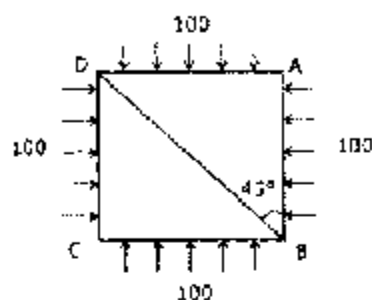


CIVIL ENGINEERING

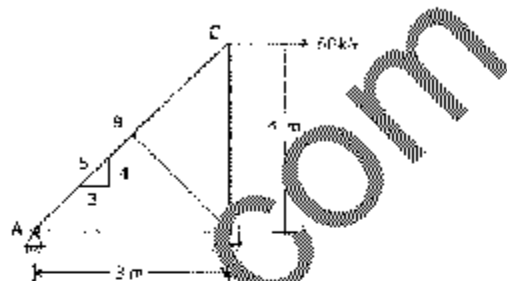


The principal stresses in N/mm^2 on a square element are shown in the figure above. What is the intensity of tangential stress (p_t) on the plane BD?

- 50 N/mm^2
- 0
- 100 N/mm^2
- 200 N/mm^2

d. $\frac{50\sqrt{2}}{2} \text{ kN (tensile)}$

1.



Due to horizontal pull of 60 kN at C, what is the force induced in the member AB?

- 0
- 10 kN
- 80 kN
- 100 kN

A parabolic arch, symmetrical, with hinges at centre and ends, carries a point load P at distance x from left support. The arch has a span of 20 m and rise of 5 m. What is the value of x if the left hinge reaction is inclined with a slope of two vertical on one horizontal?

- 8 m
- 5 m
- 4 m
- 2.5 m

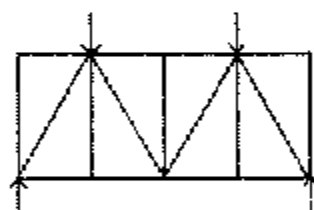
6. A symmetrical circular arch of span 25 m with a central rise of 5 m is hinged at crown and springing. It carries a point load on the arch in the span between the left hinge and central hinge. If the inclination of the thrust at the right hinge is θ measured from horizontal, then what is the value of $\tan \theta$?

- 2.5
- 1.0
- 0.4
- Not possible to calculate with given data

7. Which one of the following statements is correct?

- Very parabolic ally between panel points

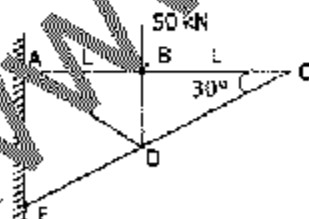
2.



In the plane truss shown above, how many numbers have zero force?

- 3
- 5
- 7
- 9

3.



In the pin-jointed plane truss shown above, what is the magnitude and nature of force in member BC?

- Zero
- 50 kN (tensile)
- 50 kN (compressive)

- b. Vary exponentially between panel points
- c. Vary linearly between panel points
- d. Vary following a cubic relationship between panel points



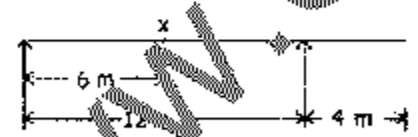
Due to settlement of support at A of propped cantilever shown in the figure given above, what is the vertical reaction at B?

- a. $\frac{12EI\Delta}{l^3}$
- b. $\frac{5EI\Delta}{l^3}$
- c. $\frac{4EI\Delta}{l^3}$
- d. $\frac{3EI\Delta}{l^3}$

For the movement of vehicles at an intersection of two roads without any interference, which type of grade separation is generally preferred?

- a. Delta
- b. Diamond
- c. Trumpet
- d. Cloverleaf

Select the correct influence line diagram for shear force at X of the following beam.



- (a)
- (b)
- (c)
- (d)

When a single point load W travels over a simply supported beam, what is shape of

the graph for maximum positive or negative shear force?

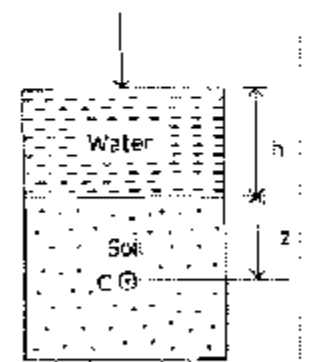
- a. A triangle with maximum ordinate W at centre and zero at two simple supports.
- b. A triangle with maximum ordinate W at a support
- c. A rectangle with ordinate W
- d. A parabola with maximum ordinate W at centre of span and zero at support.

Which one of the following represents the correct relationship between seepage pressure (p_s), unit weight of water (γ_w) and hydraulic gradient (i) inside an earth dam?

- a. $p_s = i \gamma_w$
- b. $p_s = \gamma_w i$
- c. $p_s = \gamma_w i^2$
- d. $p_s = \gamma_w i^3$

At what value of saturation does the zero air voids curve in a compaction test represent the dry density?

- a. 0%
- b. 80%
- c. 100%
- d. 50%



In the figure shown above, which one of the following correctly represents effective stress at C? (Symbols have the usual meanings).

- a. $(h+z)\gamma_w$
- b. $z\gamma_w$
- c. $z\gamma_{sat}$
- d. $h\gamma_w + z\gamma_{sat}$

Match List I (Different types of soil) with List II (Symbol of soil) and

select the correct answer using the code given below the lists:

List I

- A. Well-graded gravel sand mixture with little or no fines
- B. Poorly graded sands or gravelly sands with little or no fines
- C. Inorganic silts and very fine sands or clayey silts with low plasticity
- D. Inorganic clays of liquid limit over 50%

List II

- 1. ML
- 2. CH
- 3. CW
- 4. SP

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

16. Assertion (A): Incremental analysis using internal rate of return as the basis is the method best preferred by top management.

Reason (R): Selective choice of projects on offer at any point of time can be made as laddered merit by such an analysis.

- 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

17. Assertion (A): Replacement of equipment usually results in replacement instead of retirement.

Reason (R): Use in degraded post of service is often a justification for replacement.

- 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

18. Assertion (A): EOQ analysis needs to be adopted in respect of each item of inventory in each of the A, B and C categories of inventory.

Reason (R): EOQ analysis aims at minimizing the system cost.

- 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

19. Assertion (A): ATC-PTC concept can be adopted compatibly with PERT concept.

Reason (R): Both sets of concepts are intended to force the project time to conform to the desired socio-political objectives.

- 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

20. Assertion (A): For a rapid closure of a valve at the end of a pipeline rise of inertia pressure behind the valve remains constant irrespective of time of valve closure.

Reason (R): Inertia pressure rise behind the valve is constant during critical time which equals time of travel of pressure wave over two times the length of pipeline.

- 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

21. Assertion (A): The tractive effort of a locomotive should be double the hauling capacity of locomotive which is dependent on weight on the driving wheels and coefficient of friction.

Reason (R): If locomotive engine applies more power than hauling capacity, the driving wheels will slip.

- 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

22. Assertion (A): Points of potential conflicts in case of both roads of intersection having two lanes, two-way traffic are 24.

Reason (R): Points of potential conflicts are not dependent on the number of land on intersecting lanes.

- 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

23. Assertion (A): PCU values are used to calculate the total equivalent traffic volume on road.

Reason (R): PCU value of any vehicle is an indicator of relative damage caused by a vehicle to a pavement as compared to passenger car.

- 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): Clays are an excellent backfill material.

Reason (R): It is difficult to compact them.

- 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): In conjugate beam method, a simple support of a real beam is assumed as a simple support for the conjugate beam also.

Reason (R): In a real beam, at the simple support there is no deflection but there is slope.

- 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. Consider the following statements:

- 1. Book value is the unamortized cost of the asset as it still appears on the accounting books of the business.
- 2. Termination of economic life implies disposal of the equipment

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

27. Values of standard normal distribution functions are extracted as under:

| | | | | | | | |
|--------|------|------|------|-------|-------|-------|-------|
| Z : | 0.20 | 0.25 | 0.30 | 0.35 | 0.40 | 0.45 | 0.50 |
| Value: | 0.38 | 0.60 | 0.62 | 0.64 | 0.655 | 0.674 | 0.69 |
| Z: | 0.55 | 0.60 | 0.65 | 0.70 | 0.75 | 0.80 | 0.85 |
| Value: | 0.71 | 0.73 | 0.75 | 0.758 | 0.773 | 0.786 | 0.805 |

In given PERT network, there are two parallel paths A and B from beginning to end with the following characteristics:

Path A Path B

| | | |
|--------------------------|------|----|
| Expected duration D days | 85 | 84 |
| Std. duration of D, days | 12.5 | 16 |

What is the expectation of the project being completed 180 days

- a. 0.080
- b. 0.102
- c. 0.126
- d. 0.138

28. Over the project period, a total of 5000 items of a certain material would be needed at a uniform rate of consumption. The unit cost is Rs. 75, the carrying cost is 6% and the ordering cost is Rs. 100 per order. What is the best ordering lot for economic purchase?

- a. 11 times at 520 number each and then the balance
- b. 500 each time
- c. 600 each time
- d. 800 each time for 7 times and then the balance

29.

| A | | B | | C | |
|---------|--------|---------|----|---|----|
| D | DC | D | DC | D | DC |
| 10-2000 | 8-2500 | 12-800 | | | |
| 9-2200 | 7-2800 | 11-900 | | | |
| 8-2500 | 6-3100 | 10-1000 | | | |

Three activities A, B and C in series have been estimated to incur direct costs in rupees (DC) for activity durations in days (D) as indicated. What is the minimum total cost of the whole set of activities for a total duration of 28 days without considering overhead costs?

- a. Rs. 5,500
- b. Rs. 5,600
- c. Rs. 5,700
- d. Rs. 5,800

30. Two reservoirs are connected by two pipes A and B of same f and length in series. If the diameter A is 30% larger than that of B, what is the ratio of head loss in A to that of B?

- a. 0.77
- b. 0.59
- c. 0.50
- d. 0.27

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

List I (Equation used)

- A. Continuity equation
- B. Energy equation
- C. Control volume and momentum equation
- D. Moment of momentum equation

List II (Practical Problem)

- 1. Force on a anchor block
- 2. to find rotational speed of law sprir Kite
- 3. Flow analysis of a pipe network
- 4. Flow computation in branching pipe

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

32. In a 4 m wide rectangular channel with 08 m depth of flow, a sharp-crested weir of 2.5 m length with its sill 0.3 m above the channel bed is fixed symmetrically across the width of the channel. Taking the flow

to be free but with end contractions, what would be the discharge neglecting approach velocity effect? (Take $C_d = 0.625$)

- a. $1.39 m^3/s$
- b. $1.42 m^3/s$
- c. $1.49 m^3/s$
- d. $1.56 m^3/s$

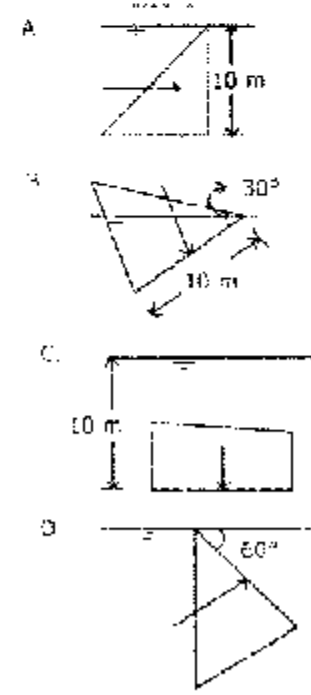
33. The velocity for a steady three-dimensional flow field is defined as $\vec{V} = (x^2 - yz^2)\vec{i} + xy^2\vec{j} + (xy - 2yz)\vec{k}$

At point (1,2,3), what is the approximate value of the magnitude of the velocity?

- a. 21
- b. 18
- c. 10
- d. 4

34. A plane lamina is subjected to hydrostatic pressure (take $g = 10 m/s^2$). List I shows its placing below water surface and List II shows the magnitude of total pressure for given placing. Lamina is 10 m x 1 m size. Match List I with List II and select the correct answer using the codes given below the lists:

List I



List II

- 1. 250 kN
- 2. 433 kN
- 3. 500 kN

4. 1000 kN

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

35. Mercury (density = 13600 kg/m³, $\sigma = 0.49 \text{ N/mm}$, $\theta = 0^\circ$) is contained in a wide beaker. A 2 mm internal diameter open-ended capillary tube is inserted in the middle of the beaker into the mercury. The meniscus in the tube will be below the external mercury surface by how much distance?

- 4.2 mm
- 5.7 mm
- 6.8 mm
- 7.3 mm

36. Match List I (Expression) for shear stress in terms of rate of angular deformation) with List II (Type of fluid) and select the correct answer using ch code given below the lists:

List I

- $\tau = \mu \left(\frac{du}{dy} \right)$
- $\tau = \mu \left(\frac{du}{dy} \right)^n$, $n > 1$
- $\tau = \mu \left(\frac{du}{dy} \right)^n$, $n < 1$
- $\tau = \mu \left(\frac{du}{dy} \right)^n$, $n = 1$

List II

- Thixotropic fluid
- Viscoplastic fluid
- Newtonian fluid
- Dilatant fluid
- Pseudo-plastic

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

37. Which one of the following characteristics of ballast makes it unsuitable for use?

- High resilience
- High stability

c. High water absorption

d. High modulus

38. Which one of the following types of sleepers has the best shock absorbing capacity as well as dampening property?

- CST sleeper
- Wooden sleeper
- Concrete sleeper
- Steel sleeper

39. What is the distance through which the tongue rail moves laterally at the toe of the switch for moment of train arrival?

- Flange way clearance
- Heel divergence
- Throw of the switch
- None of the above

40. The amount of gradient is required to be reduced, when on a horizontal curve and gradient has to be provided together. What is this process known as?

- Momentum gradient
- Washer gradient
- Grade compensation
- Grade resistance

41. If R is the radius of the circular railway curve in meters and D is the degree of the curve, then which one of the following is the expression for D?

- $D = 360/R$
- $D = 1080/R$
- $D = 1720/R$
- $D = 720/R$

42. Which one of the following is not a standard spike for railways?

- Dog spike
- Cat spike
- Screw spike
- Round spike

43. Which one of the following is not the reason for coning of wheels?

- To reduce the wear and tear of wheel flanges and rails
- To provide the possibility of lateral movement of axle
- To reduce the unit weight of wheels
- To prevent wheels from slipping to some extent

44. Consider the following statements

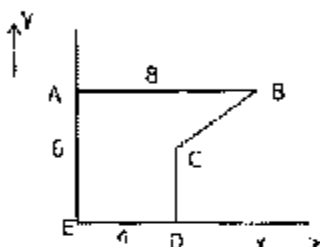
In the design of modern concrete pavements, tie bars used

1. As load transfer devices
2. In expansion joints
3. In contraction joints
4. In warping joints

Which of the statements given above is/are correct?

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

45



What is the y-coordinate of the centroid of the area ABCDE shown in the figure given above?

- a. 3.2
- b. 3.3
- c. 3.4
- d. 3.5

46.

A car negotiates a curve on a slippery road at a constant speed of 10 m/s . If the coefficient of friction is 0.5, what is the minimum radius of the arc to which the car can turn?

- a. 20 m
- b. 10 m
- c. 5 m
- d. 4 m

47

Two forces $P = 6 \text{ N}$ and $Q = 10 \text{ N}$ act on a particle and their lines of action are inclined to each other at an angle of 60° . What is the magnitude of the third force R which will keep the particle in equilibrium?

- a. 13.30 N
- b. 13.89 N
- c. 14.00 N
- d. 14.02 N

48.

If the magnitude of the result of two forces F and $2F$ acting at a point O is 50 N , and the included angle between F and $2F$ is 90° , then what is the magnitude of F ?

- a. $F = 10 \text{ N}$
- b. $F = 50\sqrt{2} \text{ N}$
- c. $F = 25\sqrt{2} \text{ N}$
- d. $F = 10\sqrt{5} \text{ N}$

49

An object of mass 5.0 kg falls from rest through a vertical distance of 200 m and acquires a velocity of 10 m/s . What is the work done by the air resistance on the object? (Take $g = 10 \text{ m/s}^2$).

- a. 75 J
- b. 150 J
- c. 750 J
- d. 850 J

50

The acceleration of a particle starting from rest varies with time according to the relation $a = \omega^2 \sin \omega t$.

What is the displacement of the this particle at time t ?

- a. $\frac{1}{\omega} \sin \omega t$
- b. $\frac{1}{\omega^2} \cos \omega t$
- c. $\frac{1}{\omega^2} \sin \omega t$
- d. $-\frac{1}{2}(\cos \omega t - \sin \omega t)t^2$

A stone dropped from the top of a tower is found to travel $(5/9)$ of the height of the tower during the last second of its fall. What is the total time of fall?

- a. 2s
- b. 3s
- c. 6s
- d. 4s

52

A shot of mass m penetrates a thickness t of a fixed plate of mass M . If the plate were free to move and the resistance supposed to be uniform, which one of the following is the thickness penetrated?

- a. $\frac{Mt}{Mf - m}$
- b. $\frac{mt}{Mf - m}$
- c. $\frac{t}{Mf - m}$
- d. $\frac{t}{Mf - 2m}$

53

Which of the following is the correct statement?

A particle in simple harmonic motion while passing through the mean position will have

- a. Minimum kinetic energy and minimum potential energy
 b. Maximum kinetic energy and maximum potential energy
 c. Maximum potential energy and minimum kinetic energy
 d. Maximum kinetic energy and minimum potential energy

54. Where is d'Alembert's principle employed?

- a. In the design of long columns
 b. To determine stresses induced in thick cylinders
 c. To reduce a problem of kinetics to an equivalent problem of statics
 d. In the analysis of many geotechnical problems

55. The shear modulus of a material is half of its Young's modulus. What is the value of its Poisson's ratio?

- a. 1
 b. 0.5
 c. Zero
 d. 0.5

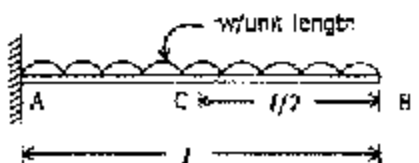
56. What is range of values of Poisson's for ductile materials?

- a. 0.10 to 0.15
 b. 0.16 to 0.20
 c. 0.21 to 0.24
 d. 0.25 to 0.33

57. A cantilever beam of span l carries a uniformly varying load of zero intensity at the free end and w per unit length at the fixed end. What does the integration of the ordinate of the bending moment diagram between the limits of the free and fixed ends of the beam give?

- a. Bending moment at the fixed end
 b. Shear force at the fixed end
 c. Bending moment at the free end
 d. Shear force at the free end

58.



In the cantilever beam shown above, what is the percentage of bending moment at $l/2$ with respect to the maximum bending moment at the fixed support?

- a. 15%
 b. 20%
 c. 25%
 d. 30%

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

List I

- A. Cantilever beam
 B. Overhanging beam
 C. Fixed beam
 D. Simply supported beam

List II

1. At the support, shear force exists, BM is zero
 2. Deflection is zero, but BM exists at the supports
 3. Shear force and BM exist at the supports
 4. BM exists, deflection is zero at the supports

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

60.

A fixed beam and a simply supported beam having same span and develop same maximum bending moment due to uniformly distributed load on entire span. What is the ratio of uniformly distributed load on fixed beam to that on simply supported beam?

- a. 0.5
 b. 1
 c. 1.5
 d. 2

61.

In the cross-section of a rectangular beam, what is the ratio of the average shear stress to the maximum shear stress?

- a. 3/2
 b. 2/3
 c. 4/3
 d. 3/4

62.

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

List I

- A. Beam

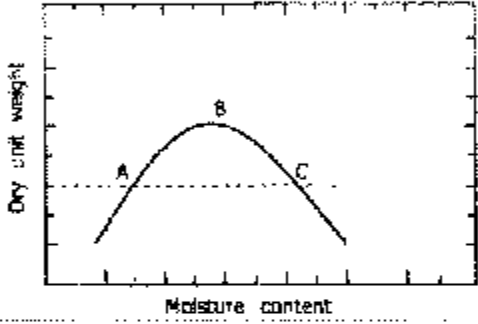
- B. Column
- C. Circular section of diameter d of a shaft
- D. Close-coiled helical spring

List II

1. Member subjected to twisting
2. Member used to store strain energy
3. Member subject to buckling
4. Member subjected to bending

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

63.



The standard Proctor compaction curve a clay is depicted in the above figure. Points A, B and C correspond to the compaction states of the soil, which fall on this curve. For which point(s) is the coefficient of permeability minimum.

- a. A and C
- b. A
- c. B
- d. C

64. Match List-I with List-II and select the correct answer using the code given below the list.

List-I (Investigator)

- A. Kempton
- B. Coulomb
- C. Terzaghi
- D. Darcy

List II (Equation or Law)

1. $v = ki$
2. $\sigma' = \sigma \tan \phi$
3. $S = c + \sigma \tan \phi$
4. $U = B[\sigma_1 + A(\sigma_1 - \sigma_2)]$

| | A | B | C | D |
|--|---|---|---|---|
|--|---|---|---|---|

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

65. Soil at a site consists of two layers. The top layer has permeability k units and bottom layer has permeability $5k$ units. If the thickness of both the layers is equal, then what is the average permeability in the vertical direction?

- a. $3k$ units
- b. $(5/3)k$ units
- c. $(6/5)k$ units
- d. $(5/6)k$ units

66. Field vane shear is the appropriate field test for obtaining the shear strength of which one of the following?

- a. Stiff clay
- b. Weathered rock
- c. Sand
- d. Soft clay

67. A clay layer, 5 m thick undergoes 50% consolidation in 5 years when subjected to an average pressure increase of 50 kN/m^2 . If the clay layer were 10 m thick, in what period would it undergo 50% consolidation for the same pressure?

- a. 10 years
- b. 2.5 years
- c. 25 years
- d. 20 years

68. Consider the following statements-

1. In the laboratory consolidation test, initial compression is the result of displacement of soil particles.
2. Primary consolidation is due to dissipation of pore water pressure.
3. Secondary compression starts after complete dissipation of pore water pressure.
4. Primary consolidation and secondary compression occur simultaneously

Which of the statements given above are correct?

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

69. Which one of the following is the correct statement?

Vibratory rollers are suitable for compacting

- a. Organic soil
- b. Clays
- c. Sands and gravels
- d. Clayey silts

70. Which one of the following is the appropriate field test for estimating the angle of shearing resistance of a sand deposit?

- a. Field vane shear test
- b. Plate load test
- c. Standard penetration test
- d. Electrical resistivity test

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

List I (Cause)

- A. Tamping
- B. Consolidation
- C. Triaxial compression
- D. Seepage

List II (Effect)

- 1. Shearing
- 2. Piping
- 3. Expulsion of air
- 4. Reduction in water

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

72. Consider the following statements:

- 1. The parameters c , ϕ obtained using Coulomb's theory are empirical
- 2. Mohr's envelop is a straight line.
- 3. The characteristics of soil are not used in the construction of Mohr's circle.
- 4. The strength of a soil is a function of effective stress.

Which of the statements given above are correct?

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

73. Which one of the following is the correct statement?

Cyclic load test on a pile is conducted to

- a. Determine the safe lateral load for the pile
- b. Determine the settlement corresponding to the alterable load for the working pile
- c. Determine the safe tensile load for the pile
- d. Separate point resistance and skin friction for the pile

74. On which of the following do the numerical values of Terzaghi's bearing capacity factors depend?

- a. Angle of internal friction of soil and depth of foundation
- b. Angle of internal friction of soil only
- c. Coefficient of surcharge of soil and bulk density of soil
- d. Uniformity coefficient of soil and dry density of soil

75. Which one of the following is the correct statement?

The contact pressure distribution below a rigid footing on the surface of a clay soil is

- a. Uniform for the full width
- b. Maximum at the edges and minimum at the centre
- c. Maximum at the centre and minimum at the edges
- d. None of the above

76. Two piles, one a bored cast-in-situ pile and another a precast driven pile, both of same length and diameter are constructed in a loose sand deposit. If the bearing capacity of the bored pile is Q_1 , and that of the precast driven pile is Q_2 , then which of the following is correct?

- a. $Q_1 > Q_2$
- b. $Q_1 = Q_2$
- c. $Q_1 < Q_2$
- d. No specific comparison may hold good

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

List I (Pipe Material)

- A. RCC
- B. Cast-iron
- C. Steel
- D. Asbestos cement

List II (Characteristics)

- 1. No necessity for expansion joints
- 2. Low weight
- 3. Durable, non-corrosive
- 4. Withstands head up to 60 m

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

78. Consider the following statements:
- 1. Butterfly valve is used for throttling and controlling flow rate.
 - 2. Check valve is used in the discharge piping of a pump.
 - 3. Air-relief valve is placed in the pipeline at the valleys to automatically vent the accumulated air in the system.
 - 4. Altitude valve is provided in user overhead tank.

Which of the statements given above are correct?

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

79. In a circular sewer of diameter D, if the depth of flow is D/4, what is the wetted perimeter equal to?

- a. $\pi D/4$
- b. $\pi D/2$
- c. $\pi D/3$
- d. $2\pi D/3$

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

List I (Type of trap)

- A. Intercepting trap
- B. Gull trap
- C. Siphon trap
- D. P-trap

List II (Location)

- 1. Water closet
- 2. Junction of sullage and storm water drains
- 3. At the head of each house drain
- 4. Junction of house drain and street sewer

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

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

81. Which one of the following is not biodegradable organic matter?

- a. Carbohydrates
- b. Fats
- c. Alcohols
- d. Petrol

82. What does high COD to BOD ratio of an organic pollutant represent?

- a. High biodegradability of the pollutant
- b. Low biodegradability of the pollutant
- c. Presence of free oxygen for aerobic decomposition
- d. Presence of toxic material in the pollutants

83. What is the $BOD_{0.05}$ at 20°C of a waste that yields an oxygen consumption of 2 mg/l from a 0.05% diluted sample?

- a. 50 mg/l
- b. 100 mg/l
- c. 200 mg/l
- d. 250 mg/l

84. What are the values of the permissible BOD_5 at 20°C, oil and grease and percent sodium respectively of treated municipal sewage for land irrigation?

- a. 10 mg/l, 20 mg/l, 60
- b. 60 mg/l, 20 mg/l, 100
- c. 20 mg/l, 100 mg/l, 60
- d. 20 mg/l, 60 mg/l, 100

85. If the efficiencies of GOD removal of first-stage and second-stage trickling filters are each 65.0%, then what is the overall GOD removal efficiency of these filters?

- a. 65%
- b. 77.25%
- c. 87.75%
- d. 92.6%

86. Why is a proportional flow weir provided in a grit chamber?

- a. To reduce the suspended solids entering into the grit chamber
- b. To maintain the constant flow depth in the grit chamber
- c. To take care of maintaining constant flow velocity in the grit chamber over a certain depth range

d. To allow the sewage a fresh into the grit chamber

87. An extended aeration tank receives a BOD load of 768 kg/day. If two fixed aerators with oxygen transfer capacity of 0.8 kg of O_2 /HP hour are to be installed in aeration tank, what is the capacity of each aerator?

- 10 HP
- 20 HP
- 40 HP
- 50 HP

88. A septic tank of 7 m^3 in volume serves for 5 people. If the rate of accumulation of sludge is 7- litres per capita per year and sludge is removed when it occupies 50% of its volume, what is the cleaning interval of septic tank?

- 3 years
- 5 years
- 7.5 years
- 10 years

89. A primary sludge having volume of 14 m^3 and moisture content of 94% was dewatered to have a solid content of 16%. What is its final volume?

- 2.38 m^3
- 3.50 m^3
- 5.25 m^3
- 7.00 m^3

90. In drawing AOA networks, the following time computations are involved:

- Activity listing
- Work breakdown structure
- Activity time estimation
- Consideration of available resources fit each activity
- Activity dependencies
- Flow computations
- Backward path computation
- Project duration
- Forward path computation

What is the correct sequence of the processes given above?

- 1,2,4,3,9,7,5,6,8
- 2,1,4,3,5,9,8,7,6
- 4,1,3,2,9,5,7,8,6
- Any sequence can be followed but 6 and 7 will be the last two ones

91. Consider the following statements:

Interface nodes.

- Feed into major milestone nodes
- Lead out of major milestone nodes
- Constrain milestone nodes to pre-set dates

Which of the statements given above is/are correct?

- 2 and 3 only
- 1 only
- 1 and 3 only
- 3 only

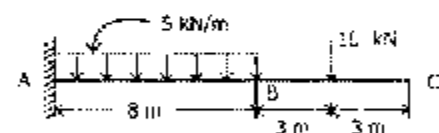
92. Consider the following statements.

- Method of slices overestimates the value of factor of safety.
- Exact value of factor of safety is obtained $\phi = 0$ analysis.
- Reduction in shearing resistance in embankment is caused by tension crack at the top of it.
- Plane surface of failure never occurs in saturated soils.

Which of the statements given above are correct?

- 1 and 4 only
- 2 and 3 only
- 3 and 4 only
- 1 and 2 only

93.



EI constant

For the beam shown above, what are the distribution factors at joint B?

- 0.4, 0.6
- 0.5, 0.5
- 0.6, 0.4
- 0.65, 0.35

94. Consider the following statements.

Excessive camber is not provided on the roads because

- Transverse tilt causes uncomfortable
- Of formation of cross ruts
- Of likely toppling over of highly laden bullock carts
- Of higher costs involved

Which of the statements given above are correct?

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

95. For total reaction time of 2.5 seconds, coefficient of friction 0.35, design speed 80 km/h, what is the stopping sight distance on a highway?

- a. 124 m
- b. 132 m
- c. 76 m
- d. 56 m

96. In highway geometric design, cumulative speed distribution is drawn and the design is checked at which percentile?

- a. 85th percentile
- b. 95th percentile
- c. 100th percentile
- d. 98th percentile

97. Match List-I (Terms Related to Traffic Signal) with List-II (Description of Terms Used in Traffic Signal) and select the correct answer using the code given below the lists:

List I

- A. Load Factor
- B. Phase
- C. Level of service

List II

1. Part of signal cycle allocated to traffic movement
2. Quantitative assessment usually measured by queue length, vehicle delay etc.
3. Measure of degree of utilization of an intersection approach road

| | B | C |
|----|---|---|
| a. | 2 | 1 |
| b. | 1 | 2 |
| | 1 | 2 |
| | 1 | 3 |
| | 1 | 3 |

98. Which one of the following is the correct statement?

On a National Highway, GSB may be used as

- a. Sub-base and drainage layer
- b. Drainage layer and prime coat
- c. Wearing course and drainage layer
- d. Sub-base and tack coat

99. Which one of the following is the correct statement?

Penetration to know bitumen grade is measured in

- a. One hundredth of mm
- b. One-tenth of mm
- c. One-tenth of an inch
- d. One micron

100. Which one of the following statements is correct?

Compared to IFR conditions, the runway capacity of a runway operating under VFR conditions

- a. Is higher
- b. Is lower
- c. Is the same
- d. Cannot be generalized

101. Consider the following statements

Difference between airport and highway pavement thickness arises due to

1. Magnitude of wheel load
2. Tyre pressure
3. Number of repetitions
4. Size of the vehicle

Which of the statements given above are correct?

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

102. A water jet 0.02 m² in area has a velocity of 15 m/s. If the jet impinges normally on a plate which is moving at a velocity 5 m/s in the direction of the jet, what is the force on the plate due to this impact? (Density = 1000 kg/m³)

- a. 200 N
- b. 2000 N
- c. 20000 N
- d. 4000 N

103. In a hydraulic jump occurring in a horizontal rectangular channel the sequent depths are 0.3 m and 1.2 m. What is the approximate value of energy loss in the jump?

- a. 1.5 m
- b. 0.9 m
- c. 0.5 m
- d. 0.35 m

104. In a tidal model, the horizontal ratio adopted is 1 in 4800. A 12-hour tide is intended to be reproduced in the model in 3 minutes. What should be the depth scale?

- a. 1/200
- b. 1/300
- c. 1/400
- d. 1/600

105. A flat plate 1.2 m wide and 3.0 m long is the boundary for air flowing at a free stream velocity of 6 m/s with $\rho = 1.208 \text{ kg/m}^3$ and $\nu = 1.47 \times 10^{-5} \text{ m}^2/\text{s}$. Up to what length over the plate will boundary layer be laminar?

- a. 1.208 m
- b. 1.225 m
- c. 1.47 m
- d. 1.82 m

106. A hemispherical parachute is to be designed so that a paratrooper weighing 1.0 kN drops through air (density = 1.5 kg/m³) and touches the ground surface with a velocity not exceeding 6 m/s, assuming $C_D = (4/3)$, what should be the approximate value of the parachute diameter, when opened?

- a. 7.5 m
- b. 6.0 m
- c. 4.5 m
- d. 3.0 m

107. Velocity defect in a pipe flow refers to which one of the following?

- a. Defect in orientation of pitot tube while measuring velocity
- b. Parallax error in measuring pitot tube reading
- c. Difference between maximum velocity and average velocity
- d. Difference between maximum velocity and local velocity

108. What is the condition for maximum transmission of power through a nozzle at the end of a long pipe?

- a. $H = h_f / 3$
- b. $h_f = H / 2$
- c. $h_f = H / 3$
- d. $H = h_f / 2$

Where H = total head at the inlet of the nozzle

h_f = head loss due to friction

109. In the bulk modulus of water is $1.96 \cdot 10^9 \text{ N/m}^2$, what is the water hammer velocity through a rigid pipeline?

- a. 1000 m/s
- b. 1400 m/s
- c. 448 m/s
- d. 4390 m/s

110. A very wide channel in laboratory is meant to deliver uniform flow rate of 2.0 m³/s per meter width, assuming Manning's $n = 0.02$. Which one of the following combinations will not give uniform flow?

- a. Flow depth 0.5 m, bed slope 1/62
- b. Flow depth 1.0 m, bed slope 1/625
- c. Flow depth 1.5 m, bed slope 1/2400
- d. Flow depth 2.0 m, bed slope 1/4000

111. An open channel flow is found to carry a discharge with $Re < 500$. How is the discharge in the channel related to hydraulic radius?

- a. $Q \propto R$
- b. $Q \propto \sqrt{R}$
- c. $Q \propto 1/R$
- d. $Q \propto R^{0.2}$

Where Q = discharge in the channel
R = hydraulic radius

112. A rectangular channel carries a discharge of 5 m³/s. The channel is 2 m wide. What is the critical depth of the flow?

- a. 1.25 m
- b. 1.07 m
- c. 0.565 m
- d. 0.86 m

113. At the same mean velocity, what is the ratio of head loss per unit length for a sewer pipe flowing full to that for the same pipe flowing half full?

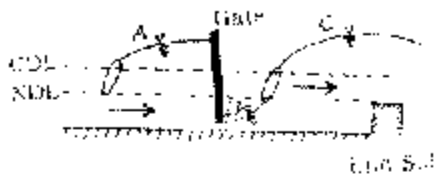
- a. 2.0
- b. 1.7
- c. 1.0
- d. 0.6

114. In a rectangular channel, the depths of flow before and after the hydraulic jump are respectively 0.2 m and 1.2 m. What is the energy loss in the jump?

- a. 1.042 m

- b. 2.084 m
c. 3.126 m
d. 4.168 m

115.



In the figure above, flow is from left to right, CDI. = critical depth line, NDI. = normal depth line, A, B and C are water surface profiles from left to right. Which are the names for A, B and C?

- | | | | |
|----|-------|-------|-------|
| | A | B | C |
| a. | M_1 | M_3 | M_2 |
| b. | M_1 | M_3 | M_1 |
| c. | S_1 | S_3 | S_1 |
| d. | S_1 | S_3 | S_2 |

116. Water is to be pumped at the rate of $0.025 \text{ m}^3/\text{s}$ from a 4 m deep ground level tank to an overhead tank. The difference in levels of the full tank levels of these tanks is 16 m. What is the approximate power required for operating a 65% efficient centrifugal pump?

- a. 7.5 kW
b. 6.0 kW
c. 3.9 kW
d. 3.2 kW

117. Consider the following statements:

- Alum coagulation decreases the alkalinity of water.
- Alum coagulation increases permanent hardness of water.
- Alum coagulation decreases pH of water.
- Alum coagulation produces aluminum hydroxide flocks in the flocculation process.

Which of the statements given above are correct?

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

118. What is the ratio of rate of back-washing to that of filtration in a typical rapid sand filter?

- a. 3
b. 4
c. 6
d. 10

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

List I

- A. Fluorides
B. Hexavalent chromium
C. Iron and manganese
D. Toxic organics

List II

- Aluminum oxide
- Reduction and precipitation
- Oxidation and precipitation
- Activated carbon treatment

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

120. The unit oxidizing power of chlorine is 35.5 and that of dichloramine is 21.48. What is the approximate percentage of the available chlorine in dichloramine?

- a. 165%
b. 140%
c. 76%
d. 60%