CAREERS 360
PREPARATION Series

GATE 2025

Civil Engineering (CE-1) (Forenoon)
Question Paper & Answer Key

General Aptitude

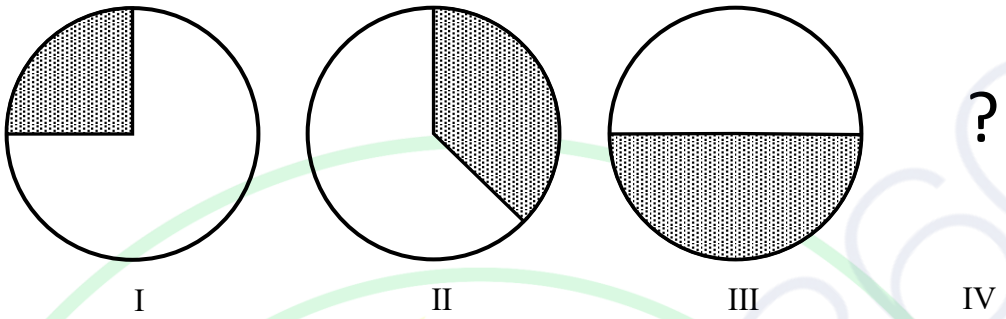
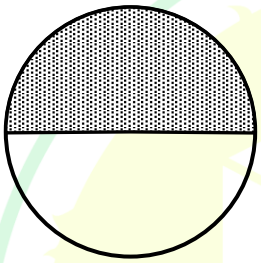
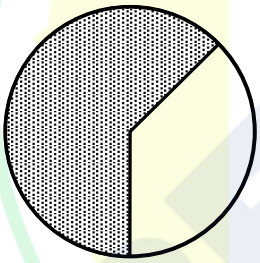
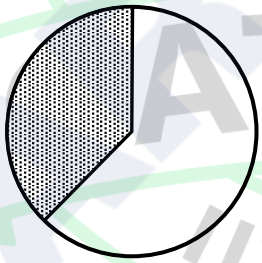
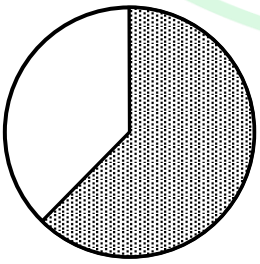
Q.1 – Q.5 Carry ONE mark Each

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

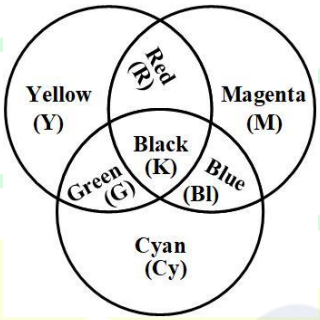
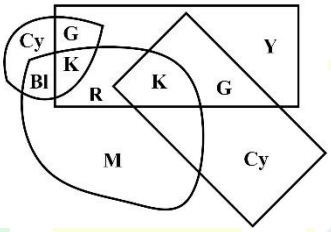
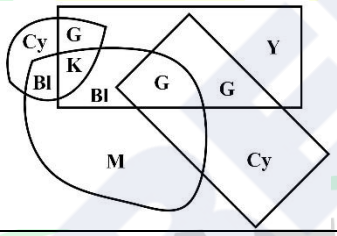
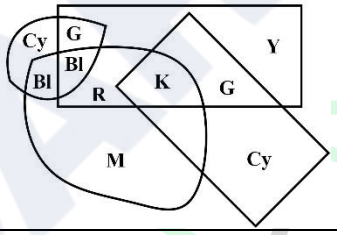
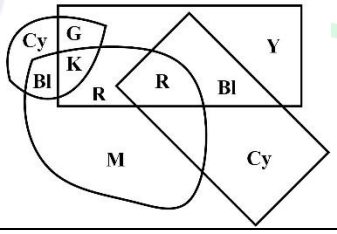
Q.4	A thin wire is used to construct all the edges of a cube of 1 m side by bending, cutting and soldering the wire. If the wire is 12 m long, what is the minimum number of cuts required to construct the wire frame to form the cube?
(A)	3
(B)	4
(C)	6
(D)	12

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)	

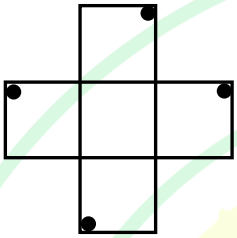
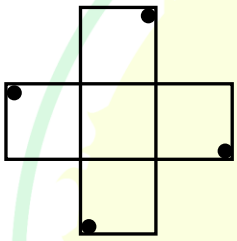
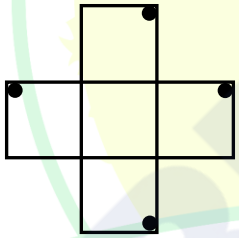
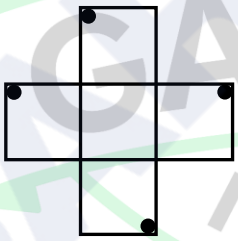
Q.6 – Q.10 Carry TWO marks Each

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)	

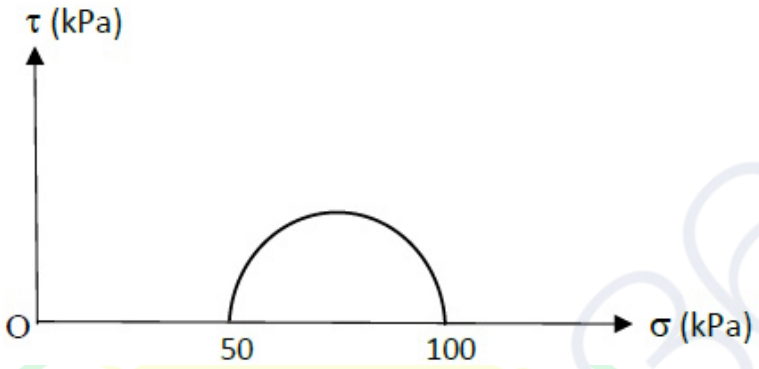
Q.11 – Q.35 Carry ONE mark Each

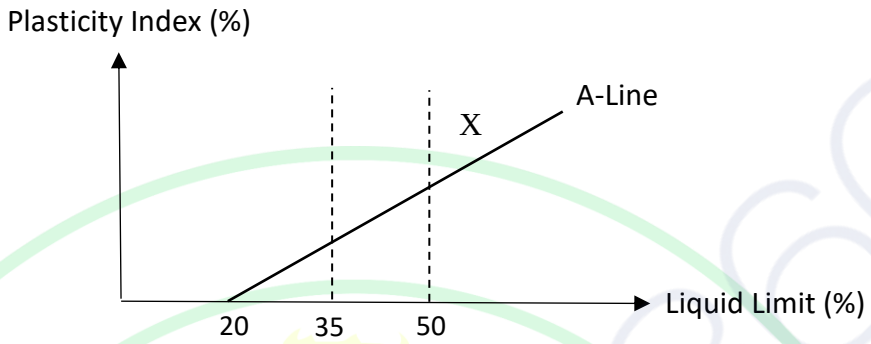
Q.11	Suppose λ is an eigenvalue of matrix A and x is the corresponding eigenvector. Let x also be an eigenvector of the matrix $B = A - 2I$, where I is the identity matrix. Then, the eigenvalue of B corresponding to the eigenvector x is equal to
(A)	λ
(B)	$\lambda + 2$
(C)	2λ
(D)	$\lambda - 2$
Q.12	Let $A = \begin{bmatrix} 1 & 1 \\ 1 & 3 \\ -2 & -3 \end{bmatrix}$ 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)	$\frac{l}{V^2 g}$

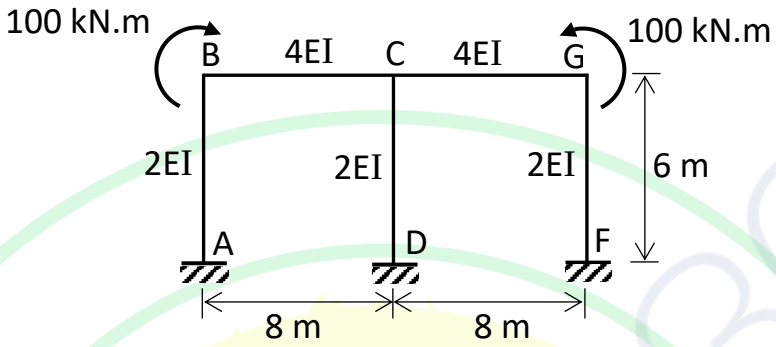
Q.20	To derive the total flood hydrograph at a catchment outlet from an isolated storm, the order in which the following methods are applied, from the first method to the last method, is
	P. Obtaining the hyetograph Q. Addition of baseflow R. Estimation of initial and infiltration losses S. Application 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

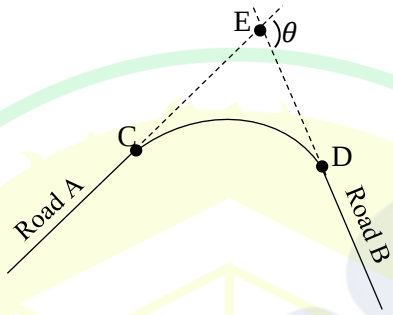
Q.25	The maximum degree of the curve that can be used for railways in a mountainous region is
(A)	10
(B)	20
(C)	50
(D)	40
Q.26	If the horizontal distance between a staff point and the point of observation is d, the error due to the curvature of earth is proportional to
(A)	d
(B)	$\frac{1}{d}$
(C)	d^2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

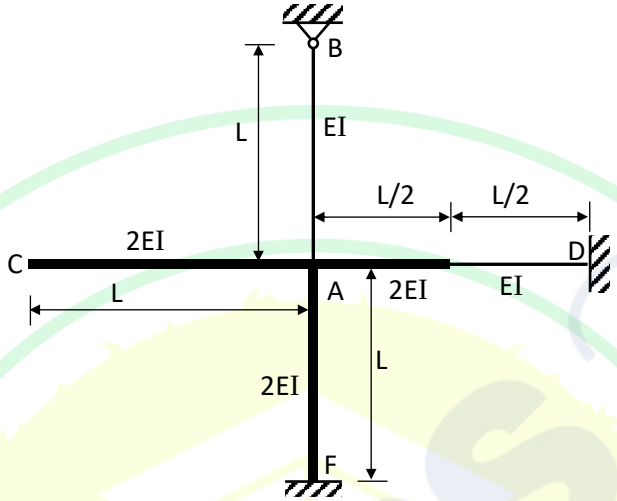
Q.31	The Surface Overflow Rate (SOR) in a rectangular sedimentation tank is 45 $m^3/m^2/d$. Minimum diameters of spherical inorganic and organic particles expected to be completely removed in this tank are calculated. Assume that Stoke's law is applicable. Which of the following options is/are *correct*: 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*:

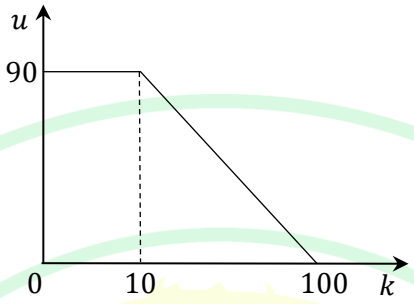
Rain gauge station	P	Q	R	S
Whether located inside the catchment	Yes	Yes	Yes	No
Thiessen weightage factor	0.25	0.50	0.10	0.15
Rainfall (mm)	100	110	100	125

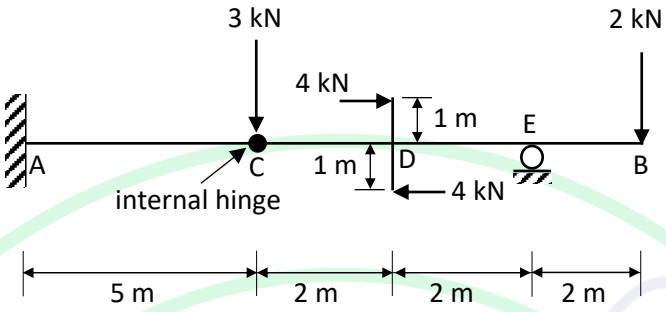
(A) The estimate obtained from the Thiessen-mean method is greater than that obtained using the arithmetic-mean method

(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

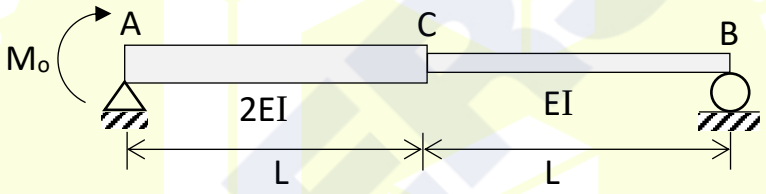
Q.41	Consider the beam ACDEB given in the figure. Which of the following statements is/are *correct*:
	
(A)	Bending moment is zero between the points A and C
(B)	There is a sudden jump in shear force at the point D
(C)	There is a sudden jump in bending moment at the point E
(D)	Bending moment is zero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

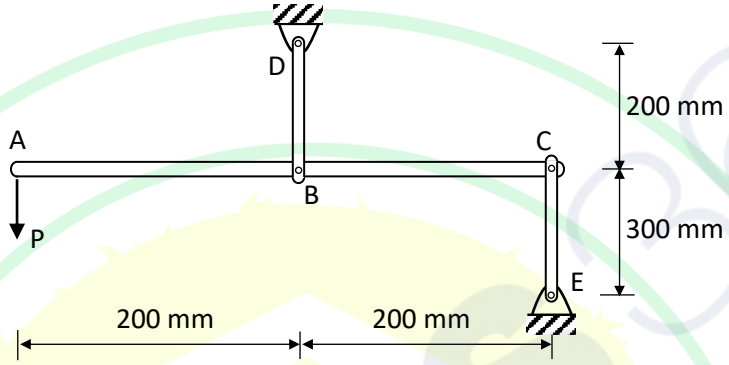
Q.42	In the context of construction project management, which of the following statements is/are *true*:
(A)	A dummy activity will consume time and resources
(B)	The programme evaluation and review technique (PERT) is best suited for projects with large uncertainties in the duration of activities
(C)	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

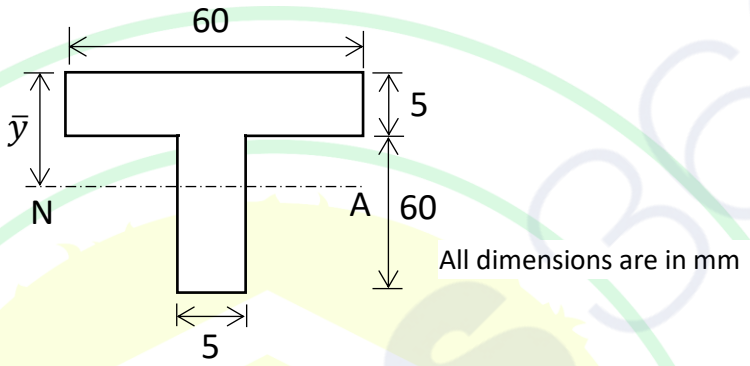
Q.43	Lacey's regime equations, followed in India for making scour calculations while designing hydraulic structures across alluvial channels, are given below. Regarding these equations, which of the following statements is/are *true*:
	$D = 0.470 \times \left[\frac{Q}{f_s}\right]^{1/3}$ $P = 4.75 \times \sqrt{Q}$ $f_s = 1.76 \times \sqrt{d}$ 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

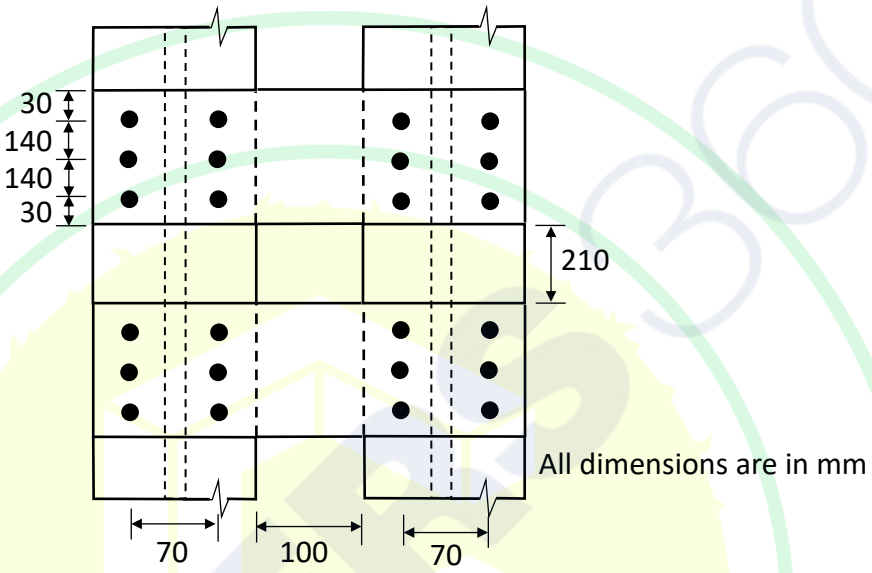
Q.44	$MgCl_2$ and $CaSO_4$ salts are added to 1 litre of distilled deionized water and mixed until completely dissolved. Total Dissolved Solids (TDS) concentration is 500 mg/l, and Total Hardness (TH) is 400 mg/l (as $CaCO_3$). The amounts of $MgCl_2$ and $CaSO_4$ added are calculated (*rounded off to 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

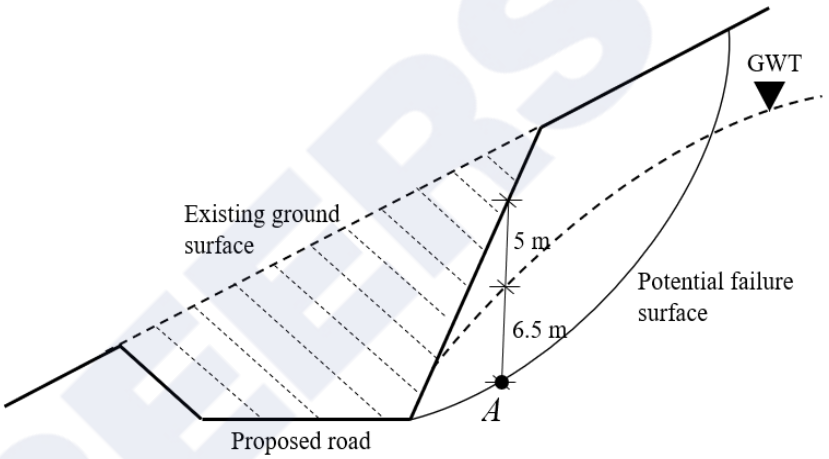
Q.46	Organic fraction of municipal solid waste (OFMSW) with bulk density of 315 kg/m^3 and water content of 30% is mixed with municipal sludge of bulk density 700 kg/m^3 and water content of 70%, such that the water content of the mixture is 40%. The amount (in kg) of sludge to be mixed per kg of OFMSW (*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*).

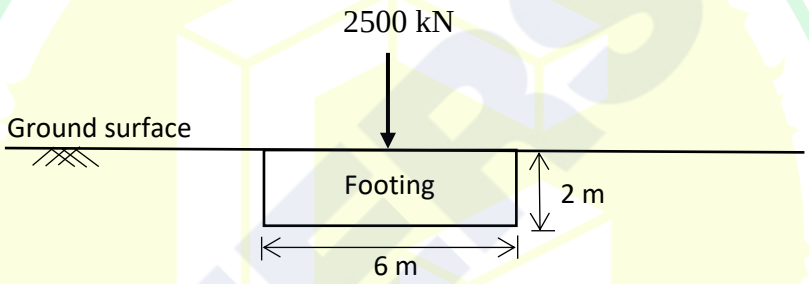
Q.49	Consider the differential equation given below. Using the Euler method with the step size (h) of 0.5, the value of y at x = 1.0 is equal to _____ (*rounded off to 1 decimal place*).
	$$\frac{dy}{dx} = y + 2x - x^2 \; ; \quad y(0) = 1 \qquad (0 \leq x < \infty)$$
Q.50	For the beam and loading shown 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*).
	

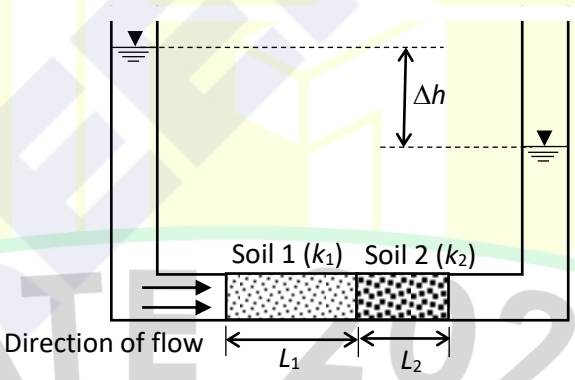
Q.51	Consider the rigid bar ABC supported by the pin-jointed links BD and CE and subjected to a load *P* at the end A, as shown in the figure. The axial rigidities of BD and CE are 22500 kN and 15000 kN, respectively. If CE elongates by 5 mm due to the load *P*, the magnitude of the downward deflection (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 $$f(x) = \begin{cases} \frac{1}{\beta - \alpha} & \alpha < x < \beta \\ 0 & \text{otherwise} \end{cases}$$
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*).
	<table><tr><td rowspan="2">Level position</td><td colspan="2">Staff readings</td></tr><tr><td>A</td><td>B</td></tr><tr><td>A</td><td>1.800</td><td>1.350</td></tr><tr><td>B</td><td>1.450</td><td>0.950</td></tr></table>

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

CAREERS 360
PREPARATION Series

GATE 2025

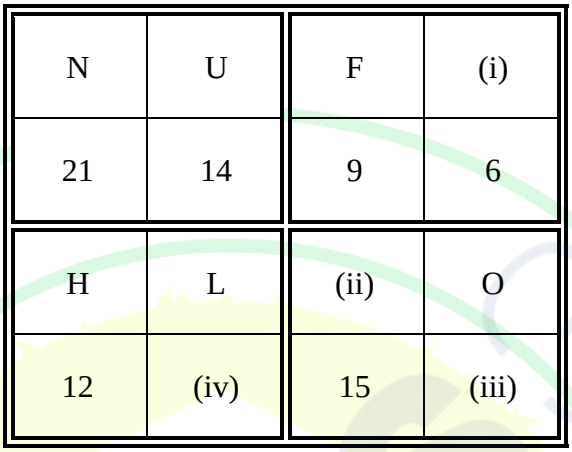
Civil Engineering (CE-2) (Afternoon)
Question Paper & Answer Key

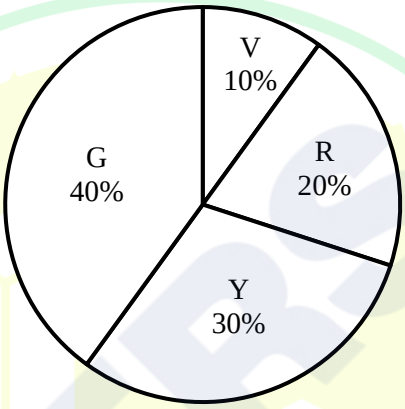
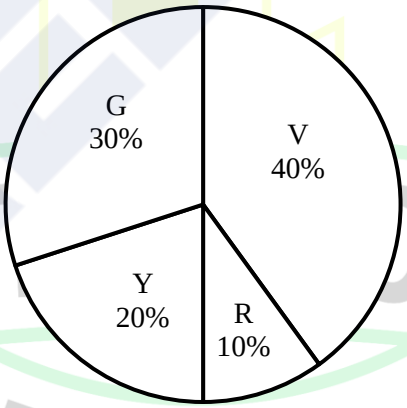
General Aptitude

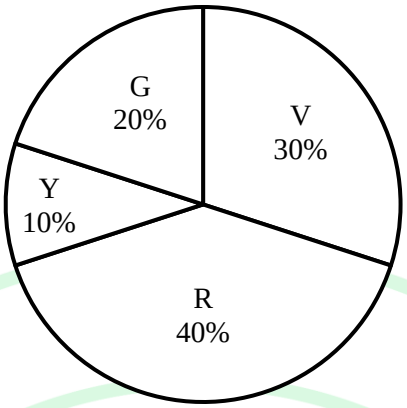
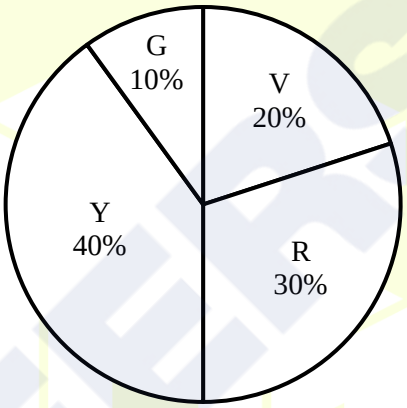
Q.1 – Q.5 Carry ONE mark Each

Q.1	Even though I had planned to go skiing with my friends, I had to _____ at the last moment because of an injury. Select the most appropriate option to complete the above sentence.
(A)	back up
(B)	back of
(C)	back on
(D)	back out
Q.2	The President, along with the Council of Ministers, _____ to visit India next week. Select the most appropriate option to complete the above sentence.
(A)	wish
(B)	wishes
(C)	will wish
(D)	is wishing

Q.3	An electricity utility company charges ₹ 7 per kWh (kilo watt-hour). If a 40-watt desk light is left on for 10 hours each night for 180 days, what would be the cost of energy consumption? If the desk light is on for 2 more hours each night for the 180 days, what would be the percentage-increase in the cost of energy consumption?
(A)	₹ 604.8; 10%
(B)	₹ 504; 20%
(C)	₹ 604.8; 12%
(D)	₹ 720; 15%

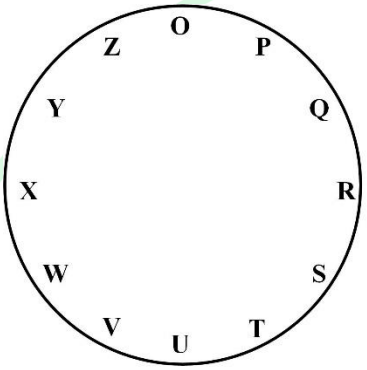
Q.4	In the context of the given figure, which one of the following options correctly represents the entries in the blocks labelled (i), (ii), (iii), and (iv), respectively?
	
(A)	Q, M, 12, and 8
(B)	K, L, 10 and 14
(C)	I, J, 10, and 8
(D)	L, K, 12 and 8

Q.5	A bag contains Violet (V), Yellow (Y), Red (R), and Green (G) balls. On counting them, the following results are obtained: (i) The sum of Yellow balls and twice the number of Violet balls is 50. (ii) The sum of Violet and Green balls is 50. (iii) The sum of Yellow and Red balls is 50. (iv) The sum of Violet and twice the number of Red balls is 50. Which one of the following Pie charts correctly represents the balls in the bag?
(A)	
(B)	

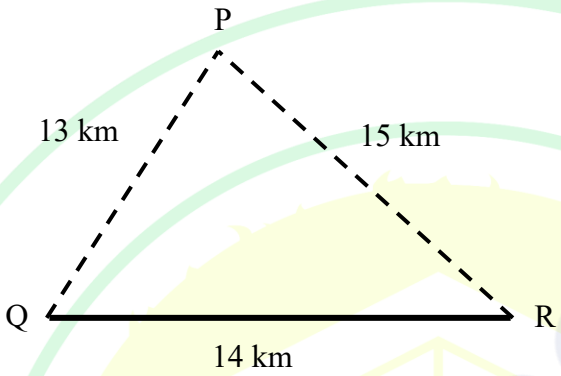
(C)	 G 20% V 30% Y 10% R 40%
(D)	 G 10% V 20% Y 40% R 30%

Q.6 – Q.10 Carry TWO marks Each

Q.6	"His life was divided between the books, his friends, and long walks. A solitary man, he worked at all hours without much method, and probably courted his fatal illness in this way. To his own name there is not much to show; but such was his liberality that he was continually helping others, and fruits of his erudition are widely scattered, and have gone to increase many a comparative stranger's reputation." (From E.V. Lucas's "A Funeral") Based only on the information provided in the above passage, which one of the following statements is true?
(A)	The solitary man described in the passage is dead.
(B)	Strangers helped create a grand reputation for the solitary man described in the passage.
(C)	The solitary man described in the passage found joy in scattering fruits.
(D)	The solitary man worked in a court where he fell ill.

Q.7	For the clock shown in the figure, if O^* = O Q S Z P R T, and X^* = X Z P W Y O Q, then which one among the given options is most appropriate for P^* ?
	
(A)	P U W R T V X
(B)	P R T O Q S U
(C)	P T V Q S U W
(D)	P S U P R T V

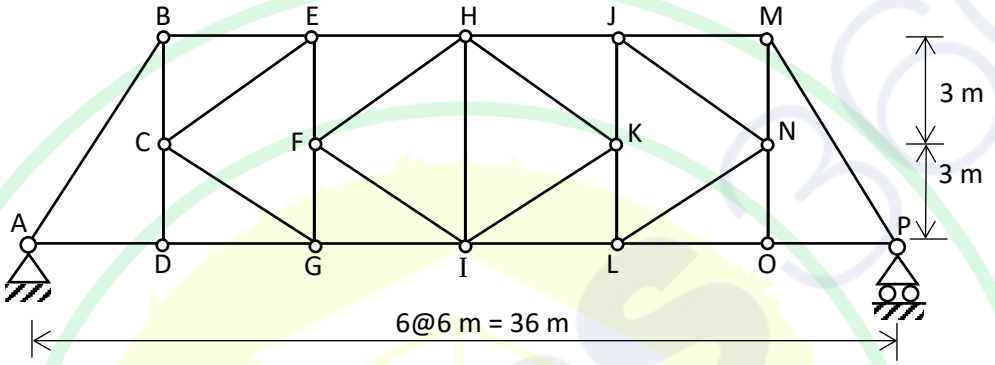
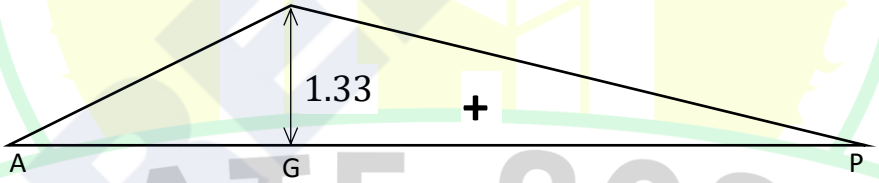
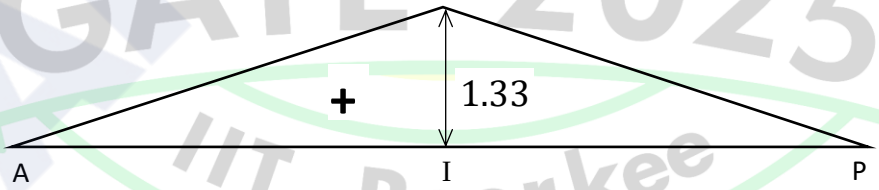
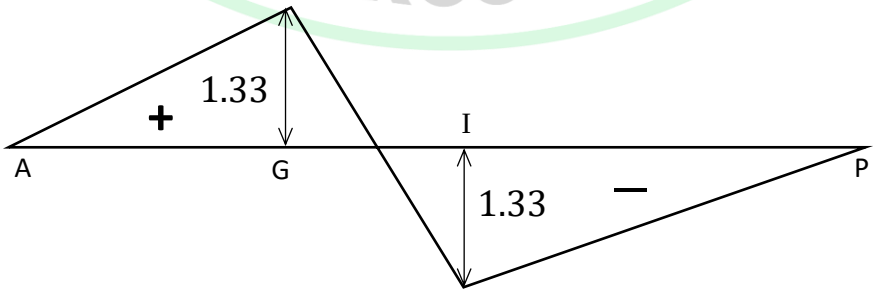
Q.8	Consider a five-digit number $PQRST$ that has distinct digits $P, Q, R, S,$ and T, and satisfies the following conditions: $P < Q$ $S > P > T$ $R < T$ If integers 1 through 5 are used to construct such a number, the value of P is:
(A)	1
(B)	2
(C)	3
(D)	4
Q.9	A business person buys potatoes of two different varieties P and Q, mixes them in a certain ratio and sells them at ₹ 192 per kg. The cost of the variety P is ₹ 800 for 5 kg. The cost of the variety Q is ₹ 800 for 4 kg. If the person gets 8% profit, what is the P:Q ratio (by weight)?
(A)	5:4
(B)	3:4
(C)	3:2
(D)	1:1

Q.10	Three villages P, Q, and R are located in such a way that the distance PQ = 13 km, QR = 14 km, and RP = 15 km, as shown in the figure. A straight road joins Q and R. It is proposed to connect P to this road QR by constructing another road. What is the minimum possible length (in km) of this connecting road? Note: The figure shown is representative.
	
(A)	10.5
(B)	11.0
(C)	12.0
(D)	12.5

Q.11 – Q.35 Carry ONE mark Each

Q.11	For the matrix $[A]$ given below, the transpose is _____.
	$[A] = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 4 & 5 \\ 4 & 3 & 2 \end{bmatrix}$
(A)	$\begin{bmatrix} 2 & 1 & 4 \\ 3 & 4 & 3 \\ 4 & 5 & 2 \end{bmatrix}$
(B)	$\begin{bmatrix} 4 & 3 & 2 \\ 5 & 4 & 1 \\ 2 & 3 & 4 \end{bmatrix}$
(C)	$\begin{bmatrix} 4 & 2 & 3 \\ 5 & 1 & 4 \\ 2 & 4 & 3 \end{bmatrix}$
(D)	$\begin{bmatrix} 2 & 3 & 4 \\ 1 & 4 & 5 \\ 4 & 3 & 2 \end{bmatrix}$
Q.12	Integration of *ln(x)* with *x* i.e.,
	$\int ln(x)\, dx =$ _____.
(A)	$x.ln(x) - x + Constant$
(B)	$x - ln(x) + Constant$
(C)	$x.ln(x) + x + Constant$
(D)	$ln(x) - x + Constant$

Q.13	Consider the following statements (P) and (Q): (P): Fly ash and ground granulated blast furnace slag can be used as mineral admixtures in concrete. (Q): As per IS 456:2000, the minimum moist curing period becomes higher when a mineral admixture is added to concrete. Identify the **CORRECT** option from choices given below.
(A)	Both (P) and (Q) are TRUE.
(B)	(P) is TRUE and (Q) is FALSE.
(C)	(P) is FALSE and (Q) is TRUE.
(D)	Both (P) and (Q) are FALSE.

Q.14	Consider the pin-jointed truss shown in the figure. Influence line is drawn for the axial force in the member G-I, when a unit load travels on the bottom chord of the truss. Identify the **CORRECT** influence line from the following options: Note: Positive value corresponds to tension and negative value corresponds to compression in the member.
	
(A)	
(B)	
(C)	
(D)	

Q.15	The most suitable test for measuring the permeability of clayey soils in the laboratory is _____.
(A)	Constant head test
(B)	Pumping out test
(C)	Hydrometer test
(D)	Falling head test
Q.16	A hydraulic jump occurs in an open channel when the slope of the channel changes from _____.
(A)	MILD slope to STEEP slope
(B)	STEEP slope to MILD slope
(C)	MILD slope to ZERO slope
(D)	STEEP slope to a STEEPER slope

Q.17	The bacteria mainly responsible for crown corrosion in a sewer is _____.
(A)	Methanogenic bacteria
(B)	Denitrifying bacteria
(C)	Sulphur reducing bacteria
(D)	*Pseudomonas* bacteria
Q.18	The recommended minimum traffic growth rate and design period considered for structural design of flexible pavements for national highways in India as per IRC 37:2018 is _____ percentage and _____ years, respectively.
(A)	5, 20
(B)	5, 30
(C)	7, 20
(D)	7, 30

Q.19	After applying the correction for elevation and temperature, the runway length is 700 m. The corrected runway length (in m) for an effective gradient of 1% is _____ (*round off to the nearest integer*).
(A)	840
(B)	700
(C)	720
(D)	740
Q.20	The point where the road alignment changes from a tangent to a curve is known as _____.
(A)	Point of deflection
(B)	Point of intersection
(C)	Point of curve
(D)	Point of tangency

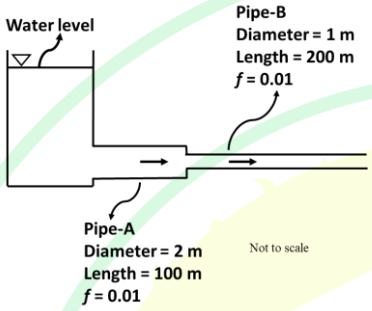
Q.21	Consider a velocity vector, $\vec{V}$ in (x, y, z) coordinates given below. Pick one or more **CORRECT** statements(s) from the choices given below.
	$\vec{V} = u\vec{x} + v\vec{y}$
(A)	z-component of Curl of velocity; $\nabla \times \vec{V} = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)\vec{z}$
(B)	z-component of Curl of velocity; $\nabla \times \vec{V} = \left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right)\vec{z}$
(C)	Divergence of velocity; $\nabla . \vec{V} = \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$
(D)	Divergence of velocity; $\nabla . \vec{V} = \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)$
Q.22	Given that A and B are not null sets, which of the following statements regarding probability is/are **CORRECT**?
(A)	P(A∩B) = P(A) P(B), if A and B are mutually exclusive.
(B)	Conditional probability, P(A|B) = 1 if B ⊂ A.
(C)	P(A∪B) = P(A) + P(B), if A and B are mutually exclusive.
(D)	P(A∩B) = 0, if A and B are independent.

Q.23	In the context of construction materials, which of the following statements is/are **CORRECT**?
(A)	If the characteristic strength is defined as that value below which not more than 50% results are expected to fall, the target mean strength in mix design will be taken same as the characteristic strength irrespective of the degree of quality control expected at the site.
(B)	Ten percent fines value is a non-dimensional quantity.
(C)	The stress-strain curve of concrete for 1-day duration of loading is associated with a smaller secant modulus of elasticity compared to the stress-strain curve of the same concrete for 10-minutes duration of loading.
(D)	The increase of carbon in steel usually leads to an increase in its 0.2% proof stress.
Q.24	Which of the following statements is/are **INCORRECT**?
(A)	As the depth of the ground water table from the ground surface increases, the effective stress in the soil decreases.
(B)	Bulking of the moist sand is due to the capillary action in the sand.
(C)	The effective stress in a liquified soil is almost zero.
(D)	The earth pressure at any point in the soil, under all conditions, is always smaller than the vertical effective stress at that point.

Q.25	Pick one or more **CORRECT** statement(s) from the choices given below, in the context of upstream and downstream cut-offs provided below the concrete apron of weirs / barrages constructed across alluvial rivers.
(A)	Cut-offs are provided to increase the rate of flow over the weir / barrage.
(B)	Cut-offs are provided to increase the seepage length and prevent failure due to piping.
(C)	The bottom level of cut-offs mainly depends on the scour depth.
(D)	Cut-offs are provided to ensure occurrence of hydraulic jump within the stilling basin.
Q.26	In the context of the effect of drainage density on the run-off generation and the hydrograph at the catchment outlet, all other factors remaining the same, pick one or more **CORRECT** statement(s) from the choices given below.
(A)	Lower drainage density results in higher peak in flood hydrograph compared to that when the drainage density is higher.
(B)	Lower drainage density results in lower peak in flood hydrograph compared to that when the drainage density is higher.
(C)	Lower drainage density results in a flood hydrograph with a longer time base compared to that when the drainage density is higher.
(D)	Lower drainage density results in a flood hydrograph with a shorter time base compared to that when the drainage density is higher.

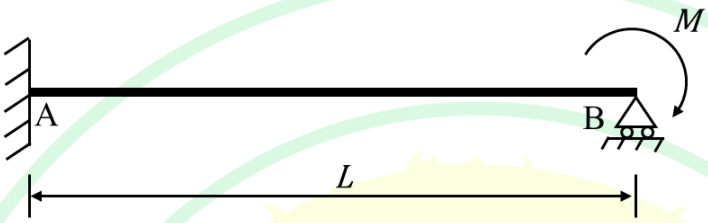
Q.27	Identify the treatment technology/technologies **NOT** recommended for highly biodegradable organic solid wastes.
(A)	Biohydrogenation
(B)	Anaerobic digestion
(C)	Composting
(D)	Open dumping
Q.28	Which of the following statements is/are **INCORRECT**?
(A)	Bitumen having lower softening point is preferred in warm climate regions.
(B)	The viscosity of bitumen influences the mixing and compaction of bituminous mix.
(C)	The air voids in the range of 3% to 5% are required to arrive at the optimum bitumen content.
(D)	The purity of bitumen can be determined using Solubility Test.

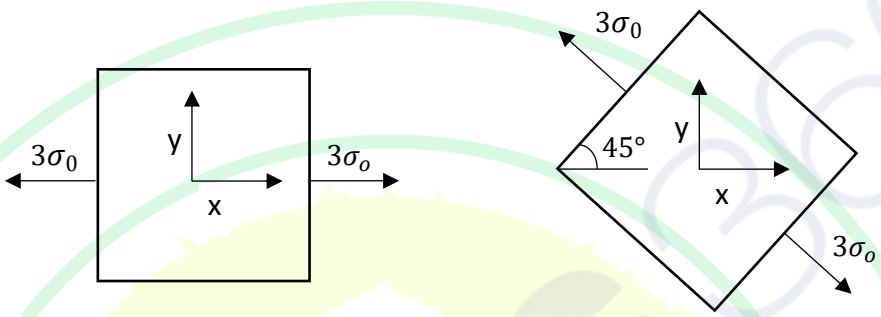
Q.29	The "order" of the following ordinary differential equation is _____.
	$\frac{d^3y}{dx^3} + \left(\frac{d^2y}{dx^2}\right)^6 + \left(\frac{dy}{dx}\right)^4 + y = 0$
Q.30	The design shear strength of a reinforced concrete rectangular beam with a width of 250 mm and an effective depth of 500 mm, is 0.3 MPa. The torsional moment capacity of the section (in kN.m) under pure torsion, as per IS 456:2000, is _____ (*round off to one decimal place*).
Q.31	From a flow-net diagram drawn under a concrete dam, following information are obtained: (i) The head difference between upstream and downstream side of the dam is 9 m. (ii) The total number of equipotential drops between upstream and downstream side of the dam is 10. (iii) The length of the field nearest to the toe of the dam in the downstream side is 1 m. If the soil below the dam is having a saturated unit weight of 21 kN/m^3 and unit weight of water is 9.81 kN/m^3, then the factor of safety against the quick condition will be _____ (*round off to two decimal places*).
Q.32	A 6 m thick clay stratum has drainage at both its top and bottom surface due to the presence of sand strata. The time to complete 50% consolidation is 2 years. The coefficient of volume change (m_v) is 1.51×10^{-3} m^2/kN and unit weight of water is 9.81 kN/m^3. The coefficient of permeability (in m/year) is _____ (*round off to three decimal places*).

Q.33	Consider steady flow of water in the series pipe system shown below, with specified discharge. The diameters of Pipes A and B are 2 m and 1 m, respectively. The lengths of pipes A and B are 100 m and 200 m, respectively. Assume the Darcy-Weisbach friction coefficient, f as 0.01 for both the pipes. The ratio of head loss in Pipe-B to the head loss in Pipe-A is _____ (*round off to the nearest integer*).
	
Q.34	Free residual chlorine concentration in water was measured to be 2 mg/l (as Cl_2). The pH of water is 8.5. By using the chemical equation given below, the HOCl concentration (in µmoles/l) in water is _____ (*round off to one decimal place*). $$HOCl \rightleftharpoons H^+ + OCl^-, \quad pK = 7.50$$ Atomic weight: Cl(35.5)
Q.35	A surveyor measured the distance between two points on the plan drawn to a scale of 1 cm = 40 m and the result was 468 m. Later, it was discovered that the scale used was 1 cm = 20 m. The true distance between the points (in m) is _____ (*round off to the nearest integer*).

Q.36 – Q.65 Carry TWO marks Each

Q.36	Pick the **CORRECT** solution for the following differential equation
	$\frac{dy}{dx} = e^{x-y}$
(A)	$y = ln(e^x + Constant)$
(B)	$ln(y) = x + Constant$
(C)	ln $(y) = ln(e^x) + Constant$
(D)	$y = x + Constant$
Q.37	A circular tube of thickness 10 mm and diameter 250 mm is welded to a flat plate using 5 mm fillet weld along the circumference. Assume Fe410 steel and shop welding. As per IS 800:2007, the torque that can be resisted by the weld (in kN.m) is _____ (*round off to one decimal place*).
(A)	65.1
(B)	78.1
(C)	156.2
(D)	130.2

Q.38	The figure shows a propped cantilever with uniform flexural rigidity EI (in N.m^2) and subjected to a moment M (in N.m). Consider forces and displacements in the upward direction as positive. Find the upward reaction at the propped support B (in N) when this support settles by $(-\Delta)$, given in metres.
	
(A)	$\frac{3M}{2L} - \frac{6EI\Delta}{L^3}$
(B)	$\frac{8M}{3L} - \frac{2EI\Delta}{L^3}$
(C)	$\frac{3M}{2L} - \frac{3EI\Delta}{L^3}$
(D)	$\frac{M}{L} - \frac{8EI\Delta}{L^3}$

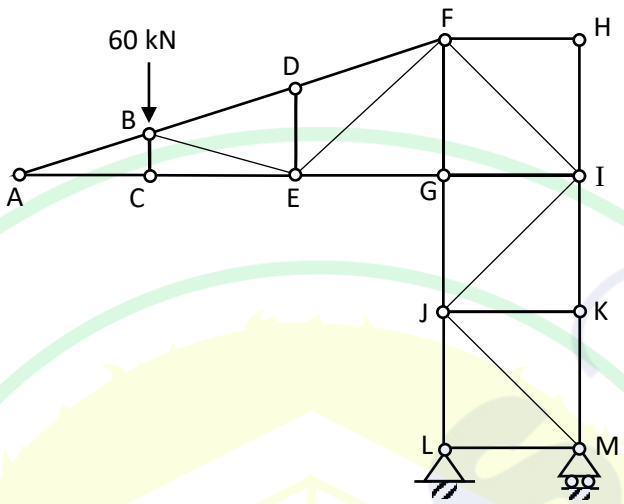
Q.39	Let the state of stress at a point in a body be the difference of two plane states of stress shown in the figure. Consider all the possible planes perpendicular to the x-y plane and passing through that point. The magnitude of the maximum compressive stress on any such plane is $k\sigma_0$, where k is equal to _____ (*round off to one decimal place*).
	
(A)	3.0
(B)	2.1
(C)	1.7
(D)	1.5

Q.40	Consider a reinforced concrete beam section of 350 mm width and 600 mm depth. The beam is reinforced with the tension steel of 800 mm^2 area at an effective cover of 40 mm. Consider M20 concrete and Fe415 steel. Let the stress block considered for concrete in IS 456:2000 be replaced by an equivalent rectangular stress block, with no change in (a) the area of the stress block, (b) the design strength of concrete (at the strain of 0.0035), and (c) the location of neutral axis at flexural collapse. The ultimate moment of resistance of the beam (in kN.m) is _____ (*round off to the nearest integer*).
(A)	170
(B)	148
(C)	125
(D)	102
Q.41	For a partially saturated soil deposit at a construction site, water content (w) is 15%, degree of saturation (S) is 67%, void ratio (e) is 0.6 and specific gravity of solids in the soil (G_s) is 2.67. Consider unit weight of water as 9.81 kN/m^3. To fully saturate 5 m^3 of this soil, the required weight of water (in kN) will be _____ (*round off to the nearest integer*).
(A)	5
(B)	6
(C)	7
(D)	8

<table>
<tr><td>Q.42</td><td>Consider flow in a long and very wide rectangular open channel. Width of the channel can be considered as infinity compared to the depth of flow. Uniform flow depth is 1.0 m. The bed slope of the channel is 0.0001. The Manning roughness coefficient value is 0.02. Acceleration due to gravity, g can be taken as 9.81 m/s^2.

The critical depth (in m) corresponding to the flow rate resulting from the above conditions is _____ (round off to one decimal place).</td></tr>
<tr><td>(A)</td><td>0.4</td></tr>
<tr><td>(B)</td><td>0.3</td></tr>
<tr><td>(C)</td><td>0.6</td></tr>
<tr><td>(D)</td><td>0.1</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Q.43</td><td>Match the following in Column I with Column II.</td></tr>
<tr><td></td><td><table>
<tr><th>Column I</th><th>Column II</th></tr>
<tr><td>(1) Vehicle Damage Factor</td><td>A. Stability of subgrade soil</td></tr>
<tr><td>(2) Passenger Car Unit</td><td>B. Capacity of a roadway</td></tr>
<tr><td>(3) Perception Reaction Time</td><td>C. Design rigid pavement</td></tr>
<tr><td>(4) California Bearing Ratio</td><td>D. Design flexible pavement</td></tr>
<tr><td></td><td>E. Stopping sight distance</td></tr>
</table></td></tr>
<tr><td>(A)</td><td>(1)-(D); (2)-(B); (3)-(E); (4)-(A)</td></tr>
<tr><td>(B)</td><td>(1)-(C); (2)-(B); (3)-(D); (4)-(A)</td></tr>
<tr><td>(C)</td><td>(1)-(D); (2)-(E); (3)-(B); (4)-(A)</td></tr>
<tr><td>(D)</td><td>(1)-(D); (2)-(B); (3)-(A); (4)-(E)</td></tr>
<tr><td></td><td></td></tr>
</table>

Q.44	Consider the function given below and pick one or more **CORRECT** statement(s) from the following choices.
	$f(x) = x^3 - \frac{15}{2}x^2 + 18x + 20$
(A)	*f(x)* has a local minimum at x = 3.
(B)	*f(x)* has a local maximum at x = 3.
(C)	*f(x)* has a local minimum at x = 2.
(D)	*f(x)* has a local maximum at x = 2.
Q.45	Pick the **CORRECT** eigen value(s) of the matrix [*A*] from the following choices.
	$[A] = \begin{bmatrix} 6 & 8 \\ 4 & 2 \end{bmatrix}$
(A)	10
(B)	4
(C)	-2
(D)	-10

Q.46	In the pin-jointed truss shown in the figure, the members that carry zero force are identified. Which of the following options is/are zero-force members?
	
(A)	BC
(B)	EG
(C)	FI
(D)	JK

Q.47	In the context of shear strength of soil, which of the following statements is/are **CORRECT**?
(A)	The unconfined compression test is a special case of the unconsolidated-undrained (UU) triaxial tests.
(B)	The shear strength parameters obtained from the consolidated-drained (CD) triaxial tests should be used to analyse rapid construction in clay.
(C)	Vane shear test is commonly used for determining *in situ* undrained strength of saturated clay soils.
(D)	In an unconsolidated-undrained (UU) triaxial tests, the angle of internal friction (ϕ) is equal to zero.
Q.48	The drag force, F_D on a sphere due to a fluid flowing past the sphere is a function of viscosity, μ, the mass density, ρ, the velocity of flow, V, and the diameter of the sphere, D. Pick the relevant (one or more) non-dimensional parameter(s) pertaining to the above process from the following list.
(A)	$\frac{F_D}{\rho V^2 D^2}$
(B)	$\frac{\rho F_D}{V^2 D^2}$
(C)	$\frac{\rho V D}{\mu}$
(D)	$\frac{\mu \rho}{V D}$

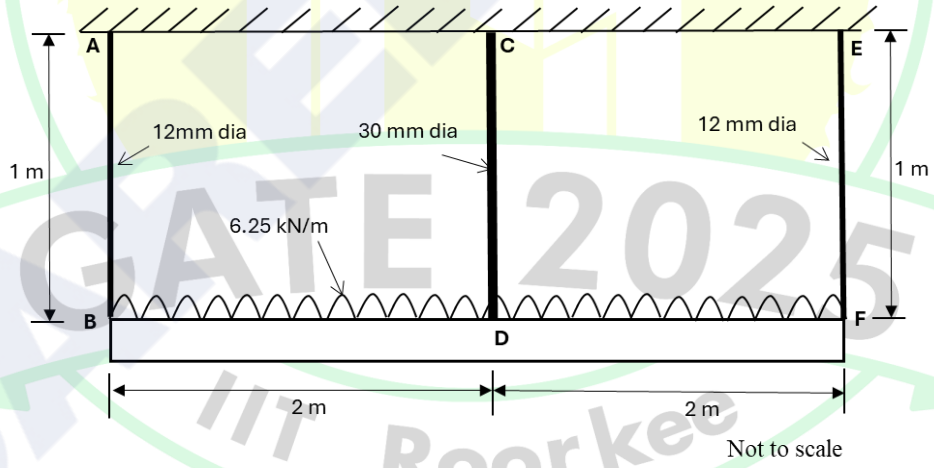
Q.49	A compound has a general formula $C_aH_bO_cN_d$ and molecular weight 187. A 935 mg/l solution of the compound is prepared in distilled deionized water. The Total Organic Carbon (TOC) is measured as 360 mg/l (as C). The Chemical Oxygen Demand (COD) and the Total Kjeldahl Nitrogen (TKN) are determined as 600 mg/l (as O_2) and 140 mg/l (as N), respectively (as per the chemical equation given below). Which of the following options is/are **CORRECT**? $$C_aH_bO_cN_d + \frac{(4a+b-2c-3d)}{4}O_2 \rightarrow aCO_2 + \frac{b-3d}{2}H_2O + dNH_3$$ Atomic weight: C(12), H(1), O(16), N(14)
(A)	a = 6
(B)	b = 7
(C)	c = 5
(D)	d = 3
Q.50	The free flow speed of a highway is 100 km/h and its capacity is 4000 vehicle/h. Assume speed density relation is linear. For a traffic volume of 2000 vehicle/h, choose all the possible speeds (in km/h) from the options given below (*round off to two decimal places*).
(A)	85.36
(B)	65.20
(C)	14.64
(D)	7.22

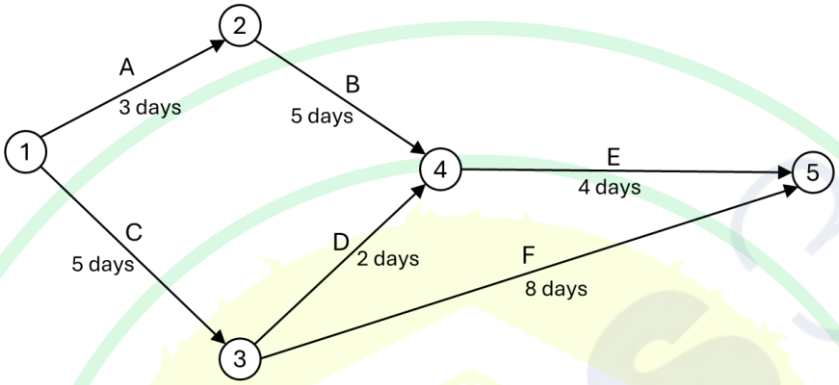
Q.51 Consider a discrete random variable X whose probabilities are given below. The standard deviation of the random variable is _____ (*round off to one decimal place*).

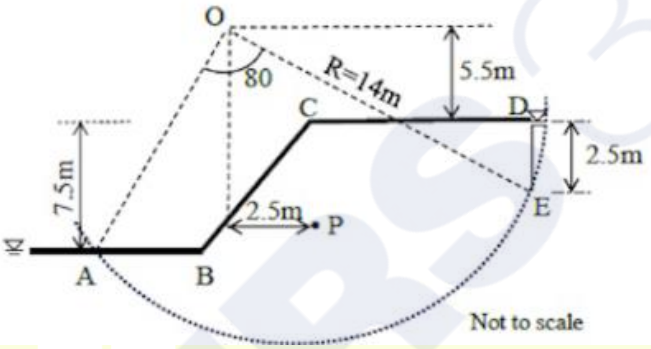
x_i	1	2	4	8
$P(X = x_i)$	0.3	0.1	0.3	0.3

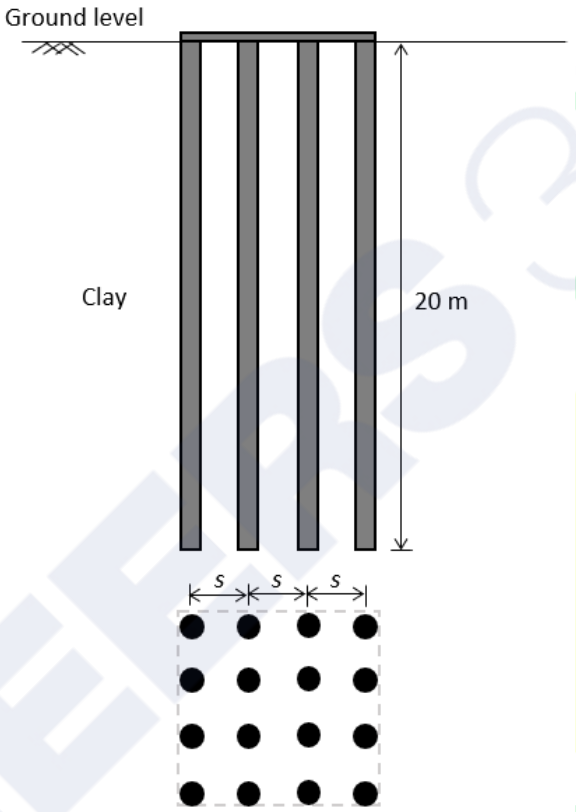
Q.52 A steel beam supported by three parallel pin-jointed steel rods is shown in the figure. The moment of inertia of the beam is 8×10^7 mm^4. Take modulus of elasticity of steel as 210 GPa. The beam is subjected to uniformly distributed load of 6.25 kN/m, including its self-weight.

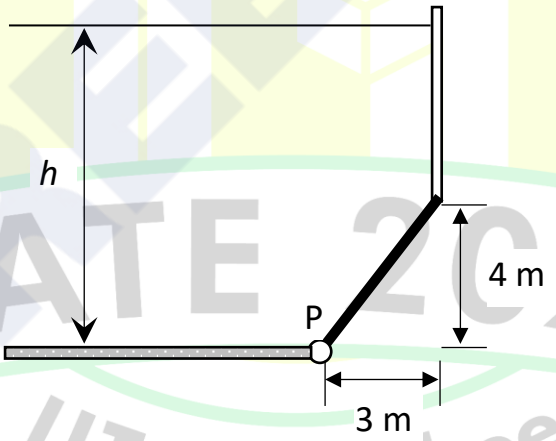
The axial force (in kN) in the centre rod CD is _____ (*round off to one decimal place*).



Q.53	The figure shows a network diagram for a construction project. The activities A, B, C, D, E, and F are represented by arrows and their durations are in the figure. The total float available for the activity E in day(s) is equal to _____ (*round off to the nearest integer*).
	
Q.54	A reinforced concrete beam has a support section with width of 300 mm and effective depth of 500 mm. The support section is reinforced with 3 bars of 20 mm diameter at the tension side. Two-legged vertical stirrups of 10 mm diameter and Fe415 steel at a spacing of 100 mm are provided as shear reinforcement. Assume that there is no possibility of diagonal compression failure at the section. As per IS 456:2000, the maximum shear resisted by the vertical stirrups (in kN), as per limit state design, is _____ (*round off to one decimal place*).

Q.55	The bank of a canal has the profile shown in the figure. The material is a homogeneous clay with a bulk unit weight of 20 kN/m^3, undrained cohesion of 30 kPa and it is fully saturated ($\phi_u = 0$). For the trial slip circle shown, the area ABCDEA is 150 m^2 and the centroid is at P. A tension crack (DE) of 2.5 m deep was also observed. Assume unit weight of water is 9.81 kN/m^3 and consider 1 m run of the bank for the analysis. Considering the canal is empty and tension crack is completely filled with water, the factor of safety against slope failure of the bank is _____ (*round off to two decimal places*).
	
Q.56	A designer used plate load test to obtain the value of the bearing capacity factor N_γ. A circular plate of 1 m diameter was placed on the surface of a dry sand layer extending very deep beneath the ground. The unit weight of the sand is 16.66 kN/m^3. The plate is loaded to failure at a pressure of 1500 kPa. Considering Terzaghi's bearing capacity theory, the bearing capacity factor N_γ is _____ (*round off to the nearest integer*).

Q.57	A 4 × 4 group pile, with each pile 20 m long and 500 mm in diameter, is installed in a square pattern in a clayey soil, as shown in the figure. The average unconfined compressive strength of the soil is 100 kN/m^2, and the adhesion factor is 0.8. Neglect the bearing at the tip of the piles. For a group efficiency factor of 1.0, the centre to centre spacing (s) of the piles (in m) would be _____ (*round off to two decimal places*).
	
Q.58	A 60 cm diameter well completely penetrates a confined aquifer of permeability 5×10^{-4} m/s. The length of the strainer (spanning the entire thickness of the aquifer) is 10 m. The drawdown at the well under steady state pumping is 1.0 m. Assume that the radius of influence for this pumping is 300 m. The discharge from the well (in litres per minute) is _____ (*round off to the nearest integer*).

Q.59	The peak of flood hydrograph due to a 3-hour duration storm in a catchment is 180 m^3/s. The total rainfall depth is 6.6 cm. It can be assumed that the average infiltration loss is 0.2 cm/h. There are no other losses. The base flow is constant at a value of 30 m^3/s. The peak value of the 3-hour unit hydrograph for this catchment (in m^3/s) is _____ (*round off to the nearest integer*).
Q.60	The shaft of a 6 m wide gate in the figure will fail at a moment of 3924 kN.m about the hinge P. The maximum value of water depth *h* (in m) that the gate can hold is _____ (*round off to the nearest integer*). Note: Density of water = 1000 kg/m^3 Acceleration due to gravity = 9.81 m/s^2
	

Q.61	The analyses results of a water sample are given below. The non-carbonate hardness of the water (in mg/L) as $CaCO_3$ is _____ (*in integer*).
	Ca^{2+} = 150 mg/L as $CaCO_3$ Mg^{2+} = 40 mg/L as $CaCO_3$ Fe^{2+} = 10 mg/L as $CaCO_3$ Na^{+} = 50 mg/L as $CaCO_3$ K^{+} = 10 mg/L as $CaCO_3$ CO_3^{2-} = 120 mg/L as $CaCO_3$ HCO_3^{-} = 30 mg/L as $CaCO_3$ Cl^{-} = 50 mg/L as $CaCO_3$; Other anions were not analysed.
Q.62	A community generates 1 million litres/day (MLD) of wastewater. This wastewater is treated using activated sludge process (ASP). The working volume of the aeration tank of the ASP is 250 m^3, and the biomass concentration in the tank is 3000 mg/L. Analyses results showed that a biomass concentration of 10 mg/L is present in the treated effluent from the secondary sedimentation tank of the ASP. Sludge wastage from the system is at a rate of 5000 L/day with a biomass concentration of 10000 mg/L. The system is in steady state condition. The biological sludge residence time (BSRT) of the system (in days) is_____ (*round off to one decimal place*).
Q.63	A settling chamber is used for the removal of discrete particulate matter from air with following conditions. Horizontal velocity of air = 0.2 m/s; Temperature of air stream = 77°C; Specific gravity of particle to be removed = 2.65; Chamber length = 12 m; Chamber height = 2 m; Viscosity of air at 77°C = 2.1 x 10^{-5} kg/m.s; Acceleration due to gravity (g) = 9.81 m/s^2; Density of air at 77°C =1.0 kg/m^3; Assume the density of water as 1000 kg/m^3 and Laminar condition exists in the chamber. The minimum size of particle that will be removed with 100% efficiency in the settling chamber (in µm) is _____ (*round off to one decimal place*).

Q.64	On a two-lane highway, a horizontal curve of radius 300 m is provided. The design speed is 80 km/h. If the longest wheelbase of vehicle expected on this highway is 7 m, then the extra widening required (in m) is _____ (*round off to two decimal places*).
Q.65	If the Fore Bearing of the lines AB and BC are 60° and 122°, respectively, then the interior angle ∠ABC (in degrees) is _____ (*round off to the nearest integer*).

Answer Key for Civil Engineering 2 (CE2)

Q. No.	Session	Q. Type	Section	Key/Range	Marks
1	8	MCQ	GA	D	1
2	8	MCQ	GA	B	1
3	8	MCQ	GA	B	1
4	8	MCQ	GA	C	1
5	8	MCQ	GA	A	1
6	8	MCQ	GA	A	2
7	8	MCQ	GA	B	2
8	8	MCQ	GA	C	2
9	8	MCQ	GA	A	2
10	8	MCQ	GA	C	2
11	8	MCQ	CE-2	A	1
12	8	MCQ	CE-2	A	1
13	8	MCQ	CE-2	A	1
14	8	MCQ	CE-2	B	1
15	8	MCQ	CE-2	D	1
16	8	MCQ	CE-2	B	1
17	8	MCQ	CE-2	C	1
18	8	MCQ	CE-2	A	1
19	8	MCQ	CE-2	A	1
20	8	MCQ	CE-2	C	1
21	8	MSQ	CE-2	A;C	1
22	8	MSQ	CE-2	B;C	1
23	8	MSQ	CE-2	A;C;D	1
24	8	MSQ	CE-2	A;D	1
25	8	MSQ	CE-2	B;C	1
26	8	MSQ	CE-2	B;C	1
27	8	MSQ	CE-2	D	1
28	8	MSQ	CE-2	A	1
29	8	NAT	CE-2	3 to 3	1
30	8	NAT	CE-2	5.7 to 6.0	1

31	8	NAT	CE-2	1.24 to 1.30	1
32	8	NAT	CE-2	0.010 to 0.015	1
33	8	NAT	CE-2	64 to 64	1
34	8	NAT	CE-2	2.50 to 2.60	1
35	8	NAT	CE-2	936 to 936	1
36	8	MCQ	CE-2	A	2
37	8	MCQ	CE-2	A	2
38	8	MCQ	CE-2	C	2
39	8	MCQ	CE-2	B	2
40	8	MCQ	CE-2	B	2
41	8	MCQ	CE-2	B	2
42	8	MCQ	CE-2	B	2
43	8	MCQ	CE-2	A	2
44	8	MSQ	CE-2	A;D	2
45	8	MSQ	CE-2	A;C	2
46	8	MSQ	CE-2	A;D	2
47	8	MSQ	CE-2	A;C;D	2
48	8	MSQ	CE-2	A;C	2
49	8	MSQ	CE-2	A;B;C	2
50	8	MSQ	CE-2	A;C	2
51	8	NAT	CE-2	2.7 to 2.9	2
52	8	NAT	CE-2	16.3 to 16.6	2
53	8	NAT	CE-2	1 to 1	2
54	8	NAT	CE-2	283.0 to 284.0	2
55	8	NAT	CE-2	1.00 to 1.10	2
56	8	NAT	CE-2	300 to 300	2
57	8	NAT	CE-2	1.50 to 1.52	2
58	8	NAT	CE-2	271 to 273	2
59	8	NAT	CE-2	25 to 25	2
60	8	NAT	CE-2	7 to 9	2
61	8	NAT	CE-2	50 to 50	2
62	8	NAT	CE-2	12.3 to 12.7	2
63	8	NAT	CE-2	21.0 to 45.0	2
64	8	NAT	CE-2	0.63 to 0.66	2
65	8	NAT	CE-2	118 to 118	2