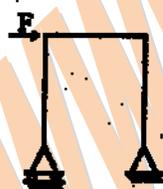


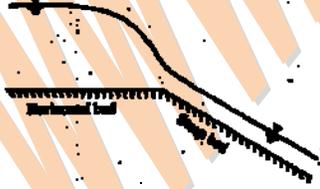
CIVIL ENGINEERING

ONE MARKS QUESTIONS

1. The symmetry of stress tensor at a point in the body under equilibrium is obtained from
 - a. conservation of mass
 - b. force equilibrium equations
 - c. moment equilibrium equations
 - d. conservation of energy
2. The components of strain tensor at a point in the plane strain case can be obtained by measuring longitudinal strain in following directions
 - a. along any two arbitrary directions
 - b. along any three arbitrary directions
 - c. along two mutually orthogonal directions
 - d. along any arbitrary direction
3. For a linear elastic frame, if stiffness matrix is doubled with respect to the existing stiffness matrix, the deflection of the resulting frame will be
 - a. twice the existing value
 - b. half the existing value
 - c. the same as existing value
 - d. indeterminate value
4. Considering beam as axially rigid, the degree of freedom of a plane frame shown below is



 - a. 9
 - b. 8
 - c. 7
 - d. 6
5. **IS:1343-1980** limits the minimum characteristic strength of prestressed concrete for post tensioned work and pretension work as
 - a. 25MPa, 30MPa respectively
 - b. 25MPa, 35MPa respectively
 - c. 30MPa, 35MPa respectively
 - d. 30MPa, 40MPa respectively
6. The partial factor of safety for concrete as per **IS:456-2000** is
 - a. 1.50
 - b. 1.15
 - c. 0.87
 - d. 0.446
7. The permissible stress in axial tension σ^{st} in steel member on the net effective area of the section shall not exceed (f_y is the yield stress)
 - a. $0.80 f_y$
 - b. $0.75 f_y$
 - c. $0.60 f_y$
 - d. $0.50 f_y$
8. Root time method is used to determine
 - a. T, time factor
 - b. c_v , coefficient of consolidation
 - c. a_v , coefficient of compressibility
 - d. m_v , coefficient of volume compressibility
9. Negative skin friction in a soil is considered when the pile is constructed through a
 - a. fill material
 - b. dense coarse sand
 - c. over consolidated stiff clay
 - d. dense fine sand
10. There are two footings resting on the ground surface. One footing is square of dimension 'B'. The other is strip footing of width 'B'. Both of them are subjected to a loading intensity of q. The pressure intensity at any depth below the base of the footing along the centre line would be
 - a. equal in both footings
 - b. large for square footing and small for strip footing
 - c. large for strip footing and small for square footing
 - d. more for strip footing at shallow depth ($\leq B$) and more for square footing at large depth ($> B$)

11. A clayey soil has a maximum dry density of 16kN/m^3 and optimum moisture content of 12%. A contractor during the construction of core of an earth dam obtained the dry density 15.2kN/m^3 and water content 11%. This construction is acceptable because
- the density is less than the maximum dry density and water content is on dry side of optimum
 - the compaction density is very low and water content is less than 12%
 - the compaction is done on the dry side of the optimum
 - both the dry density and water content of the compacted soil are within the desirable limits
12. An inert tracer is injected continuously from a point in an unsteady flow field. The locus of locations of all the tracer particles at an instance of time represents
- Streamline
 - Pathline
 - Streamtube
 - Streakline
13. The reading of differential manometer of a Venturimeter, placed at 45° to the horizontal is 11cm. If the Venturimeter is turned to horizontal position, the manometer reading will be
- Zero
 - $\frac{11}{\sqrt{2}}\text{cm}$
 - 11 cm
 - $11\sqrt{2}\text{cm}$
14. A horizontal bed channel is followed by a steep bed channel as shown in the figure. The gradually-varied profiles over the horizontal and steep beds are
- 
- H_2 and S_2 respectively
 - H_2 and S_2 respectively
 - H_3 and S_2 respectively
 - H_3 and S_2 respectively
15. Total Kjeldahl nitrogen is a measure of
- total organic nitrogen
 - total organic and ammonia nitrogen
 - total ammonia nitrogen
 - total inorganic and ammonia nitrogen
16. 1 TCU is equivalent to the colour produced by
- 1 mg/l of chloroplatinate ion
 - 1 mg/l of platinum ion
 - 1mg/l platinum in form of chloroplatinate ion
 - 1 mg/l of organo-chloroplatinate ion
17. In aerobic environment, nitrosomonas convert
- NH_3 to NO_2
 - NO_2^- to NO_3^-
 - NH_3 to N_2O
 - NO_2^- to HNO_3
18. Bulking sludge refers to having
- $F/M < 0.3/d$
 - $0.3/d < F/M < 0.6/d$
 - $F/M = \text{zero}$
 - $F/M > 0.6/d$
19. When the outflow from a storage reservoir is uncontrolled as in a freely operating spillway, the of outflow hydrograph occurs at
- the point of intersection of the inflow and outflow hydrographs
 - a point, after the intersection of the inflow and outflow hydrographs
 - the tail of inflow hydrographs
 - a point, before the intersection of the inflow and outflow hydrographs
20. The intensity of rainfall and time interval of a typical storm are:
- | Time interval (minutes) | Intensity of rainfall (mm/minute) |
|-------------------------|-----------------------------------|
| 0-10 | 0.7 |
| 10-20 | 1.1 |
| 20-30 | 2.2 |
| 30-40 | 1.5 |
| 40-50 | 1.2 |
| 50-60 | 1.3 |
| 60-70 | 0.9 |
| 70-80 | 0.4 |
- The maximum intensity of rainfall for 20 minutes duration of the storm is
- 1.5 mm/minute
 - 1.85 mm/minute

- c. 22 mm/minute
d. 3.7 mm/minute
21. On which of the canal systems, R.G Kennedy, executive engineer in the Punjab Irrigation Department made his observations for proposing his theory on stable channels?
a. Krishna Western Delta canals
b. Lower Bad Doab canals
c. Lower Chenab canals
d. Upper Bari Doab canals
22. Which one of the following equations represents the downstream profile of Ogee spillway with vertical upstream toe? (x,y) are the coordinates of the point on the downstream profile with origin at the crest of the spillway and H_d is the design head.
a. $\frac{y}{H_d} = -0.5 \left(\frac{x}{H_d} \right)^{1.85}$
b. $\frac{y}{H_d} = -0.5 \left(\frac{x}{H_d} \right)^{1/1.85}$
c. $\frac{y}{H_d} = -2.0 \left(\frac{x}{H_d} \right)^{1.85}$
d. $\frac{y}{H_d} = -2.0 \left(\frac{x}{H_d} \right)^{1/1.85}$
23. The length of summit curve on a two lane two way highway depends upon
a. allowable rate of change of centrifugal acceleration
b. coefficient of lateral friction
c. required stopping sight distance
d. required overtaking sight distance
24. Pradhan Mantri Gram Sadak Yojna (PMGSY), launched in the year 2000, aims to provide rural connectivity with all-weather roads. It is proposed to connect the habitations in plain areas of population more than 500 persons by the year
a. 2005
b. 2007
c. 2010
d. 2012
25. List-I contains some properties of bitumen. List-II gives a list of Laboratory Tests conducted on bitumen to determine the properties. Match the property with the corresponding test and select the correct

answer using the codes given below the lists :

List-I

P. Resistance to flow

Q. Ability to deform under load

R. Safety

List-II

1. Ductility test

2. Penetration test

3. Flash and fire point test

Codes :

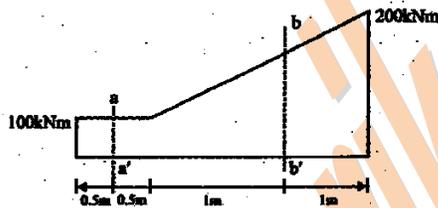
	P	Q	R
a.	2	1	3
b.	2	3	1
c.	1	2	3
d.	3	1	2

26. Bituminous concrete is a mix comprising of
a. fine aggregate, filler and bitumen
b. fine aggregate and bitumen
c. coarse aggregate, fine aggregate, filler and bitumen
d. coarse aggregate, filler and bitumen
27. Consider the matrices $X_{(4 \times 3)}$, $Y_{(4 \times 3)}$ and $P_{(2 \times 3)}$. The order of $[P(X^T Y)^{-1} P^T]^T$ will be
a. (2×2)
b. (3×3)
c. (4×3)
d. (3×4)
28. Consider a non-homogeneous system of linear equations representing mathematically an over-determined system. Such a system will be
a. consistent having a unique solution
b. consistent having many solutions
c. inconsistent having a unique solution
d. inconsistent having no solution
29. Which one of the following is NOT true for complex number Z_1 and Z_2 ?
a. $\frac{Z_1}{Z_2} = \frac{Z_1 \overline{Z_2}}{|Z_2|^2}$
b. $|Z_1 + Z_2| \leq |Z_1| + |Z_2|$
c. $|Z_1 - Z_2| \leq |Z_1| - |Z_2|$
d. $|Z_1 + Z_2|^2 + |Z_1 - Z_2|^2 = 2|Z_1|^2 + 2|Z_2|^2$
30. Which one of the following statements is NOT true?

- The measure of skewness is dependent upon the amount of dispersion
- In a symmetric distribution, the values of mean, mode and median are the same
- In a positively skewed distribution: mean > median > mode
- In a negatively skewed distribution: mode > mean > median

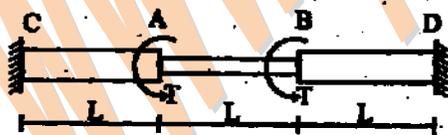
TWO MARKS QUESTIONS

- If principal stresses in a two-dimensional case are -10 MPa and 20 MPa respectively, then maximum shear stress at the point is
 - 10 MPa
 - 15 MPa
 - 20 MPa
 - 30 MPa
- The bending moment diagram for a beam is given below:



The shear force at sections aa' and bb' respectively are of the magnitude

- 100 kN, 150 kN
 - zero, 100 kN
 - zero, 50 kN
 - 100 kN, 100 kN
- A circular shaft shown in the figure is subjected to torsion T at two points A and B. The torsional rigidity of portions CA and BD is GJ_1 and that of portion AB is GJ_2 . The rotations of shaft at points A and B are θ_1 and θ_2 . The rotation θ_1 is



- $\frac{TL}{GJ_1 + GJ_2}$
- $\frac{TL}{GJ_1}$

- $\frac{TL}{GJ_2}$

- $\frac{TL}{GJ_1 - GJ_2}$

- Match the following:

List-I

- P. Slope deflection method
 Q. Moment distribution method
 R. Method of three moments
 S. Castigliano's second theorem

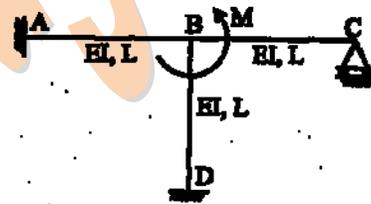
List-II

- Force method
- Displacement method

Codes :

	P	Q	R	S
a.	1	2	1	2
b.	1	1	2	2
c.	2	2	1	1
d.	2	1	2	1

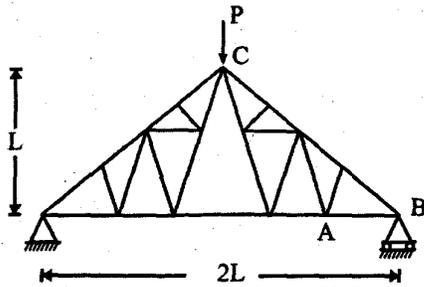
- All member of the frame shown below have the same flexural rigidity EI and length L . If a moment M is applied at joint B, the rotation of the joint is



- $\frac{ML}{12EI}$
- $\frac{ML}{11EI}$
- $\frac{ML}{8EI}$
- $\frac{ML}{7EI}$

Data for Q. 36 & Q.37 are given below. Solve the problems and choose the correct answers.

A truss is shown in the figure. Members are of equal cross section A and same modulus of elasticity E . A vertical force P is applied at point C.



36. Force in the member AB of the truss is

- $P/\sqrt{2}$
- $P/\sqrt{3}$
- $P/2$
- P

37. Deflection of the point C is

- $\frac{(2\sqrt{2}+1) PL}{2 EA}$
- $\sqrt{2} \frac{PL}{EA}$
- $(2\sqrt{2}+1) \frac{PL}{EA}$
- $(\sqrt{2}+1) \frac{PL}{EA}$

38. A rectangular column section of 250mm x 400mm is reinforced with five steel bars of grade Fe-500, each of 20mm diameters. Concrete mix is M30. Axial load on the column section with minimum eccentricity as per IS:456-2000 using limit state method can be applied upto

- 1707.37
- 1805.30
- 1806.40
- 1903.7

39. A concrete beam of rectangular cross section of 200mm x 400mm is prestressed with a force 400kN at eccentricity 100mm. The maximum compressive stress in the concrete is

- 12.5N/mm^2
- 7.5N/mm^2
- 5.0N/mm^2
- 2.5N/mm^2

40. The flexural strength of M30 concrete as per IS:456-2000 is

- 3.83 MPa
- 5.47 MPa
- 21.23 MPa

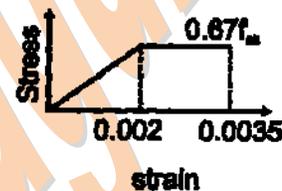
d. 30.0 MPa

41. In a random sampling procedure for cube strength of concrete, one sample consists of X number of specimens. These specimens are tested at 28 days and average strength of these X specimens is considered as test result of the sample, provided the individual variation in the strength of specimens is not more than $\pm Y$ per cent of the average strength. The values of X and Y as per IS:456-2000 are

- 4 and 10 respectively
- 3 and 10 respectively
- 4 and 15 respectively
- 3 and 15 respectively

Data for Q.42 & Q.43 are given below. Solve the problems and choose correct answers.

Assume straight line instead of parabola for stress-strain curve of concrete as given below and partial factor of safety as 1.0.



A rectangular under-reinforced concrete section of 300mm width and 500mm effective depth is reinforced with 3 bars of grade Fe-415, each of 16mm diameter. Concrete mix is M20.

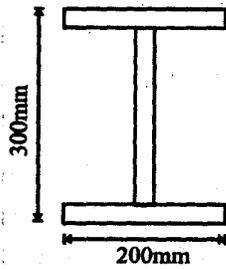
42. The depth of the neutral axis from the compression fibre is

- 76mm
- 81mm
- 87mm
- 100mm

43. The depth of the neutral axis obtained as per IS:456-2000 differs from the depth of neutral axis obtained in Q.22 by

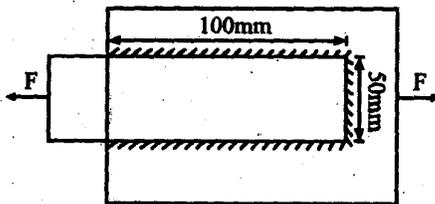
- 15mm
- 20mm
- 25mm
- 32mm

44. An unstiffened web I-section is fabricated from a 10mm thick plate by fillet welding as shown in the figure. If yield stress of steel is 250MPa, the maximum shear load that section can take is



- a. 750 kN
- b. 350 kN
- c. 337.5 kN
- d. 300 kN

45. A fillet-welded joint of 6mm size is shown in the figure. The welded surfaces meet at 60-90 degree and permissible stress in the fillet weld is 108 MPa. The safe load that can be transmitted by the joint is



- a. 162.7 kN
- b. 151.6 kN
- c. 113.4 kN
- d. 109.5 kN

46. Which one of the following is NOT correct for steel sections as per IS : 800-1984?

- a. The maximum bending stress in tension or in compression in extreme fibre calculated on the effective section of a beam shall not exceed $0.66 f_y$.
- b. The bearing stress in any part of a beam when calculated on the net area shall not exceed $0.75 c$.
- c. The direct stress in compression on the gross sectional area of axially loaded compression member shall not exceed $0.6 f_y$.
- d. None of the above.

47. A cantilever beam of length l , width b and depth d is loaded with a concentrated vertical load at the tip. If yielding starts at a load P , the collapse load shall be

- a. $2.0 P$
- b. $1.5 P$
- c. $1.2 P$
- d. P

48. In a constant head permeameter with cross section area of 10cm^2 , when the flow was taking place under a hydraulic gradient of 0.5, the amount of water collected in 60 seconds is 600cc. The permeability of the soil is

- a. 0.002 cm/s
- b. 0.02 cm/s
- c. 0.2 cm/s
- d. 2.0 cm/s

49. Two observation wells penetrated into a confined aquifer and located 1.5km apart in the direction of flow, indicate head of 45m and 20m. If the coefficient of permeability of the aquifer is 30m/day and porosity is 0.25, the time of travel of an inert tracer from one well to another is

- a. 416.7 days
- b. 500 days
- c. 750 days
- d. 3000 days

50. Assuming that a river bed level does not change and the depth of water in river was 10m, 15 m and 8 m during the months of February, July and December respectively of a particular year. The average bulk density of the soil is 20kN/m^3 . The density of water is 10kN/m^3 . The effective stress at a depth of 10m below the river bed during these months would be

- a. 300 kN/m^2 in February, 350 kN/m^2 July and 320kN/m^2 in December
- b. 100 kN/m^2 in February, 100 kN/m^2 July and 100 kN/m^2 in December
- c. 200 kN/m^2 in February, 250 kN/m^2 July and 180 kN/m^2 in December
- d. 300 kN/m^2 in February, 350 kN/m^2 July and 280 kN/m^2 in December

51. For a triaxial shear test conducted on a sand specimen at a confining pressure of 100 kN/m^2 under drained conditions, resulted in a deviator stress ($\sigma_1 - \sigma_3$) at failure of 100kN/m^2 . The angle of shearing resistance of the soil would be

- a. 18.43°
- b. 19.47°
- c. 26.56°
- d. 30°

52. A 3m high retaining wall is supporting a saturated sand (saturated due to capillary action) of bulk density 18 kN/m^3 and angle

of shearing resistance 30° . The change in magnitude of active earth pressure at the base due to rise in ground water table from the base of the footing to the ground surface shall ($\gamma_w = 10 \text{ kN/m}^3$)

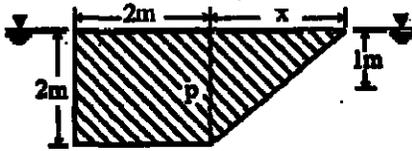
- increase by 20 kN/m^2
 - decrease by 20 kN/m^2
 - increase by 30 kN/m^2
 - decrease by 30 kN/m^2
53. For two infinite slopes (one in dry condition and other in submerged condition) in a sand deposit having the angle of shearing resistance 30° , factor of safety was determined as 1.5 (for both slopes). The slope angles would have been
- 21.05° for dry slope and 21.05° for submerged slope
 - 19.47° for dry slope and 18.40° for submerged slope
 - 18.4° for dry slope and 21.05° for submerged slope
 - 22.6° for dry slope and 19.47° for submerged slope
54. A strip footing (8m wide) is designed for a total settlement of 40mm. The safe bearing capacity (shear) was 150 kN/m^2 and safe allowable soil pressure was 100 kN/m^2 . Due to importance of the structure, now the footing is to be redesigned for total settlement of 25mm. The new width of the footing will be
- 5 m
 - 8 m
 - 12 m
 - 12.8 m
55. During the subsurface investigations for design of foundations, a standard penetration test was conducted at 4.5m below the ground surface. The record of number of blows is given below:

Penetration depth (cm)	Number of blows
0–7.5	3
7.5–15	3
15–22.5	6
22.5–30	6
30–37.5	8
37.5–45	7

Assuming the water table at ground level, soil as fine sand and correction factor for overburden as 1.0, the corrected 'N' value for the soil would be

- 18
 - 19
 - 21
 - 33
56. A soil mass contains 40% gravel, 50% sand and 10% silt. This soil can be classified as
- silty sandy gravel having coefficient of uniformity less than 60.
 - silty gravelly sand having coefficient of uniformity equal to 10.
 - gravelly silty sand having coefficient of uniformity greater than 60.
 - gravelly silty sand and its coefficient of uniformity cannot be determined.
57. A saturated soil mass has a total density 22 kN/m^3 and a water content of 10%. The bulk density and dry density of this soil are
- 12 kN/m^3 & 20 kN/m^3 respectively
 - 22 kN/m^3 & 20 kN/m^3 respectively
 - 19.8 kN/m^3 & 19.8 kN/m^3 respectively
 - 23.2 kN/m^3 & 19.8 kN/m^3 respectively
58. A stream function is given by:
- $$\psi = 2x^2y + (x+1)y^2$$
- The flow rate across a line joining points A(3, 0) and B(0, 2) is
- 0.4 units
 - 1.1 units
 - 4 units
 - 5 units
59. The circulation ' Γ ' around a circle of radius 2 units for the velocity field $u = 2x + 3y$ and $v = -2y$ is
- -6π units
 - -12π units
 - -18π units
 - -24π units
60. A tank and a deflector are placed on a frictionless trolley. The tank issues water jet (mass density of water = 1000 kg/m^3), which strikes the deflector and turns by 45° . If the velocity of jet leaving the deflector is 4 m/s and discharge is $0.1 \text{ m}^3/\text{s}$, the force recorded by the spring will be
- 100 N
 - $100\sqrt{2}$ N
 - 200 N
 - $200\sqrt{2}$ N

61. Cross-section of an object (having same section normal to the paper submerged into a fluid consists of a square of sides 2m and triangle as shown in the figure. The object is hinged at point P that is one meter below the fluid free surface. If the object is to be kept in the position as shown in the figure, the value of 'x' should be



- a. $2\sqrt{3}$
 b. $4\sqrt{3}$
 c. 4m
 d. 8m
62. Critical depth at a section of a rectangular channel is 1.5m. The specific energy at that section is
- a. 0.75m
 b. 1.0m
 c. 1.5m
 d. 2.25m
63. A partially open sluice gate discharges water into a rectangular channel. The tail water depth in the channel is 3m and Froude number is $\frac{1}{2\sqrt{2}}$. If a free hydraulic jump is to be formed at downstream of the sluice gate after the vena contract of the jet coming out from the sluice gate, the sluice gate opening should be (coefficient of contraction $C_c = 0.9$)
- a. 0.3m
 b. 0.4m
 c. 0.69m
 d. 0.9m
64. A triangular irrigation lined canal carries a discharge of $25\text{m}^3/\text{s}$ at bed slope $\frac{1}{6000}$. If the side slopes of the canal are 1 : 1 and Manning's coefficient is 0.018, the central depth of flow is equal to
- a. 2.98m

- b. 3.62m
 c. 4.91m
 d. 5.61m

65. If tomato juice is having a pH of 4.1, the hydrogen ion concentration will be
- a. $10.94 \times 10^{-5} \text{ mol/L}$
 b. $9.94 \times 10^{-5} \text{ mol/L}$
 c. $8.94 \times 10^{-5} \text{ mol/L}$
 d. $7.94 \times 10^{-5} \text{ mol/L}$

66. List-I contains some properties of water/waste water and List-II contains list of some tests on water/ waste water. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- P. Suspended solids concentration
 Q. Metabolism of biodegradable organics
 H. Bacterial concentration
 S. Coagulant dose

List-II

1. BOD
 2. MPN
 3. Jar test
 4. Turbidity

Codes :

	P	Q	R	S
a.	2	1	4	3
b.	4	1	2	3
c.	2	4	1	3
d.	4	2	1	3

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

List-I

- P. Thickening of sludge by chemical oxidation
 Q. Stabilization of sludge or chemical treatment
 H. Conditioning of sludge
 S. Reduction of sludge floatation or gravity

List-II

1. Decrease in volume of
 2. Separation of water by heat
 3. Digestion of sludge
 4. Separation of water by

	P	Q	R	S
--	---	---	---	---

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

68. A circular primary clarifier processes an average flow of $5005\text{m}^3/\text{d}$ of municipal waste water. The overflow rate is $35\text{m}^3/\text{m}^2/\text{d}$. The diameter of clarifier shall be

- a. 10.5m
 b. 11.5m
 c. 12.5m
 d. 13.5m

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

List-I

- P. Release valve
 Q. Check valve
 R. Gate valve
 S. Pilot valve

List-II

- Reduce high inlet pressure to lower outlet pressure
- Limit the flow of water to single direction
- Remove air horn the pipeline
- Stopping the flow of water in the pipeline.

Codes :

- | | P | Q | R | S |
|----|---|---|---|---|
| a. | 3 | 2 | 4 | 1 |
| b. | 4 | 2 | 1 | 3 |
| c. | 3 | 4 | 2 | 1 |
| d. | 1 | 2 | 4 | 3 |

70. In a certain situation, waste water discharged into a river mixes with the river water instantaneously and completely. Following is the data available:

- Waste water DO = 2.00mg/l
 Discharge rate = $1.10\text{m}^3/\text{s}$
 River water DO = 8.3mg/l
 Flow rate = $8.70\text{m}^3/\text{s}$
 Temperature = 20°C

Initial amount of DO in the mixture of waste and river shall be

- a. 5.3mg/l
 b. 6.5mg/l
 c. 7.6mg/l

- d. 8.4mg/l

Data for Q.71 & Q.72 are given below. Solve the problems and choose correct answers.

A city is going to install the rapid sand filter after the sedimentation tanks.

Use the following data.

- Design loading rate to the filter – $200\text{m}^3/\text{m}^2/\text{d}$
 Design flow rate – $0.5\text{m}^3/\text{s}$
 Surface area per filter box – 50m^2

71. The surface area required for the rapid sand filter will be

- a. 210m^2
 b. 215m^2
 c. 216m^2
 d. 218m^2

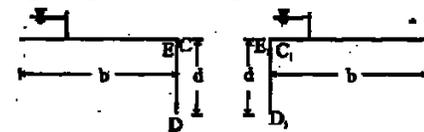
72. The number of filters required shall be

- a. 3
 b. 4
 c. 6
 d. 8

73. The culturable commanded area for a distributary is $2 \times 10^8\text{m}^2$. The intensity of irrigation for a crop is 40%. If kor water depth and kor period for the crop are 14cm and 4 weeks, respectively, the peak demand discharge is

- a. $2.63\text{m}^3/\text{s}$
 b. $4.63\text{m}^3/\text{s}$
 c. $8.58\text{m}^3/\text{s}$
 d. $11.58\text{m}^3/\text{s}$

74. Uplift pressure at points E and D (figure A) of a straight horizontal floor of negligible thickness with a sheet pile at downstream end are 28% and 20%, respectively. If the sheet pile is at upstream end of the floor (figure- B), the uplift pressures at points D_1 and C_1 are



- a. 68% and 60% respectively
 b. 80% and 72% respectively
 c. 88% and 70% respectively
 d. 100% and zero respectively.

75. A launching apron is to be designed at downstream of a weir for discharge

intensity of $6.5 \text{ m}^3/\text{s}/\text{m}$. For the design of launching aprons the scour depth is taken two times of Lacey scour depth. The silt factor of the bed material is unity. If the tail water depth is 4.4m, the length of launching apron in the launched position is

- $\sqrt{5} \text{ m}$
- 4.7 m
- 5 m
- $5\sqrt{5} \text{ m}$

Data for Q.76 & Q.77 are given below. Solve the problems and choose correct answers.

A four hour unit hydrograph of a catchment is triangular in shape with base of 80 hours. The area of the catchment is 720 km^2 . The base flow and ϕ -index are $30 \text{ m}^3/\text{s}$ and 1 mm/h, respectively. A storm of 4 cm occurs uniformly in 4 hours over the catchment.

- The peak discharge of four hour unit hydrograph is
 - $40 \text{ m}^3/\text{s}$
 - $50 \text{ m}^3/\text{s}$
 - $60 \text{ m}^3/\text{s}$
 - $70 \text{ m}^3/\text{s}$
- The peak flood discharge due to the storm is
 - $210 \text{ m}^3/\text{s}$
 - $230 \text{ m}^3/\text{s}$
 - $260 \text{ m}^3/\text{s}$
 - $720 \text{ m}^3/\text{s}$
- For a 25cm thick cement concrete pavement, analysis of stresses gives the following values:
 Wheel load stress due to corner loading $30 \text{ kg}/\text{cm}^2$
 Wheel load stress due to edge loading $32 \text{ kg}/\text{cm}^2$
 Warping stress at corner region during summer $9 \text{ kg}/\text{cm}^2$
 Warping stress at corner region during winter $7 \text{ kg}/\text{cm}^2$
 Warping stress at edge region during summer $8 \text{ kg}/\text{cm}^2$
 Warping stress at edge region during winter $6 \text{ kg}/\text{cm}^2$
 Frictional stress during summer $5 \text{ kg}/\text{cm}^2$

Frictional stress during winter $4 \text{ kg}/\text{cm}^2$

The most critical stress value for this pavement is

- $40 \text{ kg}/\text{cm}^2$
- $42 \text{ kg}/\text{cm}^2$
- $44 \text{ kg}/\text{cm}^2$
- $45 \text{ kg}/\text{cm}^2$

- The following observations were made of an axle-load survey on a road:

Axle load (kN)	Repetitions per day
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35-45	800
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75-85	400
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The standard axle-load is 80kN. Equivalent daily numbers of repetitions for the standard axle-load are

- 450
- 480
- 800
- 1200

- A transport company operates a scheduled daily truck service between city P and city Q. One-way journey time between these two cities is 85 hours. A minimum layover time of 5 hours is to be provided at each city. How many trucks are required to provide this service?

- 4
- 6
- 7
- 8

- A single lane unidirectional highway has a design speed of 65kmph. The perception-brake-reaction time of drivers is 2.5 seconds and the average length of vehicles is 5m. The coefficient of longitudinal friction of the pavement is 0.4. The capacity of this road in terms of 'vehicles per hour per lane' is

- 1440
- 750
- 710
- 680

- A road is having a horizontal curve of 40Cm radius on which a super-elevation of 0.07 is provided. The coefficient of lateral friction mobilized on the curve when a vehicle is travelling at 100 kmph is

- 0.07
- 0.13

- c. 0.15
d. 0.4
83. Consider the system of equations $A_{(n \times n)} x_{(n \times 1)} = \lambda_{(n \times 1)}$, where, λ is a scalar. Let (λ_i, x_i) be an eigen-pair of an eigen value and its corresponding eigen vector for real matrix A . Let I be a $(n \times n)$ unit matrix. Which one of the following statement is NOT correct?
- For a homogeneous $n \times n$ system of linear equations, $(A - \lambda I)x = 0$ having a nontrivial solution, the rank of $(A - \lambda I)$ is less than n .
 - For matrix A^m , m being a positive integer, (λ_i^m, x_i^m) will be the eigen-pair for all i .
 - If $A^T = A^{-1}$, then $|\lambda_i| = 1$ for all i .
 - If $A^T = A$, then λ_i is real for all i .
84. Transformation to linear form by substituting $v = y^{1-n}$ of the equation $\frac{dy}{dt} + p(t)y = q(t)y^n; n > 0$ will be
- $\frac{dv}{dt} + (1-n)pv = (1-n)q$
 - $\frac{dv}{dt} + (1-n)pv = (1+n)q$
 - $\frac{dv}{dt} + (1+n)pv = (1-n)q$
 - $\frac{dv}{dt} + (1+n)pv = (1+n)q$
85. A rail engine accelerates from its stationary position for 8 seconds and travels a distance of 280m. According to the Mean Value Theorem, the speedometer at a certain time during acceleration must read exactly
- 0 km/h
 - 8 km
 - 75 km/h
 - 126 km/h
86. The general solution of $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 17y = 0; y(0) = 1, \frac{dy}{dx}\left(\frac{x}{4}\right) = 0$ in the range $0 < x < \frac{\pi}{4}$ is given by
- $e^{-x} \left(\cos 4x + \frac{1}{4} \sin 4x \right)$
 - $e^x \left(\cos 4x - \frac{1}{4} \sin 4x \right)$
 - $e^{-4x} \left(\cos x - \frac{1}{4} \sin x \right)$
 - $e^{-4x} \left(\cos 4x - \frac{1}{4} \sin 4x \right)$
87. Value of the integral $\oint_c (xydy - y^2dx)$, where, c is the square cut from the first quadrant by the lines $x = 1$ and $y = 1$ will be (Use Green's theorem to change the line integral into double integral)
- $\frac{1}{2}$
 - 1
 - $\frac{3}{2}$
 - $\frac{5}{3}$
88. Consider likely applicability of Cauchy's Integral Theorem to evaluate the following integral counterclockwise around the unit circle c . $I = \oint_c \sec z dz$, z being a complex variable. The value of I will be
- $I = 0$: singularities set = \emptyset
 - $I = 0$: singularities set = $\left\{ \pm \frac{2n+1}{2} \pi; n = 0, 1, 2, \dots \right\}$
 - $I = \pi/2$: singularities set = $\left\{ \pm n\pi; n = 0, 1, 2, \dots \right\}$
 - none of above
- Data for Q.89 & Q.90 are given below. Solve the problems and choose correct answer.**
Give $a > 0$, we wish to calculate its reciprocal value $1/a$ by using Newton Raphson Method for $f(x) = 0$.
89. The Newton Raphson algorithm for the function will be
- $x_{k+1} = \frac{1}{2} \left(x_k + \frac{a}{x_k} \right)$
 - $x_{k+1} = \left(x_k + \frac{a}{2x_k^2} \right)$

c. $x_{k+1} = 2x_k - ax_k^2$

d. $x_{k+1} = x_k - \frac{a}{2}x_k^2$

90. For $a = 7$ and starting with $x_0 = 0.2$, the first two iterations will be

a. 0.11, 0.1299

b. 0.12, 0.1392

c. 0.12, 0.1416

d. 0.13, 0.1428