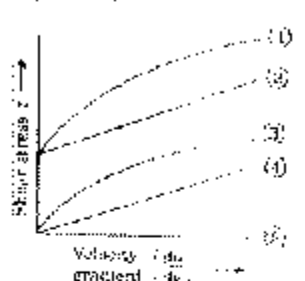


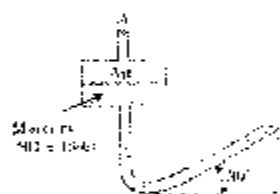
CIVIL ENGINEERING

1. Which of the curves labeled as ①, ②, ③, ④ and ⑤ in the given figure represent the Newtonian and the ideal fluid respectively?



- 1 and 5
- 2 and 4
- 3 and 4
- 4 and 5

2. The gauge pressure at point 'A' in the inclined manometer shown in the given figure is



- 6680 N/m²
- 6680 N/m²
- 3340 N/m²
- 3340 N/m²

3. A right circular wooden (sp. gr. of wood = 0.8) cone with a base diameter of 0.6 m and height of 0.8 m floats in water such that its axis remains vertical and apex is downward. The immersed depth of the cone is

- 0.480 m
- 0.533 m
- 0.600 m
- 0.743 m

4. Mach number is significant in the study of

- Kite flying
- Motion of projectiles
- Motion of two immiscible fluids with an interface

d. Motion of ship through seas

5. In pipe-flow analysis, the profile of the velocity distribution in laminar sub-layer is

- Linear
- Logarithmic
- Parabolic
- 17th power law

6. Stream function $\psi = \omega_0 \times x$ represents the

- Free vortex motion
- Uniform flow parallel to x-axis
- Uniform flow parallel to y-axis
- Uniform flow inclined to x-axis

7. The thickness of a laminar boundary layer at a distance 'x' from the leading edge over a flat plate varies as

- $x^{0.4}$
- $x^{0.5}$
- $x^{0.2}$
- x

8. The head loss at an orifice ($C_d = 0.98$) discharging under a head of 2 m is

- 0.02 m
- 0.04 m
- 0.06 m
- 0.08 m

9. A circular cylinder is rotated in anticlockwise direction and an ideal fluid flows perpendicular to its axis in horizontal direction. The cylinder will experience

- Drag in horizontal direction of flow
- Lift in vertically downward direction
- Lift in vertically upward direction
- No lift

10. While defining Froude number applicable to channels of any shape, the length parameter used is the

- Hydraulic radius
- Wetted perimeter
- Ratio of area to top width
- Depth of flow

11. Match List I with List II and select the correct answer:

List I

- A. Specific force
B. Specific energy
C. Hydraulic jump
D. Dary-Weisbach equation

List II

1. Head loss due to friction
2. Rapidly varied flow
3. Alternate depths
4. Conjugate depths

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

12. A valve at the downstream end of a 90 cm diameter pipeline carrying water is suddenly closed in such a manner that velocity of flow is decreased from 4 m/s to 1 m/s instantaneously. Assuming pipe to be rigid and K for water as 2.2×10^9 Pa, the maximum pressure rise at the valve will be

- a. 1.42×10^6 Pa
b. 1.894×10^6 Pa
c. 4.445×10^6 Pa
d. 5.933×10^6 Pa

13. Normal depth of flow computed using Manning's equation in a wide rectangular open channel of given slope and roughness and carrying a discharge of q m³/s per meter width is proportional to

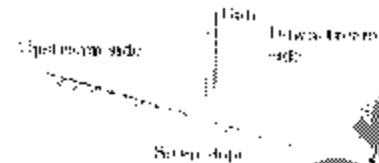
- a. q
b. $q^{1/3}$
c. $q^{2/3}$
d. $q^{1/4}$

14. The flow characteristics before and after a hydraulic jump are such that

- a. Specific forces are equal but specific energies are unequal
b. Specific forces are unequal but specific energies are equal
c. Neither specific forces nor specific energies are equal

- d. Specific forces as well as specific energies are equal

15. A sluice-gate is operated in long open channel flow with a steep slope, as shown in the given figure in such a manner that its opening is smaller than normal and critical depths.



The hydraulic jump will occur on

- a. Downstream side
b. Upstream side
c. Both upstream and downstream sides
d. Neither on the upstream side nor on the downstream side

16. In a gradually varied flow in a channel, the depth of flow and the critical depth are y and y_c respectively. If E is the specific energy and dy/dx is positive, then dE/dx would be

- a. Always negative
b. Always positive
c. Positive if $y > y_c$
d. Negative if $y > y_c$

17. Owing to a sudden closure of turbines in a powerhouse

- a. A positive surge will occur in head race channel with surge front moving downstream
b. A positive surge will occur in head race channel with surge front moving upstream
c. A negative surge will occur in head race channel with surge front moving upstream
d. A negative surge will occur in head race channel with surge front moving downstream

18. Match List I with List II and select the correct answer:

List I

- A. Infiltration galleries
B. Infiltration wells
C. Springs

D. Wells

List II

1. Outcrops of ground water which often appear as small water holes
2. Vertical cylindrical opening made in the ground for tapping water
3. Bricks masonry structures constructed along the banks of rivers for tapping water
4. Horizontal tunnels constructed through water bearing stratum
5. Drilled into the ground with the help of drilling equipment

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

19. Consider the following statements:

1. In a continuous flow type sedimentation tank, the particles to be removed, should have their settling velocity more than the surface loading rate.
2. In a continuous flow type sedimentation tank, the particles which are settling, move vertically down to the bottom.
3. Coagulant added to the water containing alkalinity results in the formation of its hydroxide compound.
4. Flocculation is the process of vigorous mixing of coagulant added to water.

Which of these statements are correct?

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

20. Match List I (Water treatment units) with List II (Normal detention time) and select the correct answer:

List I

- A. Rapid mixing device
- B. Flocculator
- C. Plain sedimentation tank
- D. Tube settlers

List II

1. 5 to 10 minutes
2. 30 seconds
3. 30 minutes
4. 2 to 3 hours

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

21. Available chlorine in bleaching powder solution is 0.3 mg/ml. The same chlorine dose of 0.1 mg/l in a 200 ml water sample, the amount of bleaching powder solution to be added is

- a. $\frac{0.1}{200} \times 0.3 \text{ ml}$
- b. $\frac{0.1}{200} \times 1000 = 0.3 \text{ ml}$
- c. $\frac{0.1}{1000} \times 200 = 0.3 \text{ ml}$
- d. $\frac{0.1}{1000} \times 200 = \frac{1}{3} \text{ ml}$

22. Consider the following valves used in rapid sand filter unit:

1. Influent valve
2. Filtered water outlet valve
3. Backwash water inlet valve
4. Wash water drain valve

Which of these valves should be closed while back-washing the rapid sand filter?

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

23. Match List I (Distribution system) with List II (Characteristics) and select the correct answer:

List I

- A. Tree system
- B. Grid-iron or reticulation system
- C. Circular system
- D. Radial system

List II

1. Main lines are laid along the periphery covering the city

2. Calculations are simple and accurate flow determination is also possible at any line
3. Large number of cut-off valves and long pipe lengths are required
4. Flow from centre to periphery

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

24. Match List I (Sewerage system) with list II (Characteristics) and select the correct answer:

List I

- A. Conservancy system
- B. Separate system
- C. Combined system
- D. Partially combined system

List II

1. Sewers carry sewage and limited storm water
2. Organic load on treatment plant is less
3. Unhygienic
4. Hydraulic load on treatment plant is less
5. Needs sewers of larger size

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

25. Consider the following parameters:

1. Fixed solids
2. Volatile solids
3. Chemical oxygen demand
4. Biochemical oxygen demand
5. Dissolved oxygen

Which of these parameters are taken into consideration for determining organic strength of a waste?

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

26. Soil pipe in plumbing services means a pipe

- a. Made of clay
- b. Carrying solid materials
- c. Carrying waste from water closets
- d. Carrying industrial waste, water

27. The five-day BOD of a waste water sample is 150 mg/l at 20° C. The reaction constant k (to the base 'e') is 0.2 per day. The ultimate first stage BOD (y_{∞}) is

- a. 225.5 mg/l
- b. 237.2 mg/l
- c. 240 mg/l
- d. 2455 mg/l

28. The dissolved oxygen sag curve manifests

- a. BOD demand
- b. BOD deficit

variation of dissolved oxygen saturation

- d. Dissolved oxygen deficit

29. The total volume of a primary settling tank is 2500 m³ and the waste-water flow is 25 × 10⁶ liters per day. The detention time in settling tank is

- a. 10:24h
- b. 24:10h
- c. 24h
- d. 1/24h

30. In conventional activated sludge process, the mean cell residence time in aeration tank is

- a. Less than 1.5h
- b. In the range of 4 to 8h
- c. In the range of 12 to 24 h
- d. In range of 4 to 15 days

31. The average investment value of an equipment over its 5-year life is Rs. 53000 whereas the annual depreciation is Rs. 11000. Cost of money is 15% p.a. and taxes are at 5% of investment value. The equipment is used for 1800 hours during each year. The hourly ownership cost for the equipment will be

- a. Rs 37.77
- b. Rs 24
- c. Rs 18

- d. Rs. 12
32. In the time-cost optimization of a project, the project can be crashed by expediting
- All activities on the critical path
 - Critical activities having minimum cost slope
 - Activities on sub-critical path
 - Critical activities having maximum cost slope
33. A firm's 'shut down' point is reached when average revenue fails to cover the
- Average total cost
 - Variable cost
 - Fixed cost
 - Marginal cost
34. The requirement of a certain component is uniformly 100 units per month in a construction activity spread over 8 months. The unit cost is Rs. 45, the carrying cost is 9% and the ordering cost is estimated to be Rs. 30 per order. If delivery is instantaneous, it is best to purchase in
- A single lot
 - 4 lots
 - 8 lots
 - 10 lots
35. Match List I (The condition of analysis) with List II (Analysis) and select the correct answer:
- List I
- Sales revenue equals the cost of production and the sales
 - Decisions concerning major inputs during price planning stage
 - To analyze the probability profile of major variables such as investment cost, sales volume, selling prices, etc.
 - To evaluate the investments from the social point of view
- List II
- Sensitivity analysis
 - Economic analysis
 - Market feasibility
 - Risk analysis
 - Break-even analysis
- | | | | | |
|----|---|---|---|---|
| | A | B | C | D |
| a. | 5 | 1 | 4 | 2 |
- b. 5 3 1 2
- c. 1 5 3 2
- d. 1 5 4 3
36. The first cost of a project, not considering aspects of rehabilitation of displaced persons and of needful reforestation, is Rs. 8.2 crores. The expected benefits, discounted for the project construction completion date, are Ps. 11.7 crores. The cost of rehabilitation of displaced persons is Rs. 0.9 crores and cost of needful reforestation is Rs. 0.7 crores. IRR can be quoted in the range of
- 1.19 to 1.23
 - 1.2 to 1.21
 - 1.15 to 1.2
 - 1.15 to 1.2
37. For four levels of investment (whether or not technology changes is also implicit), the following estimates of annualized costs and annualized benefits are made as in the given table:
- | Plan | Annualized benefits (Rs. In Lakhs) | Annualized costs (Rs. In Lakhs) |
|------|------------------------------------|---------------------------------|
| A | 5000 | 2000 |
| B | 5250 | 2300 |
| C | 5850 | 2700 |
| D | 6100 | 3000 |
- Out of these four the plan of choice
- Could be either C or D
 - Could be either A, B or D
 - Would be D
 - Would be C
38. Assertion (A): Two identical slender columns, one of high strength alloy steel and the other of ordinary structural steel will have approximately the same buckling failure strength under axial load.
- Reason (R): The moduli of elasticity of different steels are approximately same.
- Both A and R are true and R is the correct explanation of A
 - Both A and R are true but R is NOT the correct explanation of A
 - A is true but R is false
 - A is false but R is true

Assertion (A): When a material is subjected to repeated tensile stress within elastic range, it is found that the material deteriorates and fractures after many but finite number of repeated application of stress.

Reason (R): The critical stress below which fluctuating stresses cannot cause a fatigue failure is termed as 'endurance limit'.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): Thick and thin cylinders have the same stress distribution in the wall.

Reason (R): Thin cylinder assumes uniform stress distribution in the wall.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): The ultimate bearing capacity of a non-cohesive soil increases considerably with depth below ground level.

Reason (R): In cohesive soil, the ultimate bearing capacity is independent of foundation width.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): Optimum moisture content obtained from Proctors compaction test represents the water content at which the soil is fully saturated.

Reason (R): Presence of water facilitates rearrangement of soil grains under given comp active effort, thereby reducing the voids in between the soil grains.

42.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): The factor of safety obtained in the 'Fellenius method of slices' is conservative.

Reason (R): In the Fellenius method, the effect of horizontal forces acting on the sides of slices is neglected, but the effect of shearing forces acting on the sides of slices is included.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): If the highway passes by the town and not through the town, the area surrounding the highway increases if the highway passes by the town and not through the town.

Reason (R): Potential for expansion in the area surrounding the highway increases if the highway passes by the town and not through the town.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

Assertion (A): The lower critical Reynolds number for pipe flow is well defined at about 2,000 while the upper critical Reynolds number has been found to exceed even 40,000.

Reason (R): When the Reynolds number increases above that of the lower critical value, the transition tends to depend on external disturbance.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

43.

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b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

46. **Assertion (A):** In estimating population for assessing water supply demand, the geometric progression (GP) method gives correct estimates for a developed city.

Reason (R): In the GP method, a constant rate of increase in population is assumed.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
- A is true but R is false
- A is false but R is true

47. **Assertion (A):** Reflux valve is provided on the suction side of the pump

Reason (R): Reflux valve prevents backflow from the line into the pump and consequent damage to the pump set.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
- A is true but R is false
- A is false but R is true

48. **Assertion (A):** In analyzing a construction project using PERT even though the type of distribution may vary from one activity to another, the distribution function for the completion of the whole project will be approximately of a bell-shaped distribution curve.

Reason (R): This assumption is in accordance with central limit theorem.

- Both A and R are true and R is the correct explanation of A
- Both A and R are true but R is NOT the correct explanation of A
- A is true but R is false
- A is false but R is true

49. Two non-collinear equal parallel forces acting in opposite directions will have

- No resultant force and no moment
- A moment but no resultant force
- A resultant force but no moment
- A moment and a resultant force

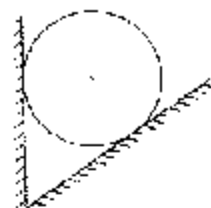
50. The vector product of two non-zero vectors is zero if and only if the vectors are

- Perpendicular
- Concurrent

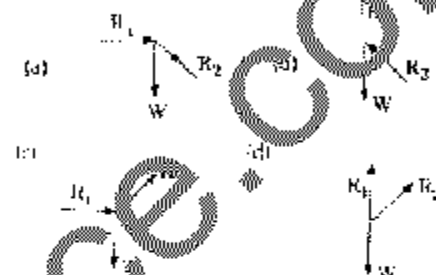
c. Parallel or collinear

d. Co-planar

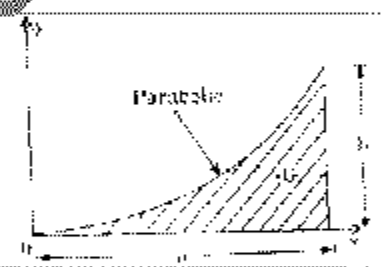
51. A ball of weight W is supported on smooth planes as shown in the given figure.



The free body diagram will be



52. The coordinates of the centroid of the shaded section shown in the given figure will be



a. $\frac{3a}{4}$ and $\frac{3h}{10}$

b. $\frac{3a}{10}$ and $\frac{h}{3}$

c. $\frac{3a}{5}$ and $\frac{3h}{8}$

d. $\frac{3a}{8}$ and $\frac{3h}{5}$

53. A right-angled triangular lamina has breadth b and depth d . The moment of inertia about a line parallel to base 'b' at a distance of $d/2$ will be

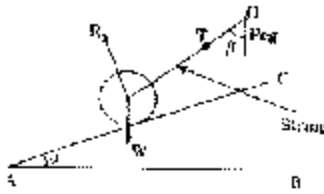
a. $\frac{5bd^3}{24}$

b. $\frac{11bd^3}{72}$

c. $\frac{bd^3}{24}$

$$d. \frac{7hd^3}{72}$$

54. In the system shown in the given figure, force W , T and R are related as



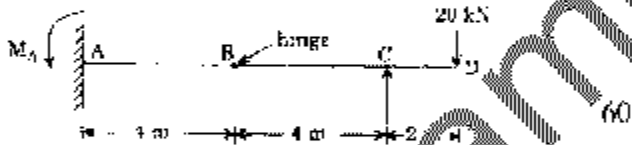
$$a. \frac{W}{\sin[180 - (\alpha + \beta)]} = \frac{T}{\sin(90 - \alpha)} = \frac{R}{\sin(90 - \beta)} \quad 59.$$

$$b. \frac{W}{\sin(\alpha - \beta)} = \frac{T}{\sin \beta} = \frac{R}{\sin \alpha}$$

$$c. \frac{W}{\sin[90 - (\alpha - \beta)]} = \frac{T}{\sin \alpha} = \frac{R}{\sin \beta}$$

$$d. \frac{W}{\sin(\alpha - \beta)} = \frac{T}{\sin \alpha} = \frac{R}{\sin \beta}$$

55. The fixed end moment M_A of the beam shown in the given figure is



- a. $+40 \text{ kN.m}$
 b. 40 kN.m
 c. $+80 \text{ kN.m}$
 d. -80 kN.m

56. A train decelerates from a speed of 72 km/h to 54 km/h over a distance of 100 m . The distance covered and the time taken by the train before it comes to halt will be

- a. 129 m and 17 s
 b. 137 m and 20 s
 c. 144 m and 22 s
 d. 151 m and 24 s

57. If P traces a circle of radius 100 cm with an angular velocity of 100 rad/s with O as centre, then the acceleration of P towards O in terms of acceleration due to gravity ' g ' would be nearly

- a. $10^2 g$
 b. $-10^2 g$
 c. $10^3 g$
 d. $-10^3 g$

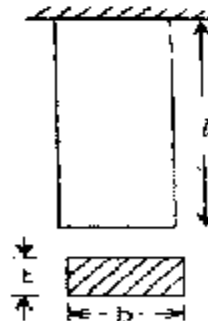
58. A ball is dropped from a height. It hits the floor with velocity $V \text{ m/s}$. If the coefficient of restitution is ' e ', then the velocity of the ball after the first rebound in the upward direction will be

- a. $eV \text{ m/s}$
 b. $e^2V \text{ m/s}$
 c. $V \text{ m/s}$
 d. Zero

- A tapering circular bar of diameter d_1 at one end varying uniformly to a diameter d_2 at the other end over a length ' L ' and Young's modulus ' E ' subjected to an axial pull of ' P '. The total elongation is equal to

- a. $\frac{4PE}{\pi L d_1^2}$
 b. $\frac{4PL}{\pi E d_1^2}$
 c. $\frac{4PE}{\pi L d_2^2}$
 d. $\frac{4PLE}{\pi d_1 d_2}$

- A bar of weight ' W ', length ' l ', breadth b and thickness ' t ' is supported as shown in the given figure (' A ' is the area of cross-section of the bar, ' E ' is the young's modulus)



- The elongation of the bar due to its own weight is

- a. $\frac{Wl}{2AE}$
 b. $\frac{Wl}{AE}$
 c. $\frac{Wl}{b^3 E}$

d. $\frac{2Wl}{AE}$

61. A steel bar is kept between two copper bars and rigidly connected at room temperature. If the system is fixed at the ends and cooled suddenly, the stresses produced in the bars will be
- Tension in steel and compression in copper
 - Compression in both steel and copper
 - Tension in both steel and copper
 - Compression in steel and tension in copper

62. If an element is subjected to three dimensional stresses of intensities p_x (tensile), p_y (compressive) and p_z (tensile), then the strain along x-axis is given by (E is modulus of elasticity of the material and $1/m$ is poisson's ratio)

a. $e_x = \frac{p_x}{E} + \frac{(p_y + p_z)}{mE}$

b. $e_x = \frac{p_x}{E} + \frac{(p_y - p_z)}{mE}$

c. $e_x = \frac{p_x}{E} + \frac{(p_y - p_z)}{mE}$

d. $e_x = \frac{p_x}{E} + \frac{(p_y + p_z)}{mE}$

63. A cantilever beam of span l and uniform flexural rigidity ' EI ' is loaded with an upward force W at the mid-point and downward force W at the free end. The deflection at the free end will be zero, if

- $W = 3Pl$
- $W = 2Pl$
- $W = 16Pl$
- $W = 8Pl$

64. For a given material, $E=2G$ (E is modulus of elasticity and G is modulus of rigidity of the material), then the bulk modulus ' K ' will be

- $E/3$
- $E/2$
- $E/4$
- E

65. If all the dimensions of a vertically suspended circular bar are doubled, then

the maximum stress produced in it due to its own weight will

- Become half
- Remain unaltered
- Be doubled
- Be tripled

66. Match List I (Various test stages) with List II (Observation) and select the correct answer

List I

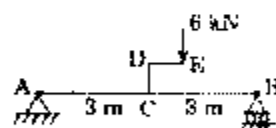
- I stage
- II stage
- III stage
- IV stage

List II

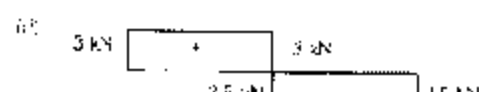
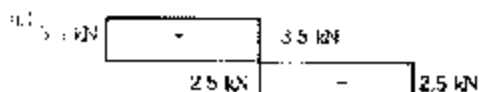
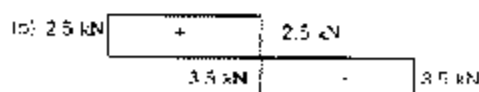
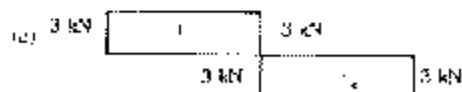
- Yield point
- Limit of proportionality
- Breaking stress
- Ultimate stress

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

67. A loaded simply supported beam is shown in the given figure. CDE (CD = DE = 0.5 m) is a rigid member



The S.F diagram of the beam is best represented as

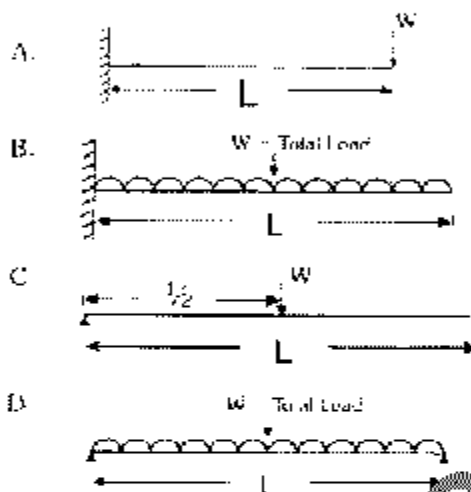


68. If an applied load passes through the shear centre of the section of the beam, then the beam will have
- No deflection
 - Neither bending nor twisting
 - No bending
 - No twisting

69. Match List I (Types of beam) with List II (Maximum deflection) and select the correct answer:

(E is modulus of elasticity and I is moment of inertia)

List I



List II

1. $\frac{WL^3}{8EI}$

2. $\frac{WL^4}{48EI}$

3. $\frac{WL^3}{3EI}$

4. $\frac{5WL^4}{384EI}$

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

70. In order to construct a simply supported beam of constant strength throughout its length in flexure, the section of the beam must be

- Prismatic
- Non-prismatic

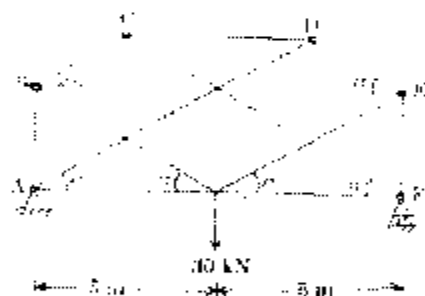
- Symmetrical
- Unsymmetrical

71. A circular column of length 2 m has Euler's crippling load of 1.5 kN. If the diameter of the column is reduced by 10%, the reduction in the crippling load will be
- 10%
 - 20%
 - 30%
 - More than 30%

72. Axial force in the member BC of the structure shown in the given figure is

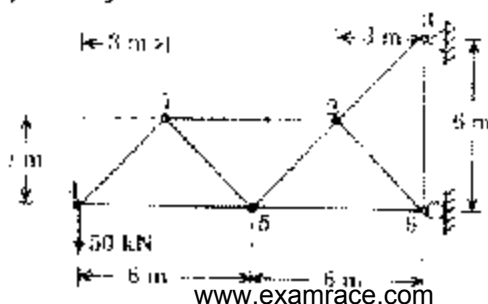


73. Axial force in the member BC of the truss shown in the given figure is (where $\alpha = 30^\circ$)



- 15 kN
- $10\sqrt{3}$ kN
- $15\sqrt{3}$ kN
- 30 kN

74. Axial forces in the members 1-2 and 1-5 of the truss shown in the given figure are respectively



- a. 50 kN (Compressive) and 25 kN (Tensile)
 b. 25 kN (Tensile) and $50\sqrt{2}$ kN (Compressive)
 c. 100 kN (Tensile) and $50\sqrt{2}$ kN
 d. 25 kN (Compressive) and $50\sqrt{2}$ kN (Tensile)

75. At a point in a strained material, two mutually perpendicular stresses

$\sigma_x = 20 \text{ N/mm}^2$ (Compressive) and

$\sigma_y = 40 \text{ N/mm}^2$ (Tensile) are acting. If the notation of tensile stress is positive and that of compressive stress is negative, then the principal stresses at that point would be

- a. 40 N/mm^2 and $-20\sqrt{2} \text{ N/mm}^2$
 b. -40 N/mm^2 and 20 N/mm^2
 c. 40 N/mm^2 and -20 N/mm^2
 d. $-40\sqrt{2} \text{ N/mm}^2$ and 20 N/mm^2

76. The diameter of shaft B is twice that of shaft A. Both shafts have the same length and are of the same material. If both are subjected to the same torque, then the ratio of the angle of twist of shaft A to that of shaft B will be

- a. 2
 b. 4
 c. 8
 d. 16

77. In the maximum shear stress theory, yielding begins when the maximum shear stress in the material is equal to the

- a. Maximum shear stress at yield point
 b. Twice the shear stress at yield point
 c. Three times shear stress at yield point
 d. Half the shear stress at yield point

78. When an axial load 'P' is applied to a helical close-coiled spring of coils 'n' mean radius R, modulus of rigidity N and wire diameter 'd' the elongation of the spring will be

- a. $\frac{64PR^3n}{Nd^3}$
 b. $\frac{32PR^3n}{Nd^3}$

c. $\frac{64PR^2n}{Nd^3}$

d. $\frac{8PR^3n}{Nd^3}$

79. If maximum principal stresses σ_1 of 90 N/mm^2 , σ_2 and σ_3 of values zero act on a cube of unit dimensions, then the maximum shear strain energy stored in it would be

- a. 337.5/G
 b. 675/G
 c. 1350/G
 d. 2700/G

80. If the flexural rigidity of the beam BC of the portal frame shown in the given figure is assumed to be zero, then the horizontal displacement of the beam would be



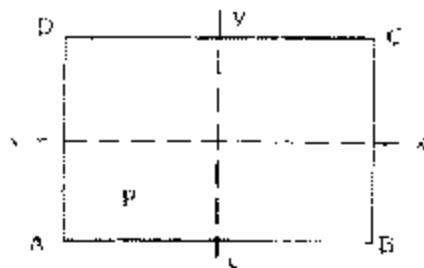
a. $\frac{Ph^3}{3EI}$

b. $\frac{Ph^3}{12EI}$

c. $\frac{Ph^3}{24EI}$

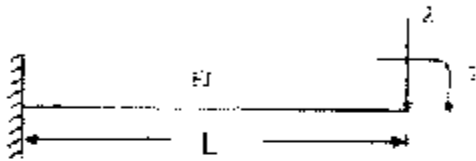
d. $\frac{Ph^3}{24EI}$

81. The reinforced cement footing shown in the given figure is loaded with a concentrated load at point 'P' so as to produce maximum bending stresses of 10 kN/m^2 and 15 kN/m^2 due to eccentricities about xx-axis and yy-axis respectively. If the direct stress due to loading is 17.5 kN/m^2 (compressive), then the result stress at corner 'B' will be



- 45 kN/m^2 (compressive)
- 12.5 kN/m^2 (compressive)
- 45 kN/m^2 (tensile)
- 2.5 kN/m^2 (tensile)

82. The flexibility matrix for the beam shown in the given figure is



- $$\begin{bmatrix} \frac{L}{EI} & \frac{L^2}{2EI} \\ \frac{L^2}{2EI} & \frac{L^3}{3EI} \end{bmatrix}$$

- $$\begin{bmatrix} \frac{L^3}{3EI} & -\frac{L^2}{2EI} \\ -\frac{L^2}{2EI} & \frac{L}{EI} \end{bmatrix}$$

- $$\begin{bmatrix} \frac{L^3}{3EI} & \frac{L^2}{2EI} \\ \frac{L^2}{2EI} & \frac{L}{EI} \end{bmatrix}$$

- $$\begin{bmatrix} \frac{4EI}{L} & -\frac{EI}{L} \\ \frac{6EI}{L} & \frac{12EI}{L^2} \end{bmatrix}$$

83. A simply supported beam with unequal levered ends is shown in the given figure



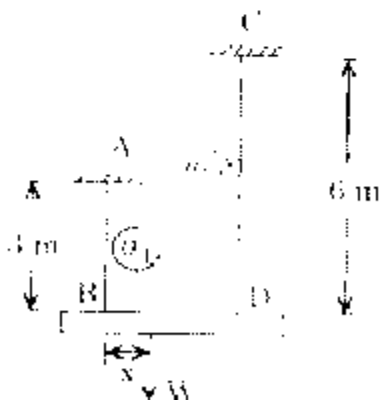
The corresponding influence line for shear for a section just to the right of the support 'A' is represented as



84. A certain steel in simple tension has proportionality limit of 200 N/mm^2 . Under a three-dimensional stress system, the principal stresses are 150 N/mm^2 (Tensile), 75 N/mm^2 (Tensile), 30 N/mm^2 (Compressive) and $\mu = 0.3$. According to maximum principal stress theory the factor of safety would be

- 4
- 5

85. In the given figure, the wires AB and CD made of the same material are used to suspend a rigid block to which the gradual load 'W' is applied in such a way that both the wires get stretched by the same amount. If stresses in wires AB and CD are σ_1 and σ_2 respectively, then the ratio σ_1 / σ_2 will be



- $3/2$
- $2/3$
- 2
- $1/2$

86. Match List I (Range of particle size) with List II (Type of soil) and select the correct answer:

List I

- A. Less than 0.002 mm
- B. 0.075 mm to 0.002 mm
- C. 80 mm to 4.75 mm
- D. 4.75 mm to 0.075 mm

List II

- 1. Gravel
- 2. Sand
- 3. Cobble
- 4. Silt
- 5. Clay

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

87. Match List I (Type of soil) with List II (Group symbol as per IS classification) and select the correct answer:

List I

- A. Well-graded gravel sand mixture with little or no fines
- B. Poorly graded sand or gravelly sand with little or no fines
- C. Inorganic silts and very fine sand
- D. Inorganic clay of high plasticity

List II

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

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

88. A soil sample has natural moisture content 'w' void ratio 'e' and specific gravity of soil solids 'G_s'. The bulk unit weight of soil 'γ' is given by (γ_w is unit weight of water)

a. $\frac{(1-w)G_s \gamma_w}{(1-e)}$

b. $\frac{(1+w)G_s \gamma_w}{(1-e)}$

c. $\frac{(1+w)G_s \gamma_w}{(1-e)}$

d. $\frac{(1-w)G_s \gamma_w}{(1-e)}$

89. Match List I with List II and select the correct answer:

List I

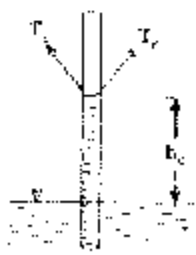
- A. Fine grained soil with $W_L = 60$, $I_p = 20$, $W_U = 8$
- B. Fine grained soil with $W_L = 60$, $I_p = 30$, $W_U = 8$
- C. Fine grained soil with $W_L = 30$, $I_p \leq 4$, $W_U = 20$
- D. Coarse grained sand with $W_L = 40$, $I_p = 15$, $W_U = 20$

List II

- 1. Expansive CH soil
- 2. non-expansive SC soil
- 3. Expansive OH soil
- 4. Non-expansive ML soil

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

90. The capillary rise 'h_c' in a pipe of diameter 'd' shown in the given figure is



a. $4T_s / \gamma_w d$

b. $2T_s / \gamma_w d$

c. $T_s / 2\gamma_w d$

d. $T_v / 4\gamma_w d$

91. In the situation shown in the given figure the coefficient of permeability of the soil is 10 cm s . The discharge in one minute will be



- a. 2 ml
b. 3 ml
c. 6 ml
d. 12 ml
92. In a soil deposit of three layers of equal thickness, the permeabilities of first, second and third layers are in the ratio of 1 : 2 : 3. The ratio of average permeability in horizontal direction (K_H) to that in the vertical direction (K_V) will be
- a. 22 : 18
b. 18 : 22
c. 24 : 12
d. 12 : 24
93. Match List I (Type of soil) with List II (Compaction parameters) and select the correct answer:

List I

- A. Sand
B. Sandy clay
C. Salty clay
D. Heavy clay

List II

1. $OMC = 18\%$ $\gamma_{d(w=100)} = 17 \text{ kN/m}^3$
2. $OMC = 14\%$ $\gamma_{d(w=100)} = 18.9 \text{ kN/m}^3$
3. $OMC = 15\%$ $\gamma_{d(w=100)} = 17.4 \text{ kN/m}^3$
4. $OMC = 10\%$ $\gamma_{d(w=100)} = 20.5 \text{ kN/m}^3$

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

94. clay specimens of soils A and B are tested for finding consolidation properties. For a certain pressure range, the ratio of coefficient of volume compressibility $m_v : m_v$ and ratio of coefficient of consolidation $C_{v1} : C_{v2}$ are respectively 2:1 and 16:9 the ratio of coefficient of permeability $K_A : K_B$ of the soils will be
- a. 8:9
b. 4:9
c. 16:9
d. 32:9

95. Consider the following methods.

1. Core cutter method
2. Sand replacement method
3. Proctor's needle method
4. Field line scar method

Which of these methods enable control of field compaction?

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

96. Match List I with List II on the basis of Terzaghi's one dimensional consolidation theory and select the correct answer using the codes given below:

(Notations have their usual meaning)

List I

- A. a_v
B. m_v
C. C_v
D. T_v

List II

1. $\frac{C_v t}{H^2}$
2. $\frac{e_1 - e_2}{\log_{10}(P_2 / P_1)}$
3. $\frac{a_v}{1 + e_v}$
4. $\frac{e_2 - e_1}{P_2 - P_1}$

	A	B	C	D
a.	3	4	1	2

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

97. Consider the following statements:

The vane shear test is

- 1. A direct test to determine shear strength parameters of saturated clays
- 2. Mostly useful in cohesion less soils
- 3. Used for determining untrained shear strength of normally consolidated, sensitive clays
- 4. To give an authentic value of ' ϕ '

Which of these statements are correct?

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

98. Consider the following assumptions:

- 1. The backfill is dry and homogeneous
- 2. The sliding wedge acts as a rigid body
- 3. The back face of the wall is a plane
- 4. The position and direction of the earth thrust are known

Which of these assumptions are common to Rankine's and Coulomb's earth pressure theories?

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

99. A vertical retaining wall retains a horizontal backfill of dry, homogeneous and isotropic cohesionless soil. If the angle of wall friction ' δ ' equals the angle of internal friction ' ϕ ', then the coefficient of active earth pressure ' K_a ' as per Coulomb's wedge theory would be

- a. $\frac{\cos \phi}{\sin \phi}$
- b. $\frac{\cos \phi}{(1 + \sin \phi)^2}$
- c. $\frac{\cos \phi}{(1 + \sqrt{2} \sin \phi)^2}$
- d. $\frac{\cos \phi}{(1 + \sqrt{2} \sin \phi)^2}$

100. Consider the following statements:

- 1. Culmann's graphical method of determining the earth pressure is based on Coulomb's wedge theory
- 2. Rankine's theory of lateral earth pressure is more versatile than Coulomb's theory
- 3. A gravity retaining wall together with the retained backfill and supporting soil is an indeterminate system

Which of these statements are correct?

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

101. Match List I (Soil and loading condition) with List II (Suitable foundation type) and select the correct answer:

List I

- A. Structural load is uniformly heavy and soil is soft clay
- B. Structural load is heavy and soil has low bearing capacity for a considerable depth
- C. Soil has good bearing capacity at shallow depth and structural load is within permissible limits
- D. Structural load of bridge is to be transferred through sandy soil to bed rock available at shallow depth

List II

- 1. Footing
- 2. Piles
- 3. Raft
- 4. Well

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

102. Which one of the following equations represents Terzaghi's ultimate bearing capacity equation?

(Notations have their usual meaning)

- a. $q_u = \gamma D_f \tan^4 \left(45^\circ + \frac{\phi}{2} \right)$
- b. $q_u = CN_c + \gamma D_f N_q + 0.5 \gamma BN_c$
- c. $q_u = CN_c S_c d_c i_c + D_f N_q S_q d_q i_q + 0.5 \gamma BN_c$

$$d. q_u = 5.14C_u - D_f$$

103. Consider the following corrections:

1. Overburden pressure
2. Dilatancy
3. Ground water
4. Size of sampler

Which of these corrections are required while using standard penetration test values?

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

104. Consider the following forces:

1. Weight of the sliding wedge of slope
2. Resultant reaction 'r' of the slip
3. Total cohesive resistance developed along the slip circle
4. Critical height of slope

Which of these are taken into consideration in the friction circle method for the equilibrium of sliding sector in the stability analysis of slope?

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

105. Consider the following important lines defining different land-widths in the context of roads

1. Centre line
2. Building line
3. Road boundary
4. Control line

The correct sequence of these lines with respect to location is

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

106. Traffic flow equation for a section of road is $u = 80 - 0.7K$ where 'u' is the speed in kmph and 'K' is the density in vpkm (vehicles per km), the maximum expected flow is

- a. 4572 vph
- b. 2286 vph
- c. 1143 vph

d. 572 vph

107. Which one of the following pairs is correctly matched?

(Notations have their usual meaning)

- a. To avoid both skidding and overturning: $P/W < h / 2h < f$
- b. Allowable maximum super elevation in plain region: 0.15
- c. Allowable coefficient of lateral friction: 0.07
- d. Attainment of super elevation: $1/2R$

108. During measurement in queuing study, a total of 1000 vehicles were observed. 85 percentile and 15 percentile speeds were obtained as 40 kmph and 10 kmph respectively. The number of vehicles moving between speeds of 10 kmph and 40 kmph would be

- a. 700
- b. 500
- c. 600
- d. 300

109. The compensated gradient provided at the curve of radius 60m with a ruling gradient of 6 percent is

- a. 5.25%
- b. 4.75%
- c. 4.5%
- d. 3.75%

110. In cement concrete pavements, tie bars are provided

- a. Near the top of slab across expansion joints
- b. Near the bottom of slab across contraction joints
- c. At mid depth of slab across longitudinal joints
- d. Near the bottom of slab across longitudinal joints

111. In a bituminous concrete mix, bitumen and aggregates by weight are 5% and 95% respectively. Specific gravity of bitumen and aggregates are 1 and 2.5 respectively. Theoretical unit weight of the mix will be

- a. 2857 kg/cu m
- b. 2630 kg cu m
- c. 2325 kg/cu m
- d. 2208 kg cu m

112. Consider the following

- 1. Radius of equivalent distribution of pressure
- 2. Width of slab
- 3. Spacing between contraction joints
- 4. Spacing between expansion joints
- 5. Radius of relative stiffness

Which of these parameters are taken into account for computing Bradbury's coefficient for temperature stresses in westergaard's analysis for rigid pavement design?

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

113. Consider the following:

- 1. Perforated pipe
- 2. Open-jointed solid pipe in a trench
- 3. Free draining material in a trench
- 4. Solid concrete pipe

Which of these are used for subsurface drainage?

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

114. Match List I (Property of aggregate) with List II (Test associated with the property) and select the correct answer.

List I

- A. Strength
- B. Hardness
- C. Toughness
- D. Durability

List II

- 1. Impact
- 2. Soundness
- 3. Stripping
- 4. Crushing
- 5. Abrasion

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

115. For the design of runways, if the standard atmospheric temperature at sea level is 15°

C, then the standard temperature at an altitude of 800 m will be

- a. 7°C
- b. 9.8°C
- c. 10.2°C
- d. 11°C

116. Consider the following factors:

- 1. Gauge length
- 2. Degree of the curve
- 3. Ruling gradient
- 4. Maximum allowable super elevation

Which of these factors determine the maximum permissible speed on BC railway tracks?

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

117. On railway tracks, corrugations normally occur in stretches where

- a. Trains stop or start
- b. Steel sleepers are used
- c. There are horizontal curves
- d. There are vertical curves

118. Maintenance of railway track at curves where wear of rails on the sides of the rail head would occur, is best achieved by

- a. Normal routine maintenance of track
- b. Reduction of expansion gaps
- c. Exchange of inner and outer rails on curves
- d. Use of head - hardened rails

119. For a sleeper density of (n - 5), the number of sleepers required for constructing a broad gauge railway track of length 640 m with standard rail length is

- a. 600
- b. 700
- c. 800
- d. 900

120. A small arm is fixed on home signal post below the main semaphore arm. This signal is called the

- a. Repeater signal
- b. Co-acting signal
- c. Calling on signal
- d. Shant signal