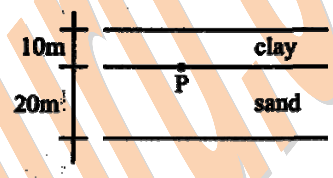
CIVIL ENGINEERING

ONE MARKS QUESTIONS

1. For linear elastic systems, the type of displacement function for the strain energy is
   a. linear
   b. quadratic
   c. cubic
   d. quartic
2. In the limit state design method of concrete structures, the recommended partial material safety factor (γ_m) for steel according to IS:456-2000 is
   a. 1.5
   b. 1.15
   c. 1.00
   d. 0.87
3. For avoiding the limit state of collapse, the safety of RC structures is checked for appropriate combinations of Dead Load (DL), Imposed Load or Live Load (IL), Wind Load (WL) and Earthquake Load (EL). Which of the following load combinations is NOT considered?
   a. 0.9DL+l.5WL
   b. l.5DL+l.5WL
   c. 1.5DL+1.5WL+1.5EL
   d. 1.2DL+1.2 IL+1.2WL
4. In a plate girder, the web plate is connected to the flange plates by fillet welding. The size of the fillet welds is designed to safely resist
   a. The bending stresses in the flanges
   b. the vertical shear force at the section
   c. the horizontal shear force between the flanges and the web plate
   d. the forces causing buckling in the web
5. Rivet value is defined as
   a. lesser of the bearing strength of rivet and the shearing strength of the rivet
   b. lesser of the bearing strength of rivet and the tearing strength of thinner plate
   c. greater of the bearing strength of rivet and the shearing of the rivet
   d. lesser of the shearing strength of the rivet and the tearing strength of thinner plate
6. A 10m thick clay layer is underlain by a sand layer of 20m depth (see figure below). The water table is 5m below the surface of clay layer. The soil above the water table is capillary saturated. The value of γ_{sat} is 19kN/m^3. The unit weight of water is γ_w. If now the water table rises to the surface, the effective stress at a point P on the interface will



   a. increase by $5\gamma_w$
   b. remain unchanged
   c. decrease by $5\gamma_w$
   d. decrease by $10\gamma_w$
7. A unit volume of a mass of saturated soil is subjected to horizontal seepage. The saturated unit weight is 22kN/m^3 and the hydraulic gradient is 0.3. The resultant body force on the soil mass is
   a. 1.98 kN
   b. 6.6 kN
   c. 11.49 kN
   d. 22.97 kN
8. In an undrained triaxial test on a saturated clay, the Poisson's ratio is
   a. $\dfrac{\sigma_3}{(\sigma_1+\sigma_3)}$
   b. $\dfrac{\sigma_3}{(\sigma_1-\sigma_3)}$
   c. $\dfrac{(\sigma_1-\sigma_3)}{\sigma_3}$
   d. $\dfrac{(\sigma_1+\sigma_3)}{\sigma_3}$
9. The un-drained cohesion of a remoulded clay soil is 10kN/m^2. If the sensitivity of the clay is 20, the corresponding remoulded compressive strength is
   a. 5 kN/m^2
   b. 10 kN/m^2
   c. 20 kN/m^2
   d. 200 kN/m^2

10. Two circular footings of diameters D_1 and D_2 are resting on the surface of the same purely cohesive soil. The ratio of their gross ultimate bearing capacities is
 a. D_1 / D_2
 b. 1.0
 c. D_1^2 / D_2^2
 d. D_2 / D_1

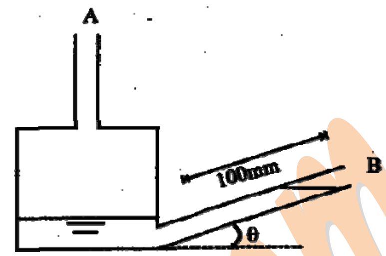
11. The ratio of saturated unit weight to dry unit weight of a soil is 1.25. If the specific gravity of solids (G_s) is 2.65, the void ratio of the soil
 a. 0.625
 b. 0.663
 c. 0.944
 d. 1.325

12. The x component of velocity in a two dimensional incompressible flow is given by u = l.5x. At the point (x, y) = (1, 0), the y component of velocity v = 0. The equation for they component of velocity is
 a. v = 0
 b. v = 1.5y
 c. v = - l.5x
 d. v = -l.5y

13. A frictionless fluid of density ρ flow through a bent pipe as shown below. If A is the cross sectional area and V is the velocity of flow, the forces exerted on segment 1 – 2 of the pipe in the x and y directions are, respectively,

 a. $\rho AV^2; 0$
 b. $\rho AV^2; \sqrt{2}\rho AV^2$
 c. 0; 0
 d. $0; \frac{1}{\sqrt{2}}\rho AV^2$

14. In the inclined manometer shown in the figure below, the reservoir is large. Its surface may be assumed to remain at a fixed elevation. A is connected to a gas pipeline and the deflection noted on the inclined glass tube is 100 mm. Assuming θ= 30° and the manometric fluid as oil with specific gravity of 0.86, the pressure at A is



 a. 43 mm water(vacuum)
 b. 43 mm water
 c. 86 mm water
 d. 100 mm water

15. For a pipe of radius, r, flowing half fill under the action of gravity, the hydraulic depth is
 a. r
 b. $\frac{\pi r}{4}$
 c. $\frac{r}{2}$
 d. 0.397r

16. A wide channel is 1m deep and has a velocity of flow, V, as 2.13 m/s. If a disturbance is caused, an elementary wave can travel upstream with a velocity of
 a. 100m/s
 b. 2.13 m/s
 c. 3.13 m/s
 d. 5.26 m/s

17. An aircraft is flying in level flight at a speed of 200km/hr through air (density, ρ = 1.2 kg/m^2, and viscosity μ = 1.6 × N-s/m^2). The lift coefficient at this speed is 0.4 and the drag coefficient is 0.0065. The mass of the aircraft is 800kg. The effective lift area of the aircraft is
 a. 21.2m^2
 b. 10.6m^2
 c. 2.2m^2
 d. 1.1m^2

18. Most of the turbidity meters work on the scattering principle. The turbidity value so obtained is expressed in
 a. CFU
 b. FTU
 c. JTU
 d. NTU

19. Hardness of water is directly measured by titration with ethylene-di-amine-tetracetic acid (EDTA) using
 a. eriochrome black T indicator
 b. ferroin indicator
 c. methyl orange indicator
 d. phenolphthalein indicator

20. The organism, which exhibits very nearly the characteristics of an ideal pathogenic indicator is
   a. Entamoeba histolytica
   b. Escherichia coli
   c. Salmonella typhi
   d. Vibrio comma

21. A sprinkler irrigation system is suitable when
   a. the land gradient is steep and the soil is easily erodible
   b. the soil is having low permeability
   c. the water table is low
   d. the crops to be grown have deep roots

22. In the context of flexible pavement design, the ratio of contact pressure to tyre pressure is called the Rigidity Factor. This factor is less than unity when the tyre pressure is
   a. less than 0.56 N/mm^2
   b. equal to 0.56 N/mm^2
   c. equal to 0.7 N/mm^2
   d. more than 0.7 N/mm^2.

23. The Star and Grid pattern of road network was adopted in
   a. Nagpur Road Plan
   b. Lucknow Road Plan
   c. Bombay Road Plan
   d. Delhi Road Plan

24. The road geometries in India are designed for the
   a. 98^{th} highest hourly traffic volume
   b. 85^{th} highest hourly traffic volume
   c. 50^{th} highest hourly traffic volume
   d. 30^{th} highest hourly traffic volume

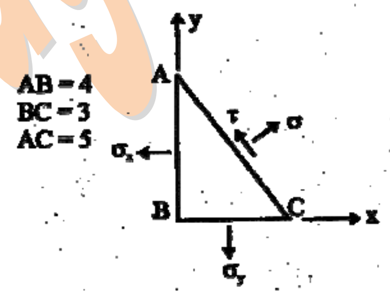
25. Real matrices $[A]_{3\times1}$, $[B]_{3\times3}$, $[C]_{3\times5}$, $[D]_{5\times3}$, $[E]_{5\times5}$ and $[F]_{5\times1}$ are given. Matrices [B] and [EJ are symmetric.
   Following statements are made with respect to these matrices.
   I. Matrix product $[F]^T$ $[C]^T$ [B] [C] [F] is a scalar.
   II Matrix product $[D]^T$ [F] [D] is always symmetric..
   With reference to above statements, which of the following applies?
   a. Statement I is true but II is false
   b. Statement I is false but II is true
   c. Both the statements are true
   d. Both the statements are false

26. The summation of series $S = 2 + \frac{5}{2} + \frac{8}{2^2} + \frac{11}{2^3} + \ldots\ldots \infty$ is
   a. 4.50
   b. 6.0
   c. 6.75
   d. 10.0

27. The value of the function $f(x) = \lim\limits_{x\to0} \frac{x^3+x^2}{2x^3-7x^2}$ is
   a. 0
   b. $-\frac{1}{7}$
   c. $\frac{1}{7}$
   d. ∞

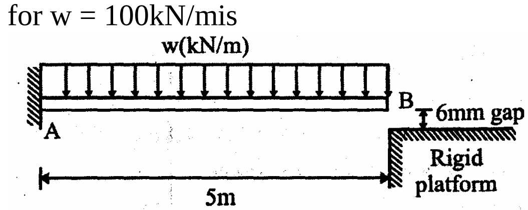
TWO MARKS QUESTIONS

28. In a two dimensional stress analysis, the state of stress at a point is shown below. If σ = 120 MPa and τ = 70 MPa, σ_x and σ_y, are respectively,



   a. 26.7MPa and l72.5MPa
   b. 54 MPa and l28MPa V
   c. 67.5 MPa and 213.3 MPa
   d. 16 MPa and 138 MPa

29. For the linear elastic beam shown in the figure, the flexural rigidity, El is 781250 $kN\text{-}m^2$. When w =10 kN/m, the vertical reaction R_A at A is 50 kN. The value of R_A for w = 100kN/mis



   a. 500 kN
   b. 425 kN
   c. 250 kN
   d. 75 kN

30. A homogenous, simply supported prismatic beam of width B, depth D and span L is subjected to a concentrated load of magnitude P. The load can be placed anywhere along the span of the beam. The maximum flexural stress developed in beam in

a. $\frac{2}{3}\frac{PL}{BD^2}$

b. $\frac{3}{4}\frac{PL}{BD^2}$

c. $\frac{4}{3}\frac{PL}{BD^2}$

d. $\frac{3}{2}\frac{PL}{BD^2}$

31. A circular solid shaft of span L =5 m is fixed at one end and free at the other end. A twisting moment T = 100 kN-m is applied at the free end. The torsional rigidity GJ is 50000 kN-m^2/rad.

Following statements are made for this shaft:

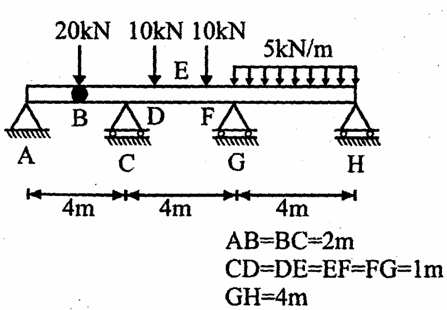
1. The maximum rotation is 0.01 rad.
2. The torsional strain energy is l kN-m.

With reference to the above statements, which of the following applies?

a. Both statements are true
b. Statement 1 is true but 2 is false
c. Statement 2 is true but 1 is false
d. Both the statements are false

Data for Q.32 & Q.33 are given below. Solve the problems and choose the correct answers.

A three-span continuous beam has an internal hinge at B. Section B is at the mid-span of AC. Section E is at the mid-span of CG. The 20 kN load is applied at section B whereas 10 kN loads are applied at sections D and F as shown in the figure. Span GH is subjected to uniformly distributed load of magnitudes kN/m. For the loading shown, shear force immediate to the right of section E is 9.84 kN upwards and the hogging moment at section E is 10.31 kN-m.



32. The magnitude of the shear force immediate to the left and immediate to the right of section B are, respectively

a. 2 and 20 kN
b. 10 kN and 10 kN
c. 20 kN and 0
d. 9.84 kN and 10.16 kN

33. The vertical reaction at support H is

a. 15 kN upward
b. 9.84 kN upward
c. 15 kN downward
d. 9.84 kN downward

34. An RC short column with 300 mm x 300 mm square cross-section is made of M20 grade concrete and has 4 numbers, 20mm diameter longitudinal bars of Fe-415 steel. It is under the action of a concentric axial compressive load. Ignoring the reduction in the area of concrete due to steel bars, the ultimate axial load carrying capacity of the column is

a. 1659 kN
b. 1548 kN
c. 1198 kN
d. 1069 kN

35. A simply supported prestressed concrete beam is 6m long and 300mm wide. Its gross depth is 600mm. It is prestressed by horizontal cable tendons at a uniform eccentricity of 100mm. The prestressing tensile force in the cable tendons is I 000kN. Neglect the self weight of beam. The maximum normal compressive stress in the beam at transfer is

a. Zero
b. 555 N/mm^2
c. 11.11 N/mm^2
d. 15.68 N/mm^2

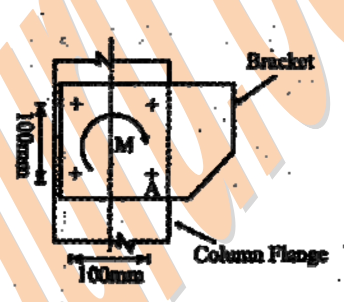
36. An RC square footing of side length 2m and uniform effective depth 200mm is provided for a 300mm x 300mm column. The line of action of the vertical compressive load passes through the centroid of the footing as well as of the column, lithe magnitude of the load is 320kN, the nominal transverse (one way) shear stress in the footing is

a. 0.26 N/mm^2
b. 0.30N/mm^2
c. 0.34N/mm^2
d. 0.75N/mm^2

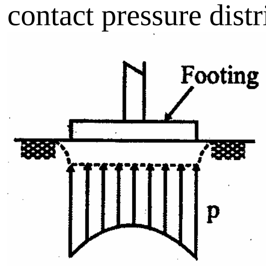
Data for Q.37 & Q.38 are given below. Solve the problems and choose correct answers.

At the limit state of collapse, an RC beam is subjected to flexural moment 200kN-m, shear force 20kN and torque 9kN-m. The beam is 300mm wide and has a gross depth of 425mm, with an effective cover of 25mm. The equivalent nominal shear stress (τ_{ve}) as calculated by using the design code turns out to be lesser than the design shear strength (τ_c) of the concrete.

37. The equivalent shear force (V_c) is
    a. 20 kN
    b. 54 kN
    c. 56 kN
    d. 68 kN
38. The equivalent flexural moment (M_{eq}) for designing the longitudinal tension steel is
    a. 187 kN-m
    b. 200 kN-m
    c. 209 kN-m
    d. 213 kN-m
39. A square steel slab base of area 1m2 is provided for a column made of two rolled channel sections. The 300mm × 300mm column carries an axial compressive load of 2000kN. The line of action of the load passes through the centroid of the column section as well as of the slab base. The permissible bending stress in the slab base is 185MPa. The required minimum thickness of the slab base is
    a. 110mm
    b. 89mm
    c. 63mm
    d. 55mm
40. A strut in a steel truss is composed of two equal angles ISA 150 mm × 150 mm of thickness 10 mm connected back-to-back to the same side of a gusset plate. The cross sectional area of each angle is 2921mm^2 and moment of inertia ($I_{xx} = I_{yy}$) is 6335000 mm^4. The distance of the centroid of the angle from its surface ($C_x = C_y$) is 40.8 mm. The minimum radius of gyration of the strut is
    a. 93.2mm
    b. 62.7mm
    c. 46.6mm
    d. 29.8mm
41. Two equal angles ISA 100mm × 100 mm of thickness 10mm are placed back-to-back and connected to the either side of a gusset plate through a single row of 16mm diameter rivets in double shear. The effective areas of the connected and unconnected legs of each of these angles are 775mm^2 and 950mm^2 respectively. If these angles are NOT tack riveted, the net effective area of this pair of angles is
    a. 3650mm^2
    b. 3450mm^2
    c. 3076mm^2
    d. 2899mm^2
42. A moment M of magnitude 50 kN-m is transmitted to a column flange through a bracket by using four 20mm diameter rivets as shown in the figure:
43.



The shear force induced in the rivet A is
    a. 250 kN
    b. 175.8 kN
    c. 125 kN
    d. 88.4 kN
44. A propped cantilever of span L is carrying a vertical concentrated load acting at midspan. The plastic moment of the section is M. The magnitude of the collapse load is
    a. $\dfrac{8M_P}{L}$
    b. $\dfrac{6M_P}{L}$
    c. $\dfrac{4M_P}{L}$
    d. $\dfrac{2M_P}{L}$
45. The figure given below represents the contact pressure distribution underneath a

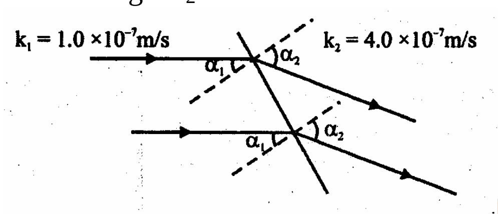


    a. rigid footing on saturated clay
    b. rigid footing on sand
    c. flexible footing on saturated clay

d. flexible footing on sand

46. A 6m thick clay layer undergoes 90% consolidation four times faster under two-way drainage as compared to one-way drainage. In an identical clay layer of 15 m two-way drainage will be faster as compared to one way drainage by
a. 8 times
b. 4 times
c. 2.5 times
d. 2 times

47. The figure below shows two flow lines for seepage across an interface between two soil media of different coefficients of permeability. If entrance angle α_1 = 30°, the exit angle a_2 will be



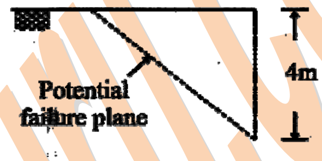
a. 7.50^0
b. 14.03°
c. 66.59°
d. 75.96°

48. An unsupported excavation is made to the maximum possible depth in a clay soil having γ_t = 18kN/m^3, c = 100kN/m^2, ϕ = 30°. The active earth pressure, according to Rankine's theory, at the base level of the excavation is
a. 115.47 kN/m^2
b. 54.36 kN/m^2
c. 27.1 8kN/m^2
d. 13.0 kN/m^2

49. A retaining wail of height 8m retains thy sand. In the initial state, the soil is loose and has a void ratio of.0.5, γ_d = 17.8kN/m^3 and ϕ = 30°. Subsequently, the backfill is compacted to a state where void ratio is 0.4, γ_d = 18.8kN/m^3 and ϕ = 35°. The ratio of initial passive thrust to the final passive thrust, according to Rankine's earth pressure theory, is
a. 0.38
b. 0.64
c. 0.77
d. 1.55

50. An infinite soil slope with an inclination of 35° is subjected to seepage parallel to its surface. The soil has c' = 100 kN/m^2 and ϕ' = 30°. Using the concept of mobilized cohesion and friction, at a factor of safety of 1.5 with respect to shear strength, the mobilized friction angle is
a. 20.02°
b. 21.05°
c. 23.33°
d. 30.00°

51. Using ϕ_u =0 analysis and assuming planar failure as shown, the minimum factor of safety against shear failure of a vertical cut of height 4m in a pure clay having c_u = 120kN/m^2 and γ_{sat} = 20kN/m^3 is



a. 1
b. 6
c. 10
d. 20

52. In the context of collecting undisturbed soil samples of high quality using a spoon sampler, following statements are made:
I. Area ratio should be less than 10%.
II. Clearance ratio should be less than 1%.
With reference to above statements, which of the following applies?
a. Both the statements are true
b. Statements His true but I is false
c. Statement I is true but His false
d. Both the statements are false

Data for Q.53 & Q.54 are given below. Solve the problems and choose the correct answers.
A group of 16 piles of 10m length and 0.5m diameter is installed in a 10m thick stiff clay layer underlain by rock. The pile-soil adhesion factor is 0.4; average shear strength of soil on the sides is 100kPa; undrained shear strength of the soil at the base is also 100 kPa.

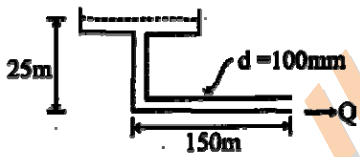
53. The base resistance of a single pile is
a. 40.00 kN
b. 88.35 kN
c. 100.00 kN
d. 176.71 kN

54. Assuming 100% efficiency, the group side resistance is
a. 5026.5 kN
b. 10000.0 kN
c. 10053.1 kN
d. 20106.0 kN

55. A velocity field is given as $\bar{V} = 2y\hat{i} + 3x\hat{j}$ where x and y are in meters. The acceleration of a fluid particle at (x, y) = (1, 1) in the x direction is
a. 0 m/s^2
b. 5.00 m/s^2
c. 6.00 m/s^2
d. 8.48 m/s^2

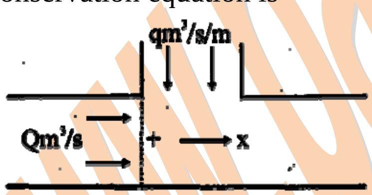
56. The velocity in m/s at a point in a two – dimensional flow is given as $\bar{V} = 2\hat{i} + 3\hat{j}$. The equation of the stream line passing through the point is
a. 3dx - 2dy = 0
b. 2x + 3y = 0
c. 3dx + 2dy = 0
d. xy = 6

57. A fire protection stem is supplied from a water tower with a bent pipe as shown in the figure. The pipe friction f is 0.03. Ignoring all minor losses, the maximum discharge, Q, in the pipe is



a. 31.7 lit/sec
b. 24.0 lit/sec
c. 15.9 lit/sec
d. 12.0 lit/sec

58. A steady flow occurs in an open channel with lateral inflow of q m^3/s per unit width as shown in the figure. The mass conservation equation is

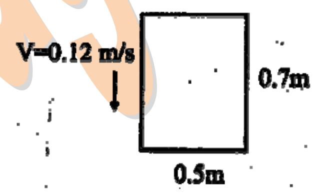


a. $\frac{\partial q}{\partial x} = 0$
b. $\frac{\partial Q}{\partial x} = 0$
c. $\frac{\partial Q}{\partial x} - q = 0$
d. $\frac{\partial Q}{\partial x} + q = 0$

59. A steep wide rectangular channel takes off from a reservoir having an elevation of 101.2m. At the entrance, the bottom elevation of the channel is 100m. If the slope of the channel is increased by 4%, the discharge per unit length in the channel will be
a. 2.24m^2/s
b. higher than2.24m^2/s by 4%
c. higher than 2.24m^2/s by 2%
d. choked

60. The height of a hydraulic jump in the stilling pool of 1:25 scale model was observed to be 10cm. The corresponding prototype height of the jump is
a. not determinable from the data given
b. 2.5m
c. 0.5m
d. 0.1m

61. A thin flat plate 0.5m × 0.7m in size settles in a large tank of water with a terminal velocity of 0.12m/s. The coefficients of drag $C_D = \frac{1.328}{\sqrt{R_L}}$ for a laminar boundary layer and $C_D = \frac{0.072}{(R_L)^{1/5}}$ for a turbulent boundary layer, where R_L, is the plate Reynolds number. Assume $\mu = 10^{-3} N-s/m^2$ and $\rho = 100 kg/m^3$

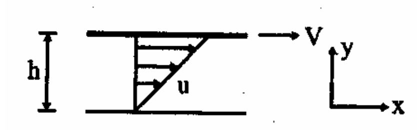


The submerged weight of the plate is
a. 0.0115 N
b. 0.0118 N
c. 0.0231 N
d. 0.0376 N

62. The allowable Net Positive Suction Head (NPSH) for a pump provided by the manufactures for a flow of 0.05m^3/s is 3.3m. The temperature o water is 30°C (vapour pressure head absolute = 0Mm), atmospheric pressure is 100 kPa absolute and the head loss from the reservoir to pump is 0.3N-m/N. The maximum height of the pump above the suction reservoir is
a. 10.19 m
b. 6.89 m
c. 6.15 m
d. 2.86 m

Data for Q.63 and Q.64 are given below. Solve the problems and choose correct answers.

The laminar flow takes place between closely spaced parallel plates as shown in figure below. The velocity profile is given by $u = V\frac{y}{h}$. The gap height, h, is 5mm and the space is filled with oil (specific gravity = 0.86, viscosity $\mu = 2\times10^{-4} N-s/m^2$). The bottom plate is stationary and the top plate moves with a steady velocity of V = 5 cm/s. The area of the plate of 0.25m^2



63. The rate of rotation of a fluid particle is given by

a. $\omega_y = 0; \omega_2 = \frac{y}{2h}$

b. $\omega_y = 0; \omega_2 = -\frac{y}{h}$

c. $\omega_y = \frac{y}{h}; \omega_2 = \frac{y}{h}$

d. $\omega_y = \frac{y}{h}; \omega_2 = 0$

64. The power required to keep the plate in steady motion is
a. 5×10^{-4} watts
b. 10^{-5} watts
c. 2.5×10^{-5} watts
d. 5×10^{-5} watts

65. The present population of a community is 28000 with an average water consumption of 4200 m^3/d. The existing water treatment plant has a design capacity of 6000m^3/d. It is expected that the population will increase to 44000 during the next 20 years. The number of years from now when the plant will reach its design capacity, assuming an arithmetic rate of population growth, will be
a. 5.5 years
b. 8.6 years
c. 15.0 years
d. 16.5 years

66. Water samples (X and Y) from two different sources were brought to the laboratory for the measurement of dissolved oxygen (DO) using modified Winkler method. Samples were transferred to 300m*l* BOD bottles 2m*l* of $MnSO_4$ solution and 2m*l* of alkaliodide-azide reagent were added to the bottles and mixed. Sample X developed a brown precipitate, whereas sample Y developed a white precipitate. In reference to these observations, the correct statement is
a. both the samples were devoid of DO
b. sample X was devoid of DO while sample Y contained DO
c. sample X contained DO while sample Y was devoid of DO
d. both the samples contained DO

67. A standard multiple-tube fermentation test was conducted on a sample of water from a surface stream. The results of the analysis for the confirmed test are given below.

Sample size (ml)	Number of positive results out of 5 tubes	Number of negative. results out of 5 tubes
1.0	4	1
0.1	3	2
0.01	1	4

MPN index and 95% confidence limits for combination of positive results when five tubes used per dilutions (10m*l*, 1.0 m*l*, 0.1 m*l*)

Combination of positives	MPN Index per 100m*l*	95% confidence limit	
		lower	Upper
4-2-1	26	12	65
4-3-1	33	15	77

Using the above MPN index table, the Most Probable Number (MPN) of the sample is
a. 26
b. 33
c. 260
d. 330

68. The design parameter for flocculation is given by a dimensionless number Gt where G is the velocity gradient and t is the detention time. Values of Gt ranging from 10^4 to 10^5 are commonly used, with ranging from 10 to 30 mitt The most preferred combination of G and t to produce smaller and denser floes is
a. large G values with short t
b. large G values with long t
c. small G values with short t
d. small G values with short t

69. Chlorine gas used for disinfection combines with water to form hypochlorous acid (HOC*l*). The HOC*l* ionizes to form hypochlorite (OC*l*$^-$) in a reversible reaction:

HOC $\Leftrightarrow$ H^+ + OCl^- (k = 2.7×10^{-8} at 20°C), the equilibrium of which is governed by pH. The sum of HOC*l* and OCl^- is known as free chlorine residual and HOC*l* is the more effective disinfectant. The 90% fraction of HOC*l* in the free chlorine residual is available at a pH value

a. 4.8
b. 6.6
c. 7.5
d. 9.4

70. An analysis for determination of solids in the return sludge of Activated Sludge Process was done as follows:

1. A crucible was dried to a constant mass of 62.485g.
2. 75 m*l* of a well-mixed sample was taken in the crucible.
3. The crucible with the sample was dried to a constant mass of 65.020g in a drying oven at 104°C.
4. The crucible with the dried sample was placed in a muffle furnace at 600°C, for an hour. After cooling, the mass of the crucible with residues was 63.145g.

The concentration of organic fraction of solids present in the return sludge sample is

a. 8800mg/*l*
b. 25000mg/*l*
c. 33800mg/*l*
d. 42600mg/*l*

71. A portion of waste water sample was subjected to standard BOD test (5 days, 20°C), yielding a value of 180mg/*l*. The reaction rate constant (to the base 'e') at 20°C was taken as 0.18 per day. The reaction rate constant at other temperature may be estimated by $k_T = k_{20}(1.047)^{T-20}$. The temperature at which the other portion of the sample should be tested, to exert the same BOD in 2.5 days, is

a. 4.9°C
b. 24.9°C
c. 31.7°C
d. 35.0°C

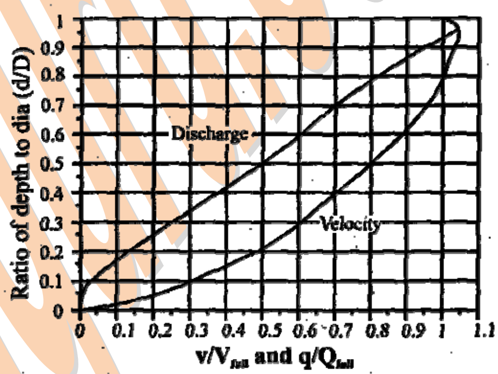
72. The following data are given for a channel-type grit chamber of length 7.5m.

1. flow-through velocity = 0.3m/s
2. the depth of waste water at flow in the channel = 0.9 m
3. specific gravity of inorganic particles = 2.5
4. g = 9.80 m/s^2, $\mu = 1.002 \times 10^{-3}$ N-s/m^2 at 20°C, ρ_w = 1000kg/m^3

Assuming that the Stoke's law is valid, the largest diameter particle that would be removed with 100 percent efficiency is

a. 0.04mm
b. 0.21mm
c. 1.92mm
d. 6.64mm

73. An existing 300mm diameter circular sewer is Laid at a slope of 1 : 28 and carries a peak discharge of 1728m^3/d. Use the partial flow diagram shown in the given figure and assume Manning's n = 0.015.



Partial flow diagram for circular sewer

At the peak discharge, the depth of flow and the velocity are, respectively,

a. 45 mm and 0.28 m/s
b. 120 mm and 0.50 m/s
c. 150 mm and 0.57 m/s
d. 300 mm and 0.71 m/s

74. The average rainfall for a 3 hour duration storm is 2.7cm and the loss rate is 0.3cm/hr. The flood hydrograph has a base flow of 20m^3/s and produces a peak flow of 210m^3/s. The peak of a 3-h unit hydrograph is

a. 125.50 m^3/s
b. 105.50 m^3/s
c. 77.77 m^3/s
d. 70.37 m^3/s

75. The rainfall during three successive 2 hour periods are 0.5, 2.8 and 1.6cm. The surface runoff resulting from this storm is 3.2cm. The ϕ index value of this storm is

a. 0.20 cm/hr
b. 0.28 cm/hr
c. 0.30 cm/hr
d. 0.80 cm/hr

76. A canal irrigates a portion of a culturable command area to grow sugarcane and

wheat. The avenge discharges required to grow sugarcane and wheat are, respectively, 0.36 and 0.27 cumecs. The time factor is 0.9.

The required design capacity of the canal is

a. 0.36 cumecs
b. 0.40 cumecs
c. 0.63 cumecs
d. 0.70 cumecs

77. The data given below pertain to the design of a flexible pavement:

Initial traffic = 1213 cvpd
Traffic growth rate = 8% per annum
Design life = 12 years
Vehicle damage factor = 2.5
Distribution factor = 1.0

The design traffic in terms of million standard axles (msa) to be catered would be

a. 0.06 msa
b. 8.40 msa
c. 21.00 msa
d. 32.26 msa

78. For a road with camber of 3% and the design speed of 80 km/hr, the minimum radius of the curve beyond which NO super elevation is needed is

a. 1680 m
b. 948 m
c. 406 m
d. 280 m

79. The co-efficient of friction in the longitudinal direction of a highway is estimated as 0.396. The braking distance for a car moving at a speed of 65km/hr is

a. 87m
b. 45m
c. 42m
d. 40m

80. Three new roads P, Q and R are planned in a district. The data for these roads are given in the table below.

Road	Length (kcm)	Number of villages with population		
		less than 2000	2000–5000	more than 5000
p	20	8	6	1
Q	28	19	8	4
R	12	7	5	2

Based on the principle of maximum utility, the order of priority for these three roads should be

a. P, Q, R
b. Q, R, P
c. R, P, Q
d. R, Q, P

81. A Marshall specimen is prepared for bituminous concrete with a bitumen content of 5 per cent by weight of total mix. The theoretical and the measured unit weights of the mix are 2.442g/cm^3 and 2.345g/cm^3, respectively. The bitumen has a specific gravity of 1.02. The per cent voids in mineral aggregate filled with bitumen (VFB) are :

a. 34.55
b. 35.9
c. 73.55
d. 74.3

82. The eigen values of the matrix $\begin{bmatrix} 4 & -2 \\ -2 & 1 \end{bmatrix}$

a. are 1 and 4
b. are –1 and 2
c. are 0 and 5
d. cannot be determined

83. The function f(x) = $2x^2 - 3x^2 - 36x + 2$ has its maxima at

a. x = –2 only
b. x = 0 only
c. x = 3 only
d. both x = – 2 and x = 3

84. Biotransformation of an organic compound having concentration (x) can be modeled using an ordinary differential equation $\frac{dx}{dt} + kx^2 = 0$, where k is the reaction rate constant. If x = a at t = 0, the solution of the equation is

a. $x = ae^{-kt}$
b. $\frac{1}{x} = \frac{1}{a} + kt$
c. $x = a\left(1 - e^{-kr}\right)$
d. $x = a + kt$

85. A hydraulic structure has four gates which operate independently. The probability of failure of each gate is 0.2. Given that gate 1 has failed, the probability that both gates 2 and 3 will fail is

a. 0.240
b. 0.200
c. 0.040
d. 0.008