GATE Civil Engineering

Sample Paper – 10

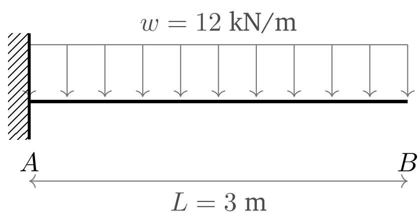
Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Civil Engineering** subject of the GATE paper conducted by the IITs and IISc (General Aptitude and Engineering Mathematics are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Take $g = 9.81$ m/s^2 and unit weight of water $\gamma_w = 9.81$ kN/m^3 unless stated otherwise.

Structural Engineering

Q1. A cantilever beam of length 3 m is fixed at A and carries a uniformly distributed load of 12 kN/m over its whole length, as shown. The maximum bending moment in the beam (magnitude, at the fixed end) is: **[1 mark]**



(A) 54 kN·m

(B) 18 kN·m

(C) 108 kN·m

(D) 36 kN·m

Q2. A prismatic steel bar of length 2 m and cross-sectional area 500 mm^2 carries an axial tensile load of 50 kN. Taking the modulus of elasticity $E = 200$ GPa, the axial elongation of the bar is: **[1 mark]**

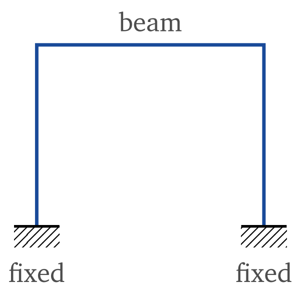
(A) 0.5 mm

(B) 2.0 mm

(C) 0.25 mm

(D) 1.0 mm

Q3. The single-bay, single-storey rigid plane frame shown has both column bases fixed to the ground. Its degree of static indeterminacy is: **[1 mark]**



(A) 1

(B) 3

(C) 6

(D) 2

Q4. In the working-stress method of IS 456, the modular ratio is taken as $m = \dfrac{280}{3\,\sigma_{cbc}}$, where σ_{cbc} is the permissible compressive stress in bending. For **M20** concrete, $\sigma_{cbc} = 7$ N/mm^2. The modular ratio is nearest to: **[1 mark]**

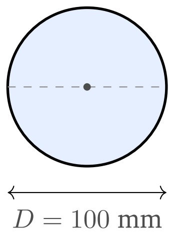
(A) 9.33

(B) 13.33

(C) 18.67

(D) 10.00

Q5. A solid circular column has a diameter of 100 mm, as shown in section, and an effective length of 3 m. The slenderness ratio of the column is: **[1 mark]**



(A) 30

(B) 60

(C) 120

(D) 48

Q6. For a certain isotropic elastic material, the modulus of elasticity is $E = 200$ GPa and the shear modulus is $G = 80$ GPa. Using $E = 2G(1 + \mu)$, the Poisson's ratio μ of the material is: **[1 mark]**

(A) 0.30

(B) 0.20

(C) 0.33

(D) 0.25

Q7. A cantilever beam of length L and flexural rigidity EI carries a uniformly distributed load of intensity w over its entire span. The maximum vertical deflection (at the free end) of the beam is: **[1 mark]**

(A) $\dfrac{5wL^4}{384EI}$

(B) $\dfrac{wL^3}{3EI}$

(C) $\dfrac{wL^4}{8EI}$

(D) $\dfrac{wL^4}{30EI}$

Q8. A straight column is fixed at its base and completely free at its top (a flagpole-type column). For use in the Euler buckling formula, the effective length of this column is: **[1 mark]**

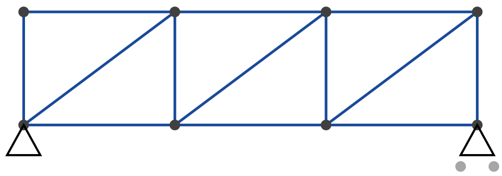
(A) $0.5\,L$

(B) $1.0\,L$

(C) $0.707\,L$

(D) $2.0\,L$

Q9. The plane truss shown below has 8 joints and 13 members, and is supported by one hinge and one roller (that is, $r = 3$ reaction components). By the count $D_s = m + r - 2j$, the truss is: **[1 mark]**



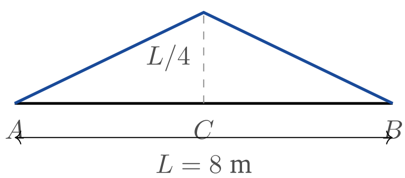
(A) statically determinate ($D_s = 0$)

(B) indeterminate to degree 1

(C) a mechanism (deficient)

(D) indeterminate to degree 2

Q10. For a simply supported beam AB of span 8 m, the influence line for the bending moment at the *midspan* section C is a triangle, as sketched. The peak ordinate of this influence line (which occurs when the unit load stands over C) is: **[1 mark]**



(A) 2 m

(B) 4 m

(C) 1 m

(D) 8 m

Q11. In the moment-distribution method, a moment is applied at one end of a prismatic member whose far end is rigidly fixed. The carry-over factor (ratio of the moment induced at the fixed end to the applied moment) is: **[1 mark]**

(A) 1.00

(B) 0.50

(C) 0.25

(D) 0.75

Q12. In the limit state design of reinforced concrete to IS 456:2000, the partial safety factor applied to the characteristic strength of **concrete**, γ_{mc}, is: **[1 mark]**

(A) 1.15

(B) 1.50

(C) 1.00

(D) 1.25

Q13. In the plastic analysis of a beam of solid rectangular cross-section, the shape factor (ratio of the plastic section modulus Z_p to the elastic section modulus Z_e) is: **[1 mark]**

(A) 1.70

(B) 1.00

(C) 2.00

(D) 1.50

Q14. In a CPM network, an activity has an earliest start time of 5 days and a latest start time of 9 days. The total float of the activity is: **[1 mark]**

(A) 4 days

(B) 14 days

(C) 9 days

(D) 5 days

Geotechnical Engineering

Q15. A soil sample has a bulk (moist) unit weight of 20 kN/m^3 at a water content of 25%. The dry unit weight of the soil is: **[1 mark]**

(A) 25.0 kN/m^3

(B) 15.0 kN/m^3

(C) 18.0 kN/m^3

(D) 16.0 kN/m^3

Q16. A cohesionless soil in the field has a void ratio of 0.70. Laboratory tests give its maximum and minimum void ratios as 0.90 and 0.50 respectively. The relative density (density index) of the soil is: **[1 mark]**

(A) 25%

(B) 50%

(C) 75%

(D) 40%

Q17. A particle-size analysis of a sand gives an effective size $D_{10} = 0.15$ mm and $D_{60} = 0.60$ mm. The coefficient of uniformity C_u of the soil is: **[1 mark]**

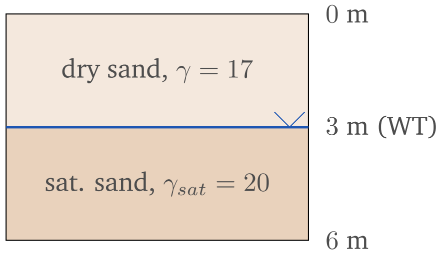
(A) 0.25

(B) 2

(C) 4

(D) 9

Q18. A soil profile is shown below. The top 3 m is dry sand of unit weight 17 kN/m^3; below the water table (at 3 m depth) the sand is saturated with unit weight 20 kN/m^3. The effective vertical stress at a depth of 6 m is nearest to: **[1 mark]**



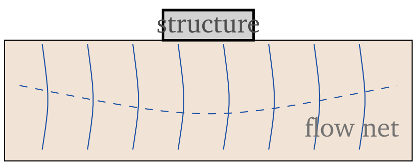
(A) 111.0 kN/m^2

(B) 102.0 kN/m^2

(C) 81.57 kN/m^2

(D) 90.0 kN/m^2

Q19. Water seeps beneath a hydraulic structure through a soil of permeability $k = 4 \times 10^{-5}$ m/s. The flow net drawn for the seepage has $N_f = 4$ flow channels and $N_d = 10$ equipotential drops, as sketched, under a total head loss of $H = 5$ m. The seepage discharge per metre length of the structure is: **[1 mark]**



(A) 2×10^{-5} m^3/s

(B) 1×10^{-4} m^3/s

(C) 5×10^{-5} m^3/s

(D) 8×10^{-5} m^3/s

Q20. In Terzaghi's one-dimensional consolidation theory, the dimensionless time factor T_v corresponding to an average degree of consolidation $U = 50\%$ is nearest to: **[1 mark]**

(A) 0.197

(B) 0.848

(C) 0.500

(D) 1.000

Geotechnical Engineering (continued)

Q21. A 4 m thick layer of normally consolidated clay has a compression index $C_c = 0.30$ and an initial void ratio $e_0 = 0.80$. Under a new loading the effective vertical stress at mid-depth increases from $\sigma'_0 = 100$ kPa to 200 kPa. The primary consolidation settlement of the layer is nearest to: **[2 marks]**

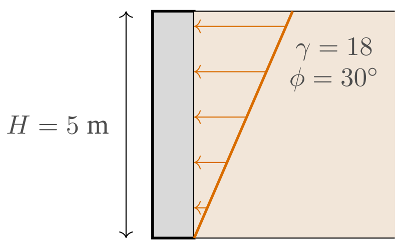
(A) 200 mm

(B) 100 mm

(C) 301 mm

(D) 150 mm

Q22. A vertical wall 5 m high retains a dry cohesionless backfill of unit weight 18 kN/m^3 and friction angle $\phi = 30°$, and the wall is pushed *into* the backfill so that the passive state develops. Using Rankine's theory, the total passive earth thrust per metre run of the wall is: **[2 marks]**



(A) 225 kN/m

(B) 675 kN/m

(C) 337.5 kN/m

(D) 1350 kN/m

Q23. A strip footing of width $B = 2$ m is founded at a depth $D_f = 1$ m in a cohesionless soil of unit weight 18 kN/m^3 (with effective cohesion $c' =$

0). For the friction angle involved, Terzaghi's bearing-capacity factors are $N_q = 18$ and $N_\gamma = 15$. The gross ultimate bearing capacity, $q_u = c'N_c + \gamma D_f N_q + 0.5\,\gamma B N_\gamma$, is: **[2 marks]**

(A) 594 kPa

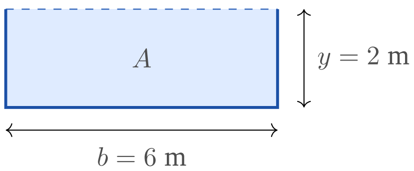
(B) 324 kPa

(C) 270 kPa

(D) 648 kPa

Water Resources Engineering

Q24. A rectangular channel of bottom width 6 m carries water at a depth of 2 m, as shown. The hydraulic radius (hydraulic mean depth) of the flow section is: **[2 marks]**



(A) 1.2 m

(B) 1.5 m

(C) 2.0 m

(D) 0.83 m

Q25. Water flows in a wide channel where the hydraulic radius is 1 m and the bed slope is 0.0004. Taking Manning's roughness coefficient $n = 0.02$, the mean velocity of flow given by Manning's formula $V = \frac{1}{n}R^{2/3}S^{1/2}$ is: **[2 marks]**

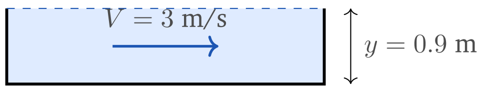
(A) 2.0 m/s

(B) 0.5 m/s

(C) 1.0 m/s

(D) 1.5 m/s

Q26. Water flows in a rectangular channel at a mean velocity of 3 m/s and a depth of 0.90 m, as shown. The Froude number of the flow is nearest to (which also tells the state of flow): **[2 marks]**



(A) 0.50 (subcritical)

(B) 1.01 (near critical)

(C) 2.00 (supercritical)

(D) 0.34 (subcritical)

Q27. Water at kinematic viscosity $\nu = 1 \times 10^{-6}$ m^2/s flows through a pipe of diameter 0.10 m at a mean velocity of 1 m/s. The Reynolds number of the flow is: **[2 marks]**

(A) 1×10^3

(B) 1×10^5

(C) 1×10^4

(D) 1×10^6

Q28. Water flows in a rectangular channel at a depth of 1 m with a mean velocity of 2 m/s. The specific energy of the flow, $E = y + \dfrac{V^2}{2g}$, is nearest to: **[2 marks]**

(A) 1.20 m

(B) 1.00 m

(C) 2.04 m

(D) 0.20 m

Q29. A pump lifts water at a discharge of 0.5 m^3/s against a total head of 20 m. Taking the unit weight of water as 9.81 kN/m^3, the water (output) power delivered by the pump, $P = \gamma_w QH$, is: **[2 marks]**

(A) 9.81 kW

(B) 49.05 kW

(C) 98.1 kW

(D) 196.2 kW

Q30. A storm of total rainfall depth 6 cm falls uniformly over a catchment in 3 hours and produces 3 cm of direct runoff. Assuming a constant loss rate, the ϕ-index (infiltration index) of the catchment is: **[2 marks]**

(A) 1.0 cm/hr

(B) 2.0 cm/hr

(C) 3.0 cm/hr

(D) 0.5 cm/hr

Q31. Ground water flows through a confined aquifer of thickness 10 m and width 500 m. The coefficient of permeability is 30 m/day and the hydraulic gradient is 0.002. Using Darcy's law $Q = k\,i\,A$, the discharge through the aquifer is: **[2 marks]**

(A) 30 m^3/day

(B) 60 m^3/day

(C) 150 m^3/day

(D) 300 m^3/day

Q32. A canal carries a discharge of 5 cumec and supplies water to a crop whose duty at the head of the canal is 2000 hectares per cumec. The area of the crop that can be irrigated by this canal is: **[2 marks]**

(A) 2000 ha

(B) 10000 ha

(C) 400 ha

(D) 5000 ha

Q33. A watershed of area 100 km^2 receives an annual rainfall of 120 cm. Taking the annual runoff coefficient as 0.40, the volume of annual runoff from the watershed is: **[2 marks]**

(A) 1.2×10^8 m^3

(B) 4.8×10^6 m^3

(C) 4.8×10^7 m^3

(D) 1.2×10^7 m^3

Q34. A flood magnitude has a return period of 50 years. The probability that this flood magnitude is *not* equalled or exceeded in any one given year is: **[2 marks]**

(A) 50

(B) 0.02

(C) 0.50

(D) 0.98

Environmental Engineering

Q35. A water sample contains calcium ions Ca^{2+} at a concentration of 40 mg/L. Expressed as calcium carbonate (equivalent weight of Ca $= 20$, of $CaCO_3 = 50$), the hardness contributed by calcium is: **[2 marks]**

(A) 40 mg/L as $CaCO_3$

(B) 100 mg/L as $CaCO_3$

(C) 50 mg/L as $CaCO_3$

(D) 200 mg/L as $CaCO_3$

Q36. A sedimentation tank has an effective volume of 200 m^3 and treats a steady flow of 800 m^3/day. The detention (retention) time of the tank is: **[2 marks]**

(A) 3 hours

(B) 6 hours

(C) 12 hours

(D) 4 hours

Q37. A town has a population of $20{,}000$ and the per-capita BOD contribution is 0.06 kg per person per day. The total daily BOD load generated by the town is: **[2 marks]**

(A) 12 kg/day

(B) 120 kg/day

(C) 1200 kg/day

(D) 12000 kg/day

Q38. At a location the air near the ground is under a strong temperature inversion (temperature rises with height, a very stable atmosphere). A chimney plume released into such an air mass most typically takes the form known as: **[2 marks]**

(A) looping

(B) coning

(C) lofting

(D) fanning

Q39. Two independent noise sources, each producing a sound pressure level of 60 dB at a point, operate together. The combined sound pressure level at that point, using $L = 10\log_{10}\left(\sum 10^{L_i/10}\right)$, is nearest to: **[2 marks]**

(A) 63 dB

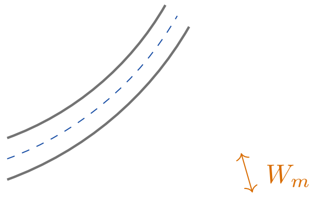
(B) 120 dB

(C) 66 dB

(D) 60 dB

Transportation & Geomatics Engineering

Q40. A two-lane road (each wheel-base length $l = 6$ m) is taken round a horizontal curve of radius $R = 100$ m. The mechanical widening of the pavement on the curve, $W_m = \dfrac{n\,l^2}{2R}$ with $n = 2$ lanes, is: **[2 marks]**



carriageway on curve

(A) 0.72 m

(B) 0.18 m

(C) 0.50 m

(D) 0.36 m

Q41. A highway is designed for a speed of 80 km/h. The design value of the combined superelevation and side friction is $(e + f) = 0.15$. The ruling minimum radius of the horizontal curve, $R = \dfrac{V^2}{127\,(e + f)}$, is nearest to: [2 marks]

(A) 252 m

(B) 280 m

(C) 336 m

(D) 420 m

Q42. On a single-lane approach to a signal, vehicles cross the stop line at a steady saturation time headway of 2 seconds per vehicle. The saturation flow (capacity) of the lane, $= \dfrac{3600}{\text{headway}}$, is: [2 marks]

(A) 1200 veh/hr

(B) 900 veh/hr

(C) 1800 veh/hr

(D) 3600 veh/hr

Q43. In levelling over a long sight, the combined correction for the curvature of the earth and atmospheric refraction is $C = 0.0673\,D^2$, where D is the sight distance in kilometres and C is in metres. For a sight distance of 2 km, the combined correction is: [2 marks]

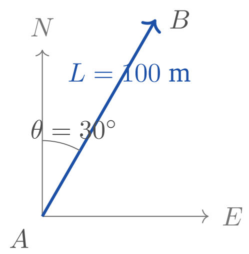
(A) 0.0673 m

(B) 0.269 m

(C) 0.135 m

(D) 0.539 m

Q44. A survey line AB is 100 m long and has a whole-circle bearing of 30° (measured clockwise from north), as shown. The departure (east–west component) of the line, $= L\sin\theta$, is: **[2 marks]**



(A) 86.6 m

(B) 100 m

(C) 50 m

(D) 70.7 m

Q45. A simple circular curve of radius 200 m has a deflection (intersection) angle of 60°. The tangent length of the curve, $T = R\tan\frac{\Delta}{2}$, is nearest to: **[2 marks]**

(A) 346.4 m

(B) 57.7 m

(C) 200 m

(D) 115.47 m

Q46. In balancing a closed traverse, the total error in latitude is found to be 0.3 m and the total error in departure is 0.4 m. The magnitude of the closing error of the traverse, $= \sqrt{(\Sigma L)^2 + (\Sigma D)^2}$, is: **[2 marks]**

(A) 0.5 m

(B) 0.7 m

(C) 0.35 m

(D) 0.25 m

Detailed Solutions

Q1.

Solution

Concept – maximum moment in a cantilever under a full-span UDL: For a cantilever carrying a uniform load over its whole length, the largest bending moment is at the fixed end and equals $M_{\max} = \dfrac{wL^2}{2}$.

Step 1 – list the data: $w = 12$ kN/m, $L = 3$ m.

Step 2 – write the formula: $M_{\max} = \dfrac{wL^2}{2}$

Step 3 – evaluate L^2: $L^2 = 3^2 = 9\ \text{m}^2$

Step 4 – substitute: $M_{\max} = \dfrac{12 \times 9}{2}$

Step 5 – complete the arithmetic: $M_{\max} = \dfrac{108}{2}$

$M_{\max} = 54$ kN·m

Final Answer: $M_{\max} = 54$ kN·m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – axial elongation of a prismatic bar: $\delta = \dfrac{PL}{AE}$, with all quantities in consistent units.

Step 1 – convert the data to N and mm: $P = 50$ kN $= 50000$ N, $L = 2$ m $= 2000$ mm, $A = 500\ \text{mm}^2$, $E = 200$ GPa $= 200000\ \text{N/mm}^2$.

Step 2 – form the numerator: $PL = 50000 \times 2000 = 1.0 \times 10^8$

Step 3 – form the denominator: $AE = 500 \times 200000 = 1.0 \times 10^8$

Step 4 – divide: $\delta = \dfrac{1.0 \times 10^8}{1.0 \times 10^8}$

$\delta = 1.0$ mm

Final Answer: $\delta = 1.0$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept – static indeterminacy of a plane rigid frame: $D_s = 3m + r - 3j$, where m is the number of members, r the number of reaction components and j the number of joints.

Step 1 – count the members: Two columns and one beam, so $m = 3$.

Step 2 – count the joints: Two base joints plus two beam–column joints, so $j = 4$.

Step 3 – count the reactions: Each fixed base gives 3 reactions, so $r = 2 \times 3 = 6$.

Step 4 – substitute into the formula: $D_s = 3(3) + 6 - 3(4)$

Step 5 – evaluate: $D_s = 9 + 6 - 12$

$D_s = 3$

Final Answer: $D_s = 3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – modular ratio in the working-stress method: $m = \dfrac{280}{3\,\sigma_{cbc}}$, where σ_{cbc} is the permissible bending compressive stress of the concrete grade.

Step 1 – read the permissible stress for M20: $\sigma_{cbc} = 7\ \text{N/mm}^2$.

Step 2 – form the denominator: $3 \times \sigma_{cbc} = 3 \times 7 = 21$

Step 3 – divide: $m = \dfrac{280}{21}$

Step 4 – evaluate: $m = 13.33$

Final Answer: $m = 13.33 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – slenderness ratio uses the least radius of gyration: Slenderness ratio $= \dfrac{L_e}{r}$, and for a solid circular section $r = \dfrac{D}{4}$.

Step 1 – compute the radius of gyration: $r = \dfrac{D}{4} = \dfrac{100}{4}$

$r = 25$ mm

Step 2 – convert the effective length to mm: $L_e = 3 \text{ m} = 3000 \text{ mm}$

Step 3 – form the slenderness ratio: $\dfrac{L_e}{r} = \dfrac{3000}{25}$

Step 4 – evaluate: $\dfrac{L_e}{r} = 120$

Step 5 – check the radius of gyration: $r^2 = \dfrac{I}{A} = \dfrac{\pi D^4/64}{\pi D^2/4} = \dfrac{D^2}{16}$, so $r = D/4$, confirming 25 mm.

Final Answer: slenderness ratio $= 120 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – elastic constants relation: $E = 2G(1+\mu)$, so $\mu = \dfrac{E}{2G} - 1$.

Step 1 – list the data: $E = 200$ GPa, $G = 80$ GPa.

Step 2 – form the ratio $E/2G$: $\dfrac{E}{2G} = \dfrac{200}{2 \times 80} = \dfrac{200}{160}$

$= 1.25$

Step 3 – subtract 1: $\mu = 1.25 - 1$

$\mu = 0.25$

Step 4 – sanity check: Most metals have μ between 0.25 and 0.35, so 0.25 is physically reasonable.

Final Answer: $\mu = 0.25 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – standard deflection of a UDL cantilever: For a cantilever of length L and rigidity EI carrying a uniform load w over its full span, the maximum deflection occurs at the free tip.

Step 1 – recall the standard result: $\delta_{\max} = \dfrac{wL^4}{8EI}$

Step 2 – confirm the dependence: For a distributed load the deflection grows with L^4 (not L^3), which rules out the point-load forms.

Why the other options are wrong:

- A, $5wL^4/384EI$: is the midspan deflection of a **simply supported** beam under a UDL, not a cantilever.
- B, $wL^3/3EI$: is the tip deflection of a cantilever under a **concentrated** end load, not a UDL.
- D, $wL^4/30EI$: corresponds to a triangularly varying load, not a uniform load.

Final Answer: $\delta_{\max} = \dfrac{wL^4}{8EI} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – effective length depends on the end restraints: $L_e = k\,L$, where k is set by how the ends are held.

Step 1 – identify the end conditions: The base is **fixed** and the top is **free** (a cantilever column / flagpole).

Step 2 – recall the factor for fixed–free: $k = 2.0$

Step 3 – write the effective length: $L_e = 2.0\,L$

Why the other options are wrong:

- A, $0.5L$: applies to a column **fixed at both ends.**
- B, $1.0L$: applies to a column **hinged at both ends.**
- C, $0.707L$: applies to a column **fixed at one end and hinged at the other.**

Final Answer: $L_e = 2.0L \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept – static determinacy of a plane truss: $D_s = m + r - 2j$. If $D_s = 0$ the truss is just-rigid (determinate); if $D_s > 0$ it is indeterminate; if $D_s < 0$ it is a mechanism.

Step 1 – list the counts: $m = 13$ members, $r = 3$ reactions, $j = 8$ joints.

Step 2 – form $2j$**:** $2j = 2 \times 8 = 16$

Step 3 – substitute: $D_s = 13 + 3 - 16$

Step 4 – evaluate: $D_s = 0$

Step 5 – classify: $D_s = 0$ means the truss is exactly rigid, that is **statically determinate**.

Final Answer: $D_s = 0$, statically determinate $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q9**

Q10.

Solution

Concept – influence line for the midspan bending moment: For a simply supported beam of span L, the influence line for the bending moment at midspan is a triangle whose apex ordinate is $\dfrac{L}{4}$ (occurring when the unit load is at midspan).

Step 1 – list the span: $L = 8$ m.

Step 2 – write the peak ordinate: Peak $= \dfrac{L}{4}$

Step 3 – substitute: Peak $= \dfrac{8}{4}$

Step 4 – evaluate: Peak $= 2$ m

Step 5 – reasoning check: With the unit load at midspan, each reaction is $\frac{1}{2}$; the moment at the centre is $\frac{1}{2} \times \frac{L}{2} = \frac{L}{4} = 2$ m. Consistent.

Final Answer: peak ordinate $= 2$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q10**

Q11.

Solution

Concept – carry-over factor in moment distribution: For a prismatic member with the far end fixed, half of the moment applied at the near end is carried over to the fixed far end.

Step 1 – recall the standard value: Carry-over factor $= 0.5$ for a prismatic (uniform-section) member with the far end fixed.

Step 2 – justify it briefly: The near-end stiffness is $4EI/L$; the moment induced at the fixed far end is $2EI/L$ per unit rotation, and $\dfrac{2EI/L}{4EI/L} = 0.5$.

Why the other options are wrong:

- A, 1.0: would mean the whole moment is transferred, which is not the case for a prismatic member.

- C and D: do not correspond to the standard prismatic carry-over.

Final Answer: carry-over factor $= 0.5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – partial safety factors on material strength in IS 456 limit-state design: The characteristic strength of each material is divided by its partial safety factor to get the design strength.

Step 1 – recall the value for concrete: For concrete, $\gamma_{mc} = 1.50$.

Step 2 – distinguish from steel: For reinforcing steel the factor is $\gamma_{ms} = 1.15$, a separate value.

Why the other options are wrong:

- A, 1.15: is the factor for **reinforcing steel**, not concrete.
- C, 1.00: applies no safety margin at all.
- D, 1.25: is used for structural steel (γ_{m1}) in IS 800, not for concrete in IS 456.

Final Answer: $\gamma_{mc} = 1.50 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – shape factor of a cross-section: Shape factor $= \dfrac{Z_p}{Z_e}$, the ratio of the plastic to the elastic section modulus.

Step 1 – write the elastic modulus of a rectangle: $Z_e = \dfrac{bd^2}{6}$

Step 2 – write the plastic modulus of a rectangle: $Z_p = \dfrac{bd^2}{4}$

Step 3 – form the ratio: $\dfrac{Z_p}{Z_e} = \dfrac{bd^2/4}{bd^2/6} = \dfrac{6}{4}$

Step 4 – evaluate: $\dfrac{Z_p}{Z_e} = 1.5$

Final Answer: shape factor $= 1.5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – total float in CPM: Total float $=$ LST $-$ EST $=$ LFT $-$ EFT, the spare time by which an activity may be delayed without delaying the project.

Step 1 – list the data: Earliest start EST $= 5$ days, latest start LST $= 9$ days.

Step 2 – subtract: Total float $= 9 - 5$

Step 3 – evaluate: Total float $= 4$ days

Final Answer: total float $= 4$ days $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept – dry unit weight from bulk unit weight and water content: $\gamma_d = \dfrac{\gamma}{1+w}$, with w as a decimal fraction.

Step 1 – convert the water content: $w = 25\% = 0.25$

Step 2 – form the denominator: $1 + w = 1 + 0.25 = 1.25$

Step 3 – divide the bulk unit weight: $\gamma_d = \dfrac{20}{1.25}$

Step 4 – evaluate: $\gamma_d = 16.0\ \text{kN/m}^3$

Final Answer: $\gamma_d = 16\ \text{kN/m}^3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept – relative density (density index): $I_D = \dfrac{e_{\max} - e}{e_{\max} - e_{\min}}$, comparing the field void ratio with the loosest and densest states.

Step 1 – list the data: $e_{\max} = 0.90$, $e_{\min} = 0.50$, field $e = 0.70$.

Step 2 – compute the numerator: $e_{\max} - e = 0.90 - 0.70 = 0.20$

Step 3 – compute the denominator: $e_{\max} - e_{\min} = 0.90 - 0.50 = 0.40$

Step 4 – divide: $I_D = \dfrac{0.20}{0.40} = 0.50$

$I_D = 50\%$

Final Answer: $I_D = 50\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – coefficient of uniformity: $C_u = \dfrac{D_{60}}{D_{10}}$, a measure of the spread of particle sizes.

Step 1 – list the data: $D_{60} = 0.60$ mm, $D_{10} = 0.15$ mm.

Step 2 – form the ratio: $C_u = \dfrac{0.60}{0.15}$

Step 3 – evaluate: $C_u = 4$

Step 4 – interpret: $C_u = 4$ (a value greater than 1 but modest) indicates a fairly uniform, poorly graded sand.

Final Answer: $C_u = 4 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept – effective stress in a layered profile with a water table: $\sigma' = \sigma - u$. Above the water table the soil is dry; below it the pore pressure is $u = \gamma_w z_w$.

Step 1 – total stress from the dry layer (0 to 3 m): $\sigma_1 = 17 \times 3 = 51$ kPa

Step 2 – total stress from the saturated layer (3 to 6 m): $\sigma_2 = 20 \times 3 = 60$ kPa

Step 3 – total stress at 6 m: $\sigma = 51 + 60 = 111$ kPa

Step 4 – pore water pressure at 6 m (water 3 m above this point): $u = \gamma_w \times z_w = 9.81 \times 3 = 29.43$ kPa

Step 5 – subtract to get effective stress: $\sigma' = 111 - 29.43$

$\sigma' = 81.57$ kPa

Final Answer: $\sigma' = 81.57\ \text{kN/m}^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept – seepage discharge from a flow net: $q = k\,H\,\dfrac{N_f}{N_d}$, where N_f is the number of flow channels and N_d the number of equipotential drops.

Step 1 – list the data: $k = 4 \times 10^{-5}$ m/s, $H = 5$ m, $N_f = 4$, $N_d = 10$.

Step 2 – form the shape factor: $\dfrac{N_f}{N_d} = \dfrac{4}{10} = 0.4$

Step 3 – multiply k by H: $kH = 4 \times 10^{-5} \times 5 = 2 \times 10^{-4}$

Step 4 – multiply by the shape factor: $q = 2 \times 10^{-4} \times 0.4$

$q = 8 \times 10^{-5}$ m^3/s per metre

Final Answer: $q = 8 \times 10^{-5}$ m^3/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept – time factor for a given degree of consolidation: The Terzaghi solution gives standard T_v values; for $U \le 60\%$, $T_v = \dfrac{\pi}{4}U^2$.

Step 1 – write the small-U relation: $T_v = \dfrac{\pi}{4}\,U^2$

Step 2 – put $U = 0.50$: $T_v = \dfrac{\pi}{4}\,(0.50)^2$

Step 3 – square U: $(0.50)^2 = 0.25$

Step 4 – multiply: $T_v = \dfrac{\pi}{4} \times 0.25 = 0.7854 \times 0.25$

$T_v = 0.196 \approx 0.197$

Final Answer: $T_v \approx 0.197 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – primary consolidation settlement of a normally consolidated clay: $S = \dfrac{C_c\,H}{1+e_0}\,\log_{10}\dfrac{\sigma_0' + \Delta\sigma}{\sigma_0'}$.

Step 1 – list the data: $C_c = 0.30$, $H = 4$ m, $e_0 = 0.80$, $\sigma_0' = 100$ kPa, $\sigma_0' + \Delta\sigma = 200$ kPa.

Step 2 – form the leading coefficient: $\dfrac{C_cH}{1+e_0} = \dfrac{0.30\times 4}{1+0.80} = \dfrac{1.2}{1.8}$
$= 0.6667$ m

Step 3 – form the stress ratio: $\dfrac{200}{100} = 2$

Step 4 – take the logarithm: $\log_{10} 2 = 0.3010$

Step 5 – multiply: $S = 0.6667 \times 0.3010$

$S = 0.2007$ m

Step 6 – convert to millimetres: $S = 0.2007 \times 1000 \approx 200$ mm

Final Answer: $S \approx 200$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept – Rankine passive thrust on a wall with cohesionless backfill: $P_p = \frac{1}{2}K_p\,\gamma\,H^2$, with $K_p = \dfrac{1+\sin\phi}{1-\sin\phi}$.

Step 1 – compute the passive earth-pressure coefficient: $K_p = \dfrac{1+\sin 30^\circ}{1-\sin 30^\circ} = \dfrac{1+0.5}{1-0.5}$

$K_p = \dfrac{1.5}{0.5} = 3$

Step 2 – evaluate H^2: $H^2 = 5^2 = 25\ \text{m}^2$

Step 3 – substitute into the thrust formula: $P_p = \frac{1}{2}\times 3\times 18\times 25$

Step 4 – simplify step by step: $3\times 18 = 54$

$P_p = \frac{1}{2}\times 54\times 25$

$= \frac{1}{2}\times 1350$

$P_p = 675$ kN/m

Final Answer: $P_p = 675$ kN/m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – Terzaghi bearing capacity of a strip footing in cohesionless soil: $q_u = c'N_c + \gamma D_f N_q + 0.5\,\gamma B N_\gamma$; with $c' = 0$ the first term drops out.

Step 1 – kill the cohesion term: $c' = 0$, so $c'N_c = 0$.

Step 2 – compute the surcharge term: $\gamma D_f N_q = 18 \times 1 \times 18 = 324$ kPa

Step 3 – compute the width term: $0.5\,\gamma B N_\gamma = 0.5 \times 18 \times 2 \times 15$

$= 0.5 \times 18 = 9$

$= 9 \times 2 = 18$

$= 18 \times 15 = 270$ kPa

Step 4 – add the two terms: $q_u = 324 + 270$

$q_u = 594$ kPa

Final Answer: $q_u = 594$ kPa $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – hydraulic radius of a rectangular channel: $R = \dfrac{A}{P}$, with area $A = b\,y$ and wetted perimeter $P = b + 2y$.

Step 1 – compute the area of flow: $A = b\,y = 6 \times 2 = 12$ m^2

Step 2 – compute the wetted perimeter: $P = b + 2y = 6 + 2(2) = 6 + 4 = 10$ m

Step 3 – divide: $R = \dfrac{12}{10}$

Step 4 – evaluate: $R = 1.2$ m

Final Answer: $R = 1.2$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept – Manning's formula for mean velocity: $V = \dfrac{1}{n} R^{2/3} S^{1/2}$.

Step 1 – list the data: $n = 0.02$, $R = 1$ m, $S = 0.0004$.

Step 2 – evaluate $R^{2/3}$: $R^{2/3} = 1^{2/3} = 1$

Step 3 – evaluate $S^{1/2}$: $S^{1/2} = \sqrt{0.0004} = 0.02$

Step 4 – form $1/n$: $\dfrac{1}{n} = \dfrac{1}{0.02} = 50$

Step 5 – multiply the three factors: $V = 50 \times 1 \times 0.02$

$V = 1.0$ m/s

Final Answer: $V = 1.0$ m/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept – Froude number of open-channel flow: $Fr = \dfrac{V}{\sqrt{g\,y}}$; $Fr < 1$ is subcritical, $Fr = 1$ critical, $Fr > 1$ supercritical.

Step 1 – list the data: $V = 3$ m/s, $y = 0.90$ m, $g = 9.81$ m/s^2.

Step 2 – compute gy: $gy = 9.81 \times 0.90 = 8.829$

Step 3 – take the square root: $\sqrt{8.829} = 2.9714$

Step 4 – divide: $Fr = \dfrac{3}{2.9714}$

$Fr = 1.0096 \approx 1.01$

Step 5 – classify: $Fr \approx 1$, so the flow is essentially at the critical state.

Final Answer: $Fr \approx 1.01 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – Reynolds number for pipe flow: $Re = \dfrac{VD}{\nu}$, using the kinematic viscosity.

Step 1 – list the data: $V = 1$ m/s, $D = 0.10$ m, $\nu = 1 \times 10^{-6}$ m^2/s.

Step 2 – form the numerator: $VD = 1 \times 0.10 = 0.10$

Step 3 – divide by the viscosity: $Re = \dfrac{0.10}{1 \times 10^{-6}}$

Step 4 – evaluate: $Re = 1 \times 10^5$

Step 5 – interpret: $Re = 10^5 \gg 4000$, so the flow is turbulent.

Final Answer: $Re = 1 \times 10^5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – specific energy of open-channel flow: $E = y + \dfrac{V^2}{2g}$, the energy per unit weight measured above the channel bed.

Step 1 – list the data: $y = 1$ m, $V = 2$ m/s, $g = 9.81$ m/s^2.

Step 2 – square the velocity: $V^2 = 2^2 = 4$ m^2/s^2

Step 3 – form the velocity head: $\dfrac{V^2}{2g} = \dfrac{4}{2 \times 9.81} = \dfrac{4}{19.62}$

$= 0.2039$ m

Step 4 – add the depth: $E = 1 + 0.2039$

$E = 1.204 \approx 1.20$ m

Final Answer: $E \approx 1.20 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept – water power of a pump: $P = \gamma_w\, Q\, H$, where γ_w is the unit weight of water in kN/m^3, Q the discharge and H the head.

Step 1 – list the data: $\gamma_w = 9.81$ kN/m^3, $Q = 0.5$ m^3/s, $H = 20$ m.

Step 2 – multiply γ_w and Q: $\gamma_w Q = 9.81 \times 0.5 = 4.905$

Step 3 – multiply by the head: $P = 4.905 \times 20$

$P = 98.1$ kW

Step 4 – note the units: $\text{kN/m}^3 \times \text{m}^3/\text{s} \times \text{m} = \text{kN} \cdot \text{m/s} = \text{kW}$, so the answer is in kilowatts.

Final Answer: $P = 98.1 \text{ kW} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept – ϕ-index (constant loss rate): $\phi = \dfrac{P-R}{t_r}$, where P is the total rainfall, R the runoff and t_r the storm duration.

Step 1 – list the data: $P = 6$ cm, $R = 3$ cm, $t_r = 3$ hr.

Step 2 – compute the loss depth: $P - R = 6 - 3 = 3$ cm

Step 3 – divide by the duration: $\phi = \dfrac{3}{3}$

$\phi = 1.0$ cm/hr

Final Answer: $\phi = 1.0$ cm/hr $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept – Darcy's law for aquifer flow: $Q = k\,i\,A$, where A is the cross-sectional area of flow (thickness $\times$ width).

Step 1 – compute the flow area: $A = \text{thickness} \times \text{width} = 10 \times 500 = 5000\ \text{m}^2$

Step 2 – list the other data: $k = 30$ m/day, $i = 0.002$.

Step 3 – multiply k and i: $k\,i = 30 \times 0.002 = 0.06$ m/day

Step 4 – multiply by the area: $Q = 0.06 \times 5000$

$Q = 300\ \text{m}^3/\text{day}$

Final Answer: $Q = 300\ \text{m}^3/\text{day} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – duty relates discharge to irrigated area: Duty $D = \dfrac{\text{area irrigated}}{\text{discharge}}$, so area $= D \times Q$.

Step 1 – list the data: $Q = 5$ cumec, $D = 2000$ ha/cumec.

Step 2 – multiply: Area $= 2000 \times 5$

Step 3 – evaluate: Area $= 10000$ ha

Final Answer: area $= 10000$ ha $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q32

Q33.

Solution

Concept – annual runoff volume: Volume $= C \times P \times A$, where C is the runoff coefficient, P the rainfall depth and A the catchment area, all in consistent units.

Step 1 – convert the rainfall to metres: $P = 120 \text{ cm} = 1.20 \text{ m}$

Step 2 – convert the area to square metres: $A = 100 \text{ km}^2 = 100 \times 10^6 = 1 \times 10^8 \text{ m}^2$

Step 3 – multiply rainfall by area (gross volume): $P \times A = 1.20 \times 1 \times 10^8 = 1.2 \times 10^8 \text{ m}^3$

Step 4 – apply the runoff coefficient: $V = 0.40 \times 1.2 \times 10^8$

$V = 4.8 \times 10^7 \text{ m}^3$

Final Answer: $V = 4.8 \times 10^7 \text{ m}^3 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept – exceedance and non-exceedance probability: The annual exceedance probability is $P = \frac{1}{T}$, so the non-exceedance probability is $1 - \frac{1}{T}$.

Step 1 – write the exceedance probability: $P = \frac{1}{T} = \frac{1}{50}$

Step 2 – evaluate: $P = 0.02$

Step 3 – take the complement: Non-exceedance $= 1 - 0.02$

$= 0.98$

Step 4 – interpret: There is a 98% chance that this flood magnitude is not reached or exceeded in any given year.

Final Answer: non-exceedance probability $= 0.98 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – expressing hardness as calcium carbonate: Hardness as $CaCO_3$ = concentration $\times \dfrac{\text{eq. wt. of } CaCO_3}{\text{eq. wt. of the ion}}$.

Step 1 – list the data: $Ca^{2+} = 40$ mg/L, eq. wt. of Ca $= 20$, eq. wt. of $CaCO_3 = 50$.

Step 2 – form the multiplying factor: $\dfrac{50}{20} = 2.5$

Step 3 – multiply the concentration: Hardness $= 40 \times 2.5$

$= 100$ mg/L as $CaCO_3$

Final Answer: hardness $= 100$ mg/L as $CaCO_3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – detention time of a tank: $t = \dfrac{V}{Q}$, the average time a parcel of water spends in the tank.

Step 1 – list the data: $V = 200$ m^3, $Q = 800$ m^3/day.

Step 2 – divide: $t = \dfrac{200}{800} = 0.25$ day

Step 3 – convert to hours: $t = 0.25 \times 24$

$t = 6$ hours

Final Answer: $t = 6$ hours $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – total BOD load from per-capita contribution: Load = (per-capita BOD) $\times$ (population).

Step 1 – list the data: Per-capita BOD $= 0.06$ kg/person/day, population $= 20{,}000$.

Step 2 – multiply: Load $= 0.06 \times 20000$

Step 3 – evaluate: Load $= 1200$ kg/day

Final Answer: BOD load $= 1200$ kg/day $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept – plume behaviour under a temperature inversion: Under a strong inversion the atmosphere is very stable, so vertical motion is suppressed and the plume spreads sideways in a thin horizontal layer. This shape is called *fanning*.

Step 1 – identify the stability condition: Temperature rises with height (inversion), which is a strongly stable atmosphere.

Step 2 – reason about vertical mixing: A stable layer resists up-and-down motion, so the plume cannot mix vertically; it fans out horizontally.

Step 3 – name the plume: This is the **fanning** plume.

Why the other options are wrong:

- A, looping: occurs in a very **unstable** (superadiabatic) atmosphere.
- B, coning: occurs in a **neutral** atmosphere.
- C, lofting: occurs when an unstable layer sits above a stable layer.

Final Answer: fanning $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – adding sound levels on a logarithmic scale: $L = 10\log_{10}\left(\sum 10^{L_i/10}\right)$; equal sources add $10\log_{10} n$ to a single level.

Step 1 – convert each level to a relative intensity: $10^{60/10} = 10^6$ for each source.

Step 2 – add the two intensities: $10^6 + 10^6 = 2 \times 10^6$

Step 3 – take the logarithm and multiply by 10**:** $L = 10\log_{10}(2 \times 10^6)$

$= 10\,(\log_{10} 2 + 6)$

$= 10\,(0.301 + 6)$

Step 4 – evaluate: $L = 10 \times 6.301$

$L = 63.01 \approx 63$ dB

Step 5 – interpret: Doubling the number of equal sources adds only about 3 dB, not 6 dB, which is why $60 + 60 \neq 120$.

Final Answer: $L \approx 63$ dB $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – mechanical widening of pavement on a curve: $W_m = \dfrac{n\,l^2}{2R}$, where n is the number of lanes, l the wheel-base and R the radius.

Step 1 – list the data: $n = 2$, $l = 6$ m, $R = 100$ m.

Step 2 – evaluate l^2: $l^2 = 6^2 = 36\ \mathrm{m}^2$

Step 3 – form the numerator: $n\,l^2 = 2 \times 36 = 72$

Step 4 – form the denominator: $2R = 2 \times 100 = 200$

Step 5 – divide: $W_m = \dfrac{72}{200}$

$W_m = 0.36$ m

Final Answer: $W_m = 0.36\ \mathrm{m} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept – ruling minimum radius of a horizontal curve: $R = \dfrac{V^2}{127\,(e+f)}$, with V in km/h and R in metres.

Step 1 – list the data: $V = 80$ km/h, $e + f = 0.15$.

Step 2 – square the speed: $V^2 = 80^2 = 6400$

Step 3 – compute the denominator: $127 \times (e+f) = 127 \times 0.15 = 19.05$

Step 4 – divide: $R = \dfrac{6400}{19.05}$

$R = 335.96 \approx 336$ m

Final Answer: $R \approx 336\ \mathrm{m} \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – saturation flow from the time headway: The maximum number of vehicles per hour is $\dfrac{3600}{h}$, where h is the saturation headway in seconds.

Step 1 – list the data: $h = 2$ s per vehicle.

Step 2 – divide 3600 **by the headway:** Capacity $= \dfrac{3600}{2}$

Step 3 – evaluate: Capacity $= 1800$ veh/hr

Final Answer: capacity $= 1800$ veh/hr $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept – combined curvature and refraction correction: $C = 0.0673\, D^2$, with D in kilometres and C in metres.

Step 1 – list the data: $D = 2$ km.

Step 2 – square the distance: $D^2 = 2^2 = 4$

Step 3 – multiply: $C = 0.0673 \times 4$

$C = 0.2692 \approx 0.269$ m

Final Answer: $C \approx 0.269$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept – departure of a survey line: Departure $= L \sin\theta$, the east–west component of the line, where θ is the whole-circle bearing.

Step 1 – list the data: $L = 100$ m, $\theta = 30°$.

Step 2 – evaluate the sine: $\sin 30° = 0.5$

Step 3 – multiply: Departure $= 100 \times 0.5$

$= 50$ m

Step 4 – cross-check the latitude: Latitude $= L\cos\theta = 100\cos 30° = 86.6$ m, which is the north–south component (not asked here).

Final Answer: departure $= 50$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – tangent length of a simple circular curve: $T = R\tan\frac{\Delta}{2}$, where Δ is the deflection angle.

Step 1 – list the data: $R = 200$ m, $\Delta = 60^\circ$.

Step 2 – halve the deflection angle: $\frac{\Delta}{2} = \frac{60^\circ}{2} = 30^\circ$

Step 3 – evaluate the tangent: $\tan 30^\circ = 0.5774$

Step 4 – multiply by the radius: $T = 200 \times 0.5774$

$T = 115.47$ m

Final Answer: $T = 115.47$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – closing error of a traverse: The closing error is the resultant of the total latitude error and the total departure error: $e = \sqrt{(\Sigma L)^2 + (\Sigma D)^2}$.

Step 1 – list the data: $\Sigma L = 0.3$ m, $\Sigma D = 0.4$ m.

Step 2 – square each component: $(\Sigma L)^2 = 0.3^2 = 0.09$

$(\Sigma D)^2 = 0.4^2 = 0.16$

Step 3 – add the squares: $0.09 + 0.16 = 0.25$

Step 4 – take the square root: $e = \sqrt{0.25}$

$e = 0.5$ m

Final Answer: closing error $= 0.5$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	D	3	B	4	B	5	C
6	D	7	C	8	D	9	A	10	A
11	B	12	B	13	D	14	A	15	D
16	B	17	C	18	C	19	D	20	A
21	A	22	B	23	A	24	A	25	C
26	B	27	B	28	A	29	C	30	A
31	D	32	B	33	C	34	D	35	B
36	B	37	C	38	D	39	A	40	D
41	C	42	C	43	B	44	C	45	D
46	A								