General Aptitude

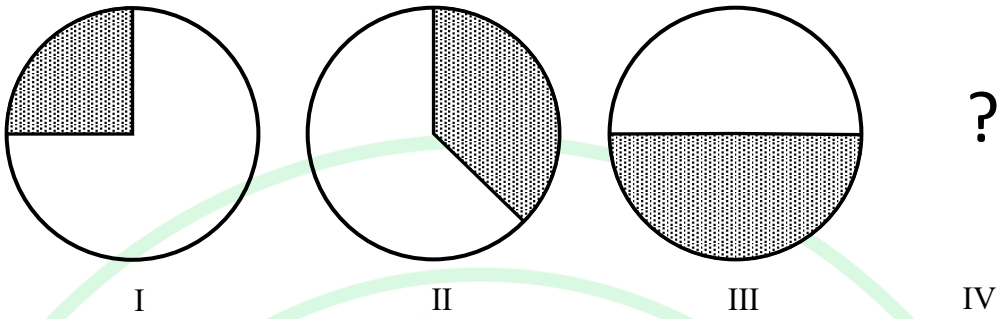
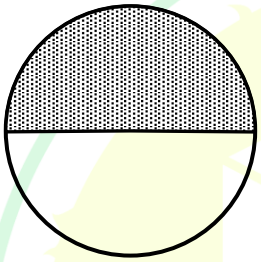
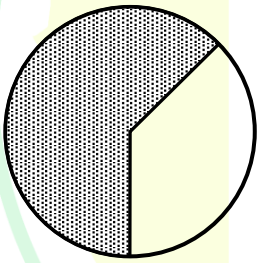
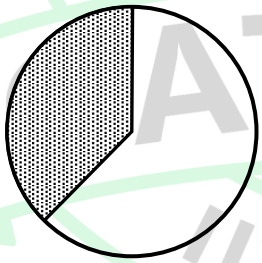
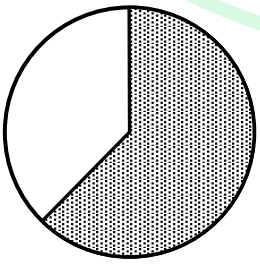
Q.1 – Q.5 Carry ONE mark Each

Q.1	Is there any good show _____ television tonight? Select the most appropriate option to complete the above sentence.
(A)	in
(B)	at
(C)	within
(D)	on

Q.2	As the police officer was found guilty of embezzlement, he was _____ dismissed from the service in accordance with the Service Rules. Select the most appropriate option to complete the above sentence.
(A)	sumptuously
(B)	brazenly
(C)	unintentionally
(D)	summarily

Q.3	The sum of the following infinite series is:
	$\frac{1}{1!}+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}+\frac{1}{5!}+\cdots$
(A)	π
(B)	$1+e$
(C)	$e-1$
(D)	e

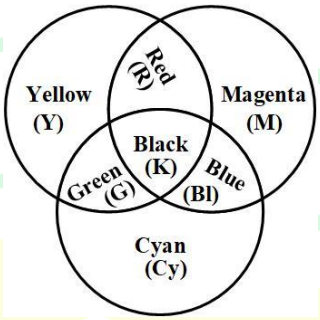
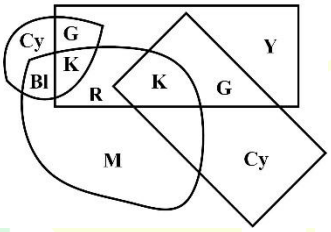
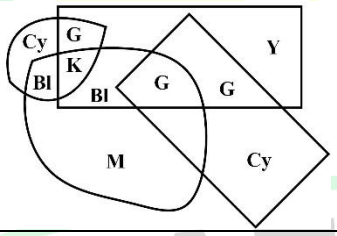
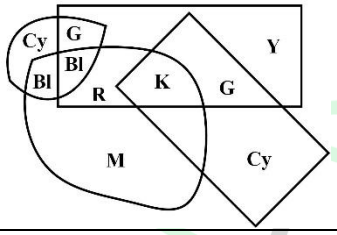
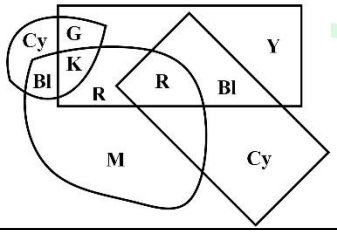
Q.4	A thin wire is used to construct all the edges of a cube of 1 m side by bending, cutting and soldering the wire. If the wire is 12 m long, what is the minimum number of cuts required to construct the wire frame to form the cube?
(A)	3
(B)	4
(C)	6
(D)	12

Q.5	The figures I, II and III are parts of a sequence. Which one of the following options comes next in the sequence at IV?
	
(A)	
(B)	
(C)	
(D)	

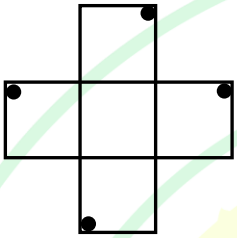
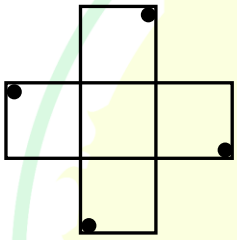
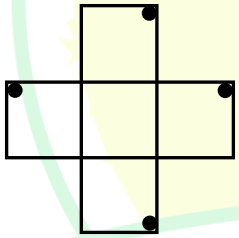
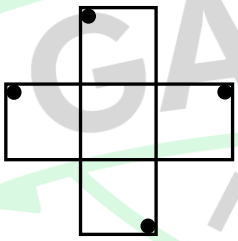
Q.6 – Q.10 Carry TWO marks Each

Q.6	"Why do they pull down and do away with crooked streets, I wonder, which are my delight, and hurt no man living? Every day the wealthier nations are pulling down one or another in their capitals and their great towns: they do not know why they do it; neither do I. It ought to be enough, surely, to drive the great broad ways which commerce needs and which are the life-channels of a modern city, without destroying all history and all the humanity in between: the islands of the past." (From Hilaire Belloc's "The Crooked Streets") Based only on the information provided in the above passage, which one of the following statements is true?
(A)	The author of the passage takes delight in wondering.
(B)	The wealthier nations are pulling down the crooked streets in their capitals.
(C)	In the past, crooked streets were only built on islands.
(D)	Great broad ways are needed to protect commerce and history.

Q.7	Rohit goes to a restaurant for lunch at about 1 PM. When he enters the restaurant, he notices that the hour and minute hands on the wall clock are exactly coinciding. After about an hour, when he leaves the restaurant, he notices that the clock hands are again exactly coinciding. How much time (in minutes) did Rohit spend at the restaurant?
(A)	$64\frac{6}{11}$
(B)	$66\frac{5}{13}$
(C)	$65\frac{5}{11}$
(D)	$66\frac{6}{13}$

Q.8	A color model is shown in the figure with color codes: Yellow (Y), Magenta (M), Cyan (Cy), Red (R), Blue (Bl), Green (G), and Black (K). Which one of the following options displays the color codes that are consistent with the color model?
	
(A)	
(B)	
(C)	
(D)	

Q.9	A circle with center at $(x, y) = (0.5,\ 0)$ and radius = 0.5 intersects with another circle with center at $(x, y) = (1, 1)$ and radius = 1 at two points. One of the points of intersection (x, y) is:
(A)	$(0, 0)$
(B)	$(0.2, 0.4)$
(C)	$(0.5, 0.5)$
(D)	$(1, 2)$

Q.10	An object is said to have an n-fold rotational symmetry if the object, rotated by an angle of $\frac{2\pi}{n}$, is identical to the original. Which one of the following objects exhibits 4-fold rotational symmetry about an axis perpendicular to the plane of the screen? Note: The figures shown are representative.
(A)	
(B)	
(C)	
(D)	

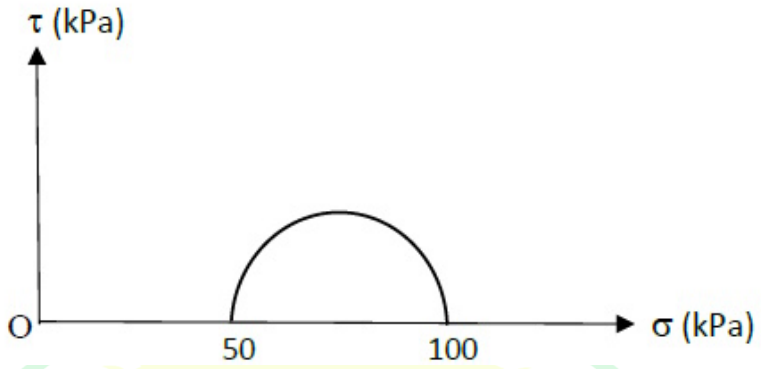
Q.11 – Q.35 Carry ONE mark Each

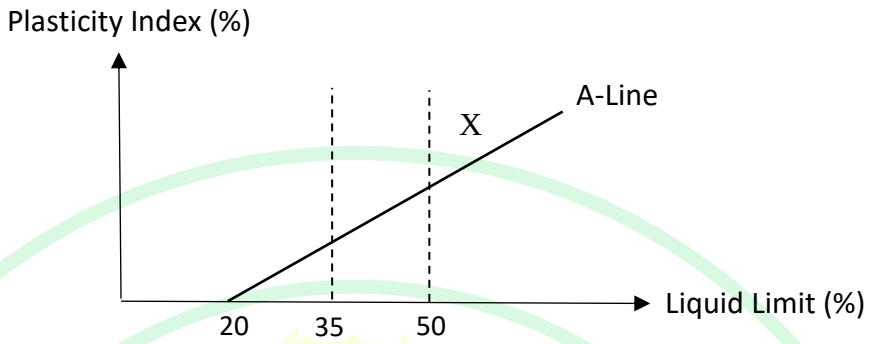
Q.11	Suppose λ is an eigenvalue of matrix A and x is the corresponding eigenvector. Let x also be an eigenvector of the matrix $B = A - 2I$, where I is the identity matrix. Then, the eigenvalue of B corresponding to the eigenvector x is equal to
(A)	λ
(B)	$\lambda + 2$
(C)	2λ
(D)	$\lambda - 2$
Q.12	Let $A = \begin{bmatrix} 1 & 1 \\ 1 & 3 \\ -2 & -3 \end{bmatrix}$ and $b = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$. For $Ax = b$ to be solvable, which one of the following options is the *correct* condition on b_1, b_2, and b_3:
(A)	$b_1 + b_2 + b_3 = 1$
(B)	$3b_1 + b_2 + 2b_3 = 0$
(C)	$b_1 + 3b_2 + b_3 = 2$
(D)	$b_1 + b_2 + b_3 = 2$

Q.13	Which one of the following options is the *correct* Fourier series of the periodic function $f(x)$ described below:
	$f(x)=\begin{cases}0 & \text{if } -2<x<-1\\ 2k & \text{if } -1<x<1\\ 0 & \text{if } 1<x<2\end{cases}$; period = 4
(A)	$f(x)=\frac{k}{2}+\frac{2k}{\pi}\left(\cos\frac{\pi}{2}x-\frac{1}{3}\cos\frac{3\pi}{2}x+\frac{1}{5}\cos\frac{5\pi}{2}x-+\cdots\right)$
(B)	$f(x)=\frac{k}{2}+\frac{2k}{\pi}\left(\sin\frac{\pi}{2}x-\frac{1}{3}\sin\frac{3\pi}{2}x+\frac{1}{5}\sin\frac{5\pi}{2}x-+\cdots\right)$
(C)	$f(x)=k+\frac{4k}{\pi}\left(\cos\frac{\pi}{2}x-\frac{1}{3}\cos\frac{3\pi}{2}x+\frac{1}{5}\cos\frac{5\pi}{2}x-+\cdots\right)$
(D)	$f(x)=k+\frac{4k}{\pi}\left(\sin\frac{\pi}{2}x-\frac{1}{3}\sin\frac{3\pi}{2}x+\frac{1}{5}\sin\frac{5\pi}{2}x-+\cdots\right)$

Q.14	X is a random variable that can take any one of the values 0, 1, 7, 11, and 12. The probability mass function for X is $P(X = 0) = 0.4;\ \ P(X = 1) = 0.3;\ \ P(X = 7) = 0.1;$ $P(X = 11) = 0.1;\ \ P(X = 12) = 0.1$ Then, the variance of X is
(A)	20.81
(B)	28.40
(C)	31.70
(D)	10.89
Q.15	As per IS 456:2000 provisions for two-way slabs with continuous edges, the longitudinal steel reinforcement to be provided in the edge strip is based on
(A)	the calculated minimum bending moment
(B)	the area of longitudinal steel provided in the middle strip in the shorter span
(C)	the area of longitudinal steel provided in the middle strip in the longer span
(D)	the prescribed minimum cross-sectional area of longitudinal steel for slabs

Q.16	Identify the FALSE statement from the following options:
(A)	The compressive strength of a concrete test specimen can vary depending on its shape and size
(B)	Air-dried and saturated test specimens show the same compressive strength for concrete
(C)	Curing conditions, such as temperature and relative humidity, can influence the compressive strength of concrete
(D)	Compressive strength depends on the water-to-binder ratio used in the concrete mixture

Q.17	The results of a consolidated drained triaxial test on a normally consolidated clay are shown in the figure. The angle of internal friction is
	
(A)	$\sin^{-1}\left(\frac{1}{2}\right)$
(B)	$\sin^{-1}\left(\frac{1}{3}\right)$
(C)	$\sin^{-1}\left(\frac{2}{3}\right)$
(D)	$\sin^{-1}\left(\frac{3}{4}\right)$

Q.18	The standard plasticity chart for the classification of a fine-grained soil is shown in the figure. As per the Indian standard soil classification system, X represents
	
(A)	inorganic clay with medium plasticity
(B)	inorganic silt with medium plasticity
(C)	inorganic clay with high plasticity
(D)	inorganic silt with high compressibility

Q.19	For a flowing fluid, a dimensionless combination of velocity (V), length scale (l), and acceleration due to gravity (g) would be
(A)	$\frac{V^2}{gl}$
(B)	$\frac{Vg}{l}$
(C)	$\frac{gl^2}{V}$
(D)	$\frac{l}{V^2 g}$

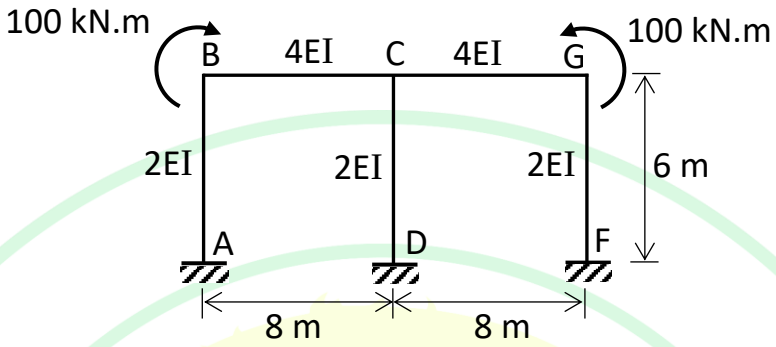
Q.20	To derive the total flood hydrograph at a catchment outlet from an isolated storm, the order in which the following methods are applied, from the first method to the last method, is
	P. Obtaining the hyetograph Q. Addition of baseflow R. Estimation of initial and infiltration losses S. Application of unit hydrograph
(A)	PRSQ
(B)	PQRS
(C)	RPSQ
(D)	PSQR
Q.21	Fecal Coliform (FC) concentration in river water was measured as 10780 cfu/100 ml. The FC concentration after the conventional water treatment, but before chlorination, was measured as 23 cfu/100 ml. The 'Log Kill' (inactivation) of FC due to the conventional water treatment is closest to
(A)	4.00
(B)	2.50
(C)	2.67
(D)	3.00

Q.22	A hydrocarbon (C_nH_m) is burnt in air ($O_2 + 3.78N_2$). The stoichiometric fuel to air mass ratio for this process is Note: Atomic Weight: C(12), H(1) Effective Molecular Weight: Air(28.8) Ignore any conversion of N_2 in air to the oxides of nitrogen (NO_x)
(A)	$0.0291\frac{(4n+m)}{(12n+m)}$
(B)	$34.42\frac{(12n+m)}{(4n+m)}$
(C)	$34.42\frac{(4n+m)}{(12n+m)}$
(D)	$0.0291\frac{(12n+m)}{(4n+m)}$

Q.23	All the vehicles that come during a particular peak hour come during a 10-minute period within this hour. The 15-minute peak hour factor for this peak hour is
(A)	0.25
(B)	0.167
(C)	0.75
(D)	1.0
Q.24	In the context of testing bitumen, which one of the following statements is FALSE:
(A)	The depth of penetration of needle in the standard penetration test is measured in the units of one-tenth of millimeter
(B)	Softening point is measured using a ring and ball apparatus
(C)	Softening point is measured in the units of time
(D)	Ductility is measured in the units of length

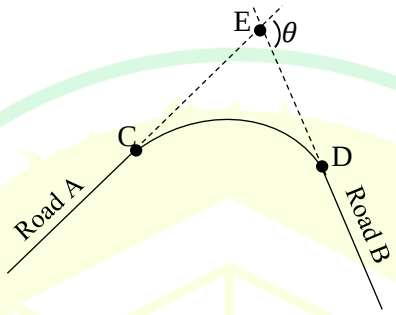
Q.25	The maximum degree of the curve that can be used for railways in a mountainous region is
(A)	10
(B)	20
(C)	50
(D)	40
Q.26	If the horizontal distance between a staff point and the point of observation is d, the error due to the curvature of earth is proportional to
(A)	d
(B)	$\frac{1}{d}$
(C)	d^2
(D)	$\frac{1}{d^2}$

Q.27	If the quadrantal bearing of a line is N30°W, then the whole circle bearing of the line is
(A)	120°
(B)	210°
(C)	300°
(D)	330°
Q.28	Which of the following equations belong/belongs to the class of second-order, linear, homogeneous partial differential equations:
(A)	$\frac{\partial^2 u}{\partial t^2} = c^2\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) + xy$
(B)	$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$
(C)	$\frac{\partial u}{\partial t} = c\frac{\partial u}{\partial x}$
(D)	$\left(\frac{\partial^2 u}{\partial t^2}\right)^2 = c^2\frac{\partial^2 u}{\partial x^2}$

Q.29	Consider the frame shown in the figure under the loading of 100 kN.m couples at the joints B and G. Considering only the effects of flexural deformations, which of the following statements is/are *true*:
	
(A)	Axial force is zero in the member CD
(B)	Shear force is zero in the member CD
(C)	There is no rotation in the joint C
(D)	The magnitude of bending moment developed in the member BC at the end C is more than 50 kN.m
Q.30	For the Bernoulli's equation to be applicable in a fluid flow situation, which of the following conditions is/are to be satisfied:
(A)	Fluid should be frictionless
(B)	Fluid should be incompressible
(C)	Flow should be steady
(D)	Flow should be rotational

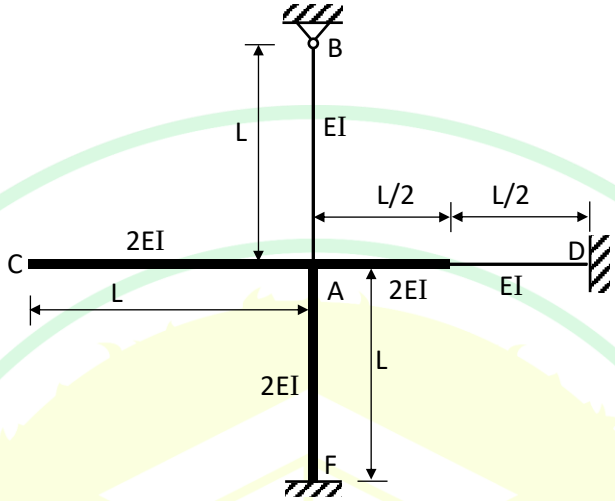
Q.31	The Surface Overflow Rate (SOR) in a rectangular sedimentation tank is 45 $m^3/m^2/d$. Minimum diameters of spherical inorganic and organic particles expected to be completely removed in this tank are calculated. Assume that Stoke's law is applicable. Which of the following options is/are *correct*: Specific gravity of inorganic particles = 2.65 Specific gravity of organic particles = 1.20 Acceleration due to gravity (g) = 9.81 m/s^2 Kinematic viscosity (ν) = 1×10^{-6} m^2/s
(A)	Minimum diameter of inorganic particles is 24 μm
(B)	Minimum diameter of organic particles is 69 μm
(C)	Minimum diameter of inorganic particles is 15 μm
(D)	Minimum diameter of organic particles is 55 μm

Q.32	Aeration is employed as a treatment option for the removal of several pollutants from contaminated water. Identify the pollutant(s), where aeration is employed as a part of their removal:
(A)	Iron
(B)	Cadmium
(C)	Manganese
(D)	Zinc
Q.33	If the weights retained on the 2.36 mm, 1.18 mm, 600 µm, and 300 µm sieves are 30%, 35%, 15%, and 20%, respectively, of the total weight of an aggregate sample, then the fineness modulus of the sample is _____ (*rounded off to 2 decimal places*).
Q.34	A water resources project with an expected life of 25 years has to be designed for an acceptable risk of 5% against a design flood. The return period for the design flood (in years) is _____ (*rounded off to the nearest integer*).

Q.35	Road A and Road B are joined by a circular horizontal curve of radius 200 m as shown in the figure. Road A and Road B are tangential to the curve at the points C and D, respectively. Had the curve not been there, straight roads A and B would have met at the point E. The distance from C to E is 92 m. The value of angle θ (in degrees) is _____ (*rounded off to 1 decimal place*). Note: The value of angle θ is to be calculated only from the consideration of Euclidean geometry and the data given in the problem.
	

Q.36 – Q.65 Carry TWO marks Each

Q.36	The value of $\lim_{x\to\infty}(x-\sqrt{x^2+x})$ is equal to
(A)	-1
(B)	-0.5
(C)	-2
(D)	0

Q.37	In the rigid-jointed frame shown in the figure, the distribution factor of the member AD is closest to
	
(A)	0.254
(B)	0.267
(C)	0.398
(D)	0.421

Q.38	In an oedometer apparatus a specimen of fully saturated clay has been consolidated under a vertical pressure of 100 kPa and is at equilibrium state. Immediately on increasing the vertical pressure to 150 kPa, the effective stress σ' and excess pore water pressure Δu will be
(A)	$\sigma' = 50$ kPa, $\Delta u = 100$ kPa
(B)	$\sigma' = 100$ kPa, $\Delta u = 50$ kPa
(C)	$\sigma' = 150$ kPa, $\Delta u = 50$ kPa
(D)	$\sigma' = 100$ kPa, $\Delta u = 150$ kPa

Q.39 The mean rainfall over a catchment has to be estimated. The data for four rain gauges located in and around the catchment is listed in the table. Which one of the following statements is *correct*:

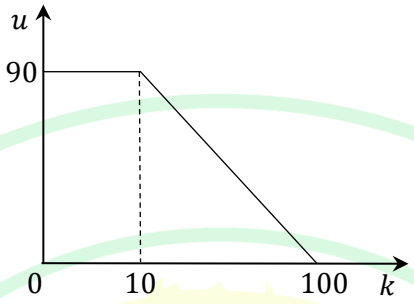
Rain gauge station	P	Q	R	S
Whether located inside the catchment	Yes	Yes	Yes	No
Thiessen weightage factor	0.25	0.50	0.10	0.15
Rainfall (mm)	100	110	100	125

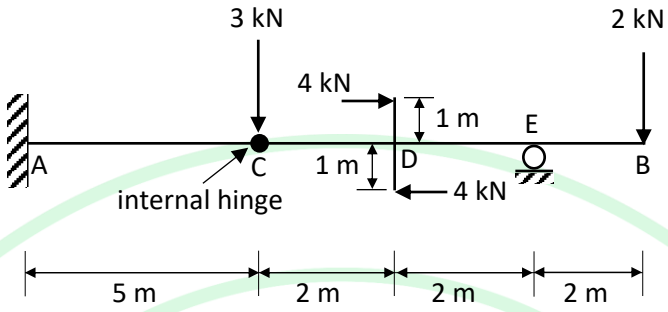
(A) The estimate obtained from the Thiessen-mean method is greater than that obtained using the arithmetic-mean method

(B) The estimate obtained from the Thiessen-mean method is equal to that obtained using the arithmetic-mean method

(C) The estimate obtained from the Thiessen-mean method is less than that obtained using the arithmetic-mean method

(D) The Thiessen-mean method cannot be applied in this case

Q.40	The speed-density relation on a one-way, single lane road is shown in the figure, where speed u is in km/hour and density k is in vehicles/km. The maximum flow (in vehicles/hour) on this road is
	
(A)	2500
(B)	900
(C)	2250
(D)	2000

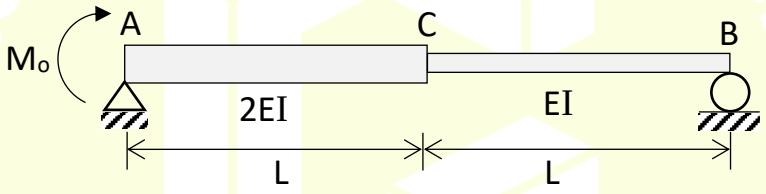
Q.41	Consider the beam ACDEB given in the figure. Which of the following statements is/are *correct*:
	
(A)	Bending moment is zero between the points A and C
(B)	There is a sudden jump in shear force at the point D
(C)	There is a sudden jump in bending moment at the point E
(D)	Bending moment is zero somewhere between the points D and E

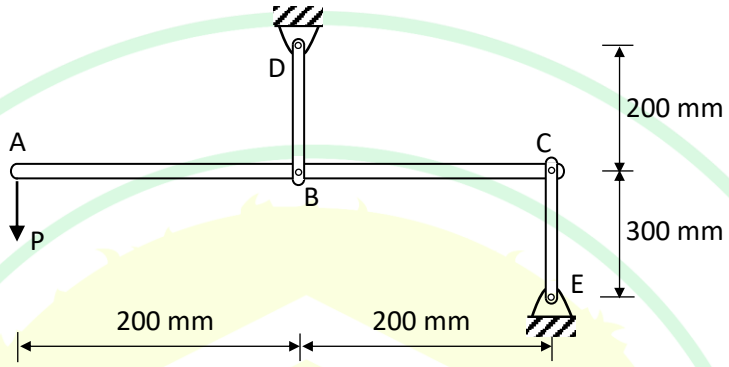
Q.42	In the context of construction project management, which of the following statements is/are *true*:
(A)	A dummy activity will consume time and resources
(B)	The programme evaluation and review technique (PERT) is best suited for projects with large uncertainties in the duration of activities
(C)	A Gantt chart is commonly used for identifying the 'critical path' of activities in a project
(D)	Free float is the amount of time by which the start of an activity can be delayed without causing a delay in the start of a following activity

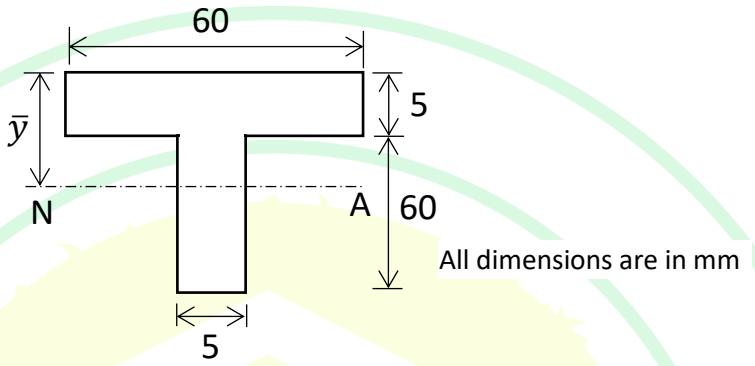
Q.43	Lacey's regime equations, followed in India for making scour calculations while designing hydraulic structures across alluvial channels, are given below. Regarding these equations, which of the following statements is/are *true*:
	$D = 0.470 \times \left[\frac{Q}{f_s}\right]^{1/3}$ $P = 4.75 \times \sqrt{Q}$ $f_s = 1.76 \times \sqrt{d}$ where, Q is discharge and f_s is silt factor.
(A)	D is the depth of scour below the existing riverbed
(B)	P is the Lacey's waterway width
(C)	d is the average grain size diameter of the bed material in centimetres
(D)	D is the depth of scour below the design flood level

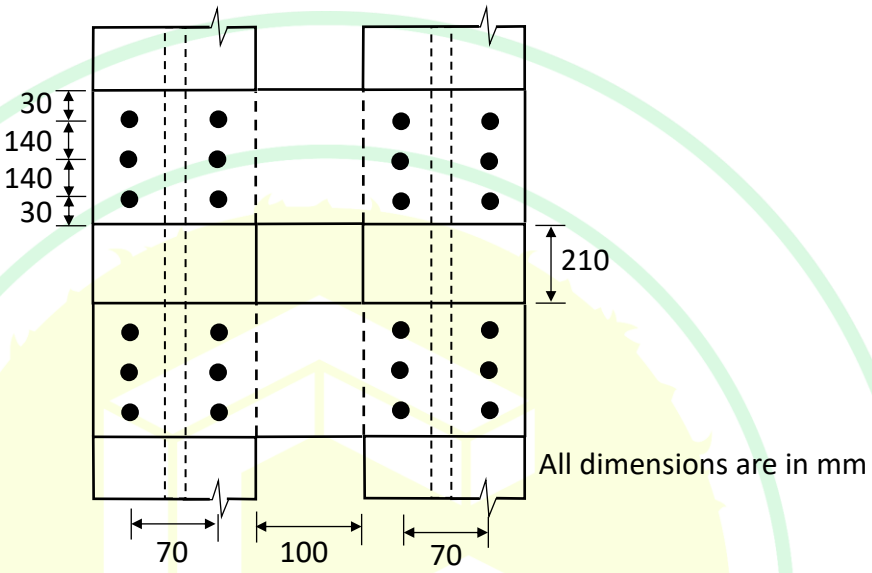
Q.44	$MgCl_2$ and $CaSO_4$ salts are added to 1 litre of distilled deionized water and mixed until completely dissolved. Total Dissolved Solids (TDS) concentration is 500 mg/l, and Total Hardness (TH) is 400 mg/l (as $CaCO_3$). The amounts of $MgCl_2$ and $CaSO_4$ added are calculated (*rounded off to the nearest integer*). Which of the following options is/are *true*: Atomic weights: Ca(40), Mg(24), S(32), O(16), Cl(35.5), C(12)
(A)	Amount of $MgCl_2$ added is 143 mg
(B)	Amount of $CaSO_4$ added is 357 mg
(C)	Amount of $MgCl_2$ added is 103 mg
(D)	Amount of $CaSO_4$ added is 397 mg
Q.45	A facultative pond system is employed for wastewater treatment. Which of the following statements is/are *true*:
(A)	The dissolved oxygen concentration will be high during daytime compared to night-time
(B)	The pH will be high during daytime compared to night-time
(C)	The dissolved oxygen concentration will be low during daytime compared to night-time
(D)	The pH will be low during daytime compared to night-time

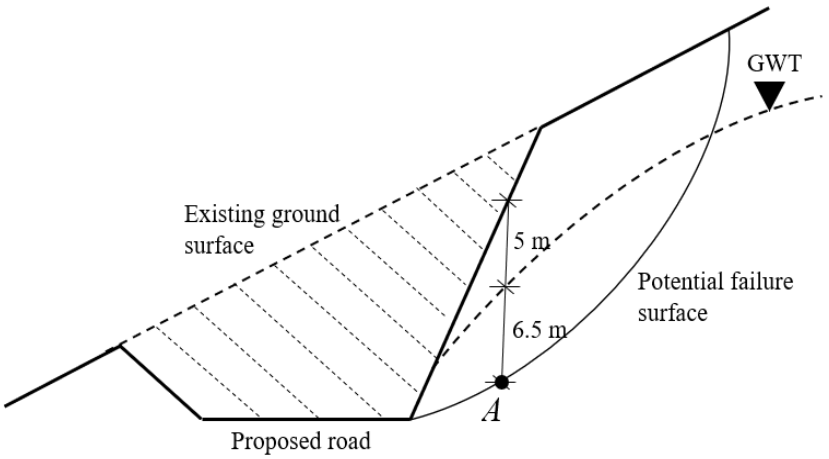
Q.46	Organic fraction of municipal solid waste (OFMSW) with bulk density of 315 kg/m^3 and water content of 30% is mixed with municipal sludge of bulk density 700 kg/m^3 and water content of 70%, such that the water content of the mixture is 40%. The amount (in kg) of sludge to be mixed per kg of OFMSW (*rounded off to 2 decimal places*) and the density of the mixture (in kg/m^3) (*rounded off to the nearest integer)* are calculated. Which of the following options is/are *true*:
(A)	0.33 kg of sludge added per kg of OFMSW
(B)	Density of the mixture is 365 kg/m^3
(C)	0.66 kg of sludge added per kg of OFMSW
(D)	Density of the mixture is 450 kg/m^3
Q.47	Let y be the solution of the initial value problem $y'' + 0.8y' + 0.16y = 0$, where $y(0) = 3$ and $y'(0) = 4.5$. Then, $y(1)$ is equal to _____ (*rounded off to 1 decimal place*).
Q.48	The maximum value of the function $h(x) = -x^3 + 2x^2$ in the interval [-1,1.5] is equal to _____ (*rounded off to 1 decimal place*).

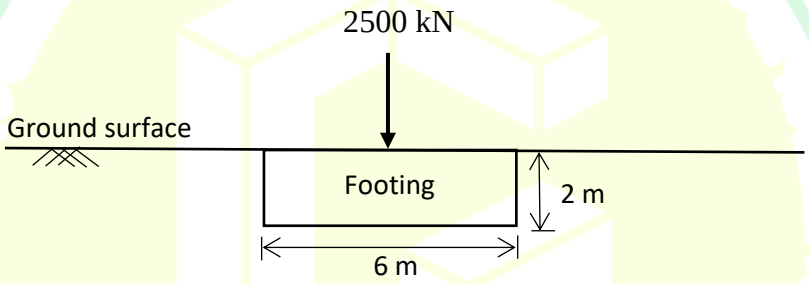
Q.49	Consider the differential equation given below. Using the Euler method with the step size (h) of 0.5, the value of y at x = 1.0 is equal to _____ (*rounded off to 1 decimal place*).
	$$\frac{dy}{dx} = y + 2x - x^2 \; ; \quad y(0) = 1 \qquad (0 \leq x < \infty)$$
Q.50	For the beam and loading shown in the figure, the second derivative of the deflection curve of the beam at the mid-point of AC is given by $\alpha M_0/8EI$. The value of α is _____ (*rounded off to the nearest integer*).
	

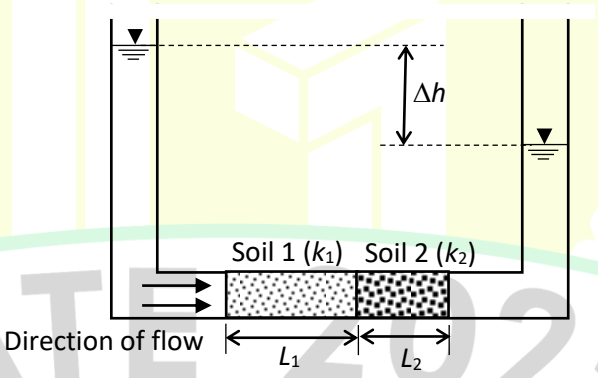
Q.51	Consider the rigid bar ABC supported by the pin-jointed links BD and CE and subjected to a load *P* at the end A, as shown in the figure. The axial rigidities of BD and CE are 22500 kN and 15000 kN, respectively. If CE elongates by 5 mm due to the load *P*, the magnitude of the downward deflection (in mm) of the end A would be _____ (*rounded off to the nearest integer*).
	
Q.52	Consider a reinforced concrete beam section of 300 mm width and 700 mm depth. The beam is reinforced with the tension steel of 2000 mm^2 area at an effective cover of 50 mm. Concrete in the tension zone is assumed to be cracked. Assume the modular ratio of 12 and Young's modulus of 200 GPa for steel. When the extreme fibre in the compression zone undergoes the strain of 0.0004 due to the applied bending moment, the stress in the steel (in MPa) is _____ (*rounded off to the nearest integer*).

Q.53	Consider the beam section shown in the figure, with $\bar{y}$ indicating the depth of neutral axis (NA). The section is only subjected to an increasing bending moment. It is given that $\bar{y}$ = 18.75 mm, when the section has not yielded at the top and bottom fibres. Further, $\bar{y}$ decreases to 5 mm, when the entire section has yielded. The shape factor of the section is _____ (*rounded off to 2 decimal places*).
	

Q.54	Consider the built-up column made of two I-sections as shown in the figure, with each batten plate bolted to a component I-section of the column through 6 black bolts. Each connection of the batten plate with the component section is to be designed for a longitudinal shear of 70 kN and moment of 10 kN.m. The minimum bolt value required (in kN) is _____ (*rounded off to the nearest integer*).
	

Q.55	A cut slope is made in a silty clay soil for a new road project, as shown in the figure. The locations of ground water table (GWT) and potential failure surface are shown in the figure. After the cut is made, the excess pore water pressure is fully dissipated, and the shear stress at the point A is 60 kN/m^2. The factor of safety at the point A for long-term stability is _____ (*rounded off to 2 decimal places*). Note: Shear strength properties of silty clay: c' = 15 kN/m^2, ϕ' = 15°, and c_u = 75 kN/m^2 Unit weight of soil above the GWT (γ) = 19 kN/m^3 Unit weight of soil below the GWT (γ_{sat}) = 20 kN/m^3 Unit weight of water (γ_w) = 9.81 kN/m^3
	

Q.56	A 6 m × 6 m square footing constructed in clay is subjected to a vertical load of 2500 kN at its centre. The base of the footing is 2 m below the ground surface, as shown in the figure. The footing is made of 2 m thick concrete. The ground water table is at a great depth. Considering Terzaghi's bearing capacity theory, the factor of safety of footing against the bearing capacity failure is _____ (*rounded off to 2 decimal places*). Note: Unit weight of concrete = 24 kN/m^3 Properties of clay: c = 50 kN/m^2, $\phi = 0°$, and γ = 19 kN/m^3 For $\phi = 0°$: $N_c = 5.7$, $N_q = 1$, $N_\gamma = 0$
	
Q.57	A clayey soil has a moisture content of 18%, a specific gravity of soil solids of 2.74, and a degree of saturation of 65%. The soil soaks up water during a rain event, and the degree of saturation increases to 85.2%. The change of the volume during the soaking is negligible. The new moisture content (in %) of the soil will be _____ (*rounded off to 2 decimal places*).

Q.58	A single pile with 450 mm diameter has been driven into a homogeneous clay layer, which has an undrained cohesion (c_u) of 20 kPa and unit weight of 18 kN/m^3. The ground water table is found to be at the surface of the clay layer. The adhesion factor (α) of the soil is 0.95 and bearing capacity factor (N_c) is 9. The pile is supporting a column load of 144 kN with a factor of safety of 3.0 against ultimate axial pile capacity in compression. The required embedment depth of the pile (in m) is _____ (*rounded off to the nearest integer*).
Q.59	Two soils of permeabilities k_1 and k_2 are placed in a horizontal flow apparatus, as shown in the figure. For Soil 1, L_1 = 50 cm, and k_1 = 0.055 cm/s; for Soil 2, L_2 = 30 cm, and k_2 = 0.035 cm/s. The cross sectional area of the horizontal pipe is 100 cm^2, and the head difference (Δh) is 150 cm. The discharge (in cm^3/s) through the soils is _____ (*rounded off to 2 decimal places*).
	

Q.60	A hydraulic jump is formed in a 5 m wide rectangular channel, which has a horizontal bed and is carrying a discharge of 15 m^3/s. The depth of water upstream of the jump is 0.5 m. The power dissipated by the jump (in kW) is _____ (*rounded off to the nearest integer*). Note: Acceleration due to gravity = 9.81 m/s^2 Density of water = 1000 kg/m^3 Kinetic energy correction factor = 1.0
Q.61	A symmetrical trapezoidal canal is 100 km long. The bottom width is 10 m and the side slope is 1 Horizontal : 1 Vertical. The average flow depth in the canal is 2.5 m throughout the month of April. The measurement from a Class-A evaporimeter in the vicinity of the canal indicated an average evaporation rate of 0.5 cm/day in April. The volume of water evaporated from the canal (in m^3) in the month of April is close to _____ $\times 10^3$ (*rounded off to 1 decimal place*).
Q.62	A 5.0 m wide rectangular channel carries a discharge of 10 m^3/s at a depth of 1.5 m under uniform flow. To produce critical flow conditions without affecting the upstream conditions, the channel bottom elevation should be raised (in m) by _____ (*rounded off to 2 decimal places*). Assume that there is no loss of head at the raise, kinetic energy correction factor is 1.0, and acceleration due to gravity is 9.81 m/s^2.

Q.63

A one-way, single lane road has traffic that consists of 30% trucks and 70% cars. The speed of trucks (in km/h) is a uniform random variable on the interval (30, 60), and the speed of cars (in km/h) is a uniform random variable on the interval (40, 80). The speed limit on the road is 50 km/h. The percentage of vehicles that exceed the speed limit is _____ (*rounded off to 1 decimal place*).

Note: X is a uniform random variable on the interval (α, β), if its probability density function is given by

$$f(x) = \begin{cases} \dfrac{1}{\beta - \alpha} & \alpha < x < \beta \\ 0 & \text{otherwise} \end{cases}$$

Q.64

In levelling between two points A and B on the opposite banks of a river, the readings are taken by setting the instrument both at A and B, as shown in the table. If the RL of A is 150.000 m, the RL of B (in m) is _____ (*rounded off to 3 decimal places*).

Level position	Staff readings	
	A	B
A	1.800	1.350
B	1.450	0.950

Q.65	During determination of the bulk specific gravity of compacted bituminous specimen, the mass in air of the specimen is 1260 g and volume is 525 cm^3. The density of water is 1.0 g/cm^3. The theoretical maximum specific gravity of mix is 2.510. The percentage air voids in the compacted specimen is _____ (*rounded off to 2 decimal places*).

Answer Key for Civil Engineering 1 (CE1)

Q. No.	Session	Q. Type	Section	Key/Range	Marks
1	7	MCQ	GA	D	1
2	7	MCQ	GA	D	1
3	7	MCQ	GA	C	1
4	7	MCQ	GA	A	1
5	7	MCQ	GA	B	1
6	7	MCQ	GA	B	2
7	7	MCQ	GA	C	2
8	7	MCQ	GA	A	2
9	7	MCQ	GA	B	2
10	7	MCQ	GA	B	2
11	7	MCQ	CE-1	D	1
12	7	MCQ	CE-1	B	1
13	7	MCQ	CE-1	C	1
14	7	MCQ	CE-1	A	1
15	7	MCQ	CE-1	D	1
16	7	MCQ	CE-1	B	1
17	7	MCQ	CE-1	B	1
18	7	MCQ	CE-1	C	1
19	7	MCQ	CE-1	A	1
20	7	MCQ	CE-1	A	1
21	7	MCQ	CE-1	C	1
22	7	MCQ	CE-1	D	1
23	7	MCQ	CE-1	A	1
24	7	MCQ	CE-1	C	1
25	7	MCQ	CE-1	D	1
26	7	MCQ	CE-1	C	1
27	7	MCQ	CE-1	D	1
28	7	MSQ	CE-1	B	1
29	7	MSQ	CE-1	B;C	1
30	7	MSQ	CE-1	A;B;C	1

31	7	MSQ	CE-1	A;B	1
32	7	MSQ	CE-1	A;C	1
33	7	NAT	CE-1	3.74 to 3.76	1
34	7	NAT	CE-1	476 to 500	1
35	7	NAT	CE-1	48 to 51	1
36	7	MCQ	CE-1	B	2
37	7	MCQ	CE-1	C	2
38	7	MCQ	CE-1	B	2
39	7	MCQ	CE-1	A	2
40	7	MCQ	CE-1	A	2
41	7	MSQ	CE-1	A;D	2
42	7	MSQ	CE-1	B;D	2
43	7	MSQ	CE-1	B;D	2
44	7	MSQ	CE-1	C;D	2
45	7	MSQ	CE-1	A;B	2
46	7	MSQ	CE-1	A;B	2
47	7	NAT	CE-1	5.7 to 5.9	2
48	7	NAT	CE-1	2.9 to 3.1	2
49	7	NAT	CE-1	2.4 to 2.8	2
50	7	NAT	CE-1	3 to 3	2
51	7	NAT	CE-1	14 to 14	2
52	7	NAT	CE-1	125 to 127	2
53	7	NAT	CE-1	1.80 to 1.82	2
54	7	NAT	CE-1	21 to 24	2
55	7	NAT	CE-1	0.96 to 0.98	2
56	7	NAT	CE-1	4.62 to 4.70	2
57	7	NAT	CE-1	23.30 to 23.70	2
58	7	NAT	CE-1	15 to 16	2
59	7	NAT	CE-1	8.44 to 8.56	2
60	7	NAT	CE-1	69 to 75	2
61	7	NAT	CE-1	120.0 to 180.0	2
62	7	NAT	CE-1	0.45 to 0.51	2
63	7	NAT	CE-1	61.0 to 63.0	2
64	7	NAT	CE-1	150.470 to 150.480	2
65	7	NAT	CE-1	4.22 to 4.56	2