

GENERAL ABILITY

Q. No. 1 - 5 Carry One Mark Each

1. Rescue teams deployed _____ disaster hit areas combat _____ a lot of difficulties to save the people.

- (A) to, to (B) in, with (C) with, at (D) with, with

Answer: (D)

2. Select the most appropriate word that can replace the underlined word without changing the meaning of the sentence:

Now-a-days, most children have a tendency to belittle the legitimate concerns of their parents.

- (A) Applaud (B) Begudge (C) Disparage (D) Reduce

Answer: (C)

3. In a school of 1000 students, 300 students play chess and 600 students play football. If 50 students play both chess and football, the number of students who play neither is _____.

- (A) 150 (B) 50 (C) 100 (D) 200

Answer: (A)

4. After the inauguration of the new building, the Head of Department (HOD) collated faculty preferences for office space. P wanted a room adjacent to the lab. Q wanted to be close to the lift. R wanted a view of the playground and S wanted a corner office.

Assuming that everyone was satisfied, which among the following shows a possible allocation?

(A)

	PLAYGROUND			
	HoD	Q	R	S
	P			LIFT
	LAB			

(B)

	PLAYGROUND			
	S	R	HoD	Q
Road				
	P			LIFT
	LAB			

(C)

	PLAYGROUND			
	HoD	S	R	Q
	P			LIFT
	LAB			

(D)

	PLAYGROUND			
Road	S	R	P	HoD
	Q			LIFT
	LAB			

Answer: (A)

5. If $f(x) = x^2$ for each $x \in (-\infty, \infty)$, then $\frac{f(f(f(x)))}{f(x)}$ is equal to _____.

- (A) $(f(x))^2$ (B) $(f(x))^3$ (C) $(f(x))^4$ (D) $f(x)$

Answer: (B)

Q. No. 6 - 10 Carry One Mark Each

6. Nominal interest rate is defined as the amount paid by the borrower to the lender for using the borrowed amount for a specific period of time. Real interest rate calculated on the basis of actual value (inflation-adjusted), is approximately equal to the difference between nominal rate and expected rate of inflation in the economy. Which of the following assertions is best supported by the above information?

- (A) Under low inflation, real interest rate is low and borrowers get benefited.
 (B) Under high inflation, real interest rate is low and borrowers get benefited.
 (C) Under low inflation, real interest rate is high and borrowers get benefited.
 (D) Under high inflation, real interest rate is low and lenders get benefited.

Answer: (B)

7. For the year 2019, which of the previous year's calendar can be used?

- (A) 2011 (B) 2013 (C) 2012 (D) 2014

Answer: (B)

8. The ratio of ‘the sum of the odd positive integers from 1 to 100’ to ‘the sum of the even positive integers from 150 to 200’ is _____.
- (A) 50: 91 (B) 1: 1 (C) 1: 2 (D) 45: 95

Answer: (A)

9. Select the word that fits the analogy:

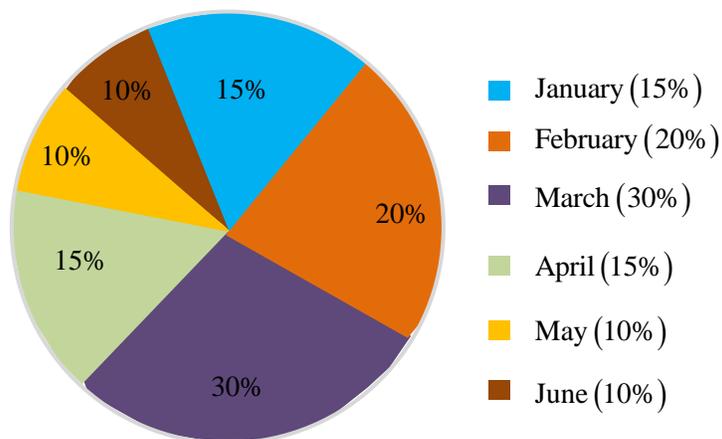
Partial : Impartial : : Popular : _____

- (A) Impopular (B) Dispopular (C) Mispopular (D) Unpopular

Answer: (D)

10. The monthly distribution of 9 Watt LED bulbs sold by two firms X and Y from January to June 2018 is shown in the pie-chart and the corresponding table.

Percentage of 9 Watt LED bulbs sold by the firms X and Y from January 2018 to June, 2018



Month	Ratio of LED bulbs Sold by two firms (X : Y)
January	7 : 8
February	2 : 3
March	2 : 1
April	3 : 2
May	1 : 4
June	9 : 11

If the total number of LED bulbs sold by two firms during April-June 2018 is 50000, then the number of LED bulbs sold by the firm Y during April-June 2018 is _____.

- (A) 11250 (B) 9750 (C) 8250 (D) 8750

Answer: (*)

9. The ratio of the plastic moment capacity of a beam section to its yield moment capacity is termed as
(A) aspect ratio (B) load factor (C) shape factor (D) slenderness ratio

Answer: (C)

10. A soil has dry weight of 15.5 kN/m^3 , specific gravity of 2.65 and degree of saturation of 72%. Considering the unit weight of water as 10 kN/m^3 , the water content of the soil (in %, round off to two decimal places) is _____.

Answer: (19.28)

11. Soil deposit formed due to transportation by wind is termed as
(A) lacustrine deposit (B) alluvial deposit
(C) estuarine deposit (D) aeolian deposit

Answer: (D)

12. A sample of 500 g dry sand, when poured into a 2 litre capacity cylinder which is partially filled with water, displaces 188 cm^3 of water. The density of water is 1 g/cm^3 . The specific gravity of the sand is
(A) 2.55 (B) 2.72 (C) 2.66 (D) 2.52

Answer: (C)

13. For an axle load of 15 tonne on a road, the Vehicle Damage Factor (round off to two decimal places), in terms of the standard axle load of 8 tonne, is _____.

Answer: (12.35)

14. Muskingum method is used in
(A) hydrologic channel routing (B) hydraulic channel routing
(C) hydrologic reservoir routing (D) hydraulic reservoir routing

Answer: (B)

15. Superpassage is a canal cross-drainage structure in which
- (A) canal water flows under pressure below a natural stream
 - (B) natural stream water flows under pressure below a canal
 - (C) canal water flows with free surface below a natural stream
 - (D) natural stream water flows with free surface below a canal

Answer: (C)

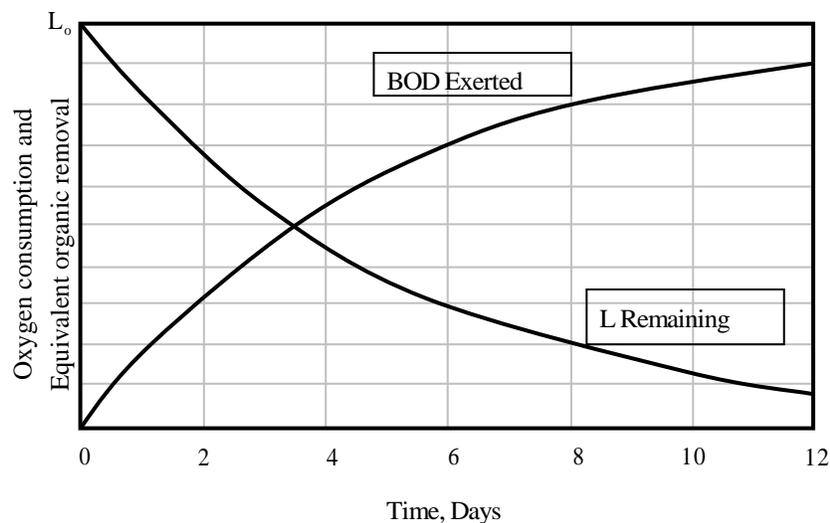
16. A gas contains two types of suspended particles having average sizes of $2\ \mu\text{m}$ and $50\ \mu\text{m}$. Amongst the options given below, the most suitable pollution control strategy for removal of these particles is
- (A) electrostatic precipitator followed by cyclonic separator
 - (B) bag filter followed by electrostatic precipitator
 - (C) settling chamber followed by bag filter
 - (D) electrostatic precipitator followed by venturi scrubber

Answer: (C)

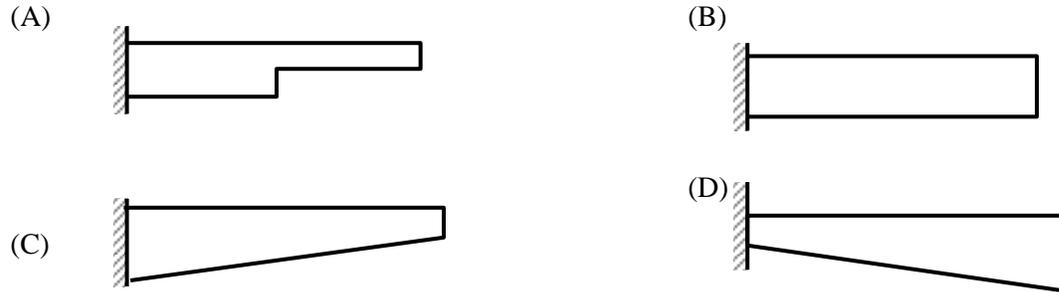
17. 24-h traffic count at a road section was observed to be 1000 vehicles on a Tuesday in the month of July. If daily adjustment factor for Tuesday is 1.121 and monthly adjustment factor for July is 0.913, the Annual Average Daily Traffic (in veh/day, roundoff to the nearest integer) is _____.

Answer: (1023.473)

18. The relationship between oxygen consumption and equivalent biodegradable organic removal (i.e. BOD) in a closed container with respect to time is shown in the figure.



From the flexure-critical perspective, the most economical longitudinal profile of the beam to carry the given loads amongst the options given below, is



Answer: (D)

22. Velocity distribution in a boundary layer is given by $\frac{u}{U_\infty} = \sin\left(\frac{\pi y}{2\delta}\right)$, where u is the velocity at vertical coordinate y , U_∞ is the free stream velocity and δ is the boundary layer thickness. The values of U_∞ and δ are 0.3m/s and 1.0m, respectively. The velocity gradient $\left(\frac{\partial u}{\partial y}\right)$ (in s^{-1} , round off to two decimal places) at $y=0$, is _____.

Answer: (0.47)

23. The integral

$$\int_0^1 (5x^3 + 4x^2 + 3x + 2) dx$$

is estimated numerically using three alternative methods namely the rectangular, trapezoidal and Simpson's rules with a common step size. In this context, which one of the following statements is TRUE?

- (A) Simpson's rule as well as rectangular rule of estimation will give NON-zero error.
- (B) Only Simpson's rule of estimation will give zero error.
- (C) Simpson's rule, rectangular rule as well as trapezoidal rule of estimation will give NON-zero error.
- (D) Only the rectangular rule of estimation will give zero error.

Answer: (B)

24. The following partial differential equation is defined for $u: u(x, y)$

$$\frac{\partial u}{\partial y} = \frac{\partial^2 u}{\partial x^2}; \quad y \geq 0; \quad x_1 \leq x \leq x_2$$

The set of auxiliary conditions necessary to solve the equation uniquely, is

- (A) one initial condition and two boundary conditions
- (B) three initial conditions
- (C) two initial conditions and one boundary condition
- (D) three boundary conditions

Answer: (A)

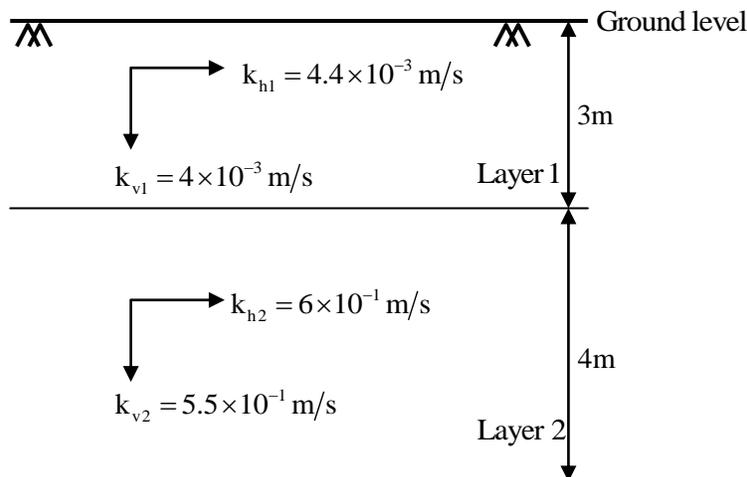
25. A triangular direct runoff hydrograph due to a storm has a time base of 90 hours. The peak flow of $60 \text{ m}^3/\text{s}$ occurs at 20 hours from the start of the storm. The area of catchment is 300 km^2 . The rainfall excess of the storm (in cm), is

- (A) 5.40
- (B) 2.00
- (C) 3.24
- (D) 6.48

Answer: (C)

Q. No. 26-55 Carry Two Marks Each

26. Permeability tests were carried out on the samples collected from two different layers as shown in the figure (not drawn to the scale). The relevant horizontal (k_h) and vertical (k_v) coefficients of permeability are indicated for each layer.

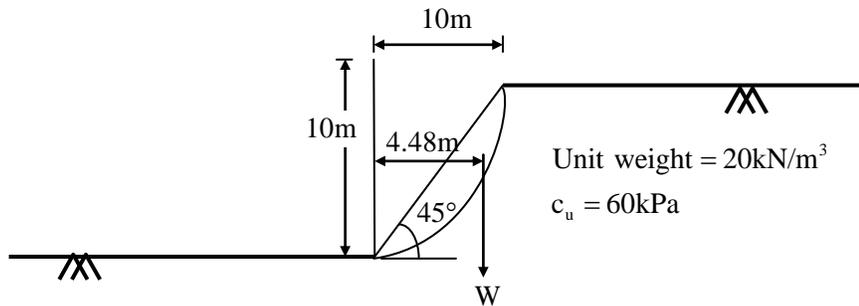


The ratio of the equivalent horizontal to vertical coefficients of permeability, is

- (A) 37.29 (B) 80.20 (C) 0.03 (D) 68.25

Answer: (A)

- 27.** A 10 m high slope of dry clay soil (unit weight = 20 kN/m^3), with a slope angle of 45° and the circular slip surface, is shown in the figure (not drawn to the scale). The weight of the slip wedge is denoted by W . The undrained unit cohesion (c_u) is 60 kPa.



The factor of safety of the slope against slip failure, is

- (A) 0.58 (B) 1.84 (C) 1.57 (D) 1.67

Answer: (B)

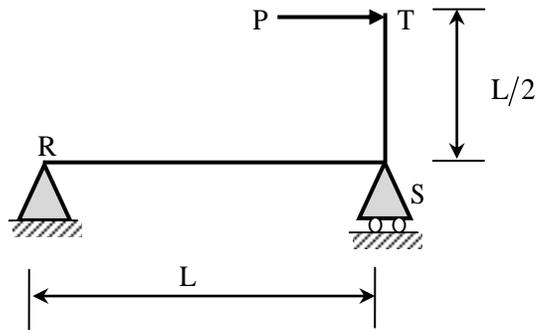
- 28.** A hydraulic jump occurs, in a triangular (V-shaped) channel with side slopes 1:1 (vertical to horizontal). The sequent depths are 0.5 m and 1.5 m. The flow rate (in m^3/s , round off to two decimal places) in the channel is _____.

Answer: (1.73)

- 29.** The diameter and height of a right circular cylinder are 3 cm and 4 cm, respectively. The absolute error in each of these two measurements is 0.2 cm. The absolute error in the computed volume (in cm^3 , round off to three decimal places), is _____.

Answer: (5.184)

30. The planar structure RST shown in the figure is roller-supported at S and pin-supported at R. Members RS and ST have uniform flexural rigidity (EI) and S is a rigid joint. Consider only bending deformation and neglect effects of self-weight and axial stiffening.

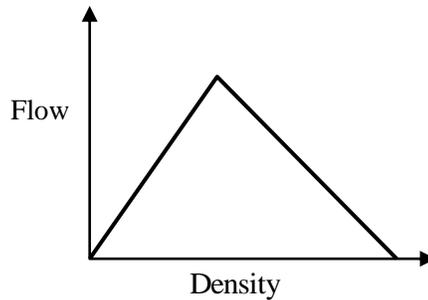


When the structure is subjected to a concentrated horizontal load P at the end T , the magnitude of rotation at the support R , is

- (A) $\frac{PL^2}{12EI}$ (B) $\frac{PL^2}{6EI}$ (C) $\frac{PL^3}{12EI}$ (D) $\frac{PL}{6EI}$

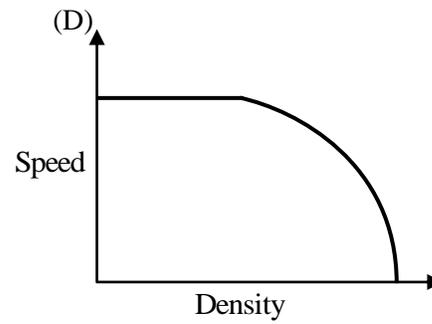
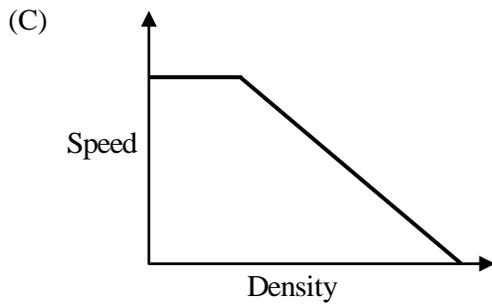
Answer: (A)

31. The flow-density relationship of traffic on a highway is shown in the figure



The correct representation of speed-density relationship of the traffic on this highway is

- (A) (B)

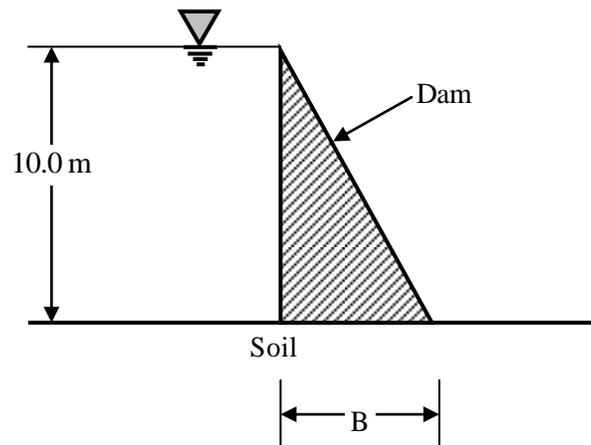


Answer: (B)

32. A sample of water contains an organic compound $C_8H_{16}O_8$ at a concentration of 10^{-3} mol/litre. Given that the atomic weight of C = 12 g/mol, H = 1 g/mol, and O = 16 g/mol, the theoretical oxygen demand of water (in g of O_2 per litre, round off to two decimal places), is _____.

Answer: (0.256)

33. A concrete dam holds 10 m of static water as shown in the figure (not drawn to the scale). The uplift assumed to vary linearly from full hydrostatic head at the heel, to zero at the toe of dam.

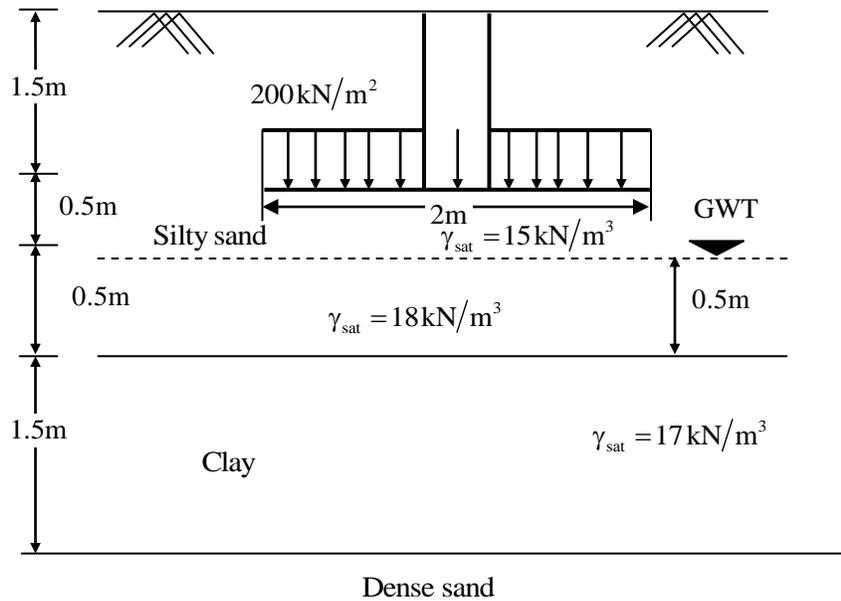


The coefficient of friction between the dam and foundation soil is 0.45. Specific weights of concrete and water are 24 kN/m^3 and 9.81 kN/m^3 , respectively.

For NO sliding condition, the required minimum base width B (in m, round off to two decimal places) is _____.

Answer: (15.873)

34. A footing of size $2\text{ m} \times 2\text{ m}$ transferring a pressure of 200 kN/m^2 , is placed at a depth of 1.5 m below the ground as shown in the figure (not drawn to the scale). The clay stratum is normally consolidated.

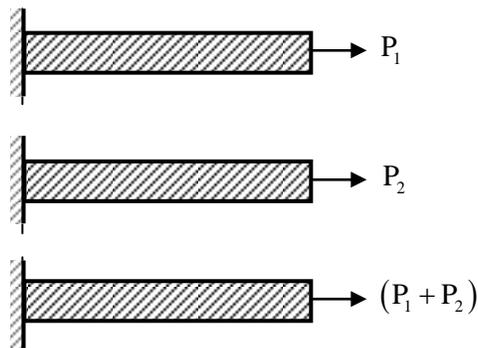


The clay has specific gravity of 2.65 and compression index of 0.3.

Considering 2: 1 (vertical to horizontal) method of load distribution and $\gamma_w = 10\text{ kN/m}^3$, the primary consolidation settlement (in mm, round off to two decimal places) of the clay stratum is _____.

Answer: (74.28)

35. A prismatic linearly elastic bar of length L , cross-sectional area A , and made up of a material with Young's modulus E , is subjected to axial tensile force as shown in the figures. When the bar is subjected to axial tensile force P_1 and P_2 , the strain energies stored in the bar are U_1 and U_2 , respectively.

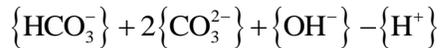


If U is the strain energy stored in the same bar when subjected to an axial tensile force $(P_1 + P_2)$, the correct relationship is

- (A) $U = U_1 - U_2$ (B) $U > U_1 + U_2$ (C) $U = U_1 + U_2$ (D) $U < U_1 + U_2$

Answer: (B)

36. Alkalinity of water, in equivalent/litre/(eq/litre), is given by



Where, $\{\}$ represents concentration in mol/litre, $\text{CO}_3^{2-} = 3.04 \times 10^{-4}$ mol/litre and the pH of water = 9.0. The atomic weights are : Ca = 40; C = 12 and O = 16. If the concentration of OH^- and H^+ are NEGLECTED, the alkalinity of the water sample (in mg/litre as CaCO_3), is

- (A) 100.0 (B) 50.0 (C) 65.2 (D) 130.4

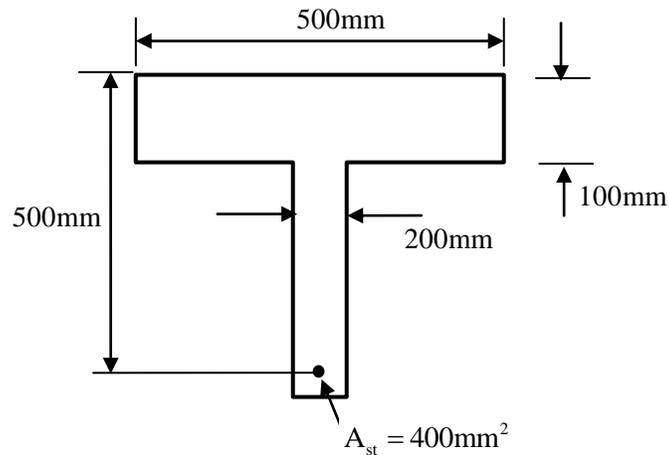
Answer: (D)

37. A theodolite was set up at a station P. The angle of depression to a vane 2 m above the foot of a staff held at another station Q was 45° . The horizontal distance between stations P and Q is 20 m. The staff reading at a benchmark S of RL 433.050 m is 2.905 m. Neglecting the errors due to curvature and refraction, the RL of the station Q (in m), is

- (A) 431.050 (B) 435.955 (C) 413.050 (D) 413.955

Answer: (D)

38. The cross-section of the reinforced concrete beam having an effective depth of 500 mm is shown in the figure (not drawn to the scale). The grades of concrete and steel used are M35 and Fe550, respectively. The area of tension reinforcement is 400 mm^2 . It is given that corresponding to 0.2% proof stress, the material safety factor is 1.15 and the yield strain of Fe550 steel is 0.0044.



As per IS 456:2000, the limiting depth (in mm, round off to the nearest integer) of the neutral axis measured from the extreme compression fiber, is _____.

Answer: (221.52)

39. A cast iron pipe of diameter 600 mm and length 400 m carries water from a tank and discharges freely into air at a point 4.5 m below the water surface in the tank. The friction factor of the pipe is 0.018. Consider acceleration due to gravity as 9.81 m/s^2 . The velocity of the flow in pipe (in m/s, round off to two decimal places) is _____.

Answer: (2.557)

40. A theodolite is set up at station A. The RL of instrument axis is 212.250 m. The angle of elevation to the top of a 4 m long staff, held vertical at station B, is 7° . The horizontal distance between station A and B is 400 m. Neglecting the errors due to curvature of earth and refraction, the RL (in m, round off to three decimal places) of station B is _____.

Answer: (257.36)

41. An ordinary differential equation is given below:

$$6 \frac{d^2 y}{dx^2} + \frac{dy}{dx} - y = 0$$

(A) $y(x) = C_1 e^{\frac{x}{3}} + C_2 e^{-\frac{x}{2}}$

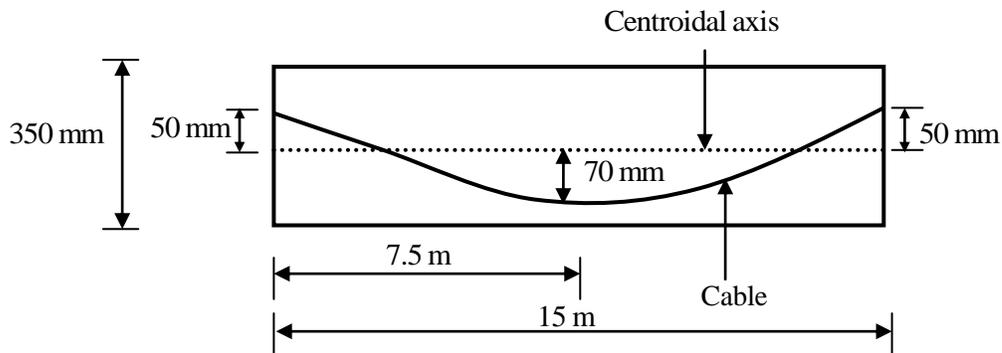
(B) $y(x) = C_1 x e^{-\frac{x}{3}} + C_2 e^{\frac{x}{2}}$

(C) $y(x) = C_1 e^{-\frac{x}{3}} + C_2 e^{\frac{x}{2}}$

(D) $y(x) = C_1 e^{-\frac{x}{3}} + C_2 x e^{\frac{x}{2}}$

Answer: (A)

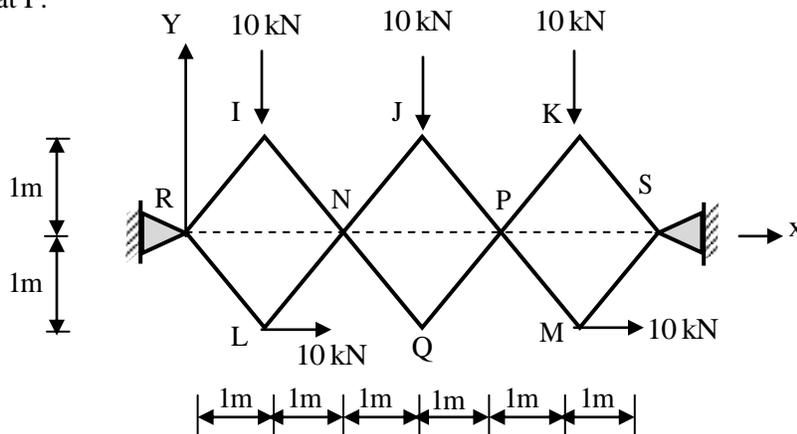
- 42.** A concrete beam of span 15 m, 150 mm wide and 350 mm deep is prestressed with a parabolic cable as shown in the figure (not drawn to the scale). Coefficient of friction for the cable is 0.35, and coefficient of wave effect is 0.0015 per metre.



If the cable is tensioned from one end only, the percentage loss (round off to one decimal place) in the cable force due to friction, is _____.

Answer: (4.49)

- 43.** Joints I, J, K, L, Q and M of the frame shown in the figure (not drawn to the scale) are pins. Continuous members IQ and LJ are connected through a pin at N. Continuous members JM and KQ are connected through a pin at P.



The frame has hinge supports at joints R and S. The loads acting at joints I, J and K are along the negative Y direction and the loads acting at joints L, M are along the positive X direction.

The magnitude of the horizontal component of reaction (in kN) at S, is

- (A) 15 (B) 10 (C) 5 (D) 20

Answer: (A)

- 44.** A 5 m high vertical wall has a saturated clay backfill. The saturated unit weight and cohesion of clay are 18 kN/m^3 and 20 kPa, respectively. The angle of internal friction of clay is zero. In order to prevent development of tension zone, the height of the wall is required to be increased. Dry sand is used as backfill above the clay for the increased portion of the wall. The unit weight and angle of internal friction of sand are 16 kN/m^3 and 30° , respectively. Assume that the back of the wall is smooth and top of the backfill is horizontal. To prevent the development of tension zone, the minimum height (in m, round off to one decimal place) by which the wall has to be raised, is _____.

Answer: (2.5)

- 45.** The ion product of water (pK_w) is 14. If a rain water sample has a pH of 5.6, the concentration of OH^- in the sample (in 10^{-9} mol/litre, round off to one decimal place), is _____.

Answer: (3.981)

- 46.** A waste to energy plant burns dry solid waste of composition: Carbon = 35%, Oxygen = 26%, Hydrogen = 10%, Sulphur = 6%, Nitrogen = 3% and Inerts = 20%. Burning rate is 1000 tonnes/d. Oxygen in air by weight is 23%. Assume complete conversion of Carbon to CO_2 . Hydrogen to H_2O , Sulphur to SO_2 and Nitrogen to NO_2 .

Given Atomic weights: $H = 1, C = 12, N = 14, O = 16, S = 32$.

The stoichiometric (theoretical) amount of air (in tonnes/d, round off to the nearest integer) required for complete burning of this waste, is _____.

Answer: (6956.5)

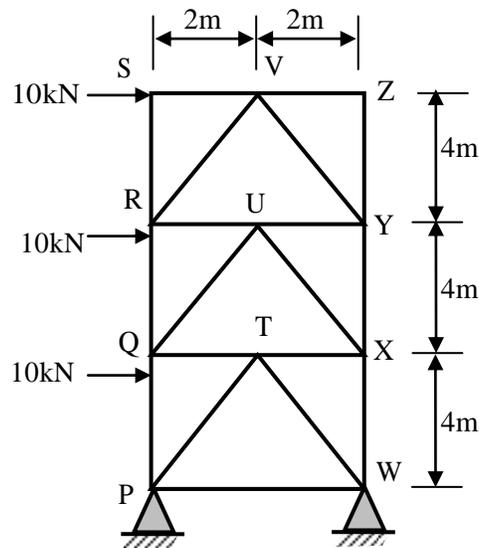
47. The Fourier series to represent $x - x^2$ for $-\pi \leq x \leq \pi$ is given by

$$x - x^2 = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos nx + \sum_{n=1}^{\infty} b_n \sin nx$$

The value of a_0 (round off to two decimal places), is _____.

Answer: (-6.58)

48. The plane truss has hinge supports at P and W and is subjected to the horizontal forces as shown in the figure (not drawn to the scale).



Representing the tensile force with '+' sign and the compressive force with '-' sign, the force in member XW (in kN, round off to the nearest integer), is _____.

Answer: (30)

49. For the hottest month of the year at the proposed airport site, the monthly mean of the average daily temperature is 39°C . The monthly mean of the maximum daily temperature is 48°C for the same month of the year. From the given information, the calculated Airport Reference Temperature (in $^\circ\text{C}$), is

(A) 42 (B) 39 (C) 36 (D) 48

Answer: (A)

50. A constant-head permeability test was conducted on a soil specimen under a hydraulic gradient of 2.5. The soil specimen has specific gravity of 2.65 and saturated water content of 20%. If the coefficient of permeability of the soil is 0.1 cm/s, the seepage velocity (in cm/s, round off to two decimal places) through the soil specimen is _____.

Answer: (0.72)

51. The design speed of a two-lane two-way road is 60 km/h and the longitudinal coefficient of friction is 0.36. The reaction time of a driver is 2.5 seconds. Consider acceleration due to gravity as 9.8 m/s². The intermediate sight distance (in m, round off to the nearest integer) required for the road is _____.

Answer: (162)

52. Crops are grown in a field having soil, which has field capacity of 30% and permanent wilting point of 13%. The effective depth of root zone is 80 cm. Irrigation water is supplied when the average soil moisture drops to 20%. Consider density of the soil as 1500 kg/m³ and density of water as 1000 kg/m³. If the daily consumptive use of water for the crops is 2 mm, the frequency of irrigating the crops (in days), is
(A) 7 (B) 13 (C) 10 (D) 11

Answer: (*)

53. A 4 × 4 matrix [P] is given below:

$$[P] = \begin{bmatrix} 0 & 1 & 3 & 0 \\ -2 & 3 & 0 & 4 \\ 0 & 0 & 6 & 1 \\ 0 & 0 & 1 & 6 \end{bmatrix}$$

The eigen values of [P] are

(A) 1, 2, 3, 4 (B) 0, 3, 6, 6 (C) 3, 4, 5, 7 (D) 1, 2, 5, 7

Answer: (D)

54. Group-I gives a list of test methods for evaluating properties of aggregates. Group-II gives the list of properties to be evaluated.

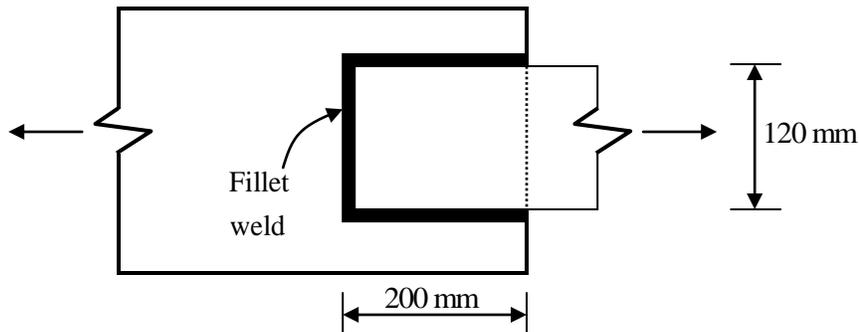
Group-I: Test Methods	Group-II: Properties
P. Soundness test	1. Strength
Q. Crushing test	2. Resistance to weathering
R. Los Angeles abrasion test	3. Adhesion
S. Stripping value test	4. Hardness

The correct match of test methods under Group-I to properties under Group-II, is

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

Answer: (C)

55. Two steel plates are lap jointed in a workshop using 6 mm thick fillet weld as shown in the figure (not drawn to the scale). The ultimate strength of the weld is 410 MPa.



As per Limit State Design is IS 800: 2007, the design capacity (in kN, round off to three decimal places) of the welded connection, is _____.

Answer: (413.6)

★★★ END OF THE PAPER ★★★