GATE question paper Civil Engineering (CE) 2005

GATE CIVIL ENGINEERING 2005 (CE)

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Q.1- Q.30 Carry One Mark Each.

1. Consider the matrices $X_{(4\times3)}$, $Y_{(4\times3)}$ and $P_{(2\times3)}$.
The order of $[P(X^TY)^{-1}P^T)^T$ will be
(a) (2 × 2) (b) (3 × 3) (c) (4 × 3) (d) (3x4)

2. 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 a many solutions
(c) inconsistent having a unique solution (d) inconsistent having no solution

3. Which one of the following is NOT true for complex number Z_1 and Z_2 ?
(a) $\frac{Z_1}{Z_2} = \frac{Z_1\bar{Z}_2}{|Z_2|^2}$
(b) $|Z_1 + Z_2| \le |Z_1| + |Z_2|$
(c) $|Z_1 - Z_2| \ge |Z_1| - |Z_2|$
(d) $|Z_1 + Z_2|^2 + |Z_1 - Z_2|^2 = 2|Z_1|^2 + 2|Z_2|^2$

4. Which one of the following statement is NOT true ?
(a) The measure of skewness is dependent upon the amount of dispersion
(b) In a symmetric distribution, the values of mean, mode and median are the same
(c) In a positively skewed distribution : mean > median > mode
(d) In a negatively skewed distribution : mode > mean > median

5. IS : 1343 – 1980 limits the minimum characteristics strength of prestressed concrete for post tensioned works and pretension work as
(a) 25 MPa, 30 MPa respectively
(b) 25 MPa, 35 MPa respectively
(c) 30 MPa, 35 MPa respectively
(d) 30 MPa, 40 MPa respectively

6. The permissible stress in axial tension s_{st} in steel member on the net effective area of the section shall not exceed the following value (f_y is the yield stress)
(a) $0.80f_y$ (b) $0.75f_y$ (c) $0.60f_y$ (d) $0.50f_y$

7. 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

8. 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

9. 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

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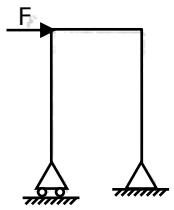
10. Considering beam as axially rigid, the degree of freedom of a plane frame shown below is



(a) 9

(b) 8

(c) 7

(d) 6

11. For a linear elastic frame, if stiffness matrix is doubled, 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

12. A clayey soil has a maximum dry density of 16 kN/m^3 and optimum moisture content of 12%. A contractor during the construction of core of an earth dam obtained the dry density 15.2 kN/m^3 and water content 11%. This construction is acceptable because.

(a) the density is less than the maximum dry density and water content is on dry side of optimum.

(b) the compaction density is very low and water content is less than 12%.

(c) the compaction is done on the dry side of the optimum.

(d) both the dry density and water content of the compacted soil are within the desirable limits

13. 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

14. 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

15. 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 centerline would be

(a) equal in both footings

(b) large for square footing and small for strip footing

(c) large for strip footing and small or square footing

(d) more for strip footing at shallow depth ($\leq$ B) and more for square footing at large depth (>B)

16. 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

(a) Streamline (b) Pathline (c) Steamtube (d) Streakline

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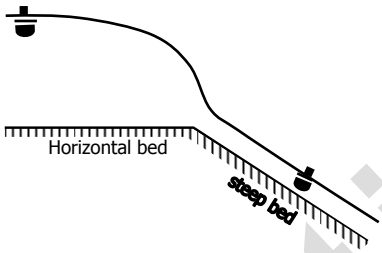
17. A horizontal bed channel is followed by a steep bed channel as shown in the figure. The gradually-varied profiles over the horizontal and steep beds are



(a) H_2 and S_2 respectively

(a) H_2 and S_1 respectively

(a) H_3 and S_2 respectively

(a) H_3 and S_1 respectively

18. The reading of differential manometer of a Venturimeter, placed at 45° to the horizontal is 11 cm. If the Ventruimeter is turned to horizontal position, the manometer reading will be.

(a) zero (b) $\frac{11}{\sqrt{2}}$ cm

(c) 11 cm (d) $11\sqrt{2}$ cm

19. The intensity of rain fall 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

(a) 1.5 mm/minute (b) 1.85 mm/minute

(c) 2.2 mm/minute (d) 3.7 mm/minute

20. When the outflow from a storage reservoir is uncontrolled as in a freely operating spillway, the peak of outflow hydrograph occurs at

(a) at point of inter-section of the inflow and outflow hydrographs

(b) a point, after the inter-section of the inflow and outflow hydrographs

(c) the tail of inflow hydrographs

(d) a point, before the inter-section of the inflow and outflow hydrographs

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 Bari 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 face? {(x, y) are the co-ordinates of the point on the downstream profile with origin at the crest of the spillway and H_d is the design head}

(a) $\frac{y}{H_d} = -0.5\left(\frac{x}{H_x}\right)^{1.85}$ (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) $\frac{y}{H_d} = -2.0\left(\frac{x}{H_d}\right)^{1/1.85}$

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23. In aerobic environment, nitrosomonas convert
(a) NH_3 to NO_2 (b) NO_2^- to NO_3^- (c) NH_3 to N_2O (d) NO_2^- to HNO_3

24. Total Kjedahl nitrogen is a measure of
(a) total organic nitrogen
(b) total organic and ammonia nitrogen
(c) total ammonia nitrogen
(d) total inorganic and ammonia nitrogen

25. 1 TCU is equivalent to the colour produced by
(a) 1 mg/L of chlorplatinate ion
(b) 1 mg/L of platinum ion
(c) 1 mg/L Platinum in form of chlorplatinate ion
(d) 1 mg/L of organo-chlorplatinate ion

26. Bulking sludge refers to having
(a) F / M < 0.3 / d
(b) 0.3 / d < F / M < 0.6 / d
(c) F / M = zero
(d) F / M > 0.6 / d

27. Pradhan Mantri Gram Sadak Yojna (PMGSY) launched in the year 2000, aims to provide rural connectively 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) 207 (c) 2007 (d) 201

28. Group I contains some properties of Bitumen. Group II gives a list of Laboratory Tests conducted on Bitumen to determine the properties. Match the property with the corresponding test

Group I	**Group II**
P. Resistance to flow	1. Ductility test
Q. Ability to deform under load	2. Penetration test
R. Safety	3. Flash and Fire point test

(a) P-2, Q-1, R-3
(b) P-2, Q-3, R-1
(c) P-1, Q-2, R-3
(d) P-3, Q-1, R-2

29. 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

30. Bituminous concrete is a mix comprising o
(a) fine aggregate, filter and bitumen
(b) fine aggregate and bitumen
(c) coarse aggregate, fine aggregate, filter and bitumen
(d) coarse aggregate, filter and bitumen

Q.31-Q.80 Carry Two Marks Each

31. Consider the system of equations

$A_{(mxn)}\ x_{(-1xt)} = 1_{(n \times 1)}$, where, 1 is a scalar.

Let (I_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□n) unit matrix. Which one of the following statement is NOT correct ?

(a) For a homogeneous n □ n system of linear equations, (A-II) x= 0 having a nontrivial solution, the rank of (A-II) is less than n.

(b) For matrix A^m, m being a positive integer, $(□_i^m, x_i^m)$ will be the eigen-pair for all i.

(c) If $A^T = A^{-1}$, then $[1_i] = 1$ for all i

(d) If $A^T = A$, then 1_i is real for all i

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32. 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

(a) $\frac{dv}{dt} + (1 - n)pv = (1 - n)q$ (b) $\frac{dv}{dt} + (1 - n)pv = (1 + n)q$

(c) $\frac{dv}{dt} + (n + n)pv = (n - n)q$ (d) $\frac{dv}{dt} + (1 + n)\,pv = (1 + n)\,q$

33. A rail engine accelerates from its stationary position for 8 seconds and travels a distance of 280 m. According to the Mean Value Theorem, the speedometer at a certain time during acceleration must read exactly.

(a) 0 km/h (b) 8 km (c) 75 km/h (d) 126 km/h

34. The solution of $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 17y = 0$; (0) = 1,

$\frac{dy}{dx}\left(\frac{p}{4}\right) = 0$ in the range $0 < x < \frac{\pi}{4}$ is given by

(a) $e^{-x}\left(\cos 4x - \frac{1}{4}\sin 4x\right)$ (b) $e^{x}\left(\cos 4x - \frac{1}{4}\sin 4x\right)$

(c) $e^{-4x}\left(\cos 4x - \frac{1}{4}\sin x\right)$ (d) $e^{-4x}\left(\cos 4x - \frac{1}{4}\sin 4x\right)$

35. Value of the integral $\oint_c (xydy - y^2dx)$, where, c is the square cut from the first quadrant by the line x = 1 and y = 1 will be (Use Green's theorem to change the line integral into double integral)

(a) $\frac{1}{2}$ (b) 1 (c) $\frac{3}{2}$ (d) $\frac{5}{3}$

36. Consider likely applicability of Cauchy's Integral Theorem to evaluate the following integral counter clockwise around the unit circle c.

$I = \oint_c \sec z\, dz$

z being a complex variable. The value of I will be

(a) I = 0 : singularities set = ϕ

(b) I = 0: singularities set = $\left\{\pm\frac{2n+1}{2}\pi \;\; n = 0, 1, 2.....\right\}$

(c) I = /2 : singularities set = {n , n = 0, 1, 2, ...}

(d) None of above

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

(a) 12.5 N/mm^2 (b) 7.5 N/mm^2 (c) 5.0 N/mm^2 (d) 2.5 N/mm^2

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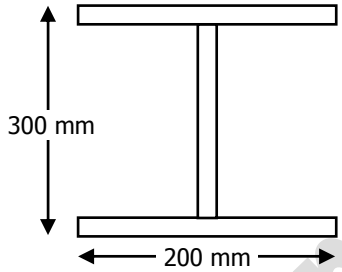
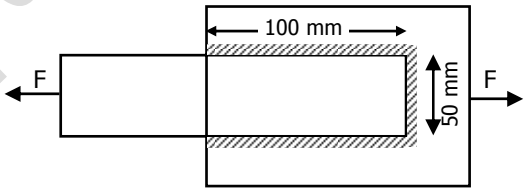
38. Which one of the following is NOT correct for steel sections as per IS : 800-1984 ?
(a) The maximum bending stress in tension or in compression in extreme fibre calculated on the effective section of a beam shall not exceed $0.66f_y$.
(b) The bearing stress in any part of a beam when calculated on the area shall not exceed 0.75 f_y.
(c) The direct stress in compression on the gross sectional area of axial loaded compression member shall not exceed 0.6 f_y.
(d) None of above.

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



(a) 750 kN (b) 350 kN (c) 337.5 kN (d) 300 kN

40. 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

41. A cantilever beam of length I, 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

42. The flexural strength of M 30 concrete as per IS : 456-2000 is
(a) 3.83 MPa (b) 5.47 MPa (c) 21.23 MPa (d) 30.0 MPa

43. 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 percent of the average strength. The values of X and Y as per IS : 456-2000 are
(a) 4 and 10 respectively (b) 3 and 10 respectively
(c) 4 and 15 respectively (d) 3 and 15 respectively

44. A rectangular column section of 250 mm □ 400 mm is reinforced with five steel bars of grade Fe 500, each of 20 mm diameter. Concrete mix is M 30.Axial load on the column section with minimum eccentricity as per IS : 456-2000 using limit state method can be applied upto
(a) 1707.37 (b) 1805.30 (c) 1806.40 (d) 1903.7

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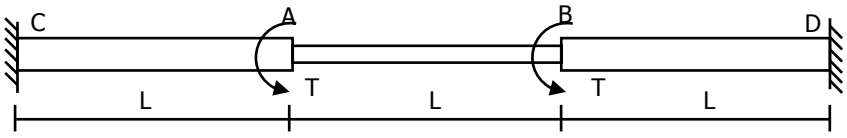
45. A circular shaft shown in the figure is subjected to torsion T at two points A and B. The torsional rigidity of portions CA and BD is GJ_1 and that of portion AB is GJ_2. The rotations of shaft at point A and B are θ_1 and θ_2. The rotation θ_i is

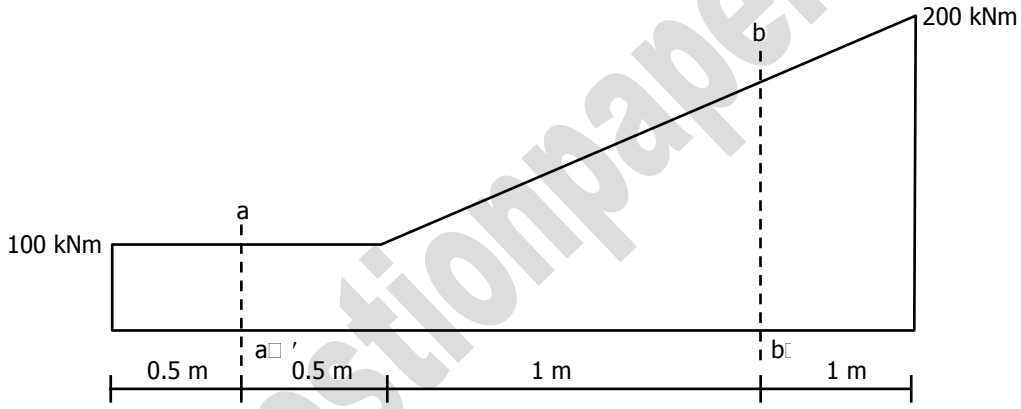


(a) $\frac{TL}{GJ_1 + GJ_2}$ (b) $\frac{TL}{GJ_1}$ (c) $\frac{TL}{GJ_2}$ (d) $\frac{TL}{GJ_1 - GJ_2}$

46. If principal stresses in a two-dimensional case are – 10MPa and 20 MPa respectively, then maximum shear stress at the point is

(a) 10 MPa (b) 15 MPa (c) 20 MPa (d) 30 MPa

47. The bending moment diagram for a beam is given below :
The shear force at sections aa' ad bb' respectively are of the magnitude.



(a) 100 kN, 150 kN (b) zero, 100 kN
(c) zero, 50 kN (d) 100 kN, 100 kN

48. For a 25 cm thick cement concrete pavement, analysis of stresses gives the following values Wheel load stress due to corner loading 30 kg/cm^2

Wheel load stress due to edge loading 32 kg/cm^2

Warping stress at corner region during summer 9 kg/cm^2

Warping stress at edge region during winter 7 kg/cm^2

Warping stress at edge region during summer 8 kg/cm^2

Warping stress at edge region during winter 6 kg/cm^2

Frictional stress during winter 5 kg/cm^2

Frictional stress during winter 4 kg/cm^2

The most critical stress value for this pavement is

(a) 40 kg/cm^2 (b) 42 kg/cm^2
(c) 44 kg/cm^2 (d) 45 kg/cm^2

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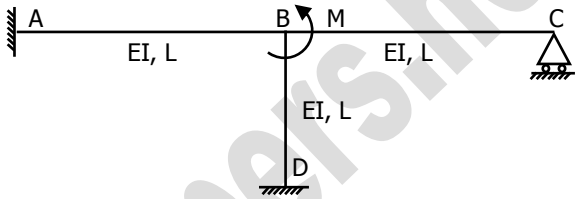
49. Match the following :

Group I	**Group 2**
P. Slope deflection method	1. Force method
Q. Moment distribution method	2. Displacement method
R. Method of three moments	
S. Castigliano's second theorem	

(a) P-1, Q-2, R-1, S-2 (b) P-1, Q-1, R-2, S-2
(c) P-2, Q-2, R-1, S-1 (d) P-2, Q-1, R-2, S-1

50. All members 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 point is

(a) $\frac{ML}{12EI}$
(b) $\frac{ML}{11EI}$
(c) $\frac{ML}{8EI}$
(d) $\frac{ML}{7EI}$



51. A soil mass contains 40% gravel, 50% sand and 10% silt. This soil can be classified as
(a) silty sandy gravel having coefficient of uniformity less than 60.
(b) silty gravelly sand having coefficient of uniformity equal to 10.
(c) gravelly silty sand having coefficient of uniformity greater than 60.
(d) gravelly silty sand and its coefficient of uniformity cannot be determined.

52. A saturated soil mass has a total density 22kN/m^3 and a water content of 10%. The bulk density and dry density of this soil are
(a) 12 kN/m^3 and 20 kN/m^3 respectively.
(b) 22 kN/m^3 and 20 kN/m^3 respectively.
(c) 19.8 kN/m^3 and 19.8 kN/m^3 respectively.
(d) 23.2 kN/m^3 and 19.8 kN/m^3 respectively.

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

54. Assuming that a river bed level does not change and the depth of water in river was 10 m, 15 m and 8 m during months of February, July and December respectively of a particular year. The average bulk density of the soil is 20 kN/m^3. The density of water is 110 kN/m^3. The effective stress at a depth of 10 m below the river bed during these months would be
(a) 300 kN/m^2 in February, 350 kN/m^2 july and 320 kN/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.

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55. For a triaxial shear test conducted on a sand specimen at a confining pressure of 100 kN/m2 under drained conditions, resulted in a deviator stress (s_1-s_3) at failure of 100 kN/m^2. The angle of shearing resistance of the soil would be
(a) 18.43° (b) 19.47° (c) 26.56° (d) 30°

56. 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)	No. 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 for overburden as 1.0, the corrected 'N' value for the soil would be
(a) 18 (b) 19 (c) 21 (d) 33

57. 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
(a) 21.05° for dry slope and 21.05° for submerged slope.
(b) 19.47° for dry slope and 18.40° for submerged slope.
(c) 18.4° for dry slope and 21.05° for submerged slope.
(d) 22.6° for dry slope and 19.47° for submerged slope.

58. 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 25 mm. The new width of footing will be
(a) 5 m (b) 8 m (c) 12 m (d) 12.8 m

59. A 3 m 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 ($\gamma_w \approx 10$ kN/m^3)
(a) increase by 20 kN/m^2 (b) decrease by 20 kN/m^2
(c) increase by 30 kN/m^2 (d) decrease by 30 kN/m^2

60. Critical depth at a section of a rectangular channel is 1.5 m. The specific energy at that section is
(a) 0.75 m (b) 1.0 m (c) 1.5 m (d) 2.25 m

61. A partially open sluice gate discharges water into a rectangular channel. The tail water depth in the channel is 3 m and Froude number is $\frac{1}{2\sqrt{2}}$. If a free hydraulic jump is to be formed at a downstream of the sluice gate after the vena contracta of the jet coming out from the sluice gate, the sluice gate opening should be (coefficient of contraction C_c = 0.9)
(a) 0.3 m (b) 0.4 m (c) 0.69 m (d) 0.9 m

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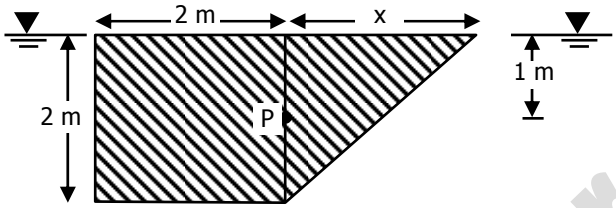
62. A stream function is given by

$Y = 2x^2y + (x+1)y^2$

The flow rate across a line joining points A(3,0) and B(0,2) is

(a) 0.4 units (b) 1.1 units (c) 4 units (d) 5 units

63. Cross-section of an object (having same section normal to the paper) submerged into a fluid consists of a square of sides 2 m 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 'x' should be

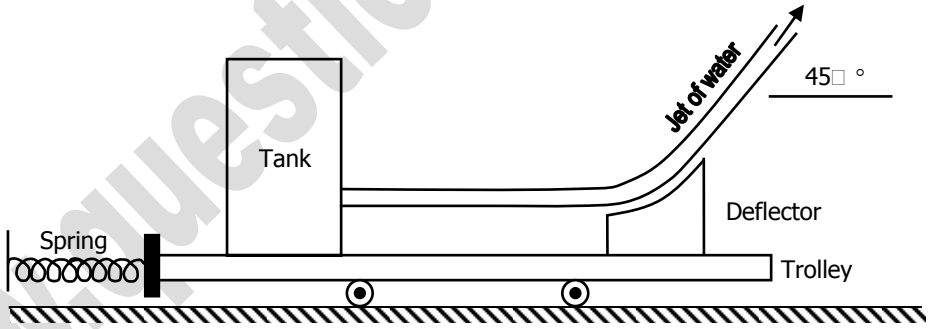


(a) $2\sqrt{3}$ (b) $4\sqrt{3}$ (c) 4 m (d) 8 m

64. The circulation 'G' around a circle of radius 2 units for the velocity field u = 2x + 3y and v = 2y is

(a) -6□ units (b) -12□ units (c) -18□ units (d) -24□ units

65. 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 truns by 45□. If the velocity of jet leaving the deflector is 4 m/s and discharge is 0.1 m^3/s, the force recorded by the spring will be



(a) 100 N (b) $100\sqrt{2}$ N (c) 200 N (d) $200\sqrt{2}$ N

66. Two observation wells penetrated into a confined acquifer and located 1.5 km apart in the direction of flow, indicate head of 45 m and 20 m. If the coefficient of permeability of the acquifer 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

67. A triangular irrigation lined canal carries a discharge of 25m^3/s at bed slope = 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) 1.98 m (b) 2.98 m (c) 3.62 m (d) 5.62 m

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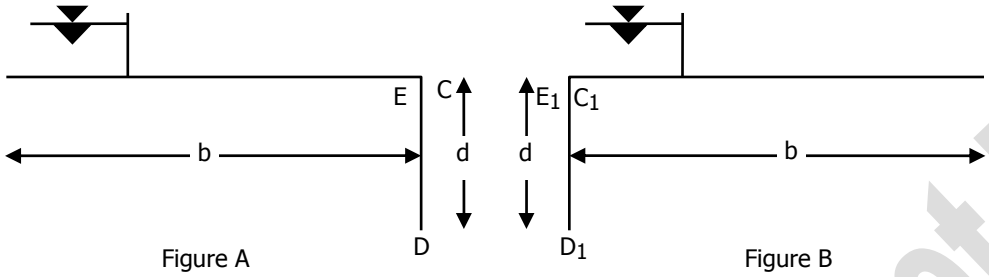
68. Uplift pressures at points E and D (Figure A) of a straight horizontal floor of negligible thickness with a sheet pile at downstream end are 28% and 20%, respectively. If the sheet pile is at upstream end of the floor (Figure B), the uplift pressures at points D_1 and C_1 are



(a) 68% and 60% respectively (b) 80% and 72% respectively
(c) 88% and 70% respectively (d) 100% and zero respectively

69. A launching apron is to be designed at downstream of a weir for discharge intensity of 6.5 $m^3/s/m$. 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 tailwater depth is 4.4 m, the length of launching apron in the launched position is

(a) $\sqrt{5}$ m (b) 4.7 m (c) 5 m (d) $5\sqrt{5}$ m

70. The culturable commanded area for a distributary is $2\times10^8 m^2$. The intensity of irrigation for a crop is 40%. If kor water depth and kor period for the crop are 14 cm and 4 weeks, respectively, the peak demand discharge is

(a) 2.63 m^3/s (b) 4.63 m^3/s (c) 8.58 m^3/s (d) 11.58 m^3/s

71. If tomato juice is having a pH of 4.1, the hydrogen ion concentration will be

(a) 10.94×10^{-5} mol/L (b) 9.94×10^{-5} mol/L
(c) 8.94×10^{-5} mol/L (d) 7.94×10^{-5} mol/L

72. Group 1 contains some properties of water / wastewater and group 2 contains list of some tests on water/waste water. Match the property with corresponding test.

Group 1	Group 2
P. Suspended solids concentration	1. BOD
Q. Metabolism of biodegradable organics	2. MPN
R. Bacterial concentration	3. Jar test
S. Coagulant dose	4. Turbidity

(a) P-2, Q-1, R-4, S-3 (b) P-4, Q-1, R-2,S-3
(c) P-2, Q-4, R-1, S-3 (d) P-4, Q-2, R-1, S-3

73. Match the following

Group I	Group 2
P. Thickening of sludge	1. Decrease in volume of sludge by chemical oxidation
Q. Stabilization of sludge	2. Separation of water by heat or chemical treatment
R. Conditioning of sludge	3. Digestion of sludge
S. Reduction of sludge	4. Separation of water by flotation or gravity

(a) P-4, Q-3, R-1, S-2 (b) P-3, Q-2, R-4, S-1
(c) P-4, Q-3, R-2, S-1 (d) P-2, Q-1, R-3, S-4

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74. Match the following

Group 1	Group 2
P. Release valve	1. Reduce high inlet pressure t lower outlet pressure
Q. Check valve	2. Limit the flow of water to single direction
R. Gate valve	3. Remove air from the pipeline
S. Pilot valve	4. Stopping the flow of water in the pipeline

(a) P-3, Q-2, R-4, S-1 (b) P-4, Q-2, R-1, S-3
(c) P-3, Q-4, R-2, S-1 (d) P-1, Q-2, R-4, S-3

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

Wastewater : DO = 2.00 mg/L
Discharge rate = 1.10 m^3/s
River water DO = 8.3 mg/L
Flow rate = 8.70 m^3/s
Temperature = 20□℃

Initial amount of DO in the mixture of waste and river shall be
(a) 5.3 mg/L (b) 6.5 mg/L (c) 7.6 mg/L (d) 8.4 mg/L

76. A circular primary clarifier processes an average flow of 5005 m^3/d of municipal wastewater. The overflow rate is 35 m^3/d. The diameter of clarifier shall be
(a) 10.5 m (b) 11.5 m (c) 12.5 m (d) 13.5 m

77. 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.
(a) 4 (b) 6 (c) 7 (d) 8

78. A single lane unidirectional highway has a design speed of 65 kmph The perception-brake-reaction time of drivers is 2.5 seconds and the average length of vehicles is 5 m. 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.
(a) 1440 (b) 750 (c) 710 (d) 680

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

Axle Load (kN)	**Repetitions per day**
35-45	800
75-85	400

The standard axle-load is 80 kN. Equivalent daily number of repetitions for the standard axle-load are
(a) 450 (b) 480 (c) 800 (d) 1200

80. A road is having a horizontal curve of 400 m 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
(a) 0.07 (b) 0.13 (c) 0.15 (d) 0.4

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Q81a-Q.85b Carry Two Marks Each

Statement for Linked Answer Questions 81a and 81b :

Given a > 0, we wish to calculate its reciprocal value $\frac{1}{a}$ by using Newton Raphson method for f(x) = 0

81.a. The Newton Raphson algorithm for the function will be

(a) $x_{K+1} = \frac{1}{2}\left(x_K + \frac{a}{x_K}\right)$ (b) $x_{K+1} = x_K\left(\frac{a}{2}x_K^2\right)$

(c) $X_{K+1} = 2X_K - aX_K^2$ (d) $X_{K+1} = X_K - \frac{a}{2}X_K^2$

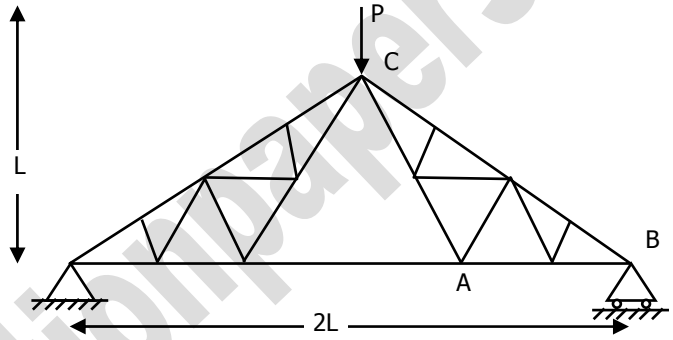
81b. For a = 7 and starting with x_0= 0.2, the first two iterations will be

(a) 0.11, 0.1299 (b) 0.12, 0.1392

(c) 0.12, 0.1416 (d) 0.13, 0.1428

Statement for Linked Answer Questions 82a and 82b :

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



82a. Force in the member AB of the truss is

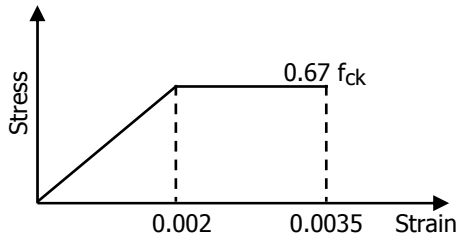
(a) P / $\sqrt{2}$ (b) P/ $\sqrt{3}$ (c) P/2 (d) P

82b. Deflection of the point C is

(a) $\frac{(2\sqrt{2}-1)}{2}\frac{PL}{EA}$ (b) $\sqrt{2}\frac{PL}{EA}$ (c) $(2\sqrt{2}-1)\frac{PL}{EA}$ (d) $(\sqrt{2}-1)\frac{PL}{EA}$

Statement for Linked Answer Questions 83a and 83b :

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



A rectangular under-reinforced concrete section of 300 mm width and 500 mm effective depth is reinforced with 3 bars of grade Fe415, each of 16 mm diameter. Concrete mix is M20.

83a. The depth of the neutral axis from the compression fibre is

(a) 76 mm (b) 81 mm (c) 87 mm (d) 100 mm

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83b. The depth of the neutral axis obtained as per IS : 456-2000 differs from the depth of neutral axis obtained in Q. 83 (a) by

(a) 15 mm (b) 20 mm (c) 25 mm (d) 32 mm

Statement for Linked Answer Questions 84a and 84b :

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 f-index are 30m^3/s and 1 mm/h, respectively. A storm of a 4 cm occurs uniformly in 4 hours over the catchment.

84a. The peak discharge of four hour unit hydrograph is

(a) 40 m^3/s (b) 50 m^3/s (c) 60 m^3/s (d) 70 m^3/s

84b. The peak flood discharge due to the storm is

(a) 210 m^3/s (b) 230 m^3/s (c) 260 m^3/s (d) 720 m^3/s

Statement for Linked Answer Questions 85a and 85b :

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 m^3/m^2d

Design flow rate 0.5 m^3/s

Surface area per filter box 50m^2

85a. The surface area required for the rapid sand filter will be

(a) 210 m^2 (b) 215 m^2 (c) 216 m^2 (d) 218 m^2

85b. The number of filters required shall be

(a) 3 (b) 4 (c) 6 (d) 8

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Answer key GATE 2005

1	a	2	a	3	c	4	d	5	d	6	c	7	a	8	c	9	b	10	d
11	c	12	d	13	b	14	a	15	c	16	d	17	a	18	c	19	b	20	a
21	d	22	a	23	a	24	b	25	c	26	a	27	b	28	a	29	c	30	c
31	d	32	a	33	d	34	a	35	b	36	a	37	a	38	d	39	d	40	c
41	b	42	a	43	d	44	a	45	a	46	b	47	c	48	b	49	c	50	b
51	b	52	b	53	d	54	b	55	b	56	c	57	a	58	d	59	b	60	d
61	c	62	c	63	a	64	b	65	d	66	c	67	a	68	b	69	c	70	b
71	d	72	b	73	a	74	a	75	c	76	d	77	d	78	c	79	a	80	b
81a	c	81b	b	82a	c	82b	c	83a	d	83b	c	84a	b	84b	a	85a	c	85b	c