

CE - GATE 2014 - Paper

CE - PAPER NO. 1

G. A. Questions

Q. No. 1 – 5 Carry One Mark Each

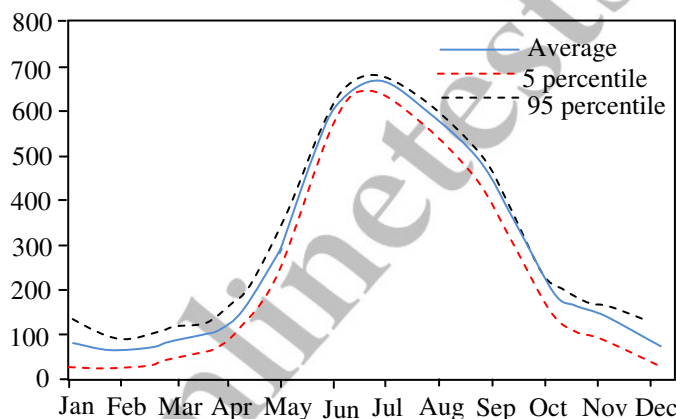
- Q.1 A student is required to demonstrate a high level of comprehension of the subject, especially in the social sciences.
The word closest in meaning to comprehension is
(A) understanding (B) meaning (C) concentration (D) stability
- Q.2 Choose the most appropriate word from the options given below to complete the following sentence.
One of his biggest _____ was his ability to forgive.
(A) vice (B) virtues (C) choices (D) strength
- Q.3 Rajan was not happy that Sajjan decided to do the project on his own. On observing his unhappiness, Sajjan explained to Rajan that he preferred to work independently.
Which one of the statements below is logically valid and can be inferred from the above sentences?
(A) Rajan has decided to work only in a group.
(B) Rajan and Sajjan were formed into a group against their wishes.
(C) Sajjan had decided to give in to Rajan's request to work with him.
(D) Rajan had believed that Sajjan and he would be working together.
- Q.4 If $y = 5x^2 + 3$, then the tangent at $x = 0, y = 3$
(A) passes through $x = 0, y = 0$ (B) has a slope of +1
(C) is parallel to the x-axis (D) has a slope of -1
- Q.5 A foundry has a fixed daily cost of Rs 50,000 whenever it operates and a variable cost of Rs 800Q, where Q is the daily production in tonnes. What is the cost of production in Rs per tonne for a daily production of 100 tonnes?

Q. No. 6 – 10 Carry One Mark Each

- Q.6 Find the odd one in the following group: ALRVX, EPVZB, ITZDF, OYEIK
(A) ALRVX (B) EPVZB (C) ITZDF (D) OYEIK
- Q.7 Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and so on). Anuj lives on an even-numbered floor. Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person combinations is correct?

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
(A)	6	2	5	1	3	4
(B)	2	6	5	1	3	4
(C)	4	2	6	3	1	5
(D)	2	4	6	1	3	5

- Q.8 The smallest angle of a triangle is equal to two thirds of the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. The largest angle of the triangle is twice its smallest angle. What is the sum, in degrees, of the second largest angle of the triangle and the largest angle of the quadrilateral?
- Q.9 One percent of the people of country X are taller than 6 ft. Two percent of the people of country Y are taller than 6 ft. There are thrice as many people in country X as in country Y. Taking both countries together, what is the percentage of people taller than 6 ft?
 (A) 3.0 (B) 2.5 (C) 1.5 (D) 1.25
- Q.10 The monthly rainfall chart based on 50 years of rainfall in Agra is shown in the following figure. Which of the following are true? (k percentile is the value such that k percent of the data fall below that value)



- (i) On average, it rains more in July than in December
 (ii) Every year, the amount of rainfall in August is more than that in January
 (iii) July rainfall can be estimated with better confidence than February rainfall
 (iv) In August, there is at least 500 mm of rainfall
 (A) (i) and (ii) (B) (i) and (iii) (C) (ii) and (iii) (D) (iii) and (iv)

Civil Engineering Questions

Q. No. 1 – 25 Carry One Mark Each

1. $\lim_{x \rightarrow \infty} \left(\frac{x + \sin x}{x} \right)$ equals to
 (A) $-\infty$ (B) 0 (C) 1 (D) ∞

2. Given the matrices $J = \begin{bmatrix} 3 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 6 \end{bmatrix}$ and $K = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$, the product K^T

3. The probability density function of evaporation on any day during a year in a watershed is given by

$$f(E) = \begin{cases} \frac{1}{5} & 0 \leq E \leq 5 \text{ mm/day} \\ 0 & \text{otherwise} \end{cases}$$

The probability that E lies in between 2 and 4 mm/day in a day in the watershed is (in decimal) _____

4. The sum of Eigen values of the matrix, [M] is

$$\text{where } [M] = \begin{bmatrix} 215 & 650 & 795 \\ 655 & 150 & 835 \\ 485 & 355 & 550 \end{bmatrix}$$

- (A) 915 (B) 1355 (C) 1640 (D) 2180
5. With reference to the conventional Cartesian (x, y) coordinate system, the vertices of a triangle have the following coordinates: $(x_1, y_1) = (1, 0)$; $(x_2, y_2) = (2, 2)$; and $(x_3, y_3) = (4, 3)$. The area of the triangle is equal to

- (A) $\frac{3}{2}$ (B) $\frac{3}{4}$ (C) $\frac{4}{5}$ (D) $\frac{5}{2}$

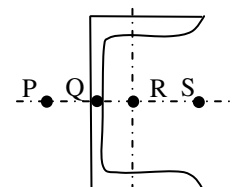
6. Match the information given in Group – I with those in Group II.

Group - I	Group - II
(p) Factor to decrease ultimate strength to design strength	(1) Upper bound on ultimate load
(q) Factor to increase working load to ultimate load for design	(2) Lower bound on ultimate load
(r) Statical method of ultimate load analysis	(3) Material partial safety factor
(s) Kinematical mechanism method of ultimate load analysis	(4) Load factor

- (A) P – 1; Q – 2; R – 3; S – 4 (B) P – 2; Q – 1; R – 4; S – 3
(C) P – 3; Q – 4; R – 2; S – 1 (D) P – 4; Q – 3; R – 2; S – 1

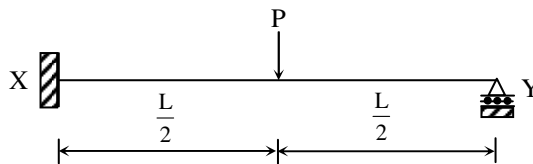
7. The possible location of shear centre of the channel section, shown below, is

- (A) P (B) Q (C) R (D) S

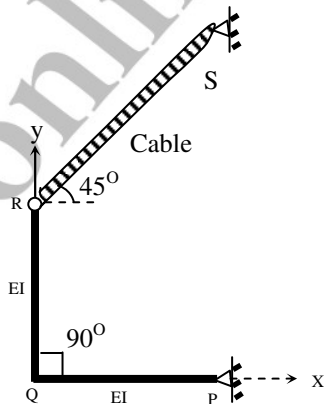


CE - GATE 2014 - Paper

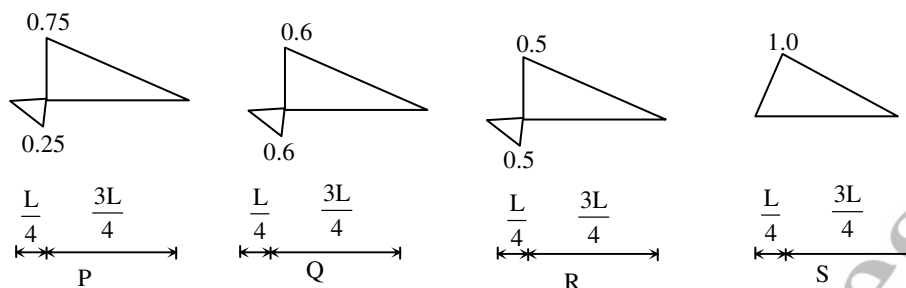
8. The ultimate collapse load (P) in terms of plastic moment M_p by kinematic approach for a propped cantilever of length L with P acting at its mid-span as shown in the figure, would be



- (A) $P = \frac{2M_p}{L}$ (B) $P = \frac{4M_p}{L}$ (C) $P = \frac{6M_p}{L}$ (D) $P = \frac{8M_p}{L}$
9. While designing, for a steel column of Fe250 grade, a base plate resting on a concrete pedestal of M20 grade, the bearing strength of concrete (in N/mm^2) in limit state method of design as per IS:456-2000 is _____
10. A steel section is subjected to a combination of shear and bending actions. The applied shear force is V and the shear capacity of the section is V_s . For such a section, high shear force (as per IS:800-2007) is defined as
- (A) $V > 0.6V_s$ (B) $V > 0.7V_s$
(C) $V > 0.8V_s$ (D) $V > 0.9V_s$
11. The degree of static indeterminacy of a rigid jointed frame PQR supported as shown in the figure is



- (A) Zero (B) One (C) Two (D) Unstable
12. In a beam of length L , four possible influence line diagrams for shear force at a section located at a distance of $\frac{L}{4}$ from the left end support (marked as P, Q, R and S) are shown below. The correct influence line diagram is



- (A) P (B) Q (C) R (D) S

13. The degree of disturbance of the sample collected by the sampler is expressed by a term called the "area ratio". If the outer diameter and inner diameter of the sampler are D_o and D_i respectively, the area ratio is given by

- (A) $\frac{D_o^2 - D_i^2}{D_i^2}$ (B) $\frac{D_i^2 - D_o^2}{D_i^2}$ (C) $\frac{D_o^2 - D_i^2}{D_o^2}$ (D) $\frac{D_i^2 - D_o^2}{D_o^2}$

14. For a saturated cohesive soil, a triaxial test yields the angle of internal friction (ϕ) as zero. The conducted test is

- (A) Consolidated Drained (CD) test (B) Consolidated Undrained (CU) test
(C) Unconfined Compression (UC) test (D) Unconsolidated Undrained (UU) test

15. The action of negative skin friction on the pile is to

- (A) increase the ultimate load on the pile (B) reduce the allowable load on the pile
(C) maintain the working load on the pile (D) reduce the settlement of the pile

16. A long slope is formed in a soil with shear strength parameters: $c' = 0$ and $\phi' = 34^\circ$. A firm stratum lies below the slope and it is assumed that the water table may occasionally rise to the surface, with seepage taking place parallel to the slope. Use $\gamma_{mt} = 18 \text{ kN/m}^3$ and $\gamma_w = 10 \text{ kN/m}^3$. The maximum slope angle (in degrees) to ensure a factor of safety of 1.5, assuming a potential failure surface parallel to the slope, would be

- (A) 45.3 (B) 44.7 (C) 12.3 (D) 11.3

17. An incompressible homogeneous fluid is flowing steadily in a variable diameter pipe having the large and small diameters as 15 cm and 5 cm, respectively. If the velocity at a section at the 15 cm diameter portion of the pipe is 2.5 m/s, the velocity of the fluid (in m/s) at a section falling in 5 cm portion of the pipe is _____

18. A conventional flow duration curve is a plot between

- (A) Flow and percentage time flow is exceeded
(B) Duration of flooding and ground level elevation
(C) Duration of water supply in a city and proportion of area receiving supply exceeding this duration
(D) Flow rate and duration of time taken to empty a reservoir at that flow rate

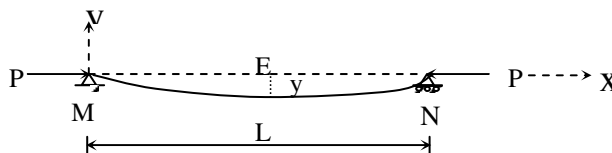
19. In reservoirs with an uncontrolled spillway, the peak of the plotted outflow hydrograph
(A) lies outside the plotted inflow hydrograph
(B) lies on the recession limb of the plotted inflow hydrograph
(C) lies on the peak of the inflow hydrograph
(D) is higher than the peak of the plotted inflow hydrograph
20. The dimension for kinematic viscosity is
(A) $\frac{L}{MT}$ (B) $\frac{L}{T^2}$ (C) $\frac{L^2}{T}$ (D) $\frac{ML}{T}$
21. Some of the nontoxic metals normally found in natural water are
(A) arsenic, lead and mercury (B) calcium, sodium and silver
(C) cadmium, chromium and copper (D) iron, manganese and magnesium
22. The amount of CO_2 generated (in kg) while completely oxidizing one kg of CH_4 to the end products is _____
23. The minimum value of 15 minute peak hour factor on a section of a road is
(A) 0.10 (B) 0.20 (C) 0.25 (D) 0.33
24. The following statements are related to temperature stresses developed in concrete pavement slabs with free edges (without any restraint):
(P) The temperature stresses will be zero during both day and night times if the pavement slab is considered weightless
(Q) The temperature stresses will be compressive at the bottom of the slab during night time if the self-weight of the pavement slab is considered
(R) The temperature stresses will be compressive at the bottom of the slab during day time if the self-weight of the pavement slab is considered
The TRUE statement(s) is(are)
(A) P only (B) Q only (C) P and Q only (D) P and R only
25. The Reduced Levels (RLs) of the points P and Q are +49.600 m and +51.870 m respectively. Distance PQ is 20 m. The distance (in m from P) at which the +51.000 m contour cuts the line PQ is
(A) 15.00 (B) 12.33 (C) 3.52 (D) 2.27

CE - GATE 2014 - Paper

Q. No. 26 – 55 Carry Two Marks

26. If the following equation establishes equilibrium in slightly bent position, the mid-span deflection of a member shown in the figure is

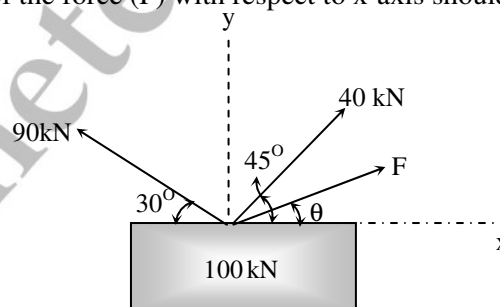
$$\frac{d^2y}{dx^2} + \frac{P}{EI} y = 0$$



If α is amplitude constant for y , then

- (A) $y = \frac{1}{P} \left(1 - \alpha \cos \frac{2\pi x}{L} \right)$ (B) $y = \frac{1}{P} \left(1 - \alpha \sin \frac{2\pi x}{L} \right)$
 (C) $y = \alpha \sin \frac{n\pi x}{L}$ (D) $y = \alpha \cos \frac{n\pi x}{L}$
27. A box of weight 100 kN shown in the figure is to be lifted without swinging. If all forces are coplanar, the magnitude and direction (θ) of the force (F) with respect to x-axis should be

- (A) $F = 56.389$ kN and $\theta = 28.28^\circ$
 (B) $F = -56.389$ kN and $\theta = -28.28^\circ$
 (C) $F = 9.055$ kN and $\theta = 1.414^\circ$
 (D) $F = -9.055$ kN and $\theta = -1.414^\circ$

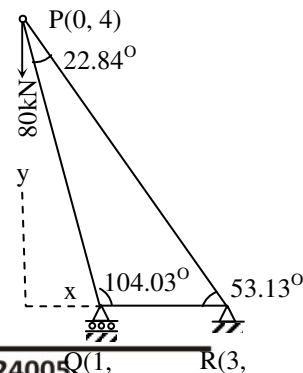


28. A particle moves along a curve whose parametric equations are: $x = t^3 + 2t$, $y = -3e^{-2t}$ and $z = 2\sin(5t)$, where x , y and z show variations of the distance covered by the particle (in cm) with time t (in s). The magnitude of the acceleration of the particle (in cm/s^2) at $t = 0$ is _____

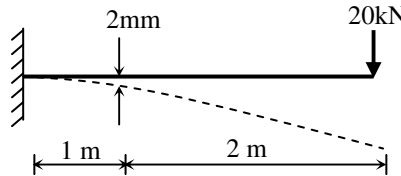
29. A traffic office imposes on an average 5 number of penalties daily on traffic violators. Assume that the number of penalties on different days is independent and follows a Poisson distribution. The probability that there will be less than 4 penalties in a day is _____

30. Mathematical idealization of a crane has three bars with their vertices arranged as shown in the figure with a load of 80 kN hanging vertically. The coordinates of the vertices are given in parentheses. The force in the member QR, F_{QR} will be

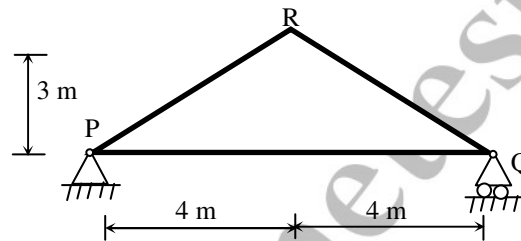
- (A) 30 kN Compressive (B) 30 kN Tensile
 (C) 50 kN Compressive (D) 50 kN Tensile



31. For the cantilever beam of span 3 m (shown below), a concentrated load of 20 kN applied at the free end causes a vertical displacement of 2 mm at a section located at a distance of 1 m from the fixed end. If a concentrated vertically downward load of 10 kN is applied at the section located at a distance of 1 m from the fixed end (with no other load on the beam), the maximum vertical displacement in the same beam (in mm) is



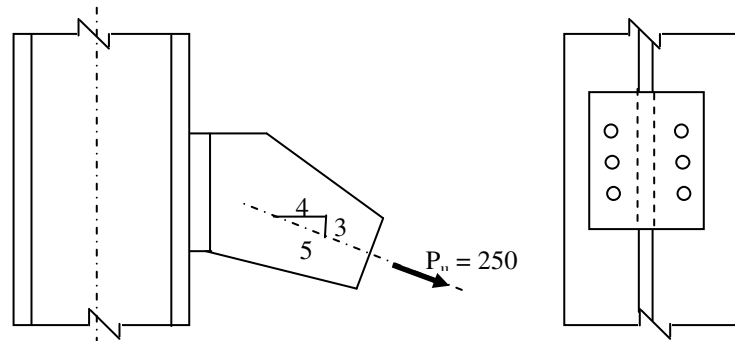
32. For the truss shown below, the member PQ is short by 3 mm. The magnitude of vertical displacement of joint R (in mm) is _____



33. A rectangular beam of width (b) 230 mm and effective depth (d) 450 mm is reinforced with four bars of 12 mm diameter. The grade of concrete is M20 and grade of steel is Fe500. Given that for M20 grade of concrete the ultimate shear strength, $\tau_{\infty} = 0.36 \text{ N/mm}^2$ for steel percentage, $p = 0.25$, and $\tau_{\infty} = 0.48 \text{ N/mm}^2$ for $p = 0.50$. For a factored shear force of 45 kN, the diameter (in mm) of Fe500 steel two legged stirrups to be used at spacing of 375 mm, should be
- (A) 8 (B) 10 (C) 12 (D) 16

34. The tension and shear force (both in kN) in each bolt of the joint, as shown below, respectively are

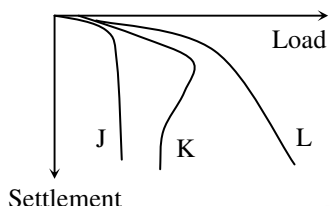
- (A) 30.33 and 20.00
 (B) 30.33 and 25.00
 (C) 33.33 and 20.00
 (D) 33.33 and 25.00



35. For a beam of cross-section, width = 230 mm and effective depth = 500 mm, the number of rebars of 12 mm diameter required to satisfy minimum tension reinforcement requirement specified by IS:456-2000 (assuming grade of steel reinforcement as Fe500) is _____

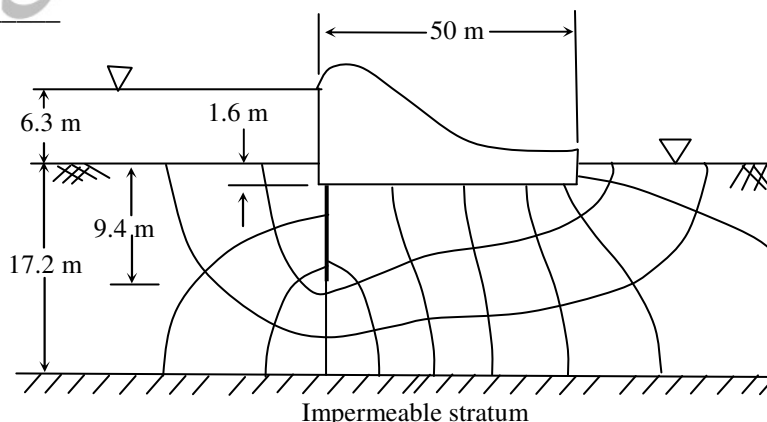
CE - GATE 2014 - Paper

36. In a reinforced concrete section, the stress at the extreme fibre in compression is 5.80 MPa. The depth of neutral axis in the section is 58 mm and the grade of concrete is M25. Assuming linear elastic behavior of the concrete, the effective curvature of the section (in per mm) is
 (A) 2.0×10^{-6} (B) 3.0×10^{-6} (C) 4.0×10^{-6} (D) 5.0×10^{-6}
37. Group I contains representative load-settlement curves for different modes of bearing capacity failures of sandy soil. Group II enlists the various failure characteristics. Match the load-settlement curves with the corresponding failure characteristics.

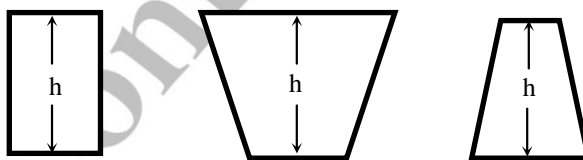


Group I	Group II
(p) Curve J	(1) No apparent heaving of soil around the footing
(q) Curve K	(2) Rankine's passive zone develops imperfectly
(r) Curve L	(3) Well defined slip surface extends to ground surface

- (A) P - 1, Q - 3, R - 2 (B) P - 3, Q - 2, R - 1
 (C) P - 3, Q - 1, R - 2 (D) P - 1, Q - 2, R - 3
38. A given cohesionless soil has $e_{max} = 0.85$ and $e_{min} = 0.50$. In the field, the soil is compacted to a mass density of 1800 kg/m^3 at a water content of 8%. Take the mass density of water as 1000 kg/m^3 and G, as 2.7. The relative density (in %) of the soil is
 (A) 56.43 (B) 60.25 (C) 62.87 (D) 65.7
39. The following data are given for the laboratory sample.
 $\sigma_0' = 175 \text{ kPa}$; $e_0 = 1.1$; $\sigma_0' + \Delta\sigma_0' = 300 \text{ kPa}$; $e = 0.9$
 If thickness of the clay specimen is 25mm, the value of coefficient of volume compressibility is $\text{_____} \times 10^{-4} \text{ m}^2 / \text{kN}$
40. The flow net constructed for the dam is shown in the figure below. Taking the coefficient of permeability as $3.8 \times 10^{-6} \text{ m/s}$, the quantity of flow (in cm^3/s) under the dam per meter of dam is _____



41. A horizontal jet of water with its cross-sectional area of 0.0028 m^2 hits a fixed vertical plate with a velocity of 5 m/s . After impact the jet splits symmetrically in a plane parallel to the plane of the plate. The force of impact (in N) of the jet on the plate is
 (A) 90 (B) 80 (C) 70 (D) 60
42. A venturimeter, having a diameter of 7.5 cm at the throat and 15 cm at the enlarged end, is installed in a horizontal pipeline of 15 cm diameter. The pipe carries an incompressible fluid at a steady rate of $30 \text{ litres per second}$. The difference of pressure head measured in terms of the moving fluid in between the enlarged and the throat of the venturimeter is observed to be 2.45 m . Taking the acceleration due to gravity as 9.81 m/s^2 , the coefficient of discharge of the venturimeter (correct up to two places of decimal) is _____
43. A rectangular channel having a bed slope of 0.0001 , width 3.0 m and Manning's coefficient 'n' 0.015 , carries a discharge of $1.0 \text{ m}^3/\text{s}$. Given that the normal depth of flow ranges between 0.76 m and 0.8 m . The minimum width of a throat (in m) that is possible at a given section, while ensuring that the prevailing normal depth is not exceeded along the reach upstream of the contraction, is approximately equal to (assume negligible losses)
 (A) 0.64 (B) 0.84 (C) 1.04 (D) 1.24
44. Three rigid buckets, shown as in the figures (1), (2) and (3), are of identical heights and base areas. Further, assume that each of these buckets have negligible mass and are full of water. The weights of water in these buckets are denoted as W_1 , W_2 , and W_3 respectively. Also, let the force of water on the base of the bucket be denoted as F_1 , F_2 , and F_3 respectively. The option giving an accurate description of the system physics is



ALL THREE BUCKETS HAVE THE SAME BASE AREA

- (1) (2) (3)
- (A) $W_2 = W_1 = W_3$ and $F_2 > F_1 > F_3$ (B) $W_2 > W_1 > W_3$ and $F_2 > F_1 > F_3$
 (C) $W_2 = W_1 = W_3$ and $F_1 = F_2 = F_3$ (D) $W_2 > W_1 > W_3$ and $F_1 = F_2 = F_3$
45. An incompressible fluid is flowing at a steady rate in a horizontal pipe. From a section, the pipe divides into two horizontal parallel pipes of diameters d_1 and d_2 (where $d_1 = 4d_2$) that run for a distance of L each and then again join back to a pipe of the original size. For both the parallel pipes, assume the head loss due to friction only and the Darcy-Weisbach friction factor to be the same. The velocity ratio between the bigger and the smaller branched pipes is _____
46. 16 MLD of water is flowing through a 2.5 km long pipe of diameter 45 cm . The chlorine at the rate of 32 kg/d is applied at the entry of this pipe so that disinfected water is obtained at the exit. There is a proposal to increase the flow through this pipe to 22 MLD from 16 MLD . Assume the dilution coefficient, $n = 1$. The minimum amount of chlorine (in kg per day) to be applied to achieve the same degree of disinfection for the enhanced flow is
 (A) 60.50 (B) 44.00 (C) 38.00 (D) 23.27

CE - GATE 2014 - Paper

47. The potable water is prepared from turbid surface water by adopting the following treatment sequence.
- (A) Turbid surface water → Coagulation → Flocculation → Sedimentation → Filtration → Disinfection → Storage & Supply
- (B) Turbid surface water → Disinfection → Flocculation → Sedimentation → Filtration → Coagulation → Storage & Supply
- (C) Turbid surface water → Filtration → Sedimentation → Disinfection → Flocculation → Coagulation → Storage & Supply
- (D) Turbid surface water → Sedimentation → Flocculation → Coagulation → Disinfection → Filtration . Storage & Supply

48. For a sample of water with the ionic composition shown in the figure below, the carbonate and non-carbonate hardness concentrations (in mg/l as CaCO₃), respectively are:

meq/l	0	4	5	7
	Ca ²⁺		Mg ²⁺	Na ⁺
	HCO ₃ ⁻		SO ₄ ²⁻	
meq/l	0	3.5		7

- (A) 200 and 50 (B) 175 and 75 (C) 75 and 175 (D) 50 and 200
49. A straight 100 m long raw water gravity main is to carry water from an intake structure to the jack well of a water treatment plant. The required flow through this water main is 0.21 m³/s. Allowable velocity through the main is 0.75 m/s. Assume $f = 0.01$, $g = 9.81 \text{ m/s}^2$. The minimum gradient (in cm/100 m length) to be given to this gravity main so that the required amount of water flows without any difficulty is ____
50. A traffic survey conducted on a road yields an average daily traffic count of 5000 vehicles. The axle load distribution on the same road is given in the following table:

Axle load (tonnes)	Frequency of traffic (%)
18	10
14	20
10	35
8	15
6	20

- The design period of the road is 15 years, the yearly traffic growth rate is 7.5% and the load safety factor (LSF) is 1.3. If the vehicle damage factor (VDF) is calculated from the above data, the design traffic (in million standard axle load, MSA) is
51. The perception-reaction time for a vehicle travelling at 90 km/h, given the coefficient of longitudinal friction of 0.35 and the stopping sight distance of 170 m (assume $g = 9.81 \text{ m/s}^2$), is _____ seconds.
52. The speed-density (u-k) relationship on a single lane road with unidirectional flow is $u = 70 - 0.7k$, where u is in km/hr and k is in veh/km. The capacity of the road (in veh/hr) is _____

CE - GATE 2014 - Paper

53. An isolated three-phase traffic signal is designed by Webster's method. The critical flow ratios for three phases are 0.20, 0.30, and 0.25 respectively, and lost time per phase is 4 seconds. The optimum cycle length (in seconds) is _____

54. A levelling is carried out to establish the Reduced Levels (RL) of point R with respect to the Bench Mark (BM) at P. The staff readings taken are given below.

Staff Station	BS	IS	FS	RL
P	1.655 m			100.000 m
Q	-0.950 m		-1.500 m	
R			0.750 m	?

If RL of P is +100.000 m, then RL (in m) of R is

- (A) 103.355 (B) 103.155 (C) 101.455 (D) 100.355

55. Group I lists tool/instrument while Group II lists the method of surveying. Match the tool/instrument with the corresponding method of surveying.

Group I	Group II
(p) Alidade	(1) Chain surveying
(q) Arrow	(2) Levelling
(r) Bubble tube	(3) Plain table surveying
(s) Stadia hair	(4) Theodolite surveying

(A) P – 3; Q – 2; R – 1; S – 4

(B) P – 2; Q – 4; R – 3; S – 1

(C) P – 1; Q – 2; R – 4; S – 3

(D) P – 3; Q – 1; R – 2; S – 4