. Wet dock is an enclosed or partially enclosed basin provided with locks and entrance gate to keep the water level at a fairly constant level.

Which of the statements given above are correct?

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

72. The percentage of time in a year during which the cross wind component remains within the limit, is:

- a. Wind coverage
- b. Head wind

c. Prevailing wind

d. Cross wind

73. At a certain station, the mean of the average temperature is 25°C and mean of the maximum daily temperature is 40°C . What is the airport reference temperature (ART)?

- a. 46.6°C
- b. 45°C
- c. 35°C
- d. 30°C

74. Consider the following statements with respect to tunnelling methods:

1. Full face excavation is suitable for small size tunnel or short length in competent rock. It is not suitable in urban areas.
2. Heading and benching method is suitable for soft rock tunnelling of medium size.
3. Lift method is suitable for large tunnels in difficult or incompetent rock.

Which of the statements given above are correct?

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

75. The velocity distribution for flow over a plate is given by $u = 0.5 y - y^2$ where u is the velocity in m/s at a distance y meter above the plate. If the dynamic viscosity of the fluid is 0.9 Ns/m^2 , then what is the shear stress at 0.20 m from the boundary?

- a. 0.9 N/m^2
- b. 1.8 N/m^2
- c. 2.25 N/m^2
- d. 0.09 N/m^2

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

List I

- A. Equation of motion along a streamline
- B. Euler's equation
- C. Pressure exerted by a free jet
- D. Rotating lawn Sprinkler

List II

1. Principle of moment of momentum
2. Bernoulli's equation
3. Equation for conservation of momentum
4. Momentum equation

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

77. The pressure gradient in the direction of flow is equal to the:

- a. Shear gradient parallel to the direction of flow
- b. Shear gradient normal to the direction of flow
- c. Velocity gradient parallel to the direction of flow
- d. Velocity gradient normal to the direction of flow

78. Which one of the following statements is not correct?

- a. Models are always smaller than the prototypes.
- b. Dynamic similarity between a model and a prototype can be verified by equating Reynold's number in a viscous flow.
- c. Mach number achieves significance when the velocity of fluid approaches or exceeds the sonic velocity.
- d. Distorted models are always exaggerated on vertical scale.

79. Which one of the following statements is correct?

- a. The function of an air vessel in a reciprocating pump is to obtain:
- b. reduction of suction head
- c. rise in delivery head
- d. continuous supply of water at uniform rate
- e. increase in supply of water

80. Match List I (Type of Curve) with List II (Flow Condition) and select the correct answer using the code given below the Lists :

List I

- A. M1
- B. H3
- C. S2
- D. A2

List II

1. Slope upward in the direction of flow
2. Back water profile
3. Hydraulic jump occurs
4. Hydraulic drop occurs

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

81. A high efficiency pump is required for low discharge, high head and low maintenance cost. Delivery of water need not be continuous. The pump need not run at high speed. Which one of the following is the correct choice?

- a. Centrifugal pump
- b. Reciprocating pump
- c. Air lift pump
- d. Hydraulic ram

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

List I

- A. Storage
- B. Pondage
- C. Pondage factor
- D. Daily load factor

List II

1. Small storage
2. Ratio of total inflow to the total number of days power plant operates in a week
3. Large reservoirs
4. (Average plant load) $\times$ (Peak load)
5. Ratio of average load to peak load

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

- d. 5 2 1 4
83. Match List I (Factor) with List II (Ratio) and select the correct answer using the code given below the Lists:

List I

- A. Load factor
- B. Capacity factor
- C. Diversity factor
- D. Plant use factor

List II

- 1. Sum of individual maximum demands
Simultaneous maximum demand
- 2. Maximum demand Station capacity
- 3. Average load Maximum load
- 4. Energy produced Installed capacity
time in hours

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

84. For which one of the following purposes is the double mass curve used?
- a. Checking on the consistency of precipitation records
 - b. Prediction of annual precipitation
 - c. Defining which periods of storm should be analyzed to obtain the maximum useful information from storm rainfall records
 - d. For estimating the capacity of a reservoir
85. For a given storm, other factors remaining same:
- a. Basins with large drainage densities give smaller flood peaks.
 - b. Low drainage density basins give shorter time bases of hydrographs.
 - c. The flood peak is independent of the drainage density
 - d. Basins having low drainage density give smaller peaks in flood hydrographs.
86. The discharge per unit drawdown at the well is known as:
- a. Specific yield
 - b. Specific storage

- c. Specific retention
- d. Specific capacity

87. The channel section can be designed on the basis of Lacey's Theory. The steps are mentioned below:

- 1. Finding out the perimeter
- 2. Finding out the velocity
- 3. Calculation of the silt factor
- 4. Finding out the area

What is the correct sequence of the steps?

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

88. In Lacey's regime theory the velocity of flow is proportional to:

- a. C
- b. C^2
- c. $(Q/f)^{1/3}$
- d. $(Q/f)^{2/3}$

89. Which of the following are the purposes of a groyne as a river training structure?

- 1. It contracts a river channel to improve its depth.
- 2. It protects the river bank.
- 3. It does not allow silt to deposit in the vicinity.
- 4. It trains the flow along a certain course.

Select the correct answer using the code given below:

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

90. Denehy's groyne is a special type of groyne which is:

- a. Pointing upstream
- b. Pointing downstream
- c. Hockey type
- d. T-headed

91. In a laminar boundary layer, the velocity distribution can be assumed to be given, in usual notations, as

$$\frac{u}{v} = \frac{y}{\delta}$$

Which one of the following is the correct expression for the displacement thickness δ^* for this boundary layer?

- a. $\delta^* = \delta$
- b. $\delta^* = \delta/2$
- c. $\delta^* = \delta/4$
- d. $\delta^* = \delta/6$

92. For Froude number of a hydraulic jump is 5.5. The jump can be classified as a/an:

- a. Undular jump
- b. Oscillating jump
- c. Weak jump
- d. Steady jump

93. Match List I (Treatment Process) with List II (Removed Matter) and select the correct answer using the code given below the Lists:

List I

- A. Plain Sedimentation
- B. Chemical Precipitation
- C. Slow Sand Filtration
- D. Aeration

List II

- 1. Dissolved gases
- 2. Dissolved solids
- 3. Suspended solids with specific gravity more than 1.0
- 4. Floating solids
- 5. Bacterial cells

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

94. A sample of ground water at a pH of 7.0 contains 122 mg/l of bicarbonates. What is the alkalinity of this water (in terms of CaCO_3)?

- a. 120 mg/l
- b. 60 mg/l
- c. 100 mg/l
- d. 200 mg/l

95. Match List I (Type of Pile) with List II (Situation for Use) and select the correct answer using the code given below the Lists:

List I

- A. End bearing pile
- B. Pedestal pile
- C. Friction pile
- D. Sand piles

List II

- 1. When weak foundation soil is to be compacted
- 2. When foundation soil is granular
- 3. When foundation soil is relatively weak
- 4. When hard formation or rock is at a shallow depth

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

96. While driving a large number of piles in loose sand:

- a. It is advantageous to follow a sequence of pile driving such that the inner piles are driven first and then proceed outwards
- b. It is advantageous to follow a sequence of pile driving such that the piles near the periphery are driven first and inner piles are driven later
- c. It is advantageous to follow a sequence of pile driving such that alternately inner and outer piles are driven
- d. Driving of piles can be done in any random order

97. In a plate load test, how is the ultimate load estimated from the load settlement curve on a log-log graph?

- a. Directly
- b. By drawing tangents to the curve at the initial and final points
- c. By the secant method
- d. At 0.2 percent of the maximum settlement

98. The laboratory tests on a sample yielded the following results:

- Plasticity index: 32%,
- Liquidity index: -0.15,
- Activity number: 1.58.

Which of the following inferences can be drawn?

1. The soil is very stiff.
2. The soil is medium soft.
3. The soil is highly plastic.
4. The soil is medium plastic.
5. The soil is active.

Select the correct answer using the code given below:

- a. 1, 3 and 5
- b. 1, 3 and 4
- c. 2, 3 and 5
- d. 1, 2 and 4

99. In which one of the following zones is a logarithmic spiral shape of failure surface assumed in the case of bearing capacity analysis of $C-\phi$ soils?

- a. Active zone
- b. Passive zone
- c. Radial Shear zone
- d. Surcharge zone

100. Westergaard's formula for vertical stress gives greater value of stress than that by the Boussinesq's formula, when z/b exceeds:

- a. 1.5
- b. 2.5
- c. 3.5
- d. 4.0

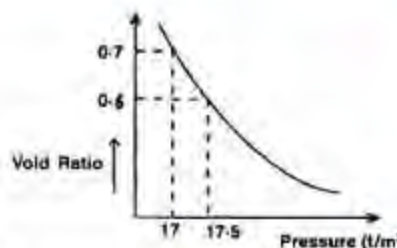
101. In a shear test on cohesionless soils, if the Initial void ratio is less than the critical void ratio, the sample will:

- a. Increase in volume
- b. Initially increase in volume and then remain constant
- c. Decrease in volume
- d. Initially decrease and then increase in volume

102. As the state of strain of an element of dense sand changes from plain strain to trivial strain condition, the effective angle of internal friction:

- a. Increases
- b. Decreases
- c. Remains constant
- d. First increases and then remains constant

103.



The void-pressure diagram is shown above. What is the coefficient of compressibility?

- a. $0.5 \text{ m}^2/\text{t}$
- b. $0.73 \text{ m}^2/\text{t}$
- c. $0.20 \text{ m}^2/\text{t}$
- d. $0.25 \text{ m}^2/\text{t}$

104. Match List I (Term) with List II (Definition) and select the correct answer using the code given below the Lists (where e is void ratio, p is effective vertical stress, k is permeability and γ_w is unit weight of water):

List I

- A. Compression index, C
- B. Coefficient of volume change, m
- C. Coefficient of compressibility, a
- D. Coefficient of consolidation, C_v

List II

1. Slope of the $e-p$ curve defined as $\Delta e/\Delta p$
2. Slope of $e-\log p$ curve given by $\{-\Delta e/\Delta(\log p)\}$
3. Term defined as $k/(m_v \gamma_w)$
4. Slope of the $c-p$ curve defined as $-\Delta e/\Delta p$

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

105. A clay layer 3 m deep is sandwiched by a pervious material. The soil reaches 90% consolidation in 3 years. At another site, the same clay layer is bounded by impervious boundary at the bottom and sand at the top. What is the time taken by this layer to reach 90% settlement?

- a. 9 years

- b. 12 years
c. 15 years
d. 21 years
106. Which of the following factors are associated with the behaviour of sand mass during earthquake to cause liquefaction?
1. Number of stress cycles
 2. The frequency and amplitude of vibration of waves generated by an earthquake
 3. Characteristics of sand
 4. Relative density
- Select the correct answer using the code given below:
- a. 1, 2 and 3
 - b. 1, 2, 3 and 4
 - c. 2 and 4
 - d. 3 and 4
107. Which one of the following different types of submerged soils is susceptible to liquefaction under earthquake shocks?
- a. Dense sand
 - b. Soft clay
 - c. Loose silt
 - d. Fissured clay
108. Which one of the following pairs is not correctly matched?
- Plume Behaviour - Atmospheric Condition*
- a. Looping : Stable
 - b. Fumigation : Inversion above and lapse below the stack
 - c. Fanning : Inversion
 - d. Trapping : Inversion above and below the stack with lapse in between
109. Which is the major pollutant present in photochemical smog?
- a. CO
 - b. SO₂
 - c. HC
 - d. NO₂
110. Consider the following statements:
In solid waste management:
1. Density separation of solid wastes can be accomplished by air classifiers.
 2. Iron recovery from solid wastes can be done by magnetic separators.
 3. Aluminium separation from solid wastes can be accomplished by eddy current separators.
- Which of the statements given above are correct?
- a. 1 and 2
 - b. 2 and 3
 - c. 1 and 3
 - d. 1, 2 and 3
111. Which one of the following statements is not correct?
- a. Settling and sludge digestion occurs in septic tanks in one compartment
 - b. Settling and sludge digestion occurs in imhoff tank in different compartments
 - c. Septic tank is a low-rate anaerobic unit whereas imhoff tank is a high rate anaerobic unit
 - d. The rate of sludge accumulation in septic tank is approximately 40-70 litres/capita/year
112. Consider the following statements:
1. Infiltration galleries are placed along the river beds at a depth of 4 to 6 m.
 2. The draw-down for the infiltration galleries is more than that for radial wells.
 3. Clogging of pipe pores in infiltration galleries is less than that for radial wells.
 4. The cost of extracting unit volume of water is more in case of infiltration galleries as compared to radial wells.
- Which of the statements given above is/are correct?
- a. 1 and 2
 - b. 1, 2 and 3
 - c. 2, 3 and 4
 - d. 4 only
113. Among the following, which is/are not pre-treatment unit(s)?
- a. Bar screen and grit chamber
 - b. Flow equalization and proportioning tank
 - c. Neutralization for pH adjustment tank
 - d. Nutrient removal tank

114. Consider the following statements in regard to aerobic and anaerobic treatment processes:

1. Biomass production in the aerobic treatment process is more as compared to the anaerobic treatment process.
2. Start-up period is more in the aerobic treatment process as compared to the anaerobic treatment process.
3. Energy consumption and production is more in the aerobic treatment process as compared to the anaerobic treatment process.

Which of the statements given above is/are correct?

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

115. What is 5 days 20°C BOD equal to?

- a. 3 days 27°C BOD
- b. 4 days 30°C BOD
- c. 6 days 32°C BOD
- d. 7 days 35°C BOD

116. Match List I (Parameter) with List II [General Standard for Discharge into the Inland Surface Water in mg/l (max)] and select the correct answer using the code given below the Lists:

List I

- A. BOD(5 day 20°C)
- B. COD
- C. Oil and grease
- D. Suspended solids

List II

1. 20
2. 100
3. 20
4. 10
5. 30

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

117. When the recirculation ratio in a high rate trickling filter is unity, then what is the value of the recirculation factor?

- a. 1
- b. >1
- c. ≤ 1
- d. Zero

118. Presence of nitrogen in a waste water sample is due to the decomposition of

- a. Carbohydrates
- b. Proteins
- c. Fats
- d. Vitamins

119. According to the theory of filtration in water treatment, which of the following mechanisms come into play when water is filtered through a filter bed?

1. Mechanical straining
2. Capillary action
3. Centrifugal force
4. Electro kinetic phenomenon
5. Osmotic force
6. Bacteriological action

Select the correct answer using the code given below:

- a. 1, 2, 4 and 6
- b. 2, 3 and 5
- c. 3, 4, 5 and 6
- d. 1, 3, 4 and 6

120. Which of the following are associated with alum coagulation?

1. A decrease of alkalinity in treated water
2. Formation of hydroxide flocs of aluminium
3. A slight decrease of pH in treated water
4. An increase of permanent hardness

Select the correct answer using the code given below:

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