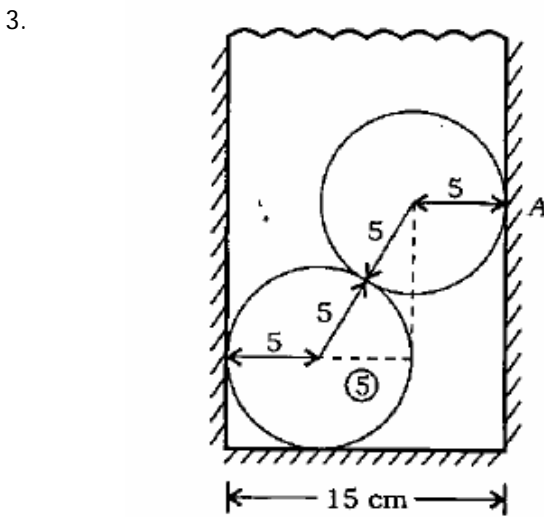


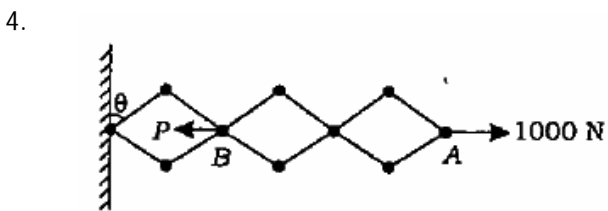
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1. Given that $F = (\alpha \cdot t^{-1} + \beta \cdot t^2)$ where F denotes force and t time; how is β described dimensionally?
 (a) MLT^{-3} (b) MLT^{-2}
 (c) LT^{-4} (d) MLT^{-4}

2. What is the unit vector of the resultant of the following two forces?
 $\vec{F}_1 = 2\hat{i} + 3\hat{j} + 4\hat{k}$
 $\vec{F}_2 = 4\hat{i} + 3\hat{j} + 2\hat{k}$
 (a) $6\hat{i} + 6\hat{j} + 6\hat{k}$
 (b) $\frac{\hat{i}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$
 (c) $-2\hat{i} + 2\hat{k}$
 (d) $2\hat{i} + 2\hat{k}$

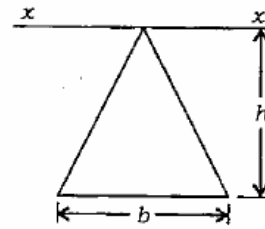


In the figure shown, consider the two identical spheres with radius 5 cm, weight 100 N each and the distance between the two walls as 15 cm. What is the reaction force at point A?
 (a) 173.2 N (b) 57.7 N
 (c) 100 N (d) 0 N



A number of rods are hinged together to form three identical rhombuses as shown in the figure. If a horizontal force of 1000 N is applied at A, what is the force P required at B for equilibrium?
 (a) 3000 N (b) 1000 N
 (c) 4000 N (d) 2000 N

5.



What is the moment of inertia of the triangle with respect to xx as shown in the figure?

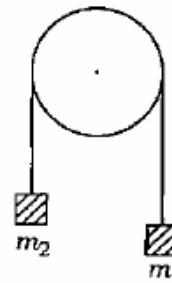
- (a) $\frac{bh^3}{12}$
 (b) $\frac{bh^3}{6}$
 (c) $\frac{bh^3}{3}$
 (d) $\frac{bh^3}{4}$

6.

A stone is released from an elevator, as it goes up with an acceleration α . If the acceleration due to gravity is g, what is the acceleration of the stone after release?

- (a) α , upward
 (b) $g - \alpha$, upward
 (c) $g - \alpha$, downward
 (d) g, downward

7.



Two masses m_1 and m_2 and m_2 ($m_1 > m_2$) are attached to the ends of a light weightless string passing over a fixed smooth guide pulley as shown in the figure. If g = acceleration due to gravity, what is the resulting acceleration?

- (a) $\left(\frac{2m_1 m_2}{m_1 + m_2}\right) \cdot g$
 (b) $\left(\frac{1}{m_1} + \frac{1}{m_2}\right) \cdot g$
 (c) $\left(\frac{m_1 - m_2}{m_1 + m_2}\right) \cdot g$
 (d) $\left(\frac{m_1 + m_2}{m_1 - m_2}\right) \cdot g$

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8. A cricket ball of mass 150 gm, moving with a velocity of 12 m/s, is hit by a bat so that the ball is turned back with a velocity of 20 m/s. The force of the blow acts for 0.01 s on the ball. What is the average force exerted by the bat on the ball?
- (a) 480 N
(b) 48 N
(c) 248 N
(d) 4.8 N

9. A thin uniform hoop ring of radius R is rolling without slipping such that the mass centre moves at a speed V. If the hoop weighs W kg, what is the corresponding kinetic energy of the hoop relative to the ground?
- (a) $\frac{WV^2}{4g}$
(b) $\frac{WV^2}{2g}$
(c) $\frac{WV^2}{g}$
(d) $\frac{2WV^2}{g}$

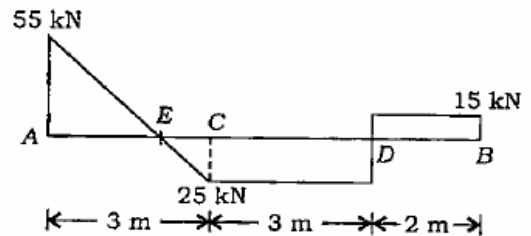
10. A mass m moving horizontally with velocity jV_0 strikes an ideal pendulum of mass m. If the two masses stick together after collision, what is the maximum height reachable by the pendulum?
- (a) $\frac{V_0^2}{8g}$
(b) $\frac{V_0^2}{4g}$
(c) $\sqrt{V_0 g}$
(d) $\sqrt{V_0 \cdot \frac{g}{2}}$

11. A ladder of weight W rests against a smooth vertical wall at one end and on rough horizontal ground at the other. The coefficient of friction between the ladder and the ground is $\frac{1}{4}$. What is the maximum angle of inclination of the ladder to the vertical if a man of weight W is to climb to the top of the ladder without disturbing the setup?
- (a) $\tan^{-1}\left(\frac{1}{4}\right)$ (b) $\tan^{-1}\left(\frac{1}{3}\right)$
(c) $\tan^{-1}\left(\frac{1}{3}\right)$ (d) $\tan^{-1}(4)$

12. At a certain stage under elastic loading, the elongation observed was 0.03 mm, the gauge length was 150 mm and the modulus of elasticity was 2×10^5 N/mm². What was the stress at that location?
- (a) 4 N/mm² (b) 40 N/mm²
(c) 80 N/mm² (d) 60 N/mm²

13. In an axially loaded compression member with a circular cross-section of radius r, what is the radius of the core section which is proof against tensile stress?
- (a) $\frac{r}{2}$ (b) $\frac{r}{3}$
(c) $\frac{r}{4}$ (d) $\frac{r}{6}$

14. The figure shows the shear force diagram for an overhanging beam ACDB.



Consider the following statements with respect of the above beam:

- The beam has supports at A and D.
- The beam carries a concentrated load at C of 25 KN.
- Bending moment at D is 15 KN m.
- The beam carries a uniformly distributed load of 80 KN over the portion AC.

Which of the statements given above is/are correct?

- (a) 1, 2 and 4 (b) 1 only
(c) 2, 3 and 4 (d) 1 and 2 only

15. Which of the following are implied in the assumption of plane sections remaining plane (in simple bending)?

- Stress is proportional to the distance from neutral axis.
- Displacement is proportional to the distance from neutral axis.
- Strain is zero across the cross section.
- Strain is directly proportional to the distance from neutral axis.

Select the correct answer using the code given below:

Code :

- (a) 1 and 4 only (b) 2 and 3
(c) 3 and 4 (d) 1, 2 and 4

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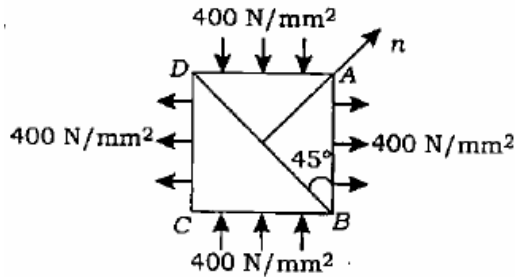
16. A beam of rectangular cross-section is to be cut from a circular beam of diameter D . What is the ratio of the depth of the beam to its width for maximum moment of resistance?

- (a) $\sqrt{3}$ (b) $\sqrt{2}$
 (c) $\frac{\sqrt{3}}{2}$ (d) $\frac{3}{\sqrt{2}}$

17. Power is transmitted through a shaft, rotating at 2.5 Hz (150 r.p.m.). The mean torque on the shaft is 20×10^3 N m. What magnitude of power in kW is transmitted by the shaft?

- (a) 50π (b) 120π
 (c) 100π (d) 150π

18.



The square element in the figure is subjected to a biaxial stress of 400 N/mm^2 as shown. What is the intensity of normal stress p_n on the plane BD?

- (a) 200 (b) $400\sqrt{2}$
 (c) $400/\sqrt{2}$ (d) 0

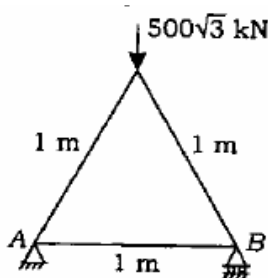
19. Which of the following is the most appropriate theory of failure for mild steel?

- (a) Maximum principal stress theory
 (b) Maximum principal strain theory
 (c) Maximum shear stress theory
 (d) Maximum strain energy theory

20. What is the normal stress on a plane inclined at 45° to the axis of a square rod of side a subjected to an axial tensile force of T ?

- (a) $\frac{T}{a^2}$ (b) $\frac{T}{2a^2}$
 (c) $\frac{T}{4a^2}$ (d) $\frac{T}{8a^2}$

21. In the following pin-jointed truss, what is the displacement of support B due to the given load?



(Cross-sectional area of each member = 50 mm^2 , modulus of elasticity $E = 2 \times 10^5 \text{ N/mm}^2$)

- (a) 3.25 mm
 (b) 2.50 mm
 (c) 1.50 mm
 (d) 0.50 mm

22.

Three semicircular symmetrically three-hinged arches have radii 5 m, 7.5 m and 10 m respectively, and each arch supports a point load W at its own crown. What is the ratio of horizontal thrusts in these arches?

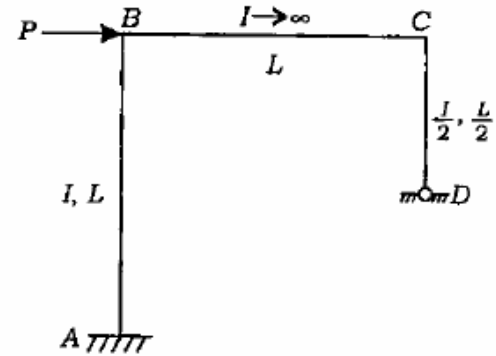
- (a) 1: 2: 3
 (b) 1: 1.5: 3
 (c) 1: 1: 1
 (d) 1: 1.5: 2

23.

For a symmetrical three-hinged arch of span 12 m and rise 2 m, the influence line diagram for horizontal thrust at either support is to be drawn. What is the maximum value influence line ordinate?

- (a) 0.75 (b) 1.00
 (c) 1.50 (d) 2.00

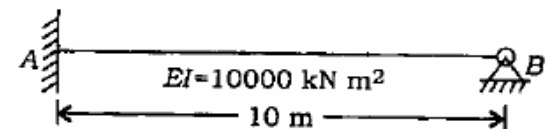
24.



In the portal frame shown, find the ratio of moments M_{BA} and M_{CD} induced at the column heads due to sideway

- (a) 2.0
 (b) 1.5
 (c) 1.25
 (d) 1.0

25.



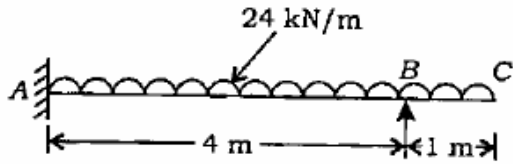
The beam AB shown, of span 10 m and having uniform $EI = 10000 \text{ kN m}^2$, is subjected to a rotation of 0.001 radian at end B. What is the fixed end moment at A?

- (a) 1.5 kN m
 (b) 2.0 kN m
 (c) 3.0 kN m
 (d) 4.0 kN m

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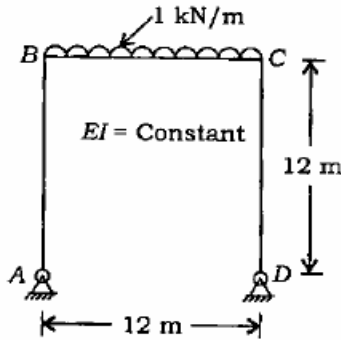
26.



What is the moment at joint A for the beam shown?

- (a) -32 KN m (b) -22 KN m
(c) -42 KN m (d) -52 KN m

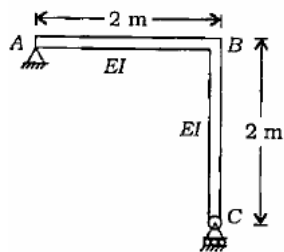
27.



What is the bending moment at B for the symmetrical portal frame shown, which is subjected to a uniformly distributed load of 1 KN/m on the beam portion?

- (a) 4.0 KN m (b) 6.4 KN m
(c) 7.2 KN m (d) 8.4 KN m

28.



What is the force required for displacing support C horizontally through a distance Δ?

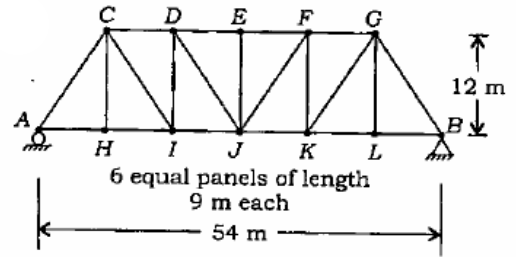
- (a) $\frac{EI\Delta}{8}$ (b) $\frac{3EI\Delta}{20}$
(c) $\frac{EI\Delta}{16}$ (d) $\frac{EI\Delta}{10}$

29.

Two point loads 2X and X spaced 3 m apart cross a girder of 9 m span. If the maximum bending moment occurring on the girder is 48 KN m, what is the value of X?

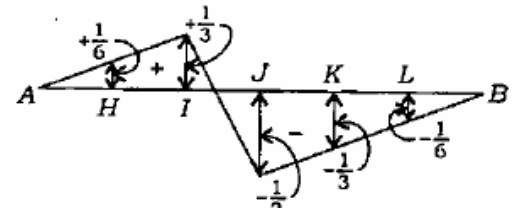
- (a) 18 KN
(b) 9 KN
(c) 6 KN
(d) 4.5 KN

30.

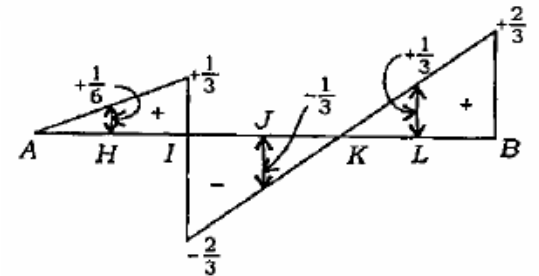


For the pin-jointed plane truss shown in the figure, which of the following diagrams represents the influence line for the bar force in the member DI, when a load travels on the bottom chord?

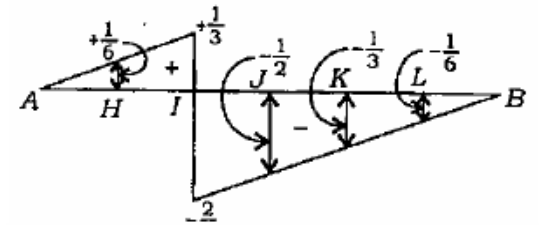
(a)



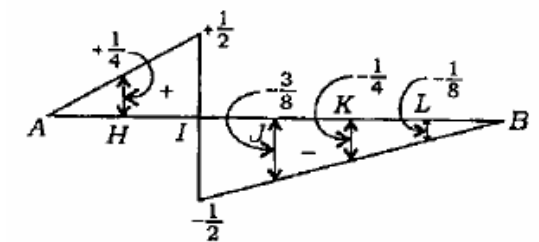
(b)



(c)



(d)



35.

Consider the following statements:

- Partially saturated soil sample is an example of three-phase system.
- Submerged density of a soil sample is equal to the saturated density divided by (1 + water content expressed as a fraction).
- Void ratio of a soil sample is defined as the ratio of volume of voids to volume of soil grains

Which of the statements given above are correct?

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

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36. Among the following types of water, which one is chemically combined in the crystal structure of the soil mineral and can be removed only by breaking the crystal structure?
- Capillary water
 - Adsorbed water
 - Hygroscopic water
 - Structural water
37. What is Newmark's chart used for?
- To know the safe bearing capacity of a footing
 - To know the settlement of a foundation
 - To know the stress intensity at any depth due to a loaded foundation
 - To know the allowable bearing pressure on the foundation
38. In a falling-head permeability test, the time taken for the head to fall from 27 cm to 3 cm is 10 minutes; if the test is repeated with the same initial head, i.e., 27 cm, what time would it take for the head to fall to 9 cm?
- 3 minutes
 - 5 minutes
 - 6 minutes
 - 7.5 minutes
39. What is the most important condition to be satisfied for piping phenomenon to occur in soils?
- Specific gravity of soil solids is more than 2.8
 - Void ratio is more than 2.0
 - Hydraulic gradient of nearly unity is maintained
 - Soil is fine-grained
40. During a laboratory consolidation test with double-drainage system, a 20 mm thick clay sample underwent 90% consolidation in 10 minutes. If another sample of the same soil is tested with single drainage with all other conditions remaining same, what would be the time required for it to undergo 90% consolidation?
- 10 minutes
 - 20 minutes
 - 30 minutes
 - 40 minutes
41. In a laboratory compaction test on soils, what is the effect of increasing compactive effort in the values of maximum dry density and optimum moisture content respectively?
- Increase, Increase
 - Increase, Decrease
 - Increase, Unaltered
 - Unaltered, Increase
42. The unconfined compressive strength of a pure clay soil is 100 Kn/m^2 . What is the value of cohesion of the soil in Kn/m^2 ?
- 200
 - 100
 - 75
 - 50
43. Using Mohr's diagram, the relation between major principal stress σ_1 , minor principal stress σ_3 and shear parameters C and ϕ is given by $\sigma_1 = \sigma_3 N\phi + 2C\sqrt{N\phi}$. What is the value of $N\phi$ in this equation?
- $\frac{1 - \sin \frac{\phi}{2}}{1 + \sin \frac{\phi}{2}}$
 - $\frac{1 + \sin \phi}{1 - \sin \phi}$
 - $\frac{1 - \sin \phi}{1 + \sin \phi}$
 - $\frac{1 + \sin \frac{\phi}{2}}{1 - \sin \frac{\phi}{2}}$
44. Consider the following statements regarding negative skin friction in piles:
- It is developed when the pile is driven through a recently deposited soil layer.
 - It is developed when the pile is driven through a layer of dense sand.
 - It is developed due to a sudden drawdown of the water table.
- Which of the statements given above is/are correct?
- 1 only
 - 2 only
 - 2 and 3
 - 1 and 3
45. In case of hill roads, which one of the following is correct?
- Resisting length should be kept as low as possible
 - Resisting length should be kept as large as possible
 - There is no relevance for resisting length
 - Resisting length should be equal to stopping sight distance

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46. Match List I with List II and select the correct answer using the code given below the lists:
- | List I | | List II | |
|----------------------|---|--|--|
| Item | | Definition | |
| A. Basic Capacity | 1 | Vehicles that pass a given point on a lane/hour | |
| B. Traffic Density | 2 | Maximum number of vehicles that can pass a given point on a lane during one hour under prevailing roadway and traffic conditions | |
| C. Traffic Volume | 3 | Number of vehicles occupying a unit length of a lane at a given instant | |
| D. Possible Capacity | 4 | Maximum number of vehicles that can pass a given point on any lane during one hour under ideal roadway and traffic conditions | |
- Code:**
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 3 | 4 |
| (b) | 4 | 1 | 3 | 2 |
| (c) | 2 | 3 | 1 | 4 |
| (d) | 4 | 3 | 1 | 2 |
47. Which one of the following dictates the minimum required sight distance in valley curves?
- Design speed
 - Height of obstacle
 - Height of driver's eye
 - Nighttime driving condition
48. Which one of the following is relevant for the determination of superelevation to be provided in horizontal curves of radius R in m in hill roads, given that the design traffic velocity is V kmph?
- $\frac{V^2}{127R}$
 - $\frac{V^2}{17.5R}$
 - $\frac{V^2}{225R}$
 - $\frac{(V + 8)^2}{127R}$
49. How many number of points of conflicts can rise with one-way regulation in both directions on an intersection having 4 legs?
- 4
 - 6
 - 8
 - 10
50. What should be the relative magnitude of free carbon in bitumen over that in tar for road construction?
- More
 - Less
 - Equal
 - Unrelative
51. If the difference in elevation between the edges of a pavement of width 9.0 m and its crown is 7.5 cm, what is the camber of the pavement?
- 1 in 60
 - 1 in 45
 - 1 in 30
 - 1 in 15
52. The modulus of subgrade reaction is evaluated from which one of the following?
- Plate-bearing test
 - CBR test
 - Direct shear test
 - Triaxial test
53. In which of the following gauges are 52 kg rails mostly used?
- Broad Gauge
 - Meter Gauge
 - Narrow Gauge
 - Both Broad and Meter Gauge
54. What is the minimum degree of curvature to which curved rails are cast?
- 1°
 - 2°
 - 3°
 - 4°
55. Given that the equilibrium cant required for 45kmph speed in a broad gauge main line is 7.78 cm, what is the value of the cant to be provided for a branch track therein?
- 0.28 cm
 - 0.18 cm
 - 0.18 cm
 - 0.28 cm
56. Consider the following reception signals:
- Outer Signal
 - Warner Signal
 - Home Signal
 - Starter Signal
- Which of the following sequences is correct id respect of reception signals as a train departs from a platform?
- 2-1-3-4
 - 4-2-1-3
 - 1-2-3-4
 - 3-2-1-4
57. In cases when the railway track is submerged, the train shall be stopped dead and then allowed to proceed. What is the maximum speed at which the journey can resume?
- 20 kmph
 - 18 kmph
 - 10 kmph
 - 1 kmph

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58. Match List I with List II and select the correct answer using the code given below the lists:
- | List I | | List II | |
|-------------|---------------------|---------|------------------------|
| Bridge type | | Use | |
| A. | Bascule Bridge | 1. | Road Bridge over River |
| B. | Plate Girder Bridge | 2. | Navigable Channel |
| C. | Suspension Bridge | 3. | Army Bridge |
| D. | Pontoon Bridge | 4. | Railway Bridge |
- Code:**
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 3 | 4 | 1 | 2 |
| (b) | 2 | 4 | 1 | 3 |
| (c) | 3 | 1 | 4 | 2 |
| (d) | 2 | 1 | 4 | 3 |
59. A space having volume of 2 m^3 is filled with water (bulk modulus of elasticity = $2 \times 10^9 \text{ Pa}$) and is subjected to a pressure of 10 bar. What is the resulting change in the volume of the water?
- (a) 0.1 L
(b) 1 L
(c) 4 L
(d) 10 L
60. Which one of the following statements is correct?
- (a) Surface tension of a liquid decreases with temperature
(b) Vapour pressure of a liquid is independent of the externally exerted pressure
(c) Dynamic viscosity is the force per unit velocity gradient
(d) Viscosity of a gas increases with temperature
61. Given $\mu = 0.06$ poise and $\rho = 0.9 \text{ gm/cm}^3$, what is the value of kinematic viscosity in stokes?
- (a) 0.04
(b) 0.054
(c) 0.067
(d) 0.082
62. Consider following four values of pressure:
- 15 m of water
 - 100 kPa
 - 2 m of mercury
 - 2000 millibar
- What is the correct sequence of these pressure magnitudes in descending order?
- (a) 3 – 4 – 1 – 2
(b) 4 – 3 – 1 – 2
(c) 3 – 1 – 2 – 4
(d) 4 – 2 – 1 – 3
63. A triangular lamina with base 3 m and height 3 m is immersed in water vertically with base parallel to water surface and vertex touching the water surface. What is the value of total water pressure on one face of the lamina?
- (a) 90 kN
(b) 67.5 kN
(c) 135 kN
(d) 180 kN
64. A buoy 2 m^3 in volume and 1 tonne in weight is fully submerged at high tide in a harbour and is held down by a chain. The specific gravity of seawater may be assumed as 1.025. What is the value of the tension in the chain?
- (a) 2.00 tonne
(b) 1.00 tonne
(c) 2.05 tonne
(d) 1.05 tonne
65. If a glass tube of small diameter d is dipped in a liquid, what is the height of rise/fall of the liquid meniscus in the tube?
- (a) $\frac{4\omega d}{\sigma \cos \alpha}$
(b) $\frac{\sigma \cos \alpha}{4\omega d}$
(c) $\frac{4\sigma \cos \alpha}{\omega d}$
(d) $\frac{\omega d}{4\sigma \cos \alpha}$
- Where:
 ω is specific weight of the liquid
 α is the relevant angle
 σ is surface tension of the liquid in the tube
66. An ocean-going ship, when on high seas, is subjected to oscillatory motion both by rolling and pitching. Which one of the following statements related to the metacentric height of the ship is correct?
- (a) It is greater for rolling than for pitching
(b) It is lesser for rolling than for pitching
(c) it is equal in both the cases
(d) it keeps varying according to direction of movement of the ship
67. A jet of water issuing from a nozzle with a velocity 20 m/s hits a flat plate moving away from it at 10 m/s. The cross-sectional area of the jet is 100 cm^2 . What is the force on the plate?
- (a) 100 N
(b) 10 N
(c) 10000 N
(d) 1000 N

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68. Match List I with List II and select the correct answer using the code given below the lists:

List I		List II	
Line		Statement	
A.	Streamlines	1.	Along with the liquid will rise to same height in piezometric tubes at different points
B.	Path lines	2.	Paths followed by different people after coming out of the door of a cinema hall
C.	Streak lines	3.	Traces of headlights of highway cars recorded by flash of a camera at night
D.	Equipotential lines	4.	Paths followed by individual paper boats floated by children in a moving stream

Code:

	A	B	C	D
(a)	1	4	2	3
(b)	3	4	2	1
(c)	1	2	4	3
(d)	3	2	4	1

69. If velocity field $\vec{v} = ax\hat{i} - ay\hat{j}$ in which x, y are in m and $a = 0.1 \text{ s}^{-1}$, what is the nature of the streamlines for the above velocity field?

- (a) Parallel lines
 (b) Concentric circles
 (c) Rectangular hyperbola
 (d) Ellipse

70. Which one of the following statements is correct, when a circulatory flow is superposed over a uniform stream in which a cylinder is held with its axis perpendicular to the flow directions?

- (a) Cylinder fluctuates about its axis
 (b) Cylinder experiences a force along the direction of the stream
 (c) Cylinder experiences a force transverse to the direction of the stream
 (d) Cylinder tends to attain infinite velocity

71. Consider the stream function $\psi = 2xy$; what is the velocity at (3, 4)?

- (a) 1.0 m/s
 (b) 8.0 m/s
 (c) 10.0 m/s
 (d) 12.0 m/s

72. A flownet is drawn for a non-homogeneous embankment section resting on an impervious rock foundation. Seepage head = h , number of flow passages = N_f , number of equipotential drops = N_d , coefficients of permeability in x (along the stream) and y (perpendicular to stream) directions are K_x and K_y respectively. Which one of the following computes the flow rate correctly?

- (a) $q = h \cdot \sqrt{\frac{K_x}{K_y}} \cdot \frac{N_d}{N_f}$
 (b) $q = h \cdot \sqrt{\frac{K_y}{K_x}} \cdot \frac{N_f}{N_d}$
 (c) $q = h \cdot \sqrt{\frac{K_x + K_y}{2}} \cdot \frac{N_f}{N_d}$
 (d) $q = h \cdot \sqrt{K_x \cdot K_y} \cdot \frac{N_f}{N_d}$

73. A 15 cm diameter pipe carries 70 lit/s of oil (sp. Gr. = 0.75). At a section 62 cm above the datum, the pressure is 2 cm vacuum of mercury (sp. Gr. = 13.6). Assuming kinetic energy correction factor of 1.1, what is the total head in m of oil at the section

- (a) 1.057 (b) 1.137
 (c) 1.148 (d) 1.228

74. In flow over a v-notch, how much error in the computation of discharge over the notch would arise from an error of 1% in the measurement of head over the notch?

- (a) 1% (b) 1.5%
 (c) 2% (d) 2.5%

75. Match List I with List II and select the correct answer using the code given below the lists:

List I		List II	
Measuring device		Formula used	
A.	Venturi meter	1.	$Q = \frac{C_d A_2 \sqrt{2gh}}{1 - \left(\frac{C_c A_2}{A_1}\right)^2}$
B.	Orifice meter	2.	$Q = \frac{8}{15} C_d \sqrt{2g} \tan \frac{\theta}{2} \cdot H^{2.5}$
C.	Pitot tube	3.	$Q = \frac{C_d A_1 \sqrt{2gh}}{\sqrt{\left(\frac{A_1}{A_2}\right)^2 - 1}}$
D.	Triangular weir	4.	$V = C_v \sqrt{\frac{2g(p_s - p_o)}{w}}$

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- Code:**
- | | A | B | C | D |
|-----|----------|----------|----------|----------|
| (a) | 2 | 4 | 1 | 3 |
| (b) | 3 | 4 | 1 | 2 |
| (c) | 2 | 1 | 4 | 3 |
| (d) | 3 | 1 | 4 | 2 |
76. All minor losses in a 15 cm diameter pipeline add up to $\left(\frac{16V^2}{2g}\right)$. What is the equivalent length of a pipeline of same diameter with Darcy's $f = 0.3$ for this condition?
- (a) 160 m
(b) 80 m
(c) 20 m
(d) 9 m
77. The pressure at the nose of a 1/5 scale model torpedo tested in fresh water at 12.3 m/s is 1.64 kg/cm² greater than the free stream pressure upstream of the torpedo nose. What would be the pressure on the nose of the prototype torpedo operated in seawater above the local free stream pressure upstream of its nose? (Specific gravity of seawater is 1.025, with its dynamic viscosity being the same as of freshwater.) (Reynolds' condition prevails.)
- (a) 0.132 kg/cm²
(b) 0.118 kg/cm²
(c) 0.084 kg/cm²
(d) 0.064 kg/cm²
78. A liquid of kinematic viscosity 1.2 stokes is to be pumped through a pipe of 10 cm dia. What will be the maximum flow possible (in cumec), under laminar flow condition?
- (a) $5.2 \times 10^{-3} \pi$
(b) $6 \times 10^{-3} \pi$
(c) $9 \times 10^{-3} \pi$
(d) $6.4 \times 10^{-3} \pi$
79. A river model is constructed to a horizontal scale of 1 : 1000 and a vertical scale of 1 : 100. If the model discharge is 0.1 m³/s, what would be the corresponding discharge in m³/s in the prototype?
- (a) 10³
(b) 10⁴
(c) 10⁵
(d) 10⁶
80. A pressure increase of 200 n/cm² increases the density of water by 0.1%. What is the bulk modulus of elasticity of water?
- (a) 200 GN/m²
(b) 20 GN/m²
(c) 2 GN/m²
(d) 0.2 GN/m²
81. Which one of the following is a dimensionally homogeneous equation with no additional attributes called for?
- (a) $V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/2}$
(b) $V = C \sqrt{R} S$
(c) $P = \frac{32\mu VL}{D^2}$
(d) $N_s = \frac{N\sqrt{P}}{H^{5/4}}$
82. A real fluid flows over a flat plate and a laminar boundary layer is formed over it. At a distance X_1 from leading edge, the local Reynolds' number is 8100 and boundary layer thickness is δ_{x_1} . At a distance X_2 where local Reynolds' number has increased to 22500, what would be the boundary layer thickness?
- (a) $2.78 \delta_{x_1}$
(b) $1.67 \delta_{x_1}$
(c) $1.23 \delta_{x_1}$
(d) $0.60 \delta_{x_1}$
83. A very large and open reservoir discharges into atmosphere through a 100 m long, 25 cm dia, $f = 0.025$, pipeline laid horizontally. The reservoir level is at a constant height of 4.905 m above the axis of the pipe. Intending to augment the available discharge at the outfall end of the pipeline, the latter half of the pipeline is duplicated with an exactly similar pipe through a junction chamber (under pressure) at the midway point. All losses other than by friction are to be neglected. What is the combined discharge available at the outfall end?
- (a) 13%
(b) 26.5%
(c) 50%
(d) 66.7%
84. A compound pipe of diameter d_1 , d_2 and d_3 sequentially having lengths l_1 , l_2 and l_3 also sequentially is to be replaced by an equivalent pipe of uniform diameter d and of the same total length l as that of the compound pipe. Which one of the following defines the equivalent pipe condition correctly?
- (a) $\frac{l}{d^2} = \frac{l_1}{d_1^2} + \frac{l_2}{d_2^2} + \frac{l_3}{d_3^2}$
(b) $\frac{l}{d^3} = \frac{l_1}{d_1^3} + \frac{l_2}{d_2^3} + \frac{l_3}{d_3^3}$
(c) $\frac{l}{d^4} = \frac{l_1}{d_1^4} + \frac{l_2}{d_2^4} + \frac{l_3}{d_3^4}$
(d) $\frac{l}{d^5} = \frac{l_1}{d_1^5} + \frac{l_2}{d_2^5} + \frac{l_3}{d_3^5}$

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85. The head loss in a pipe of diameter d carrying oil at a flow rate Q over a distance l is h . The pipe is replaced by another one with its diameter $d/2$; all other parameters remaining the same, what is the head loss in the replaced pipe?
 (a) $0.5 h$ (b) $2 h$
 (c) $8 h$ (d) $32 h$
86. What is the ratio of bed width to depth in a hydraulically most efficient trapezoidal channel section?
 (a) 0.578 (b) 1.155
 (c) 1.50 (d) 2.00
87. For a hydraulic jump formed in a horizontal rectangular channel, the conjugate depths are 1 m and 3 m. What is the loss of head in the jump?
 (a) 0.166 m (b) 0.66 m
 (c) 1.33 m (d) 2.00 m
88. Match List I with List II and select the correct answer using the code given below the lists:
- | List I | List II |
|---|---|
| Geometry of flow profile/section | Related condition |
| A. Wide rectangular channel with n defined | 1. M_2, A_2, H_2 |
| B. Gradually varied flow profile with decreasing depth along the flow direction | 2. $\frac{dy}{dx} = S_0 \frac{1 - \left(\frac{y_0}{y}\right)^{3.33}}{1 - \left(\frac{y_c}{y}\right)^3}$ |
| C. Gradually varied flow profile with increasing depth along the flow direction | 3. $\frac{dE}{dx} > 0$ if $y > y_c$ |
- Code:
- | | A | B | C |
|-----|---|---|---|
| (a) | 1 | 3 | 2 |
| (b) | 2 | 3 | 1 |
| (c) | 1 | 2 | 3 |
| (d) | 2 | 1 | 3 |
89. As per IS 458 (1971), what is the test pressure in ordinary RCC pipes of 80-600 mm diameter/
 (a) 2 kg/cm^2
 (b) 3 kg/cm^2
 (c) 4 kg/cm^2
 (d) 6 kg/cm^2
90. Match List I with List II and select the correct answer using the code given below the lists:
- | List I | List II |
|----------------|---|
| Disinfectant | Characteristic |
| A. Chlorine | 1. Post-treatment required |
| B. UV rays | 2. Residual concentration for some duration |
| C. Ozone | 3. Physical disinfectant |
| D. Excess lime | 4. Costlier |
- Code:
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 3 | 4 | 1 |
| (b) | 1 | 3 | 4 | 2 |
| (c) | 2 | 4 | 3 | 1 |
| (d) | 1 | 4 | 3 | 2 |
91. What is the hydrogen ion concentration in water of $\text{PH} = 8$?
 (a) 8 mol/L (b) 10^{-8} mol/L
 (c) 10^8 mol/L (d) 0.8 mol/L
92. What is the most commonly used additive for purposes of chemical precipitation treatment of industrial wastewater?
 (a) Lime and soda
 (b) Alum
 (c) Ferrous sulphate
 (d) Ozone
93. Match List I with List II and select the correct answer using the code given below the lists:
- | List I | List II |
|----------------------|------------------------|
| Water-borne disease | Pollutant causing |
| A. Mottling of teeth | 1. Salmonella bacteria |
| B. Hepatitis | 2. Vibrio bacteria |
| C. Typhoid | 3. Virus |
| D. Cholera | 4. Fluoride |
- Code:
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 4 | 3 | 1 | 2 |
| (b) | 2 | 1 | 3 | 4 |
| (c) | 4 | 1 | 3 | 2 |
| (d) | 2 | 1 | 1 | 4 |
94. What is the maximum permissible limit of fluoride in drinking water?
 (a) 1.2 mg/L (b) 1.5 mg/L
 (c) 3.0 mg/L (d) 0.8 mg/L
95. What is the maximum permissible limit of chromium in drinking water?
 (a) 0.01 mg/L (b) 0.001 mg/L
 (c) 0.005 mg/L (d) 0.05 mg/L

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96. Consider the following statements:
1. Calcium and magnesium as bicarbonates are responsible for carbonate hardness.
 2. The carbonate hardness is measured by the difference between the total hardness and bicarbonate hardness.
 3. The non-carbonate hardness is measured by the difference between the total hardness and the carbonate hardness.
 4. The carbonates and bicarbonates of sodium are described as negative carbonate hardness.

Which of the statements given above is/are correct?

- (a) 1, 2 and 4
- (b) 1, 3 and 4
- (c) 2 and 4 only
- (d) 3 only

97. In what intervals are rapid-sand filters to be cleaned by back-washing?
- (a) 24 – 48 hours
 - (b) 10 – 15 days
 - (c) 1 – 2 months
 - (d) 1 week

98. What is the maximum distance between successive manholes in sewers of diameter more than 1.5 m?
- | | |
|-----------|-----------|
| (a) 75 m | (b) 300 m |
| (c) 500 m | (d) 150 m |

99. What is the order of BOD₅ removal efficiency of a septic tank for isolated houses?
- | | |
|---------------|---------------|
| (a) 10 to 20% | (b) 45 to 55% |
| (c) 70 to 80% | (d) Above 90% |

100. Which one of the following describes the short-circuiting occurring in a sedimentation tank?
- (a) Detention time
 - (b) Recirculation ratio
 - (c) Surface loading
 - (d) Displacement efficiency

101. The different actions that take place in anaerobic decomposition process are the following:
1. Alkaline fermentation
 2. Acid fermentation
 3. Acid regression
 4. Methane formation
- What is the correct sequence of occurrences of these actions from earlier to later?
- (a) 2 – 1 – 3 – 4
 - (b) 2 – 3 – 1 – 4
 - (c) 1 – 2 – 3 – 4
 - (d) 4 – 2 – 3 – 1

102. Match List I with List II and select the correct answer using the code given below the lists:

List I		List II	
Sludge treatment		Purpose	
A. Digestion		1. Increasing the solids content	
B. Conditioning		2. Removal of organic and fatty acids	
C. Elutriation		3. Improving drainability of sludge	
D. Thickening		4. Removal of organic matter	

Code:

	A	B	C	D
(a)	4	3	2	1
(b)	1	3	2	4
(c)	4	2	3	1
(d)	1	2	3	4

103. Match List I with List II and select the correct answer using the code given below the lists:

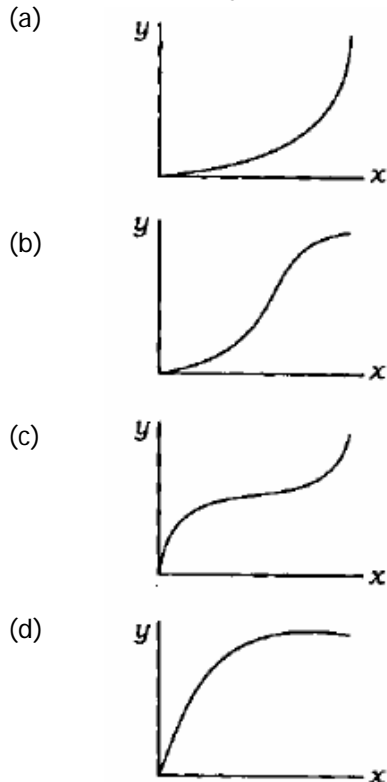
List I		List II	
Geometric feature in AOA network		Purpose and/or effect	
A. Too fewer nodes than absolutely needed for i-j notation		1. Node (not being start/end node) with either no incoming activity or no outgoing activity	
B. Arrows forming loop		2. Time computations fail to progress	
C. Node dangling		3. Facilitating later improvement of the network	
D. Missed node number (in a progressive sequence)		4. Activity not specifically identifiable	

Code:

	A	B	C	D
(a)	3	2	1	4
(b)	4	2	1	3
(c)	3	1	2	4
(d)	4	1	2	3

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104. Which one of the following represents the curve of cumulative % value (y-axis) plotted against cumulative % number of items (x-axis) in respect of inventory?



105. 'Demand in units (X)' vs. 'percentage of exceedance time for demand (Y)' are tabulated. Profit per unit if 'demanded for' is Rs 4 loss per unit if 'not demanded for' is Re 0.50.

X	0	100	200	300	400	500	550
Y	100	95	82	40	15	6	0

What is the optimal number of SKU?

- (a) 431 (b) 443
(c) 454 (d) 465

106. Consider two items of inventory whose annual consumption values are Rs 40 lakhs and Rs 2.5 lakhs, respectively. It is intended to purchase the items through a total of 25 orders per year. What is the optimum average inventory value?

- (a) Rs 1,00,000 (b) Rs 1,10,000
(c) Rs 1,25,000 (d) Rs 1,40,000

107. In a project of notational 4 months duration, the cumulative outgo and cumulative receipt of a contractor are shown. Outgo is through ABCDEFGHJKLM and receipt is through NPQRSTVWXYZ. Amounts are in thousands of rupees – cumulative, as indicated. What is the working capital required?

- (a) 700
(b) $[50 + 250 + 450 + 600 + 700] \div 5$
(c) $[50 + 250 + 150 + 220 + 90 + 40] \div 6$
(d) 370

108. Two activities A and B are segmented into four identically executable parts each, as shown in the ladder diagram. The expected duration of each of total A and total B is 16 days; the standard deviation of the expected duration of total A is 1.6 days and that of total B is 2.4 days. What is the standard deviation of the laddered network through its critical path?

- (a) 2.20 days (b) 2.53 days
(c) 2.66 days (d) 2.80 days

109. The ABC analysis is based on/applies to which one of the following?

- (a) Stock that can be readily available
(b) Probabilistic supply of stock
(c) Speed of movement of stock
(d) Need level of stock

110. Consider the following studies with respect to an appraisal of a project:

1. Engineering feasibility
2. Financial feasibility
3. Economic feasibility
4. Social feasibility
5. Identification and formulation

Indicate the most preferable sequence amongst these (iteration is not considered)?

- (a) 5 – 4 – 1 – 3 – 2
(b) 5 – 2 – 1 – 3 – 4
(c) 5 – 1 – 2 – 4 – 3
(d) 1 – 4 – 2 – 5 – 3

111. Insulation of 19 mm thickness on heating ducts will cost Rs. 22,000, which will yet result in annual heat loss in the system valued at Rs 9,000. Insulation of thickness 25 mm will cost extra Rs 9,250, which will yet result in annual heat loss in the system valued at Rs 6,500. Any thickness of insulation will have a life of 9 years and evaluation is at 8% p.a. (for which CRF is 0.16 nearly). What is the nearest approximate value of incremental benefit-cost ratio?

- (a) 2.3 (b) 2.2
(c) 2.1 (d) 2.0

Directions:

The following nine(9) items consist of two statements, on labelled as 'Assertion(A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the code given below.

Codes:

- (a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

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112. **Assertion (A):** Short-duration field tests will not reflect the performance of foundations on clayey soils.
Reason (R): Proximity effects of groundwater are not reflected in field tests.
113. **Assertion (A):** Under identical conditions, Rankine active earth pressure is greater than that by Coulomb.
Reason (R): In Coulomb analysis, the effect of wall friction is considered.
114. **Assertion (A):** Ideal shape of transition curve should be such that the rate of change of centrifugal acceleration is constant.
Reason (R): In an ideal transition curve, the length (along the curve) is inversely proportional to the radius.
115. **Assertion (A):** Tube wells are expected to give discharge many times more than that given by an open well.
Reason (R): The area draining water into a tube well is greater than that draining into an open well.
116. **Assertion (A):** Rainwater harvesting or artificial recharging of groundwater minimizes the TDS level in subsurface water.
Reason (R): TDS level falls in subsurface water due to dilution.
117. **Assertion (A):** Interface nodes, when connected to dated nodes in AOA network, may cause negative floats on the up-end (or the down-end) part of the network with respect to the dated node.
Reason (R): Given the zero date of the project, EET or LET of the dated node often gets wrongly computed.
118. **Assertion (A):** Material schedules may not always necessarily minimize the WC needs.
Reason (R): inadequate appreciation and implementation of balanced scientific policies based on ABC analysis and ECQ, together with multiple site-shifting and handling of materials interfere in working capital management.
119. **Assertion (A):** In the absence of any of the relevant data, the economic life of any equipment or project is set at 2 years.
Reason (R): Salvage value drops off significantly thereafter.

120. **Assertion (A):** The internal rate of return of a project is the discount rate which makes the net present value equal to zero, provided the present is defined as the 'zero date' of the project.
Reason (R): The internal rate of return represents the rate of return on unrecovered investment balance in the project.

End of Question Paper

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