GATE Civil Engineering

Sample Paper – 5

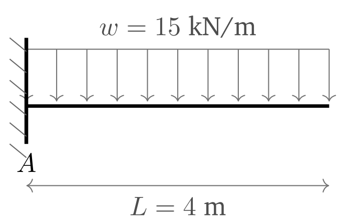
Duration: 128 Minutes **Maximum Marks: 72**

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 4 m is fixed at A and carries a uniformly distributed load of 15 kN/m over its entire span, as shown. The magnitude of the maximum bending moment (at the fixed end) is: **[1 mark]**



(A) 30 kN·m

(B) 60 kN·m

(C) 240 kN·m

(D) 120 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 $E = 200$ GPa, the axial elongation of the rod is: **[1 mark]**

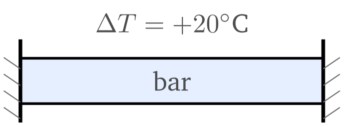
(A) 1.0 mm

(B) 0.5 mm

(C) 2.0 mm

(D) 0.25 mm

Q3. A straight bar is held rigidly between two immovable walls, as shown, so that no axial movement of its ends is possible. Its temperature is then raised uniformly by 20°C. Taking the coefficient of thermal expansion $\alpha = 12 \times 10^{-6}$ /°C and $E = 200$ GPa, the compressive thermal stress induced in the bar is: **[1 mark]**



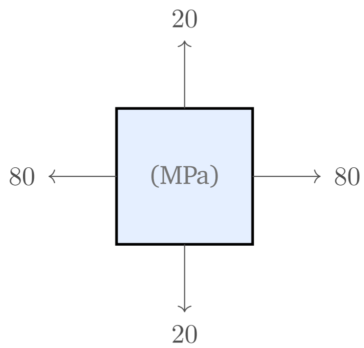
(A) 24 MPa

(B) 48 MPa

(C) 96 MPa

(D) 12 MPa

Q4. At a point in a stressed body the normal stresses are $\sigma_x = 80$ MPa and $\sigma_y = 20$ MPa (both tensile), with no shear stress on these planes, as shown. The maximum in-plane shear stress at the point is: **[1 mark]**



(A) 50 MPa

(B) 100 MPa

(C) 30 MPa

(D) 60 MPa

Q5. A structural strut has a solid circular cross-section of diameter 200 mm. The radius of gyration of the section about a centroidal axis is: **[1 mark]**

(A) 100 mm

(B) 25 mm

(C) 141.4 mm

(D) 50 mm

Q6. For an isotropic elastic material the modulus of elasticity is $E = 200$ GPa and Poisson's ratio is $\mu = 0.25$. The modulus of rigidity (shear modulus) G of the material, from $G = E/[2(1+\mu)]$, is: **[1 mark]**

(A) 80 GPa

(B) 100 GPa

(C) 160 GPa

(D) 40 GPa

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 of the beam (at the free end) is: **[1 mark]**

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

(B) $\dfrac{wL^4}{3EI}$

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

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

Q8. A single-bay, single-storey plane portal frame is fixed at both column bases (no internal hinges and no closed loop other than the frame itself, which is an open frame). The degree of static indeterminacy of the frame is: **[1 mark]**

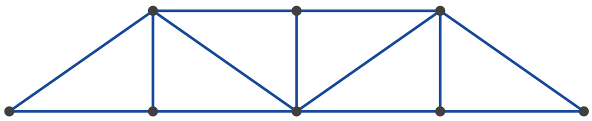
(A) 3

(B) 6

(C) 1

(D) 2

Q9. A plane truss, of the form shown below, has $m = 13$ members, $j = 8$ joints and $r = 3$ external reaction components. Using $D_s = m + r - 2j$, the degree of static indeterminacy of the truss is: **[1 mark]**



(A) 2

(B) 1

(C) 3

(D) 0

Q10. In the moment-distribution method, a moment is applied at the near end of a prismatic member whose far end is fixed. The carry-over factor (the ratio of the moment induced at the far end to that applied at the near end) is: **[1 mark]**

(A) 0.5

(B) 1.0

(C) 0.25

(D) 0.75

Q11. In the plastic analysis of beams, the shape factor of a cross-section is the ratio of its plastic moment capacity to its yield moment. For a solid *circular* cross-section, the shape factor is nearest to: **[1 mark]**

(A) 1.5

(B) 2.0

(C) 1.12

(D) 1.70

Q12. In the working stress method of IS 456:2000, the modular ratio is taken as $m = 280/(3\,\sigma_{cbc})$, where σ_{cbc} is the permissible bending compressive stress in concrete. For M20 concrete, $\sigma_{cbc} = 7$ N/mm^2. The modular ratio is nearest to: **[1 mark]**

(A) 9.33

(B) 18.67

(C) 11.2

(D) 13.33

Q13. In the limit state design of reinforced concrete to IS 456:2000, the partial safety factor for reinforcing steel is $\gamma_{ms} = 1.15$. For Fe415 steel, the design yield strength f_y/γ_{ms} is nearest to: **[1 mark]**

(A) 415 MPa

(B) 250 MPa

(C) 360.9 MPa

(D) 500 MPa

Q14. A beam has a solid rectangular cross-section 100 mm wide and 200 mm deep and is made of steel with a yield stress of 250 MPa. The fully plastic moment capacity $M_p = f_y \times Z_p$, where the plastic section modulus of a rectangle is $Z_p = bd^2/4$, is: **[1 mark]**

(A) 125 kN·m

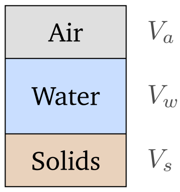
(B) 500 kN·m

(C) 250 kN·m

(D) 166.7 kN·m

Geotechnical Engineering

Q15. A soil sample has a void ratio of 0.70, a water content of 20% and a specific gravity of solids of 2.70. Using the phase relationship $S\,e = w\,G$ (illustrated by the three-phase diagram shown), the degree of saturation of the sample is nearest to: **[1 mark]**



(A) 54.0%

(B) 77.1%

(C) 70.0%

(D) 100%

Q16. A soil in its natural state has a bulk (total) unit weight of 20 kN/m^3 at a water content of 25%. The dry unit weight of the soil is: **[1 mark]**

(A) 15 kN/m^3

(B) 16 kN/m^3

(C) 25 kN/m^3

(D) 18 kN/m^3

Q17. A sand deposit has a maximum void ratio of 0.90, a minimum void ratio of 0.40 and an in-place void ratio of 0.65. The relative density (density index) of the sand is: **[1 mark]**

(A) 30%

(B) 40%

(C) 50%

(D) 62.5%

Q18. A soil deposit is dry from the ground surface down to a depth of 3 m, with a dry unit weight of 17 kN/m^3. The total vertical stress at a depth of 3 m below the surface is: **[1 mark]**

(A) 57.0 kN/m^2

(B) 34.0 kN/m^2

(C) 30.6 kN/m^2

(D) 51.0 kN/m^2

Q19. Water flows through a soil sample of cross-sectional area 0.01 m^2 under a hydraulic gradient of 0.5. The coefficient of permeability of the soil is 1×10^{-4} m/s. Using Darcy's law $Q = k\,i\,A$, the rate of discharge through the sample is: **[1 mark]**

(A) 5×10^{-7} m^3/s

(B) 5×10^{-6} m^3/s

(C) 2×10^{-7} m^3/s

(D) 1×10^{-6} m^3/s

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

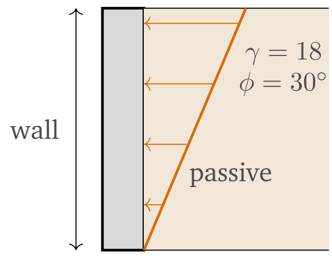
(A) 0.197

(B) 0.848

(C) 0.031

(D) 1.000

Q21. A smooth vertical retaining wall retains a dry cohesionless backfill with a horizontal surface, unit weight 18 kN/m^3 and angle of internal friction $\phi = 30°$, as shown. Using Rankine's theory, the coefficient of *passive* earth pressure $K_p = (1 + \sin\phi)/(1 - \sin\phi)$ is: **[2 marks]**



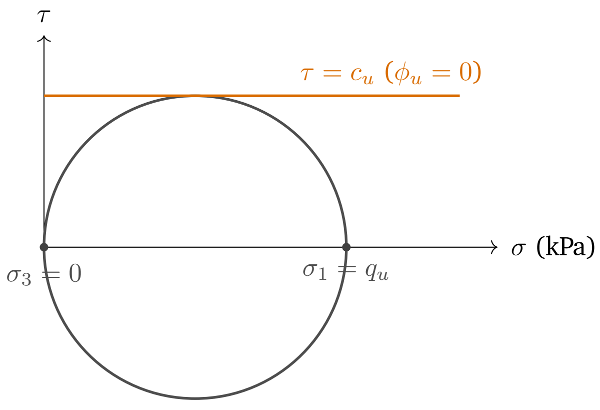
(A) 0.333

(B) 1.000

(C) 3.000

(D) 0.500

Q22. An unconfined compression test on a saturated clay under undrained ($\phi_u = 0$) conditions gives an unconfined compressive strength $q_u = 100$ kPa. Using the Mohr circle geometry shown (the failure envelope is horizontal for $\phi_u = 0$), the undrained cohesion $c_u = q_u/2$ of the clay is: **[2 marks]**



(A) 100 kPa

(B) 200 kPa

(C) 50 kPa

(D) 25 kPa

Q23. A normally consolidated clay layer 4 m thick has an initial void ratio of 0.80 and a compression index of 0.30. The effective vertical stress at the middle of the layer is 100 kPa and a wide loading raises it to 200 kPa. Using $S_c = \frac{C_c H}{1+e_0} \log_{10} \frac{\sigma'_f}{\sigma'_0}$, the primary consolidation settlement is nearest to: **[2 marks]**

(A) 100.3 mm

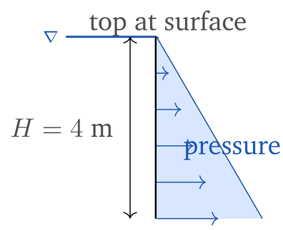
(B) 200.7 mm

(C) 301.0 mm

(D) 66.7 mm

Water Resources Engineering

Q24. A vertical rectangular gate 2 m wide and 4 m deep has its top edge lying in the free water surface on one side, as shown. Measured from the free surface, the depth of the centre of pressure on the gate is: **[2 marks]**



(A) 2.000 m

(B) 3.000 m

(C) 1.333 m

(D) 2.667 m

Q25. Water ($\nu = 1 \times 10^{-6}$ m^2/s) flows through a small pipe of diameter 50 mm at a mean velocity of 0.02 m/s. The Reynolds number of the flow, $Re = VD/\nu$, is: **[2 marks]**

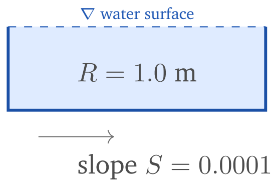
(A) 1000

(B) 2000

(C) 500

(D) 4000

Q26. An open channel carries water with a hydraulic radius of 1.0 m on a bed slope of 0.0001. Manning's roughness coefficient is $n = 0.015$. Using Manning's formula $V = \frac{1}{n}R^{2/3}S^{1/2}$, the mean velocity of flow is: **[2 marks]**



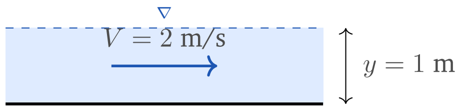
(A) 0.333 m/s

(B) 0.667 m/s

(C) 1.333 m/s

(D) 0.050 m/s

Q27. In a wide rectangular channel, water flows at a depth of 1.0 m with a mean velocity of 2 m/s, as shown. The Froude number of the flow, $Fr = V/\sqrt{g\,y}$, is nearest to: **[2 marks]**



(A) 0.320

(B) 0.639

(C) 1.280

(D) 2.000

Q28. A rectangular channel 4 m wide carries a steady discharge of 8 m^3/s. Using $y_c = \left(q^2/g\right)^{1/3}$ with q the discharge per unit width, the critical depth of flow is nearest to: **[2 marks]**

(A) 0.500 m

(B) 1.000 m

(C) 0.742 m

(D) 0.900 m

Q29. A centrifugal pump lifts a discharge of 0.5 m^3/s of water against a total head of 20 m. Assuming 100% efficiency, the water power delivered by the pump, $P = \rho g Q H$, is: **[2 marks]**

(A) 49.05 kW

(B) 196.20 kW

(C) 98.10 kW

(D) 9.81 kW

Q30. A storm produces a uniform direct runoff depth of 5 cm over a catchment of area 100 km^2. The total volume of direct runoff generated is: **[2 marks]**

(A) 5×10^4 m^3

(B) 5×10^5 m^3

(C) 5×10^7 m^3

(D) 5×10^6 m^3

Q31. A confined aquifer has a coefficient of permeability of 30 m/day and a saturated thickness of 10 m. The transmissivity of the aquifer, $T = k\,b$, is: **[2 marks]**

(A) 300 m^2/day

(B) 3 m^2/day

(C) 30 m^2/day

(D) 3000 m^2/day

Q32. A 6-hour unit hydrograph of a catchment has a peak discharge of 25 m^3/s. A 6-hour storm generates 4 cm of effective (excess) rainfall over the catchment. Assuming a negligible base flow, the peak of the resulting direct-runoff hydrograph is: **[2 marks]**

(A) 25 m^3/s

(B) $6.25\ \text{m}^3/\text{s}$

(C) $50\ \text{m}^3/\text{s}$

(D) $100\ \text{m}^3/\text{s}$

Q33. For a certain crop the duty of irrigation water at the field is 800 hectares per cumec. To irrigate a command area of 3200 hectares of this crop, the discharge required at the field, $Q = \text{Area}/\text{Duty}$, is: **[2 marks]**

(A) 2 cumec

(B) 4 cumec

(C) 8 cumec

(D) 0.25 cumec

Q34. Analysis of a long record of annual maximum floods shows that a certain flood magnitude has a probability of exceedance of 0.02 in any one year. The return period of this flood, $T = 1/P$, is: **[2 marks]**

(A) 20 years

(B) 2 years

(C) 50 years

(D) 100 years

Environmental Engineering

Q35. In the chlorination of a water supply, a chlorine dose of 5.0 mg/L is applied and, after the contact period, a free chlorine residual of 0.5 mg/L remains. The chlorine demand of the water (dose minus residual) 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 500 m^3 and treats a steady flow of 2000 m^3/day. The theoretical detention (retention) time of the tank, $t_d = V/Q$, is: **[2 marks]**

(A) 6 hours

(B) 12 hours

(C) 3 hours

(D) 4 hours

Q37. A town has a population of $1{,}00{,}000$ and a per capita water demand of 150 litres per capita per day. The average daily water demand of the town, expressed in million litres per day (MLD), is: **[2 marks]**

(A) 15 MLD

(B) 1.5 MLD

(C) 150 MLD

(D) 1500 MLD

Q38. A water sample contains calcium ions (Ca^{2+}) at a concentration of 40 mg/L. Taking the equivalent weights of Ca as 20 and of $CaCO_3$ as 50, the calcium hardness expressed as $CaCO_3$ is: **[2 marks]**

(A) 40 mg/L

(B) 200 mg/L

(C) 50 mg/L

(D) 100 mg/L

Q39. A sewage treatment unit receives wastewater with a BOD of 300 mg/L and discharges an effluent with a BOD of 30 mg/L. The BOD removal efficiency of the unit is: **[2 marks]**

(A) 90%

(B) 10%

(C) 45%

(D) 30%

Transportation & Geomatics Engineering

Q40. A vehicle moving at a design speed of 54 km/h brakes on a level road where the longitudinal friction coefficient is 0.35 (take $g = 9.81$ m/s^2). The braking distance (the distance travelled after the brakes are applied, ignoring reaction time), $d_b = V^2/(2gf)$, is nearest to: **[2 marks]**

(A) 15.0 m

(B) 32.8 m

(C) 65.6 m

(D) 22.9 m

Q41. A traffic stream follows Greenshields' linear speed–density model with a free-flow speed of 64 km/h. The speed at which the traffic flow is a maximum (the optimum speed for capacity) is: **[2 marks]**

(A) 64 km/h

(B) 16 km/h

(C) 32 km/h

(D) 48 km/h

Q42. At an approach to an intersection the hourly traffic volume is 1800 vehicles, and the highest count in any 15-minute interval within that hour is 500 vehicles. The peak-hour factor, $\text{PHF} = \dfrac{\text{hourly volume}}{4 \times (\text{peak 15-min volume})}$, is: **[2 marks]**

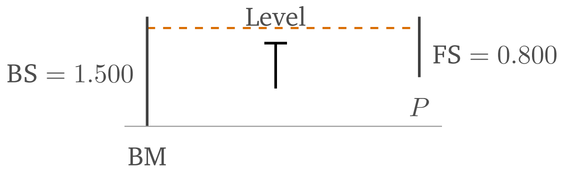
(A) 1.00

(B) 0.90

(C) 0.45

(D) 0.80

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 200.000 m, the back sight on it is 1.500 m and the fore sight on P is 0.800 m. The reduced level of P is: **[2 marks]**



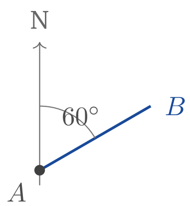
(A) 200.700 m

(B) 199.300 m

(C) 202.300 m

(D) 198.500 m

Q44. In a compass survey the fore bearing (whole circle bearing) of a survey line AB is $60°00'$, measured clockwise from magnetic north, as shown. The back bearing of the line AB is: **[2 marks]**



(A) $120°$

(B) $300°$

(C) $240°$

(D) $60°$

Q45. A simple circular curve of radius 200 m connects two straights that meet at a deflection (intersection) angle of $60°$. The tangent length of the curve, $T = R\tan(\Delta/2)$, is nearest to: **[2 marks]**

(A) 200.00 m

(B) 115.47 m

(C) 100.00 m

(D) 230.94 m

Q46. A survey line that is 100 m long on the ground is plotted on a map drawn to a representative fraction (scale) of $1 : 1000$. The length of the line as it appears on the map is: **[2 marks]**

(A) 1 cm

(B) 10 cm

(C) 100 cm

(D) 1 mm

Detailed Solutions

Q1.

Solution

Concept – maximum bending moment in a cantilever under a full-span UDL: The moment is largest at the fixed end, where $M_{\text{max}} = \dfrac{wL^2}{2}$.

Step 1 – list the data: $w = 15$ kN/m, $L = 4$ m.

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

Step 3 – evaluate L^2: $4^2 = 16$

Step 4 – substitute: $M_{\text{max}} = \dfrac{15 \times 16}{2}$

Step 5 – complete the arithmetic: $M_{\text{max}} = \dfrac{240}{2} = 120$ kN·m

Final Answer: $M_{\text{max}} = 120$ kN·m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q1

Q2.

Solution

Concept – axial elongation of a prismatic bar: $\delta = \dfrac{PL}{AE}$.

Step 1 – convert the data 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 – write the numerator: $PL = 50000 \times 2000 = 1.0 \times 10^8$ N · mm

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

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 $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – thermal stress in a fully restrained bar: When the free thermal expansion is completely prevented, the induced stress is $\sigma = E\,\alpha\,\Delta T$.

Step 1 – list the data: $E = 200$ GPa $= 200000$ N/mm^2, $\alpha = 12 \times 10^{-6}$ /°C, $\Delta T = 20$°C.

Step 2 – form the product $\alpha\,\Delta T$**:** $\alpha\,\Delta T = 12 \times 10^{-6} \times 20$

$= 240 \times 10^{-6}$

$= 2.4 \times 10^{-4}$

Step 3 – multiply by E**:** $\sigma = 200000 \times 2.4 \times 10^{-4}$

Step 4 – evaluate: $\sigma = 48$ N/mm^2 $= 48$ MPa

Final Answer: $\sigma = 48$ MPa $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – maximum in-plane shear stress for a biaxial state with no shear on the given planes: When σ_x and σ_y act with zero shear on those planes, they are the principal stresses, and $\tau_{\max} = \dfrac{\sigma_x - \sigma_y}{2}$.

Step 1 – identify the principal stresses: $\sigma_1 = 80$ MPa, $\sigma_2 = 20$ MPa (no shear on these planes).

Step 2 – take the difference: $\sigma_1 - \sigma_2 = 80 - 20 = 60$ MPa

Step 3 – halve it: $\tau_{\max} = \dfrac{60}{2}$

$\tau_{\max} = 30$ MPa

Step 4 – interpret: This is the radius of Mohr's circle, so the largest shear stress on any plane through the point is 30 MPa.

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

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – radius of gyration: $k = \sqrt{I/A}$. For a solid circle, $I = \dfrac{\pi D^4}{64}$ and $A = \dfrac{\pi D^2}{4}$, which gives $k = \dfrac{D}{4}$.

Step 1 – write I for the circle: $I = \dfrac{\pi D^4}{64}$

Step 2 – write A for the circle: $A = \dfrac{\pi D^2}{4}$

Step 3 – form the ratio I/A: $\dfrac{I}{A} = \dfrac{\pi D^4/64}{\pi D^2/4} = \dfrac{D^2}{16}$

Step 4 – take the square root: $k = \sqrt{\dfrac{D^2}{16}} = \dfrac{D}{4}$

Step 5 – substitute $D = 200$ mm: $k = \dfrac{200}{4} = 50$ mm

Final Answer: $k = 50$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

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

Step 1 – list the data: $E = 200$ GPa, $\mu = 0.25$.

Step 2 – evaluate the bracket: $1 + \mu = 1 + 0.25 = 1.25$

Step 3 – double it: $2(1+\mu) = 2 \times 1.25 = 2.5$

Step 4 – divide: $G = \dfrac{200}{2.5}$

$G = 80$ GPa

Final Answer: $G = 80$ GPa $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – standard deflection result for a cantilever under a full-span UDL: The maximum deflection is at the free end.

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

Step 2 – confirm the dependence: The deflection grows with the fourth power of the span and falls with the flexural rigidity EI, which matches option D.

Why the other options are wrong:

- A, $5wL^4/384EI$: is the midspan deflection of a **simply supported** beam under a UDL.
- B, $wL^4/3EI$: has the wrong constant; it resembles a point-load cantilever form, not a UDL.
- C, $wL^4/30EI$: is not a standard prismatic-beam UDL deflection.

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

Answer: (D) Go Back to Q7

Q8.

Solution

Concept – static indeterminacy of a rigid plane frame: $D_s = (\text{total reaction components}) - (\text{static equilibrium equations}) + (\text{internal indeterminacy})$.

Step 1 – count the reaction components: Each fixed base gives 3 reactions, so two fixed bases give $r = 3 + 3 = 6$.

Step 2 – count the equilibrium equations: A plane structure has 3 equations of static equilibrium.

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

Step 4 – internal indeterminacy: The single-bay portal is an *open* frame (no closed ring), so $D_{si} = 0$.

Step 5 – total: $D_s = 3 + 0 = 3$

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

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – degree of static indeterminacy of a plane truss: $D_s = m + r - 2j$; if $D_s = 0$ the truss is just-rigid (statically determinate).

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

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

Step 3 – add members and reactions: $m + r = 13 + 3 = 16$

Step 4 – subtract: $D_s = 16 - 16 = 0$

Step 5 – interpret: $D_s = 0$ means the truss is statically determinate (perfect/just-rigid).

Final Answer: $D_s = 0 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

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: For a prismatic (constant-EI) member, near end propped/rotated and far end fixed, the carry-over factor is $+\frac{1}{2}$.

Step 2 – write the value: COF $= 0.5$

Why the other options are wrong:

- B, 1.0: would mean the full moment is transferred, which is not the case for a fixed far end.
- C, 0.25 and D, 0.75: do not correspond to a prismatic member with a fixed far end.

Final Answer: COF $= 0.5 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

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 plastic modulus of a solid circle: $Z_p = \dfrac{D^3}{6}$

Step 2 – write the elastic modulus of a solid circle: $Z_e = \dfrac{\pi D^3}{32}$

Step 3 – form the ratio: $S = \dfrac{Z_p}{Z_e} = \dfrac{D^3/6}{\pi D^3/32} = \dfrac{32}{6\pi}$

Step 4 – evaluate: $S = \dfrac{32}{18.85} = 1.698 \approx 1.70$

Why the other options are wrong:

- A, 1.5: is the shape factor of a **rectangular** section.
- C, 1.12: is typical of a rolled I-section bent about its strong axis.

Final Answer: $S \approx 1.70 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept – modular ratio in the working stress method: $m = \dfrac{280}{3\,\sigma_{cbc}}$.

Step 1 – list the data: For M20 concrete, $\sigma_{cbc} = 7$ N/mm^2.

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

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

Step 4 – evaluate: $m = 13.33$

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

Answer: (D) Go Back to Q12

Q13.

Solution

Concept – design yield strength of reinforcing steel: In the limit state method the design strength is $\dfrac{f_y}{\gamma_{ms}}$, with $\gamma_{ms} = 1.15$.

Step 1 – list the data: $f_y = 415$ MPa (Fe415), $\gamma_{ms} = 1.15$.

Step 2 – substitute: $\dfrac{f_y}{\gamma_{ms}} = \dfrac{415}{1.15}$

Step 3 – evaluate: $= 360.87$ MPa ≈ 360.9 MPa

Step 4 – cross-check: This equals $0.87f_y = 0.87 \times 415 = 361.05$ MPa, the familiar design stress in the stress block, which agrees within rounding.

Final Answer: $f_y/\gamma_{ms} \approx 360.9$ MPa $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q13**

Q14.

Solution

Concept – fully plastic moment of a rectangular section: $M_p = f_y \times Z_p$, with $Z_p = \dfrac{b\,d^2}{4}$ for a rectangle.

Step 1 – compute the plastic section modulus: $Z_p = \dfrac{b\,d^2}{4} = \dfrac{100 \times 200^2}{4}$

Step 2 – evaluate d^2: $200^2 = 40000$

Step 3 – finish Z_p: $Z_p = \dfrac{100 \times 40000}{4} = \dfrac{4{,}000{,}000}{4} = 1.0 \times 10^6$ mm^3

Step 4 – multiply by the yield stress: $M_p = 250 \times 1.0 \times 10^6 = 250 \times 10^6$ N $\cdot$ mm

Step 5 – convert to kN·m: $M_p = 250 \times 10^6$ N $\cdot$ mm $= 250$ kN·m

Final Answer: $M_p = 250$ kN·m $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q14**

Q15.

Solution

Concept – basic weight–volume identity: $S\,e = w\,G$, so $S = \dfrac{w\,G}{e}$.

Step 1 – list the data: $e = 0.70$, $w = 0.20$, $G = 2.70$.

Step 2 – form the numerator: $w\,G = 0.20 \times 2.70 = 0.54$

Step 3 – divide by the void ratio: $S = \dfrac{0.54}{0.70}$

Step 4 – evaluate: $S = 0.771 = 77.1\%$

Final Answer: $S = 77.1\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – relating dry and bulk unit weight: $\gamma_d = \dfrac{\gamma}{1+w}$.

Step 1 – list the data: $\gamma = 20 \text{ kN/m}^3$, $w = 0.25$.

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

Step 3 – divide: $\gamma_d = \dfrac{20}{1.25}$

Step 4 – evaluate: $\gamma_d = 16 \text{ kN/m}^3$

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

Answer: (B) Go Back to Q16

Q17.

Solution

Concept – relative density (density index): $D_r = \dfrac{e_{\max} - e}{e_{\max} - e_{\min}}$.

Step 1 – list the data: $e_{\max} = 0.90$, $e_{\min} = 0.40$, $e = 0.65$.

Step 2 – compute the numerator: $e_{\max} - e = 0.90 - 0.65 = 0.25$

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

Step 4 – divide: $D_r = \dfrac{0.25}{0.50} = 0.50$

$D_r = 50\%$

Final Answer: $D_r = 50\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept – total vertical stress in a dry soil: Above the water table the soil is dry, so $\sigma_v = \gamma_d \times z$ and pore pressure is zero.

Step 1 – list the data: $\gamma_d = 17 \text{ kN/m}^3$, $z = 3$ m.

Step 2 – multiply: $\sigma_v = 17 \times 3$

Step 3 – evaluate: $\sigma_v = 51 \text{ kN/m}^2$

Step 4 – note on effective stress: Since the soil is dry, pore water pressure $u = 0$, so the effective stress equals the total stress here.

Final Answer: $\sigma_v = 51 \text{ kN/m}^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – Darcy's law for discharge: $Q = k\,i\,A$.

Step 1 – list the data: $k = 1 \times 10^{-4}$ m/s, $i = 0.5$, $A = 0.01$ m^2.

Step 2 – multiply k by i: $k\,i = 1 \times 10^{-4} \times 0.5 = 0.5 \times 10^{-4} = 5 \times 10^{-5}$

Step 3 – multiply by the area: $Q = 5 \times 10^{-5} \times 0.01$

Step 4 – evaluate: $Q = 5 \times 10^{-7}$ m^3/s

Final Answer: $Q = 5 \times 10^{-7}$ m^3/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – time factor for one-dimensional consolidation: For $U \leq 60\%$, $T_v = \frac{\pi}{4}U^2$; the standard value at $U = 50\%$ is $T_v = 0.197$.

Step 1 – put $U = 0.50$ into $T_v = \frac{\pi}{4}U^2$: $T_v = \frac{\pi}{4}(0.50)^2$

Step 2 – square the degree of consolidation: $(0.50)^2 = 0.25$

Step 3 – multiply: $T_v = 0.7854 \times 0.25$

$T_v = 0.196 \approx 0.197$

Step 4 – note: The tabulated standard value at $U = 50\%$ is $T_v = 0.197$.

Why the other options are wrong:

- B, 0.848: is the value at $U = 90\%$.
- D, 1.000: does not correspond to any standard degree of consolidation.

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

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – Rankine passive earth pressure coefficient: $K_p = \dfrac{1+\sin\phi}{1-\sin\phi}$.

Step 1 – evaluate $\sin\phi$**:** $\sin 30^\circ = 0.5$

Step 2 – form the numerator: $1+\sin\phi = 1+0.5 = 1.5$

Step 3 – form the denominator: $1-\sin\phi = 1-0.5 = 0.5$

Step 4 – divide: $K_p = \dfrac{1.5}{0.5} = 3.0$

Step 5 – cross-check: K_p should be the reciprocal of K_a; here $K_a = 1/3$, so $K_p = 3$, which agrees.

Final Answer: $K_p = 3.0 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – undrained shear strength from the unconfined compression test: For a $\phi_u = 0$ clay the Mohr circle for the UCS test has $\sigma_3 = 0$ and $\sigma_1 = q_u$, so its radius (the undrained cohesion) is $c_u = q_u/2$.

Step 1 – list the data: $q_u = 100$ kPa.

Step 2 – apply $c_u = q_u/2$**:** $c_u = \dfrac{100}{2}$

Step 3 – evaluate: $c_u = 50$ kPa

Step 4 – interpret with the figure: The horizontal failure envelope ($\phi_u = 0$) is tangent to the top of the circle at $\tau = c_u = 50$ kPa.

Final Answer: $c_u = 50$ kPa $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept – primary consolidation settlement of a normally consolidated clay: $S_c = \dfrac{C_c\,H}{1+e_0}\log_{10}\dfrac{\sigma'_f}{\sigma'_0}$.

Step 1 – list the data: $C_c = 0.30$, $H = 4$ m $= 4000$ mm, $e_0 = 0.80$, $\sigma'_0 = 100$ kPa, $\sigma'_f = 200$ kPa.

Step 2 – compute the leading factor: $\dfrac{C_c\,H}{1+e_0} = \dfrac{0.30 \times 4000}{1+0.80} = \dfrac{1200}{1.80}$

$= 666.67$ mm

Step 3 – compute the stress ratio: $\dfrac{\sigma'_f}{\sigma'_0} = \dfrac{200}{100} = 2$

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

Step 5 – multiply: $S_c = 666.67 \times 0.30103$

$S_c = 200.7$ mm

Final Answer: $S_c \approx 200.7$ mm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – centre of pressure on a vertical surface with its top at the free surface: For a vertical rectangle of depth H with the top edge at the water surface, the pressure varies linearly (triangular), and the centre of pressure lies at $\bar{h} = \dfrac{2}{3}H$ from the surface.

Step 1 – list the data: $H = 4$ m.

Step 2 – apply the result: $\bar{h} = \dfrac{2}{3}H = \dfrac{2}{3} \times 4$

Step 3 – evaluate: $\bar{h} = \dfrac{8}{3} = 2.667$ m

Step 4 – reasoning check: For a triangular pressure distribution the resultant acts through the centroid of the triangle, which is at two-thirds of the depth below the surface. This confirms 2.667 m.

Final Answer: $\bar{h} = 2.667$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – Reynolds number for pipe flow: $Re = \dfrac{VD}{\nu}$.

Step 1 – list the data: $V = 0.02$ m/s, $D = 50$ mm $= 0.05$ m, $\nu = 1 \times 10^{-6}$ m^2/s.

Step 2 – form the numerator: $VD = 0.02 \times 0.05 = 1 \times 10^{-3}$

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

Step 4 – evaluate: $Re = 1000$

Step 5 – classify: $Re = 1000 < 2000$, so the flow is laminar.

Final Answer: $Re = 1000 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept – Manning's uniform-flow formula: $V = \frac{1}{n}R^{2/3}S^{1/2}$.

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 – evaluate $1/n$: $\frac{1}{0.015} = 66.67$

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

$V = 0.667$ m/s

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

Answer: (B) Go Back to Q26

Q27.

Solution

Concept – Froude number of open-channel flow: $Fr = \frac{V}{\sqrt{g\,y}}$.

Step 1 – list the data: $V = 2$ m/s, $y = 1.0$ m, $g = 9.81$ m/s^2.

Step 2 – form the product $g\,y$: $g\,y = 9.81 \times 1.0 = 9.81$

Step 3 – take the square root: $\sqrt{9.81} = 3.132$

Step 4 – divide: $Fr = \frac{2}{3.132}$

$Fr = 0.639$

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

Final Answer: $Fr = 0.639 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – critical depth in a rectangular channel: $y_c = \left(\frac{q^2}{g}\right)^{1/3}$, where $q = Q/b$ is the discharge per unit width.

Step 1 – compute the unit discharge: $q = \frac{Q}{b} = \frac{8}{4} = 2\ \text{m}^2/\text{s}$

Step 2 – form q^2: $q^2 = 2^2 = 4$

Step 3 – divide by g: $\frac{q^2}{g} = \frac{4}{9.81} = 0.4077$

Step 4 – take the cube root: $y_c = (0.4077)^{1/3}$

$y_c = 0.742\ \text{m}$

Final Answer: $y_c \approx 0.742\ \text{m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept – water power of a pump: $P = \rho g Q H$, i.e. $P = \gamma_w Q H$ with $\gamma_w = 9.81\ \text{kN/m}^3$.

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

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

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

Step 4 – evaluate: $P = 98.1$ kW

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

Answer: (C) Go Back to Q29

Q30.

Solution

Concept – volume of direct runoff: Volume = (runoff depth) × (catchment area), with all lengths in metres.

Step 1 – convert the runoff depth to metres: $d = 5\ \text{cm} = 0.05\ \text{m}$

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

Step 3 – multiply: Volume $= 0.05 \times 1 \times 10^8$

Step 4 – evaluate: Volume $= 5 \times 10^6$ m^3

Final Answer: Volume $= 5 \times 10^6$ m$^3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept – transmissivity of a confined aquifer: $T = k\,b$, the product of the permeability and the saturated thickness.

Step 1 – list the data: $k = 30$ m/day, $b = 10$ m.

Step 2 – multiply: $T = 30 \times 10$

Step 3 – evaluate: $T = 300$ m^2/day

Final Answer: $T = 300$ m^2/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q31

Q32.

Solution

Concept – direct-runoff peak from a unit hydrograph: Because a unit hydrograph is linear, ordinates scale directly with the depth of effective rainfall: $Q_{peak} =$ (UH peak) $\times$ (effective rainfall in cm).

Step 1 – list the data: UH peak $= 25$ m^3/s (for 1 cm), effective rainfall $= 4$ cm.

Step 2 – scale the peak: $Q_{peak} = 25 \times 4$

Step 3 – evaluate: $Q_{peak} = 100$ m^3/s

Step 4 – note on base flow: Base flow is negligible, so the direct-runoff peak is also the total peak here.

Final Answer: $Q_{peak} = 100$ m^3/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept – duty, area and discharge: Duty D (ha/cumec) is the area irrigated per unit discharge, so $Q = \dfrac{\text{Area}}{D}$.

Step 1 – list the data: Area $= 3200$ ha, $D = 800$ ha/cumec.

Step 2 – substitute: $Q = \frac{3200}{800}$

Step 3 – evaluate: $Q = 4$ cumec

Final Answer: $Q = 4$ cumec $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept – return period and probability of exceedance: $T = \frac{1}{P}$, where P is the probability that the event is equalled or exceeded in any one year.

Step 1 – list the data: $P = 0.02$.

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

Step 3 – evaluate: $T = 50$ years

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

Answer: (C) Go Back to Q34

Q35.

Solution

Concept – chlorine demand: Chlorine demand = applied dose − residual.

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

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

Step 3 – evaluate: Demand $= 4.5$ mg/L

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

Answer: (B) Go Back to Q35

Q36.

Solution

Concept – detention (retention) time of a tank: $t_d = \frac{V}{Q}$.

Step 1 – list the data: $V = 500\ \text{m}^3$, $Q = 2000\ \text{m}^3/\text{day}$.

Step 2 – divide: $t_d = \frac{500}{2000} = 0.25$ day

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

Step 4 – evaluate: $t_d = 6$ hours

Final Answer: $t_d = 6$ hours $\Rightarrow \boxed{A}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q36

Q37.

Solution

Concept – average daily water demand: Demand = population × per capita demand.

Step 1 – list the data: Population $= 1{,}00{,}000$, per capita demand $= 150$ L/day.

Step 2 – multiply: Demand $= 100000 \times 150 = 1.5 \times 10^7$ L/day

Step 3 – convert to million litres per day: 1.5×10^7 L/day $= 15 \times 10^6$ L/day $= 15$ MLD

Final Answer: Demand $= 15$ MLD $\Rightarrow \boxed{A}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q37

Q38.

Solution

Concept – expressing hardness as $CaCO_3$: Hardness as $CaCO_3$ = (ion concentration) $\times \dfrac{\text{equivalent weight of } CaCO_3}{\text{equivalent weight of the ion}}$.

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

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

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

Step 4 – evaluate: Hardness $= 100$ mg/L as $CaCO_3$

Final Answer: Hardness $= 100$ mg/L as $CaCO_3 \Rightarrow \boxed{D}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q38

Q39.

Solution

Concept – BOD removal efficiency: $\eta = \dfrac{\text{BOD}_{in} - \text{BOD}_{out}}{\text{BOD}_{in}} \times 100\%$.

Step 1 – list the data: $\text{BOD}_{in} = 300$ mg/L, $\text{BOD}_{out} = 30$ mg/L.

Step 2 – compute the removed amount: $300 - 30 = 270$ mg/L

Step 3 – divide by the influent BOD: $\dfrac{270}{300} = 0.90$

Step 4 – express as a percentage: $\eta = 0.90 \times 100 = 90\%$

Final Answer: $\eta = 90\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – braking distance on a level road: $d_b = \dfrac{V^2}{2gf}$, with V in m/s.

Step 1 – convert the speed to m/s: $V = 54$ km/h $= \dfrac{54}{3.6} = 15$ m/s

Step 2 – square the speed: $V^2 = 15^2 = 225$

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

Step 4 – divide: $d_b = \dfrac{225}{6.867}$

$d_b = 32.8$ m

Final Answer: $d_b \approx 32.8$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – Greenshields' model and maximum flow: In the linear speed–density model the flow is maximum at half the free-flow speed, $V_{opt} = V_f/2$ (and at half the jam density).

Step 1 – list the data: $V_f = 64$ km/h.

Step 2 – halve the free-flow speed: $V_{opt} = \dfrac{V_f}{2} = \dfrac{64}{2}$

Step 3 – evaluate: $V_{opt} = 32$ km/h

Step 4 – reasoning: The flow $q = k\,v$ is a downward parabola in speed; its maximum occurs at the vertex $v = V_f/2$, hence 32 km/h.

Final Answer: $V_{opt} = 32$ km/h $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – peak-hour factor: $\text{PHF} = \dfrac{\text{hourly volume}}{4 \times (\text{peak 15-min volume})}$.

Step 1 – list the data: Hourly volume $= 1800$ veh, peak 15-min volume $= 500$ veh.

Step 2 – form the denominator: $4 \times 500 = 2000$

Step 3 – divide: $\text{PHF} = \dfrac{1800}{2000}$

Step 4 – evaluate: $\text{PHF} = 0.90$

Final Answer: $\text{PHF} = 0.90 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – reduced level by the height-of-instrument method: HI = RL of BM + BS, then RL of P = HI − FS.

Step 1 – list the data: RL of BM $= 200.000$ m, BS $= 1.500$ m, FS $= 0.800$ m.

Step 2 – compute the height of the instrument: HI $= 200.000 + 1.500 = 201.500$ m

Step 3 – subtract the fore sight: RL of $P = 201.500 - 0.800$

Step 4 – evaluate: RL of $P = 200.700$ m

Step 5 – cross-check by rise/fall: BS − FS $= 1.500 - 0.800 = +0.700$ (a rise), so RL of $P = 200.000 + 0.700 = 200.700$ m, which agrees.

Final Answer: RL of $P = 200.700$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – back bearing from fore bearing (whole circle bearing system): Back bearing $=$ Fore bearing $\pm 180°$; add $180°$ when the fore bearing is less than $180°$.

Step 1 – list the data: Fore bearing of $AB = 60°$.

Step 2 – since $60° < 180°$, add $180°$: Back bearing $= 60° + 180°$

Step 3 – evaluate: Back bearing $= 240°$

Step 4 – check the range: $240°$ lies between $0°$ and $360°$, so no further correction is needed.

Final Answer: Back bearing $= 240° \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – tangent length of a simple circular curve: $T = R\tan\left(\frac{\Delta}{2}\right)$.

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

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

Step 3 – evaluate the tangent: $\tan 30° = 0.57735$

Step 4 – multiply by the radius: $T = 200 \times 0.57735$

$T = 115.47$ m

Final Answer: $T \approx 115.47$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept – representative fraction (scale) of a map: Map distance $=$ Ground distance $\times$ RF, where RF $= 1/1000$.

Step 1 – list the data: Ground distance $= 100$ m, RF $= 1/1000$.

Step 2 – multiply: Map distance $= 100 \times \frac{1}{1000} = 0.1$ m

Step 3 – convert to centimetres: 0.1 m $= 0.1 \times 100 = 10$ cm

Final Answer: Map distance $= 10$ cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q46

Answer Key

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