GATE Civil Engineering

Sample Paper – 4

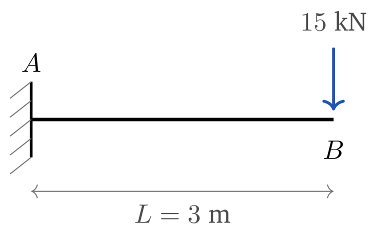
Duration: 128 Minutes **Maximum Marks: 72**

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 carries a single point load of 15 kN at its free end, as shown. The magnitude of the bending moment at the fixed support is: **[1 mark]**



(A) 45 kN·m

(B) 22.5 kN·m

(C) 15 kN·m

(D) 5 kN·m

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

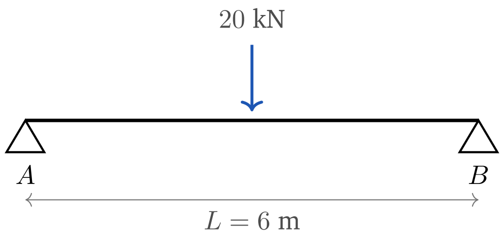
(A) 0.25 mm

(B) 0.50 mm

(C) 2.0 mm

(D) 1.0 mm

Q3. A simply supported beam of span 6 m carries a single concentrated load of 20 kN at its midspan, as shown. The maximum bending moment in the beam is: **[1 mark]**



(A) 15 kN·m

(B) 30 kN·m

(C) 60 kN·m

(D) 45 kN·m

Q4. A solid rectangular cross-section is 100 mm wide and 200 mm deep. The moment of inertia of the section about the centroidal axis parallel to the width (that is, the axis about which bending normally occurs) is: **[1 mark]**

(A) 3.33×10^7 mm^4

(B) 1.33×10^8 mm^4

(C) 6.67×10^7 mm^4

(D) 5.00×10^7 mm^4

Q5. A pin-ended (hinged at both ends) column is 3 m long and has a least radius of gyration of 30 mm. The slenderness ratio of the column is: **[1 mark]**

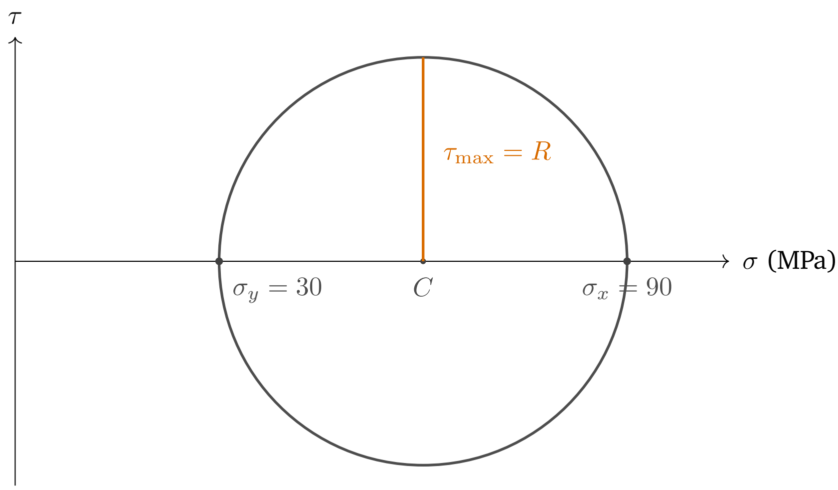
(A) 30

(B) 300

(C) 100

(D) 50

Q6. At a point in a stressed body the plane-stress state is $\sigma_x = 90$ MPa, $\sigma_y = 30$ MPa and shear stress $\tau_{xy} = 0$, as represented by the Mohr's circle shown. The maximum in-plane shear stress at the point is: **[1 mark]**



(A) 60 MPa

(B) 120 MPa

(C) 45 MPa

(D) 30 MPa

Q7. A cantilever beam of length L and flexural rigidity EI carries a single concentrated load W at its free end. The maximum vertical deflection of the beam (which occurs at the free end) is: **[1 mark]**

(A) $\dfrac{WL^3}{48EI}$

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

(C) $\dfrac{WL^3}{3EI}$

(D) $\dfrac{WL^3}{8EI}$

Q8. A straight column is fixed (restrained against rotation and translation) at one end and completely free at the other end, like a flagpole. For use in the Euler buckling formula, the effective length of this column is: **[1 mark]**

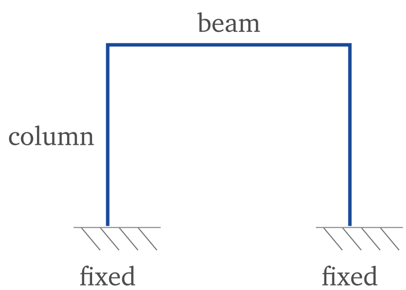
(A) $0.5\,L$

(B) $1.0\,L$

(C) $2.0\,L$

(D) $0.707\,L$

Q9. The single-bay, single-storey rigid plane portal frame shown below has both column bases *fixed* to the foundation. The degree of static indeterminacy of the frame is: **[1 mark]**



(A) 0

(B) 1

(C) 2

(D) 3

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

(A) 2 m

(B) 4 m

(C) 8 m

(D) 1 m

Q11. In the moment-distribution method, a prismatic member is rigidly connected at one joint and *fixed* at its far end. When a moment is applied at the near joint, the fraction of that moment carried over to the fixed far end (the carry-over factor) is: **[1 mark]**

(A) 1.00

(B) 0.25

(C) 0.75

(D) 0.50

Q12. In the limit state design of reinforced concrete to IS 456:2000, the maximum compressive strain permitted in concrete at the outermost compression fibre in the limit state of flexure (collapse) is: **[1 mark]**

(A) 0.0035

(B) 0.0020

(C) 0.0050

(D) 0.0010

Q13. In the plastic analysis of steel beams, the shape factor of a solid rectangular cross-section (the ratio of its plastic moment to its yield moment, M_p/M_y) is: **[1 mark]**

(A) 1.70

(B) 1.50

(C) 1.00

(D) 2.00

Q14. In a PERT network, an activity has an optimistic time $t_o = 4$ days and a pessimistic time $t_p = 16$ days. The standard deviation of the activity duration is: **[1 mark]**

(A) 2 days

(B) 12 days

(C) 6 days

(D) 3 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) 16.0 kN/m^3

(B) 25.0 kN/m^3

(C) 20.0 kN/m^3

(D) 15.0 kN/m^3

Q16. A clay soil has a liquid limit of 50%, a plastic limit of 20% and a natural (in-situ) water content of 35%. Its liquidity index is: **[1 mark]**

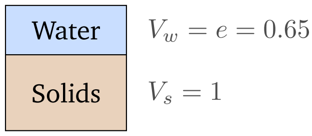
(A) 0.33

(B) 0.50

(C) 0.67

(D) 1.00

Q17. A fully saturated soil has a void ratio of 0.65 and a specific gravity of solids of 2.65. Using the two-phase (solids + water) unit diagram shown, the saturated unit weight of the soil is: **[1 mark]**



(A) 9.81 kN/m^3

(B) 16.0 kN/m^3

(C) 25.98 kN/m^3

(D) 19.62 kN/m^3

Q18. A dry sand deposit has a bulk unit weight of 18 kN/m^3, with the water table lying well below the zone of interest. The total vertical stress at a depth of 4 m below the ground surface is: **[1 mark]**

(A) 18.0 kN/m^2

(B) 36.0 kN/m^2

(C) 90.0 kN/m^2

(D) 72.0 kN/m^2

Q19. In a falling-head arrangement, water flows through a soil sample of length 3 m under a total head loss of 0.6 m across the sample. The hydraulic gradient driving the flow is: **[1 mark]**

(A) 1.8

(B) 0.5

(C) 0.2

(D) 2.0

Q20. A particle-size analysis of a sand gives $D_{60} = 0.60$ mm and $D_{10} = 0.20$ mm. The coefficient of uniformity C_u of the sand is: **[1 mark]**

(A) 0.33

(B) 3.0

(C) 0.40

(D) 1.2

Geotechnical Engineering (continued)

Q21. A normally consolidated clay layer is 5 m thick with an initial void ratio $e_0 = 0.80$ and a compression index $C_c = 0.25$. The effective overburden pressure at the middle of the layer is 100 kPa, and a foundation loading increases it by 100 kPa. The primary consolidation settlement of the layer is nearest to: **[2 marks]**

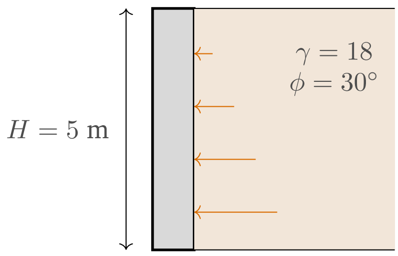
(A) 105 mm

(B) 209 mm

(C) 418 mm

(D) 300 mm

Q22. A vertical retaining wall 5 m high retains a dry cohesionless backfill with a horizontal top surface, unit weight 18 kN/m^3 and friction angle $\phi = 30°$, as shown. Using Rankine's theory, the total *passive* earth thrust per metre run mobilised against the wall is: **[2 marks]**



(A) 675 kN/m

(B) 225 kN/m

(C) 75 kN/m

(D) 337.5 kN/m

Q23. At a site the gross ultimate bearing capacity of a footing is 300 kPa. The footing is founded at a depth $D_f = 1.5$ m in a soil of unit weight 18 kN/m^3. The *net* ultimate bearing capacity of the footing is: **[2 marks]**

(A) 300 kPa

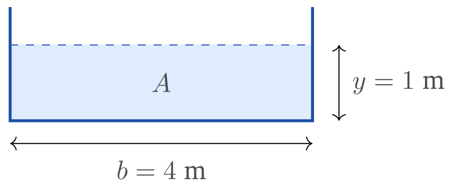
(B) 27 kPa

(C) 273 kPa

(D) 327 kPa

Water Resources Engineering

Q24. A rectangular open channel of width 4 m carries water at a depth of 1 m, as shown. The hydraulic radius (hydraulic mean depth) of the flow section is: **[2 marks]**



(A) 4.0 m

(B) 0.667 m

(C) 1.5 m

(D) 6.0 m

Q25. Water flows in a wide channel with a hydraulic radius of 1.0 m on a bed slope of 0.0001. Taking Manning's roughness coefficient $n = 0.015$, the mean velocity of flow by Manning's formula is nearest to: **[2 marks]**

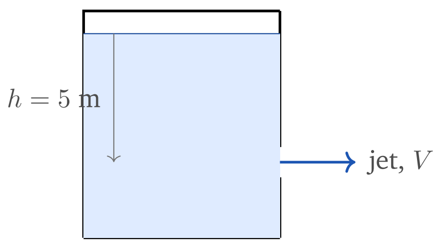
(A) 0.667 m/s

(B) 6.67 m/s

(C) 0.0667 m/s

(D) 1.0 m/s

Q26. Water discharges through a small sharp-edged orifice in the side of a large tank under a constant head of 5 m above the centre of the orifice, as shown. The theoretical (ideal) velocity of the jet at the orifice is nearest to: **[2 marks]**



(A) 5.0 m/s

(B) 49.1 m/s

(C) 9.9 m/s

(D) 14.0 m/s

Q27. Water flows through a pipe of diameter 0.20 m at a mean velocity of 3 m/s. The volumetric discharge carried by the pipe is nearest to: **[2 marks]**

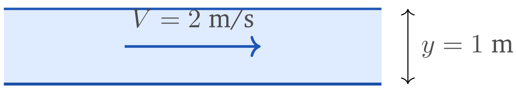
(A) 0.0942 m^3/s

(B) 0.600 m^3/s

(C) 0.0471 m^3/s

(D) 0.188 m^3/s

Q28. Water flows in a wide rectangular channel at a depth of 1 m with a mean velocity of 2 m/s, as shown. The Froude number of the flow, and hence the flow regime, is: **[2 marks]**



(A) 1.0 (critical)

(B) 2.0 (supercritical)

(C) 0.20 (subcritical)

(D) 0.639 (subcritical)

Q29. A pump lifts a discharge of 0.10 m^3/s of water against a total head of 20 m. Assuming 100% efficiency, the theoretical power required to drive the pump is: **[2 marks]**

(A) 19.62 kW

(B) 196.2 kW

(C) 9.81 kW

(D) 1.962 kW

Q30. A storm of uniform intensity 15 mm/hr lasts for 4 hours over a catchment. The average infiltration loss (ϕ-index) is 5 mm/hr. The depth of direct runoff (excess rainfall) produced by the storm is: **[2 marks]**

(A) 40 mm

(B) 60 mm

(C) 20 mm

(D) 10 mm

Q31. A catchment has an area of 120 km^2. Over one year it receives 100 cm of rainfall and its runoff coefficient is 0.40. The annual volume of runoff from the catchment is: **[2 marks]**

(A) 120 Mm^3

(B) 48 Mm^3

(C) 12 Mm^3

(D) 480 Mm^3

Q32. An irrigation canal is to supply water to a command area of 3600 hectares for a crop whose duty at the head of the field is 900 hectares per cumec. The discharge that the canal must carry is: **[2 marks]**

(A) 0.25 m^3/s

(B) 2.0 m^3/s

(C) 4.0 m^3/s

(D) 8.0 m^3/s

Q33. A flood of a certain magnitude has an annual exceedance probability of 0.02 (a return period of 50 years). The probability that this flood is *not* equalled or exceeded in any one given year is: **[2 marks]**

(A) 0.02

(B) 50

(C) 0.50

(D) 0.98

Q34. At a gauging station, a flood of a particular magnitude has an annual probability of being equalled or exceeded of 0.02. The return period (recurrence interval) of this flood is: **[2 marks]**

(A) 2 years

(B) 50 years

(C) 100 years

(D) 0.5 years

Environmental Engineering

Q35. In the disinfection of a water supply, chlorine is applied at a dose of 5.0 mg/L and the free chlorine residual measured after the required contact time is 0.5 mg/L. The chlorine demand of the water is: **[2 marks]**

(A) 5.5 mg/L

(B) 4.5 mg/L

(C) 5.0 mg/L

(D) 0.5 mg/L

Q36. A sedimentation tank has an effective volume of 400 m^3 and treats a steady flow of 2000 m^3/day. The theoretical detention (retention) time of the tank is: **[2 marks]**

(A) 0.2 hours

(B) 2.4 hours

(C) 4.8 hours

(D) 9.6 hours

Q37. A town has a population of 40,000 and an average per-capita water demand of 135 litres per day. Taking the maximum daily demand as 1.8 times the average daily demand, the maximum daily water demand of the town is: **[2 marks]**

(A) 5400 m^3/day

(B) 3000 m^3/day

(C) 9720 m^3/day

(D) 2700 m^3/day

Q38. A rapid gravity sand filter treats a flow of 3600 m^3/day through a filter bed of plan (surface) area 30 m^2. The rate of filtration (filtration loading) of the bed is: **[2 marks]**

(A) 30 m^3/m^2/day

(B) 120 m^3/m^2/day

(C) 60 m^3/m^2/day

(D) 240 m^3/m^2/day

Q39. A town of population 200,000 generates 100 tonnes of municipal solid waste per day. The per-capita rate of solid-waste generation is: **[2 marks]**

(A) 2.0 kg/capita/day

(B) 5.0 kg/capita/day

(C) 0.2 kg/capita/day

(D) 0.5 kg/capita/day

Transportation & Geomatics Engineering

Q40. A vehicle moving at a design speed of 72 km/h brakes to a stop on a level road for which the longitudinal friction coefficient is 0.35 (take $g = 9.81$ m/s^2). The braking distance (that is, the distance travelled after the brakes are applied, excluding the reaction distance) is nearest to: **[2 marks]**

(A) 37.5 m

(B) 108 m

(C) 20.0 m

(D) 58.25 m

Q41. On a single-lane road the jam density (the density at which traffic is bumper-to-bumper and completely stopped) is 100 veh/km. The average centre-to-centre spacing between successive vehicles at jam density is: **[2 marks]**

(A) 100 m

(B) 10 m

(C) 1000 m

(D) 50 m

Q42. A traffic stream follows Greenshields' linear speed–density model with a free-flow speed of 64 km/h and a jam density of 120 veh/km. The speed at which the flow (volume) is a maximum is: **[2 marks]**

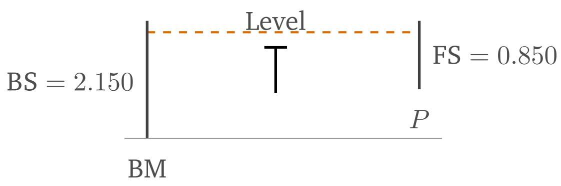
(A) 32 km/h

(B) 64 km/h

(C) 16 km/h

(D) 128 km/h

Q43. In differential levelling, a level is set up between a benchmark and a point P, as shown. The reduced level of the benchmark is 250.000 m, the back sight reading on it is 2.150 m and the fore sight reading on P is 0.850 m. The reduced level of P is: **[2 marks]**



(A) 250.750 m

(B) 251.300 m

(C) 253.000 m

(D) 248.700 m

Q44. The whole-circle bearing of a survey line AB is 120°. The back bearing of the line (that is, the whole-circle bearing of BA) is: **[2 marks]**

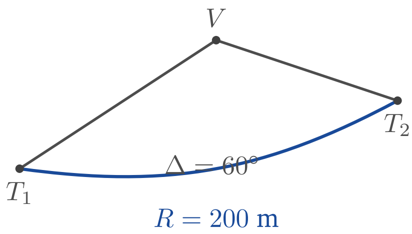
(A) $60°$

(B) $240°$

(C) $300°$

(D) $120°$

Q45. A simple circular curve of radius 200 m connects two straights that meet at a deflection (intersection) angle of $60°$, as shown. The tangent length of the curve (distance from the point of intersection to the tangent point) is nearest to: **[2 marks]**



(A) 200.00 m

(B) 100.00 m

(C) 230.94 m

(D) 115.47 m

Q46. A tacheometer with a multiplying (stadia) constant of 100 and an additive constant of 0.15 m is used with the line of sight horizontal and the staff held vertical. The observed staff intercept is 0.850 m. The horizontal distance from the instrument to the staff is: **[2 marks]**

(A) 85.15 m

(B) 85.00 m

(C) 850.0 m

(D) 8.50 m

Detailed Solutions

Q1.

Solution

Concept – bending moment at the fixed end of a cantilever: For a cantilever carrying a point load at the free end, the bending moment at the fixed support equals the load times the length of the cantilever.

Step 1 – list the data: Load $W = 15$ kN, length $L = 3$ m.

Step 2 – write the moment about the fixed end: $M = W \times L$

Step 3 – substitute the values: $M = 15 \times 3$

Step 4 – evaluate: $M = 45$ kN·m

Final Answer: $M = 45$ kN·m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – axial elongation of a bar: $\delta = \dfrac{PL}{AE}$, where P is the axial load, L the length, A the area and E the modulus of elasticity.

Step 1 – convert all quantities to consistent units: $P = 50$ kN $= 50000$ N, $L = 2$ m $= 2000$ mm, $A = 500$ mm^2, $E = 200$ GPa $= 200000$ N/mm^2.

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

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

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 – maximum moment for a central point load on a simply supported beam: $M_{\max} = \dfrac{WL}{4}$, occurring directly under the load at midspan.

Step 1 – list the data: $W = 20$ kN, $L = 6$ m.

Step 2 – substitute into the formula: $M_{\max} = \dfrac{20 \times 6}{4}$

Step 3 – multiply the numerator: $20 \times 6 = 120$

Step 4 – divide by 4**:** $M_{\max} = \dfrac{120}{4} = 30$ kN·m

Step 5 – sanity check: Each reaction is $W/2 = 10$ kN, and the midspan moment is $10 \times 3 = 30$ kN·m, which agrees.

Final Answer: $M_{\max} = 30$ kN·m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – moment of inertia of a rectangular section: About the centroidal axis parallel to the width, $I = \dfrac{b\,d^3}{12}$, where b is the width and d the depth.

Step 1 – list the dimensions: $b = 100$ mm, $d = 200$ mm.

Step 2 – evaluate d^3**:** $d^3 = 200^3 = 8.0 \times 10^6$ mm^3

Step 3 – multiply by the width: $b\,d^3 = 100 \times 8.0 \times 10^6 = 8.0 \times 10^8$

Step 4 – divide by 12**:** $I = \dfrac{8.0 \times 10^8}{12}$

$I = 6.67 \times 10^7$ mm^4

Final Answer: $I = 6.67 \times 10^7$ mm$^4 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – slenderness ratio of a column: $\lambda = \dfrac{L_e}{r_{\min}}$, where L_e is the effective length and $r_{\min}$ the least radius of gyration.

Step 1 – find the effective length: For a column hinged at both ends, $L_e = L = 3$ m $= 3000$ mm.

Step 2 – note the radius of gyration: $r_{\min} = 30$ mm.

Step 3 – form the ratio: $\lambda = \dfrac{3000}{30}$

Step 4 – evaluate: $\lambda = 100$

Final Answer: $\lambda = 100 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – maximum in-plane shear stress equals the radius of the Mohr's circle: $\tau_{\max} = \dfrac{\sigma_x - \sigma_y}{2}$ when $\tau_{xy} = 0$ (the two given stresses are then the principal stresses).

Step 1 – list the given stresses: $\sigma_x = 90$ MPa, $\sigma_y = 30$ MPa, $\tau_{xy} = 0$.

Step 2 – form the difference: $\sigma_x - \sigma_y = 90 - 30 = 60$ MPa

Step 3 – halve it (radius of the circle): $\tau_{\max} = \dfrac{60}{2}$

$\tau_{\max} = 30$ MPa

Step 4 – confirm from the Mohr's circle: The circle has centre at $\frac{90+30}{2} = 60$ MPa and radius 30 MPa; the highest point of the circle is at $\tau = 30$ MPa. Consistent.

Final Answer: $\tau_{\max} = 30 \text{ MPa} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – standard deflection result for a cantilever with an end load: For a cantilever of length L and rigidity EI carrying a load W at the free end, the free-end deflection is the largest.

Step 1 – recall the standard formula: $\delta_{\max} = \dfrac{WL^3}{3EI}$

Step 2 – confirm the dependence: The deflection grows with the cube of the length L^3 and falls with the flexural rigidity EI, which matches option C.

Why the other options are wrong:

- A, $WL^3/48EI$: is the midspan deflection of a **simply supported** beam with a central point load.
- B, $5wL^4/384EI$: is the midspan deflection of a simply supported beam under a **uniformly distributed** load w.
- D, $WL^3/8EI$: is the free-end deflection of a cantilever under a **uniformly distributed** load, not a point load.

Final Answer: $\delta_{\max} = \dfrac{WL^3}{3EI} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

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

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

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**.
- D, $0.707L$: applies to a column **fixed at one end and hinged at the other**.

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

Answer: (C) Go Back to Q8

Q9.

Solution

Concept – static indeterminacy of a rigid plane frame: $D_s = 3m + r - 3j - 3c$, where m = members, r = reaction components, j = joints, c = internal hinges. Equivalently, count the extra reactions/closed loops beyond the three equations of statics.

Step 1 – count the reaction components: Each fixed base provides 3 reactions (horizontal, vertical and moment). Two fixed bases give $r = 3 + 3 = 6$.

Step 2 – write the external equilibrium equations available: A plane structure has only 3 equations of static equilibrium.

Step 3 – find the external indeterminacy: $D_{se} = r - 3 = 6 - 3 = 3$

Step 4 – check for internal indeterminacy: The single-bay, single-storey portal frame is an open (tree-like) frame with no closed loop, so the internal indeterminacy is 0.

Step 5 – total static indeterminacy: $D_s = 3 + 0 = 3$

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

Answer: (D) Go Back to Q9

Q10.

Solution

Concept – influence line for bending moment at midspan of a simply supported beam: The influence line is a triangle with its apex under the section; for a section at distance a from A and b from B on a span L, the peak ordinate is $\dfrac{a\,b}{L}$.

Step 1 – locate the section: The section is at midspan, so $a = b = L/2 = 4$ m and $L = 8$ m.

Step 2 – write the peak ordinate: ordinate $= \dfrac{a\,b}{L} = \dfrac{4\times4}{8}$

Step 3 – evaluate: $= \dfrac{16}{8} = 2$ m

Step 4 – note the equivalent form $L/4$: For a midspan section, $\dfrac{ab}{L} = \dfrac{(L/2)(L/2)}{L} = \dfrac{L}{4} = \dfrac{8}{4} = 2$ m, which agrees.

Final Answer: maximum 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 far end.

Step 1 – recall the standard result: Carry-over factor (far end fixed) $= \dfrac{1}{2}$.

Step 2 – express as a decimal: $\dfrac{1}{2} = 0.50$

Why the other options are wrong:

- A, 1.00: would mean the whole moment is transferred, which is not the case for a prismatic member.
- B, 0.25 and C, 0.75: are not the carry-over value for a prismatic member with a fixed far end.

Final Answer: carry-over factor $= 0.50 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – limiting concrete strain in limit-state flexure (IS 456:2000): The design stress–strain curve for concrete in flexure is capped at a maximum compressive strain at the extreme fibre.

Step 1 – recall the code value: The maximum compressive strain in concrete at the outermost fibre at collapse is $\varepsilon_{cu} = 0.0035$.

Step 2 – distinguish it from the related value: The strain of 0.002 is where the concrete stress just reaches its design value $0.446 f_{ck}$; the curve then stays flat up to 0.0035, the limiting value.

Why the other options are wrong:

- B, 0.0020: is the strain at the end of the parabolic portion, not the limiting strain.
- C, 0.0050 and D, 0.0010: are not the code-specified limiting compressive strain.

Final Answer: $\varepsilon_{cu} = 0.0035 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

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

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

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

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

Step 4 – simplify: $S = \dfrac{6}{4} = 1.5$

Final Answer: $S = 1.5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – standard deviation of a PERT activity: $\sigma = \dfrac{t_p - t_o}{6}$, the spread of the beta distribution assumed for the activity time.

Step 1 – list the two extreme estimates: $t_o = 4$ days, $t_p = 16$ days.

Step 2 – form the range: $t_p - t_o = 16 - 4 = 12$

Step 3 – divide by 6**:** $\sigma = \dfrac{12}{6}$

$\sigma = 2$ days

Final Answer: $\sigma = 2 \text{ days} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

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

Step 1 – convert the water content to a fraction: $w = 25\% = 0.25$.

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

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

$\gamma_d = 16.0 \text{ kN/m}^3$

Final Answer: $\gamma_d = 16.0 \text{ kN/m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept – liquidity index: $I_L = \dfrac{w - \text{PL}}{\text{LL} - \text{PL}}$, which locates the natural water content within the plastic range.

Step 1 – list the data: $w = 35\%$, $\text{PL} = 20\%$, $\text{LL} = 50\%$.

Step 2 – compute the numerator: $w - \text{PL} = 35 - 20 = 15$

Step 3 – compute the denominator (plasticity index): $\text{LL} - \text{PL} = 50 - 20 = 30$

Step 4 – divide: $I_L = \dfrac{15}{30}$

$I_L = 0.50$

Final Answer: $I_L = 0.50 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – saturated unit weight from void ratio and specific gravity: $\gamma_{sat} = \dfrac{G+e}{1+e}\gamma_w$ for a fully saturated soil.

Step 1 – list the data: $G = 2.65$, $e = 0.65$, $\gamma_w = 9.81$ kN/m^3.

Step 2 – compute the numerator: $G + e = 2.65 + 0.65 = 3.30$

Step 3 – compute the denominator: $1 + e = 1 + 0.65 = 1.65$

Step 4 – form the ratio: $\dfrac{G+e}{1+e} = \dfrac{3.30}{1.65} = 2.0$

Step 5 – multiply by the unit weight of water: $\gamma_{sat} = 2.0 \times 9.81$

$\gamma_{sat} = 19.62$ kN/m^3

Final Answer: $\gamma_{sat} = 19.62$ kN/m$^3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept – total vertical stress in a dry soil: With the water table below the point, the pore pressure is zero, so the total vertical stress is simply $\sigma = \gamma\, z$.

Step 1 – list the data: $\gamma = 18$ kN/m^3, $z = 4$ m.

Step 2 – multiply: $\sigma = 18 \times 4$

$\sigma = 72$ kN/m^2

Step 3 – note on effective stress: Because the soil is dry, the pore pressure $u = 0$, so the effective stress equals the total stress here, 72 kPa.

Final Answer: $\sigma = 72$ kN/m$^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – hydraulic gradient: $i = \dfrac{h}{L}$, the head loss per unit length of the flow path.

Step 1 – list the data: Head loss $h = 0.6$ m, flow length $L = 3$ m.

Step 2 – form the ratio: $i = \dfrac{0.6}{3}$

Step 3 – evaluate: $i = 0.2$

Step 4 – note that i is dimensionless: Both quantities are lengths, so the gradient is a pure number, here 0.2.

Final Answer: $i = 0.2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

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

Step 1 – list the data: $D_{60} = 0.60$ mm, $D_{10} = 0.20$ mm.

Step 2 – form the ratio: $C_u = \dfrac{0.60}{0.20}$

Step 3 – evaluate: $C_u = 3.0$

Final Answer: $C_u = 3.0 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – primary consolidation settlement of a normally consolidated clay: $S_c = \dfrac{C_c H}{1 + e_0} \log_{10}\left(\dfrac{\sigma_0 + \Delta\sigma}{\sigma_0}\right)$.

Step 1 – list the data: $C_c = 0.25$, $H = 5$ m, $e_0 = 0.80$, $\sigma_0 = 100$ kPa, $\Delta\sigma = 100$ kPa.

Step 2 – compute the leading coefficient: $\dfrac{C_c H}{1 + e_0} = \dfrac{0.25 \times 5}{1 + 0.80} = \dfrac{1.25}{1.80}$ $= 0.6944$ m

Step 3 – form the stress ratio: $\dfrac{\sigma_0 + \Delta\sigma}{\sigma_0} = \dfrac{100 + 100}{100} = \dfrac{200}{100} = 2$

Step 4 – take the logarithm: $\log_{10}(2) = 0.30103$

Step 5 – multiply the two parts: $S_c = 0.6944 \times 0.30103$

$S_c = 0.209$ m

Step 6 – convert to millimetres: $S_c = 0.209 \times 1000 = 209$ mm

Final Answer: $S_c \approx 209 \text{ mm} \Rightarrow \boxed{\text{B}}$

Answer: (B) 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: $K_p = \dfrac{1+\sin 30°}{1-\sin 30°} = \dfrac{1+0.5}{1-0.5}$

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

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: $3 \times 18 = 54$

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

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

$P_p = 675$ kN/m

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

Answer: (A) Go Back to Q22

Q23.

Solution

Concept – net ultimate bearing capacity: $q_{nu} = q_u - \gamma\,D_f$, the gross value minus the overburden pressure already present at the founding level.

Step 1 – list the data: $q_u = 300$ kPa, $\gamma = 18\text{ kN/m}^3$, $D_f = 1.5$ m.

Step 2 – compute the overburden pressure: $\gamma\,D_f = 18 \times 1.5 = 27$ kPa

Step 3 – subtract from the gross value: $q_{nu} = 300 - 27$

$q_{nu} = 273$ kPa

Why the other options are wrong:

- A, 300: is the **gross** ultimate value, not the net.
- B, 27: is only the overburden pressure that was subtracted.
- D, 327: adds the overburden instead of subtracting it.

Final Answer: $q_{nu} = 273 \text{ kPa} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept – hydraulic radius of a channel: $R = \dfrac{A}{P}$, the flow area divided by the wetted perimeter.

Step 1 – compute the flow area: $A = b \times y = 4 \times 1 = 4 \text{ m}^2$

Step 2 – compute the wetted perimeter: The water touches the bed and the two side walls, so $P = b + 2y = 4 + 2(1) = 6$ m.

Step 3 – form the ratio: $R = \dfrac{A}{P} = \dfrac{4}{6}$

Step 4 – evaluate: $R = 0.667$ m

Final Answer: $R = 0.667 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

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

Step 1 – list the data: $n = 0.015$, $R = 1.0$ m, $S = 0.0001$.

Step 2 – evaluate $R^{2/3}$: $R^{2/3} = 1.0^{2/3} = 1.0$

Step 3 – evaluate $S^{1/2}$: $S^{1/2} = \sqrt{0.0001} = 0.01$

Step 4 – compute the coefficient $1/n$: $\dfrac{1}{n} = \dfrac{1}{0.015} = 66.67$

Step 5 – multiply the three factors: $V = 66.67 \times 1.0 \times 0.01$

$V = 0.667$ m/s

Final Answer: $V = 0.667 \text{ m/s} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – Torricelli's theorem for jet velocity: $V = \sqrt{2gh}$, the ideal velocity of a jet issuing under a head h.

Step 1 – list the data: $g = 9.81$ m/s^2, $h = 5$ m.

Step 2 – compute $2gh$**:** $2gh = 2 \times 9.81 \times 5 = 98.1$

Step 3 – take the square root: $V = \sqrt{98.1}$

$V = 9.9$ m/s

Step 4 – sanity check: $9.9^2 = 98.01 \approx 98.1$, which recovers $2gh$. Consistent.

Final Answer: $V = 9.9$ m/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept – discharge as area times velocity: $Q = AV$, with A the cross-sectional area of the pipe.

Step 1 – compute the pipe area: $A = \frac{\pi}{4}d^2 = \frac{\pi}{4}(0.20)^2$

$= \frac{\pi}{4} \times 0.04$

$= 0.03142$ m^2

Step 2 – multiply by the velocity: $Q = 0.03142 \times 3$

$Q = 0.0942$ m^3/s

Final Answer: $Q = 0.0942$ m^3/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept – Froude number for open-channel flow: $Fr = \frac{V}{\sqrt{gy}}$; $Fr < 1$ is sub-critical, $Fr = 1$ critical, $Fr > 1$ supercritical.

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

Step 2 – compute $g\,y$: $g\,y = 9.81 \times 1 = 9.81$

Step 3 – take the square root: $\sqrt{g\,y} = \sqrt{9.81} = 3.132$ m/s

Step 4 – divide the velocity by it: $Fr = \dfrac{2}{3.132}$

$Fr = 0.639$

Step 5 – classify: Since $Fr = 0.639 < 1$, the flow is subcritical.

Final Answer: $Fr = 0.639$ (subcritical) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – theoretical power delivered to a fluid: $P = \rho\,g\,Q\,H = \gamma_w\,Q\,H$, where $\gamma_w = \rho g$.

Step 1 – list the data: $\rho = 1000$ kg/m^3, $g = 9.81$ m/s^2, $Q = 0.10$ m^3/s, $H = 20$ m.

Step 2 – compute $\rho\,g$ (unit weight of water): $\rho\,g = 1000 \times 9.81 = 9810$ N/m^3

Step 3 – multiply by Q: $9810 \times 0.10 = 981$

Step 4 – multiply by H: $P = 981 \times 20 = 19620$ W

Step 5 – convert to kilowatts: $P = \dfrac{19620}{1000} = 19.62$ kW

Final Answer: $P = 19.62$ kW $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – runoff depth using the ϕ-index: Excess rainfall = total rainfall − infiltration loss, each computed over the storm duration.

Step 1 – compute the total rainfall depth: $P = \text{intensity} \times \text{duration} = 15 \times 4 = 60$ mm

Step 2 – compute the total infiltration loss: $F = \phi \times \text{duration} = 5 \times 4 = 20$ mm

Step 3 – subtract to get the runoff depth: $R = P - F = 60 - 20$

$R = 40$ mm

Final Answer: $R = 40$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept – annual runoff volume: $V = C \times P \times A$, the runoff coefficient times the rainfall depth times the catchment area (all in consistent units).

Step 1 – convert the units: $P = 100$ cm $= 1.0$ m, $A = 120$ km$^2 = 120 \times 10^6$ m^2, $C = 0.40$.

Step 2 – multiply the rainfall depth by the area: $P \times A = 1.0 \times 120 \times 10^6 = 120 \times 10^6$ m^3

Step 3 – apply the runoff coefficient: $V = 0.40 \times 120 \times 10^6$

$V = 48 \times 10^6$ m^3

Step 4 – express in million cubic metres: $V = 48$ Mm^3

Final Answer: $V = 48$ Mm$^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – duty relates command area to discharge: $D = \dfrac{A}{Q}$, so $Q = \dfrac{A}{D}$, where the duty D is in hectares per cumec.

Step 1 – list the data: Command area $A = 3600$ ha, duty $D = 900$ ha/cumec.

Step 2 – rearrange for discharge: $Q = \dfrac{A}{D} = \dfrac{3600}{900}$

Step 3 – evaluate: $Q = 4.0$ m^3/s

Final Answer: $Q = 4.0$ m^3/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – non-exceedance probability in a single year: If the annual exceedance probability is p, the probability of *non*-exceedance in that year is $q = 1 - p$.

Step 1 – list the exceedance probability: $p = 0.02$.

Step 2 – subtract from one: $q = 1 - 0.02$

$q = 0.98$

Step 3 – interpret: There is a 98% chance that this flood magnitude is not reached or exceeded in any given year.

Why the other options are wrong:

- A, 0.02: is the exceedance probability itself, not the non-exceedance value.
- B, 50: is the return period in years, not a probability.

Final Answer: $q = 0.98 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept – return period from annual exceedance probability: $T = \frac{1}{p}$, the reciprocal of the annual probability of being equalled or exceeded.

Step 1 – list the probability: $p = 0.02$.

Step 2 – take the reciprocal: $T = \frac{1}{0.02}$

Step 3 – evaluate: $T = 50$ years

Final Answer: $T = 50$ years $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept – chlorine demand: demand $=$ applied dose $-$ residual, the amount of chlorine consumed by the water.

Step 1 – list the data: Applied dose $= 5.0$ mg/L, residual $= 0.5$ mg/L.

Step 2 – subtract: demand $= 5.0 - 0.5$

demand $= 4.5$ mg/L

Final Answer: chlorine demand $= 4.5$ mg/L $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – detention time of a tank: $t_d = \dfrac{V}{Q}$, the tank volume divided by the throughput.

Step 1 – list the data: $V = 400\ \text{m}^3$, $Q = 2000\ \text{m}^3/\text{day}$.

Step 2 – form the ratio in days: $t_d = \dfrac{400}{2000} = 0.2$ day

Step 3 – convert days to hours: $t_d = 0.2 \times 24$

$t_d = 4.8$ hours

Final Answer: $t_d = 4.8$ hours $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept – maximum daily demand: First find the average daily demand (= per-capita rate × population), then multiply by the peak factor.

Step 1 – compute the average daily demand in litres: $Q_{avg} = 135 \times 40000 = 5{,}400{,}000$ litres/day

Step 2 – convert to cubic metres (1000 **L** $=$ 1 **m**^{3})**:** $Q_{avg} = \dfrac{5{,}400{,}000}{1000} = 5400\ \text{m}^3/\text{day}$

Step 3 – apply the peak factor of 1.8**:** $Q_{max} = 1.8 \times 5400$

$Q_{max} = 9720\ \text{m}^3/\text{day}$

Final Answer: $Q_{max} = 9720\ \text{m}^3/\text{day} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept – rate of filtration (surface loading): rate $= \dfrac{Q}{A}$, the flow divided by the plan area of the filter bed.

Step 1 – list the data: $Q = 3600\ \text{m}^3/\text{day}$, $A = 30\ \text{m}^2$.

Step 2 – form the ratio: rate $= \dfrac{3600}{30}$

Step 3 – evaluate: rate $= 120\ \text{m}^3/\text{m}^2/\text{day}$

Step 4 – interpret: This is 120 m/day, a value typical of a rapid gravity filter (far higher than a slow sand filter).

Final Answer: rate $= 120\ \text{m}^3/\text{m}^2/\text{day} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept – per-capita waste generation: rate $= \dfrac{\text{total daily mass}}{\text{population}}$, with the mass in kilograms.

Step 1 – convert the daily mass to kilograms: $M = 100\ \text{tonnes} = 100 \times 1000 = 100{,}000\ \text{kg/day}$

Step 2 – divide by the population: rate $= \dfrac{100{,}000}{200{,}000}$

Step 3 – evaluate: rate $= 0.5\ \text{kg/capita/day}$

Final Answer: rate $= 0.5\ \text{kg/capita/day} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept – braking distance on a level road: $d_b = \dfrac{v^2}{2gf}$, with v the speed in m/s and f the longitudinal friction coefficient.

Step 1 – convert the speed to m/s: $v = 72\ \text{km/h} = \dfrac{72}{3.6} = 20\ \text{m/s}$

Step 2 – square the speed: $v^2 = 20^2 = 400\ \text{m}^2/\text{s}^2$

Step 3 – compute the denominator: $2gf = 2 \times 9.81 \times 0.35 = 6.867$

Step 4 – divide: $d_b = \dfrac{400}{6.867}$

$d_b = 58.25\ \text{m}$

Final Answer: $d_b \approx 58.25\ \text{m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept – spacing at jam density: The average spacing is the reciprocal of the density; at jam density k_j, spacing $s_j = \frac{1}{k_j}$.

Step 1 – list the jam density: $k_j = 100$ veh/km.

Step 2 – take the reciprocal: $s_j = \frac{1}{100}$ km per vehicle

Step 3 – convert to metres: $s_j = \frac{1000}{100}$

$s_j = 10$ m

Final Answer: $s_j = 10 \text{ m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – speed for maximum flow in Greenshields' model: In the linear speed–density model the flow is a maximum at half the free-flow speed, $v = \frac{v_f}{2}$.

Step 1 – list the free-flow speed: $v_f = 64$ km/h.

Step 2 – halve it: $v = \frac{64}{2}$

$v = 32$ km/h

Step 3 – note on density: The corresponding density is $k_j/2 = 60$ veh/km, and the two together give the capacity; but the question asks only for the speed, 32 km/h.

Final Answer: $v = 32 \text{ km/h} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q42

Q43.

Solution

Concept – height-of-instrument method of levelling: $\text{HI} = \text{RL}_{\text{BM}} + \text{BS}$, and $\text{RL}_{\text{point}} = \text{HI} - \text{FS}$.

Step 1 – compute the height of instrument: $\text{HI} = 250.000 + 2.150$

$\text{HI} = 252.150$ m

Step 2 – subtract the fore sight to get the RL of P: $\text{RL}_P = 252.150 - 0.850$

$\mathrm{RL}_P = 251.300$ m

Step 3 – interpret: The fore sight (0.850) is smaller than the back sight (2.150), so P is higher than the benchmark, and indeed $251.300 > 250.000$. Consistent.

Final Answer: $\mathrm{RL}_P = 251.300$ m $\Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept – back bearing from fore bearing (whole-circle bearing system): Back bearing $=$ fore bearing $\pm 180°$: add $180°$ if the fore bearing is less than $180°$, otherwise subtract $180°$.

Step 1 – note the fore bearing: $\mathrm{FB}_{AB} = 120°$, which is less than $180°$.

Step 2 – apply the rule (add $180°$): $\mathrm{BB}_{AB} = 120° + 180°$

Step 3 – evaluate: $\mathrm{BB}_{AB} = 300°$

Step 4 – check the range: $300°$ lies between $0°$ and $360°$, so it is a valid whole-circle bearing.

Final Answer: back bearing $= 300° \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

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

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

Step 2 – halve the deflection angle: $\dfrac{\Delta}{2} = \dfrac{60°}{2} = 30°$

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

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

$T = 115.47$ m

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

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – tacheometric distance formula (horizontal sight, vertical staff): $D = k\,s + c$, where k is the multiplying constant, s the staff intercept and c the additive constant.

Step 1 – list the data: $k = 100$, $s = 0.850$ m, $c = 0.15$ m.

Step 2 – compute the $k\,s$ term: $k\,s = 100 \times 0.850 = 85.0$

Step 3 – add the additive constant: $D = 85.0 + 0.15$

$D = 85.15$ m

Why the other options are wrong:

- B, 85.00: ignores the additive constant $c = 0.15$ m.
- C, 850.0 and D, 8.50: misplace the decimal in the $k\,s$ product.

Final Answer: $D = 85.15$ 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	C	5	C
6	D	7	C	8	C	9	D	10	A
11	D	12	A	13	B	14	A	15	A
16	B	17	D	18	D	19	C	20	B
21	B	22	A	23	C	24	B	25	A
26	C	27	A	28	D	29	A	30	A
31	B	32	C	33	D	34	B	35	B
36	C	37	C	38	B	39	D	40	D
41	B	42	A	43	B	44	C	45	D
46	A								