CIVIL ENGINEERING

1. Which one of the following correctly defines the term Activity of clays?

a. $\frac{\text{Plasticity index}}{\text{Percentage of clay}}$

b. $\frac{\text{Plastic limit}}{\text{Liquidity index}}$

c. $\frac{\text{Unconfined compression strength}}{\text{Cohesion}}$

d. $\frac{\text{Unconfined compression strength of remolded sample}}{\text{unconfined compression strength}}$

2. The difference between maximum void ratio and minimum void ratio of a sand sample is 0.30. If the relative density of this sample is 66.6% at a void ratio of 0.40, then the void ratio of this sample at its loosest state will be

a. 0.40

b. 0.60

c. 0.70

d. 0.75

3. A particular soil sample is subjected to test for the determination of permeability coefficient in two separate constant head permeameters, whose specifications are as under:

	Peremeameter A	Permeameter
Diameter of sample	D	2D
Length of sample	2L	L

If the test on both the permeameters are conducted with equal head of water applied on the samples, then the ratio of amount of water discharged through the permeameters A and B and during a period of one hour will be

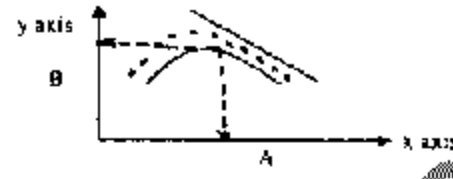
a. 4.000

b. 1.000

c. 0.250

d. 0.125

4. The standard compaction curve obtained from a laboratory test is shown in the figure



The dotted compaction curve of the same soil (shown in the figure) will be obtained if

a. Com active effort is decreased

b. Moisture content is reduced with same comp active effort

c. Moisture content is increased with same compo active effort

d. Com active effort is increased

5. The foundation soil under the toe of a dam has a void ratio e. The specific gravity of the soil solid is G. Factor of safety against piping is to be taken as 2.5. The maximum permissible upward exit gradient is given by

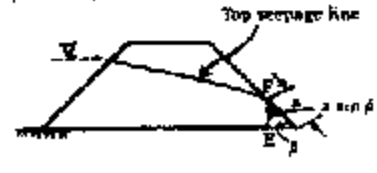
a. $i = 2.5\left(\frac{G-1}{1+e}\right)$

b. $i = 2.5\left(\frac{1-e}{G-1}\right)$

c. $i = 0.4\left(\frac{1-e}{G-1}\right)$

d. $i = 0.4\left(\frac{G-1}{1-e}\right)$

6. A homogeneous earth dam with no horizontal drainage filter at downstream is shown in the figure. The slope of the downstream side β is less than 30°. In order to determine the value of 'a' the discharge 'q' per unit length through the section of height a sin β is assumed to be (k coefficient of permeability of soil).



a. Ka sin β cos β

b. Ka sin β tan β

c. Ka $\sin^2 \beta$

d. Ka $\sin^2 \beta \tan^2 \beta$

7. Consider the flow net shown in the following figure:

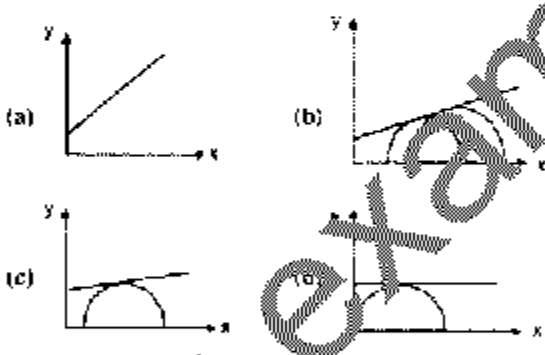
The ratio of the number of flow channels to the number of potent ion drops is

a. 3/8
b. 3/7
c. 4/7
d. 4/8

8. Which of the following parameters can be used to estimate the angle of internal friction of a sandy soil?

a. Partial size
b. Roughness of particle
c. particle size distribution
d. Density index

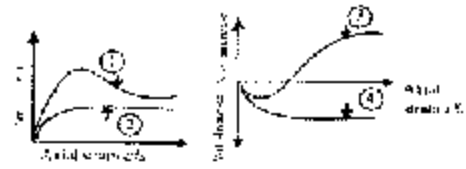
9. Which one of following diagrams correctly illustrates the Mohr's stress conditions of unconfined shear test on cohesive soil? (x-axis Normal stress; y-axis Shear stress)



10. A soil specimen having a cohesion c = 106 KN/m^2 and $\phi = 6°$ is tested in an unconfined compression test apparatus. The angle which the failure plane of the sample will make with the axis of the specimen is

a. 42°
b. 45°
c. 48°
d. 51°

11. A CD triaxial test is performed on a clay soil. The given figures show two curves each for deviator stress vs axial strain % and volume change vs axial strain %. If the clay is over consolidated, then the results would be as in curves.



a. 1 and 3
b. 1 and 4
c. 2 and 3
d. 2 and 4

12. Given that for a soil backfill.
K_A = coefficient of active earth pressure
K_0 = coefficient of earth pressure at rest
And K_p = coefficient of passive earth pressure. which one of the following represents the correct relationship between K_A, K_0 and K_p?

a. $K_0 = \sqrt{K_A K_p}$
b. $K_0 = (K_A + K_p)/2$
c. $K_0 = (K_p - K_A)/2$
d. None of the above

13. A vertical retaining wall retains a.c. -ϕ backfill and carries a surcharge of uniform intensity 'q' per unit area. The depth Z_0 from the top of the wall where the active earth pressure is zero is given by ($\alpha = 45 + \phi/2$ and γ = unit weight of the soil

a. q/γ
b. $\frac{2c}{\gamma}\tan\alpha - \frac{q}{\gamma}$
c. $\frac{2c}{\gamma}\tan\alpha + \frac{q}{\gamma}$
d. $\frac{2c}{\gamma}\tan\alpha$

14. A cantilever sheet pile derives its stability from

a. Lateral resistance of soil
b. Self-weight
c. The dead man
d. The anchor rod

15 Deflection of a sheet ppile in a braced cut

a. Increases from top to bottom
b. Decreases from top to bottom
c. Increases from top and then decreases
d. Decreases from top and then increases

16. A company saturated normally consolidated clay is tested in a triaxial test

under consolidated untrained condition. The value of pore pressure coefficient at failure, A_f, is given by ($\Delta\sigma_3$ – change in cell pressure ; $\Delta\sigma_1$ = change in axial stress; Δu – corresponding change in pore pressure)

a. $A_f = \left(\frac{\Delta u - \Delta\sigma_1}{\Delta u - \Delta\sigma_3}\right)$

b. $A_f = \left(\frac{\Delta u \quad \Delta\sigma_1}{\Delta\sigma_1 \quad \Delta\sigma_3}\right)$

c. $A_f = \left(\frac{\Delta u \quad \Delta\sigma_3}{\Delta u - \Delta\sigma_1}\right)$

d. $A_f = \left(\frac{\Delta u - \Delta\sigma_3}{\Delta\sigma_1 - \Delta\sigma_3}\right)$

17. The water table at a location is at the ground surface and the saturated unit weight of the soil is 20 kN/m^3. If, due to heavy precipitation, the water level rises to 2m above the ground level, the increase in the vertical effective stress at a point 2m below the ground surface will be

a. 40 kN/m^2
b. 20 kN/m^2
c. 10 kN/m^2
d. zero

18. The time t required for attaining a certain degree of consolidation of a clay layer is proportional to

a. H_2 and C_V
b. H_2 and $1/C_V$
c. $1/H^2$ and C_V
d. $1/H^2$ and $1/C_V$

19. Match List-I with List-II and select the correct answer using the codes given below the lists:

List I

A. Elastic settlement
B. Primary consolidation
C. Secondary consolidation
D. Creep

List II

1. Constant effective stress with change in volume of soil
2. Dissipation of excess pore water pressure
3. Occurs within a short period
4. Compression and rearrangement of particles

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

20. Given that for an over consolidated clay soil deposit, the pressure under which the deposit has been fully consolidated in the past is 125 kN/m and the present overburden pressure is 75 kN/m^2, the over consolidation ratio of the soil deposit is

a. 75/125
b. 50/75
c. 125/75
d. 200/75

21. Match List-I with List-II and select the correct answer using the codes given below the lists:

List I

A. Stress distribution due to point load in homogeneous isotropic medium
B. Stress distribution due to point load in an anisotropic soil medium
C. influence chart for stress distribution in a rectangular area
D. Influence chart for stress distribution in irregularly soaped areas

List II

1. Stein Brenner
2. Newmark
3. Boussiesq
4. Westergaard

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

22. Consider the following conditions:

1. Two-third of the final load at which total settlement is 12 mm or the permissible total settlement other than 12mm.
2. 50% of the final load which causes a settlement equal to 10% of the shaft diameter.
3. Two-third of the final load which causes a net settlement of 6mm.

4. 50% of the final load at which total settlement is equal to 7.5% of bulb diameter

If an initial pile load test is to be performed on a test under reamed pile Then the sate load on pile shall he taken as least of

a

b. 1 and 2

c. 1 and 3

d 1 and 4

e. 2 and 4

23 Given that

ω_n = Natural frequency of foundation soil system.

C_u = coefficient of elastic uniform compression of soil.

A – contact area pf foundation with soil.

And m= mass of machine plus foundation, natural frequency of foundation soil system for analysis of machine foundation Shall be determined by Barken's method by using the equation:

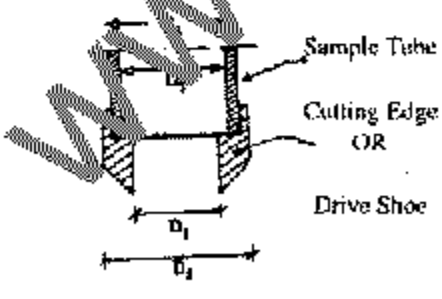
a. $\omega_n = C_u \frac{A}{m}$

b. $\omega_n = C_u \sqrt{\frac{A}{m}}$

c. $\omega_n = \frac{A}{m}\sqrt{C_u}$

d $\omega_n = \sqrt{\frac{C_u A}{m}}$

24. The given diagram relates to design features of samplers affecting soil disturbance. The area ratio of the soil sample is given by



a. $\frac{D_2^2 - D_3^2}{D_3^2}$

b $\frac{D_2^2 - D_1^2}{D_1^2}$

c $\frac{D_2^2 - D_3^2}{D_4^2}$

d $\frac{D_2^2 - D^2}{D^2}$

25. The static cone penetration test and a standard penetration test per performed on a soil at a soil at a certain depth. The value of static cone penetration test is 8MPa and the N value is 20. the soil met with at that depth is

a. Sandy silt

b. Clay-silt mixture

c. Sand and gravel mixture

d Medium dense sand

26 Consider the following statements relating to some fluid properties:

1. The variation of kinematics viscosity between liquids and gases is much less than the variation of dynamic viscosity
2. Surface energy is coursed by relative forces of cohesion and adhesion between the fluids.
3. Mercury possesses larger vapor pressure than benzene and hence benzene is more volatile.
4. Bulk modulus of water is 3,00.000 units arid that of gas is 15 units. This indicates that gas is 20,000 times more compressible than water

Of these statements

a 1,2 and 3 are correct

b 1,2 and 4 are correct

c. 2,3 and 4 are correct

d. 1,3 and 4 are correct

27 Which one of the following statements is not correct?

a. A gauge always measures pressure above the surrounding atmospheric pressure

b. At a point inside a fluid. pressure is exerted equally in all directions

c. Typical actual variation of pressure with elevation in the atmosphere is more adiabatic than isochroual

d. Vacuum pressure at a point is always measured above absolute zero pressure.

28 Consider the following statement relating to hydrostatic forces on submerged surface

1. The pressure centre is always below the centroid of any plane submerged surface that is not horizontal.
2. Total force on a curved surface is the product of the average force and the submerged area.
3. The magnitude of hydrostatic pressure at a particular depth is a function of the shape of the surface.
4. The vertical component of force on a body completely submerged in a static reservoir of fluid is equal to the weight of the fluid displaced by the body.

Of these statements

a. 1, 2 and 3 are correct
b. 2, 3 and 4 are correct
c. 1, 3 and 4 are correct
d. 1, 2 and 4 are correct

29. Consider the following statements relating to stability of floating and submerged bodies

1. A submerged body is in unstable equilibrium if the centre of gravity is below the centre of buoyancy.
2. A floating body is in stable equilibrium if the centre of gravity is below the metacentre.
3. A submerged body is in neutral equilibrium if the centre of gravity coincides with the centre of buoyancy.
4. A floating body is in unstable equilibrium if the centre of gravity is above the metacentre.

Of these statements

a. 1,2 and 3 are correct
b. 1,2 and 4 are correct
c. 2,3 and 4 are correct
d. 1,3 and 4 are correct

30. If $\phi = 3xy$ the x and y components of velocity at the point (1,3) will be

a. $u = -9; v = -3$
b. $u = -3y; v = -3x$
c. $u = \frac{\partial \phi}{\partial x}; v = \frac{\partial \phi}{\partial y}$
d. $u = -9; v = 9$

31. Match List I (Phenomena) with List II (Equation/ concept involved) and select the correct answer using the codes given below the lists:

List I

A. Force developed in a pipe bend
B. Pilot static tube
C. Flow through smaller passage produces higher velocity
D. Vortex flow

List II

1. Continuity equation
2. Energy equation
3. Momentum equation
4. Moment of momentum

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

32. The loss of head due to sudden expansion in a pipe flow is given by

a. $\frac{f L d 2}{}$
b. $\frac{V_2^2 - V_1^2}{2g}$
c. $\frac{(V_1 - V_2)^2}{2g}$
d. $\frac{V_1^2 - V_2^2}{2g}$

33. Match List-I (Typical occurrence) with List-II (Relevant flow condition) and select the correct answer using the codes given below the lists:

List I

A. Cavitations
B. Separation
C. Stagnation point
D. Wake

List II

1. Absence of fluid velocity
2. Fluid pressure reduces to vapor pressure limit
3. Bluff body in flow
4. Adverse pressure gradient in widening boundaries of flow

Codes:

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

34. Consider the following statement:
1. Velocity potential is a scalar quantity dependent upon space and time.
2. Velocity potential provides an alternate means of expressing velocity components.
3. Stream function is applicable to two-dimensional cases only.
4. Partial derivative of stream function with respect to any direction gives velocity component in that direction.

Of the statements
a. 1,2 and 3 are correct
b. 1,3 and 4 are correct
c. 1,2 and 4 are correct
d. 2,3 and 4 are correct

35. Which one of the following statements is not correct?
a. In free vortex flow, streamlines are concentric spinals and flow continuously circles the origin
b. In free vortex flow, the flow velocity is in tangential direction only and varies inversely as the distance from the origin
c. In a free vortex, flow is rotational at the core and irrigational away from it.
d. In a forced vortex, flow is rotational, that is, fluid particles undergo rotation about their mass centre

36. Consider the following statements:
1. In a source, equipotential lines are circles.
2. Flow net is a representation of 2-dimensional irrigational flow of incompressible fluid.
3. Boundaries act as limiting equipotent lines in a flownet.
4. In uniform flow region, streamlines will be parallel and equidistant.

Of these statements
a. 1,2 and 3 are correct
b. 1,2 and 4 are correct
c. 2,3 and 4 are correct
d. 1,2 and 4 are correct

37. Match List-I with List-II and select the correct answer using the codes given below the lists:

List I
A. Reynolds number
B. Froude number
C. Weber number
D. Mach number

List II
1. Gravity force
2. Surface energy force
3. Viscous force
4. Elastic force
5. Shear force

	A	B	C	D
a.	1	2	3	4
b.	1	2	4	5
c.	3	1	2	4
d.	1	2	3	5

38. Match List-I (Phenomena) with List-II (Tool for dynamic similarity) and select the correct answer using the codes given below the lists:

List I
A. Flow in open channel
B. Flow in pipes
C. Movement of a bullet in air
D. Capillary flow

List II
1. Froude number
2. Reynolds number
3. Weber number
4. Mach number
5. Cavitations number

	A	B	C	D
a.	1	2	3	4
b.	1	2	3	5
c.	2	3	4	5
d.	1	2	4	3

39. Which one of the following statements is not correct?
a. Models are normally distorted vertically to eliminate effect of Reynolds number in modeling.
b. Vertical distortions are used to reduce the influence of laminar sub layer.
c. Distortion in models can be eliminated by using roughness elements to destroy effects of Reynolds number.
d. River models may be conveniently distorted horizontally to eliminate the effect of Reynolds number.

40. Which one of the following statements is not correct?

a. In the study of flow between two fixed parallel plates, the flow is assumed two -dimensional.

b. In flow between parallel plates, if the distance between the plates and the viscosity remains constant, then the pressure gradient is also constant provided that the flow is steady.

c. Velocity distribution for laminar flow between two parallel plates shows that velocity varies directly with pressure gradient.

d. In case of flow between parallel plates, variation of shear is linear

41. Consider the following statements:

1. Flow is established in a pipe when the boundary layer thickness is equal to the radius of the pipe.
2. For laminar flow, the friction factor in Darcy Weisbach equation varies inversely as the Reynolds number.
3. For turbulent how, the friction factor in Darcy Weisbach equation varies inversely as the square of Reynolds number.
4. When the boundary layer is rough friction factor varies with the relati roughness of the pipe.

On these statements

a. 1,2 and 3 are correct
b. 1,2 and 4 are correct
c. 2,3 and 4 are correct
d. 1,3 and 4 are correct

42. Consider the following statements:

1. Pipe network analysis is normally necessary in analyzing flow in pipes at the city water supply systems.
2. Hardy-Cross method of solving pipe network is a method of a successive approximation and is not a direct method.
3. The network must satisfy the momentum equation because the flow in each pipe satisfies the head loss equation.
4. Principle of continuity is satisfied.

Of these statements

a. 1,2 and 3 are correct
b. 2,3 and 4 are correct
c. 1,3 and 4 are correct
d. 1,2 and 4 are correct

43. Which one of the following statements is not correct?

a. Water hammer occurs in a situation when there is unsteady flow in a pipe
b. Fall of pressure due to decrease in velocity results in the phenomenon of water hammer
c. Propagation of high pressure through elastic media gives rise to water hammer
d. For water hammer to occur, the valve at the end of a pipeline must be fully closed

44. Which one of the following pairs of types of flow and situations is not correctly matched?

a. Non-uniform flow ..... Velocity changes in magnitude with distance
b. Uniform flow .....Flow in a channel bend
c. Steady flow .....Velocity does not change with time
d. Tranquil flow .....Froude number of flow is less than I

45. For a circular channel (with r_0 as the radius of the channel) to be efficient,

a. The half subtended angle ft the centre with respect to the water level must be 151° 10
b. Depth of flow must be 1.88 r0
c. Depth for maximum velocity must be $1.62\ r_0$
d. The half subtended angle at the centre with respect to the water level must be 90°

46. The loss of energy in a hydraulic jump formed in a rectangular channel is given by (Symbols have the usual meanings)

a. $\Delta E = \dfrac{(y_2 - y_1)^3}{4_{xy_1}}$

b. $\Delta E = \dfrac{\nu Q (y_2 - y_1)^3}{8_{xy_2}}$

c. $\Delta E = \dfrac{\nu Q (y_2 - y_1)^3}{75 \cdot 4_{xy_2}}$

d. $\Delta E = \dfrac{(y_1 - y_2)^3}{4_{xy_2}}$

47. Which one of the following statements is not correct?
   a. Specific energy is the total energy above the floor of an open channel
   b. For a given specific energy, two depths exist and these are called alternate depths
   c. Velocity of flow is critical at maximum specific energy
   d. Critical velocity occurs at Froude number = 1

48. The ripples formed on the water surface by dropping a stone in open channel indicate the type of flow. The flow will be sub critical when
   a. The ripples are swept away downstream
   b. The ripples travel side-ways only
   c. Ripples are not formed
   d. The ripples move in upstream and downstream directions

49. Which one of the following pairs of situations and types of water surface profiles is not correctly matched?
   a. Mild slope; flow over free over fall M_2
   b. Mild slope; flow downstream of a sluice gate M_1
   c. Critical slope, flow downstream of a sluice gate C_3
   d. Critical slope; flow behind an over flow weir C_1

50. Match List-I (surface profile) with List -II (Description of the profile) and select the correct answer using the codes given below the lists

List I

A. M_2

B.

C. C_1

D.

List II

1. Convex upward; asymptotic to horizontal at d/s end, depth increasing with d/s
2. Convex downward, upstream asymptotic to normal depth with depth decreasing in d/s direction
3. Depth increasing downstream and meeting at an angle to CDL, a curve with an inflexion point
4. Convex upwards and depth increasing in flow direction; asymptotic to NDL at d/s end

Codes:

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

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

List I

A. Geographical map

B. Topographical map

C. Location map

D. Forest map

List II

1. 1 cm = 2.5 km
2. 1 cm = 0.25 km
3. 1 cm = 160 km
4. 1 cm = 5m to 25m

Codes:

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

52. Which one of the following is a conventional sign for north line is surveying?

(a) (b) (c) (d)

53. A Dumpy level is set up with its eyepiece vertically over a peg A. The height from the top of peg A to the centre of the eyepiece is 1.540 m and the reading on peg B is, 0.705 m. The level s then set up over peg B. The height of the eyepiece above peg B is 1.490 m and the reading on A is 2.195 m. The difference in level between A and B is
   a. 2.900 n
   b. 3.030 m
   c. 0.770 m
   d. 0.785 m

54. If the cross-section areas of an embankment at 30 m intervals are 20, 40, 60, 50 and 30 m^2, respectively, then the

volume of the embankment on the basis of primordial rule is

a. 5300 m^3
b. 8300 m^3
c. 9300 m^3
d. 9400 m^3

55. If h_1 and h_2 are the differences in levels between ground and the formation levels, 'm' is the slope of the sloping sides and 'D' is the distance between the cross-sections, then the primordial correction for a level section would be

a. $\frac{D}{2m(h_1 - h_2)}$

b. $\frac{D}{3m(h_1 - h_2)}$

c. $\frac{D}{6m(h_1 - h_2)^2}$

d. $\frac{D}{6m(h_1 - h_2)^3}$

56. If the bearing of a line AB is N 60 30' E and that of BC is 122° of a closed traverse ABCDE, then the measure of the interior angle B is

a. 240° 30'
b. 122° 00'
c. 118° 30
d. 154°

57. The tachometer focal length of object glass is 20 cm. the distance between the object glass and grunion axis is 0 cm and the spacing between the outer lines of diaphragm axis is 4mm If the staff intercepts are 1.000 (top) and 2.500 (middle) when the line of collimation is perfectly horizontal, then the horizontal distance between the staff station and instrument station will be

a. 3 m
b. 78 m
c. 150.3 m
d. 153 m

58. Consider the following statements regarding balancing a traverse:

1. Bow ditch's method is based on the principle that errors in linear measurements are proportional to $\sqrt{l}$ and errors in angular measurements are inversely proportional to $\sqrt{l}$ when 'l' is the length of the line
2. According to Bowditch's rule corrections to latitude (or departure) of any side = total error in latitude (or departure)

$$\times \frac{\text{length of that side}}{\text{perimeter of the traverse}}$$

3. The transit rule is: correction to latitude (or departure) of any side = $\frac{\text{latitude (or departure) of that line}}{\text{arithmetic sum of latitude (or departure)}} \times$ total error in latitude (or departure)
4. The axis method is adopted when the angles are to be measured very accurately, the corrections being applied to the lengths only

Of these statements

a. 1 and 3 are correct
b. 2 and 4 are correct
c. 1, 2 and 4 are correct
d. 2 and 3 are correct

59. If the coordinates of A are 100 N and 200 E and those of C are 100 S and 200 E, then the length AC is

a. 400.00
b. 282.85
c. 244.94
d. 200.00

60. Which one of the following instruments is used in plane table surveying for the measurements of horizontal and vertical distances directly?

a. Plain alidade
b. Telescopic alidade
c. Tacheometer
d. Clinometer

61. The deflection angle between the tangents drawn at the ends of a transition curve is 7°. The radius of the curve at the end is 400m. What is the length of the transition curve?

a. 60.00 m
b. 97.74 m
c. 120.00 m
d. 150.00 m

62. A transition curve is required for a circular curve of 200 m radius, the gauge being 1.5cm. The transition for a

velocity such that no lateral pressure is imposed on the tails and the rate of gain of radial acceleration is 30 cm/s^2. The required length of transition curve will work out to be

a. 460 m
b. 46 m
c. 4.6 m
d. 0.46 m

63. Which of the following elements of a simple curve are correctly matched?

1. Tangent length ..... $R\tan\frac{\Delta}{2}$
2. Apex distance ..... $2R\sin\frac{\Delta}{2}$
3. Length of long chord ..... $2R\cos ec\frac{\Delta}{2}$
4. Mid-ordinate ..... R versin $\frac{\Delta}{2}$

(R is the radius and Δ is the deflection angle)

Select the correct answer using the codes given below:

Codes:

a. 1 and 3
b. 2 and 4
c. 1 and 2
d. 1 and 4

64. A parabolic vertical curve is set out connecting a + 0.7 % grade and a - 0.6% grade. The chain age and R.L of the point of intersection are 1000 m and 250 m respectively. The admissible rate of change of grade is 0.05% per 20 m. The chain age of the tangent points will be

a. 600 and 1400
b. 650 and 1350
c. 700 and 1300
d. 740 and 1260

65. A,B,C are triangulation stations and S is the satellite station for B. The true angle at B is given by $\alpha = \theta - \beta_1 - \beta_2$ where $\beta_1 = SAB, \beta_2 = SCB$ and θ ASC

The position of S is

a. To the left of B
b. To the right of B
c. Between AC and B
d. Behind B

66. Consider the following statements associated with triangulation survey

1. In triangulation survey unknown distances between stations are determined using tachometric relations.
2. The triangulation station at which astronomical observations are made for azimuths are called Laplace stations.
3. In tertiary triangulation, the length of the sides is in the range 1 to 25 km.
4. The length of the base line in primary triangulation is 8 to 12 km.

Of these statements

a. 1 and 2 are correct
b. 3 and 4 are correct
c. 1 and 3 are correct
d. 2 and 4 are correct

67. Which one of the following is the combined angular corrections for angles of elevation when trigonometrically leveling? (Symbols have the usual meanings)

a. $\frac{(1-2m)d}{R\sin 1''}(+ve)$
b. $\frac{(1-2m)d}{R\sin 1''}(-ve)$
c. $\frac{(1-2m)d}{2R\sin 1''}(+ve)$
d. $\frac{(1-2m)d}{2R\sin 1''}(-ve)$

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

List I

Declination of the sun is

A. Zero and tends to change form -ve to +ve
B. Zero and tends to change from +ve to -ve
C. +23° 27'
D. -23°27'

List II

1. At the first point of Libra
2. At the first point of Aries
3. At winter solstice
4. At summer solstice

	A	B	C	D
a.	2	1	3	4

b. 2 1 4 3
c. 1 2 3 4
d. 1 2 4 3

69. A star culminates in zenith when
a. $\delta < \theta$
b. $\delta > \theta$
c. $\delta < \theta$
d. $\delta = \theta$

70. If α H, A and δ area the altitude, hour angle, azimuth and declination of a circumpolar star at its elongation in latitude λ, then which one of the following relations would hold good?
a. $\cos H = \frac{\tan \lambda}{\tan \delta}$
b. $\sin \alpha = \frac{\sin \lambda}{\sin \delta}$
c. $\sin A = \frac{\cos \delta}{\cos \lambda}$
d. All the above that is (a), (b) and (c)

71. When the latitude is 56°16' N and declination is 70° 30'S. the zenith distance at the upper culmination of the star will be
a. 73° 45
b. 73° 30
c. 35°00
d. Not determinable from the given data

72. If the parallax difference between the top and bottom of a tree is measured as 1.52 mm on a stereo-pair of photos taken at 3000 m above ground and the average photo ace is 66 mm. then the height of the tree will be
a. 45.49 m
b. 60.00 m
c. 23.61 m
d. 39.5 m

73. Given that
f = focal length of camera,
H = height of exposure station above MSL. And h = height of ground above MSL, the scale of vertical photograph is given by
a. $S_f = f / H$
b. $S_f = f / (H - h)$
c. $S_f = H / (f - h)$
d. $S_f = f (H - h)$

74. **Assertion (A):** The bending moment on a section is maximum where the shearing force changes sign.
Reason (R): In a continuous curve of bending moment, the point of zero bending moment where it changes sign, is called the point contra flexure.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

75. **Assertion (A):** For a beam with one end fixed and the other end hinged, when a positive moment 'M' is applied to the hinged end of the beam, a positive moment M/2 will be transferred to the other end.
Reason (R): As the fixed end remains horizontal and the hinged end does not deflect, a tangent at the fixed end must pass through the hinged end, that is, the moment of the area of the total bending moment diagram about the hinged end must be equal to zero.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

76. **Assertion (A):** In case of sands, the position of the water table is of great practical importance in the determination of bearing capacity of a footing on sand.
Reason (R): The unit weights of most sands, whether dry, moist or saturated, lie wilhin a narrow range of values.
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

77. **Assertion (A):** The ratio of operating frequency of machine 'f' and natural frequency of foundation soil system f_n, should be either less than 0.5 or more than 1.5.

Reason (R): The high amplitude caused during resonance ($f = f_n$) would damage the delicate parts of the machine.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

78. **Assertion (A):** In pipe flow, the upper critical Reynolds number is not well defined.

Reason (R): Flow changes from transition to full turbulence depending upon the external disturbance

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

79. **Assertion (A):** Loss of head at a sudden expansion in a pipe is greater than that at a sudden contraction.

Reason (R): Flow in a sudden expansion in a pipe is greater than that at a sudden contraction.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

80. **Assertion (A):** In a running irrigation canal regulating gates are installed at intermediate locations for control purposes. One such regulating gate is partially closed. Such a movement gives rise to a positive surge traveling downstream and a negative surge traveling upstream of the gate.

Reason (R): Any sudden change in the intermediate gate position suddenly changes the discharge both upstream and downstream of the gate. This sudden change in discharge gives rise to sudden changes in water elevations both upstream and downstream of the gate and develops in the form of an unsteady, rapidly varying flow which propagates in the form of a surge wave moving on either side of the gate.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

81. **Assertion (A):** If the plane table station 'P' lies on the great circle passing through the stations A, B and C, then the position point 'p' can be determine. by the three-point problem.

Reason (R): The problem becomes indeterminate as the three ray will interact at one point irrespective of the orientation of the plane table.

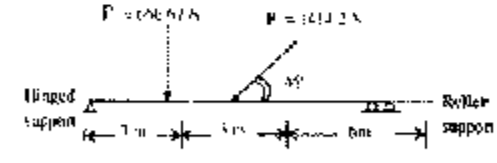
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

82. **Assertion (A):** Secondary of horizon are known as vertical circles.

Reason (R): Secondary of celestial equator are known as declination circles.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

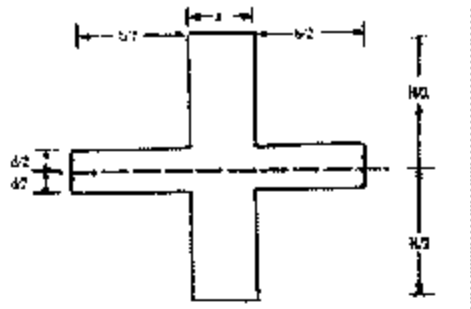
83. A beam AB is hinged at 'A' and is supported on rollers at 'B' it carries two loads p_1 and p_2 as shown in the figure:



The reactions at 'A' and 'B' will be respectively

a. 1000.0 N and 666.67 N
b. 1000.0 N and 1000.0 N
c. 1414.2 N and 66667 N
d. 1414.2 N and 1000.0 N

84. The section modulus of the structure shown in the figure is given by



a. $\frac{bd^3}{6}+\frac{aH^3}{6}$

b. $\frac{ad^3}{6}+\frac{bH^3}{6}$

c. $\frac{bd^3}{6}+\frac{aH^3}{6d}$

d. $\frac{bd^3}{6H}+\frac{aH^3}{6}$

85 The equilibrium of two equal forces P acting at 60° between then is possible if a force of $P\sqrt{3}$ is applied at an angle of

a. 30°
b. 120°
c. 150°
d. 210°

86 A ladder of weight 'W' rests against a smooth vertical wall and rests on rough horizontal ground. The coefficient of friction between the ladder and the ground is 0.25. If a man of weight 'W' can climb to the top of the ladder safely, the maximum inclination of the ladder to the vertical will be $\tan^{-1}x$, where 'x' is

a. ¼
b. 1/3
c. 3
d. 5

87 A man in a balloon rising vertically with an acceleration of 4.9 m/s^2, releases a ball 2 seconds after the balloon has been let go from the ground. The greatest height above the ground reached by the ball will be

a. 9.3 m
b. 14.7 m
c. 19.6 m
d. 24.5 m

88. A particle moves in a straight line. Its position is defined by the equation $x = 6t^2 - t^3$ where 't' is in seconds and 'x' is in meters. The maximum velocity of the particle during its motion will be

a. 12 m/s
b. 6 m/s
c. 24 m/s
d. 48 m/s

89. Given that for a particle the initial velocity is 'u', the angle of projection to the horizontal is α and x and y are the coordinates of a point on the trajectory, match List-I with List-II and select the correct answer using the codes given below the lists:

List I

A. Maximum height
B. Time of flight
C. Range
D. Trajectory

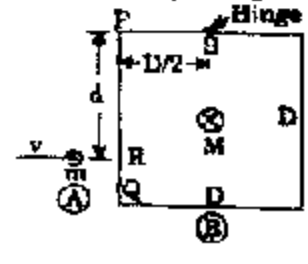
List II

1. $\left[2u\sin\alpha\right]/g$
2. $\left[u^2\sin 2\alpha\right]/g$
3. $y = x\tan\alpha - \frac{1}{2}g\frac{x^2}{u^2}\left(1+\tan^2\alpha\right)$
4. $\left[u^2\sin^2\alpha\right]/2g$

Codes:

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

90 A bullet (A) of mass 'm' is fired horizontally with a velocity 'v' on to the side PQ at R of a square panel such that PR = d. the panel hinged at S, has a mass M and is of size D x D as shown in the figure. The angular velocity 'ω' of the panel (B) immediately after the bullet is imbedded in the panel, given by



a. $mv = M\left(\frac{D}{2}\theta\right) + I\omega\left(where\ I = \frac{MD^2}{12}\right)$

b. $mvd = M\left(\frac{\omega D}{2}\right) \cdot (M - m)\left(\frac{\omega D}{2}\right) + \left(\frac{MD^2}{6}\right)\omega$

c. $md = M\left(\frac{\omega D}{2}\right)\left(\frac{D}{2}\right) + \left(\frac{MD^2}{6}\right)\omega$

d. $mv = M\left(\frac{D}{2}\omega\right) + \left(\frac{MD^2}{12}\right)\omega - 0$

91. In dealing with the collision of elastic bodies one uses

1. Principles of conservation of moments.
2. Definition of coefficient of restitution
3. Principle of conservation of energy.

If two elastic bodies of masses m_1 and m_2 moving along the same line of action collide with each other such that the velocities before impact (u_1, u_2,) change to (v_1 , v_2) respectively, then the final velocities are determined using

a. 1,2 and 3
b. 1 and 3
c. 1 and 2
d. 2 and 3

92. Two particle of mass 5 gm executes simple harmonic motion making 25 oscillations in 11 seconds. If its maximum velocity is 60 cm/s, then the amplitude of vibration will be

a. 9.0 cm
b. 6.0 cm
c. 4.5 cm
d. 3.0 cm

93. Two perfectly elastic spheres of equal mass moving in the same direction with their velocities in the ratio 2:1 have an impact. After the impact, they will

a. Move in the same direction with the same velocity ratio
b. Have a velocity ratio of 1:2
c. Move in opposite directions with a velocity ratio of 1:2
d. Move in the same direction with a velocity ratio 1:2

94. Match List-I (Quantities) with List-II (Expressions for a rigid body with mass moment of inertia I; θ, ω and α being the displacement, angular velocity and angular acceleration respectively) and select the correct answer using the codes given below the lists:

List I

A. Rotational moment(M_1)
B. Momentum
C. Kinetic energy
D. Work done

List II

1. $I\omega$
2. $M\alpha$
3. $I\alpha$
4. $0.5I\omega^2$

Codes:

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

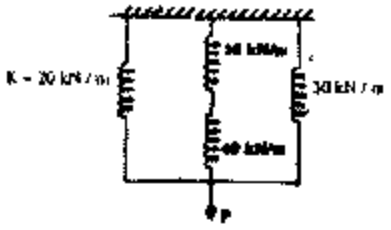
95. A spherical ball of volume 20 m^3 is placed under a certain liquid wherein the ball is subjected to a uniform hydrostatic pressure of 200 MPa. If the material of the ball has a bulk modulus of elasticity of 2.5×10^5 MPa and a poison's ratio of 0.30, then due to the hydrostatic pressure, the volume of the ball will change by

a. 0.0008 m^3
b. 0.0144 m^3
c. 0.0160 m^3
d. 0.048 m^3

96. A steel rod of circular section tapers from 2 cm diameter to 1cm diameter over a length of 50, cm. If the modulus of elasticity of the material is 2×10^6 kg/cm^2 then the increase in length under a pull of 3000 kg will be

a. $\frac{0.3}{2\pi} cm$
b. $\frac{30}{\pi} cm$
c. $\frac{300}{\pi} cm$
d. 750 cm

97. For the system of springs shown in the figure, the equivalent spring stiffness is



a. 58 kN/m
b. 62 kN/m
c. 78 kN/m
d. 90 kN/m

98. In a bar subjected to axial tension, if the normal stress on a section 1-1, perpendicular to its axis is σ, then the normal stress σ_n on an inclined section 2-2, making an angle θ with the section 1-1, will be

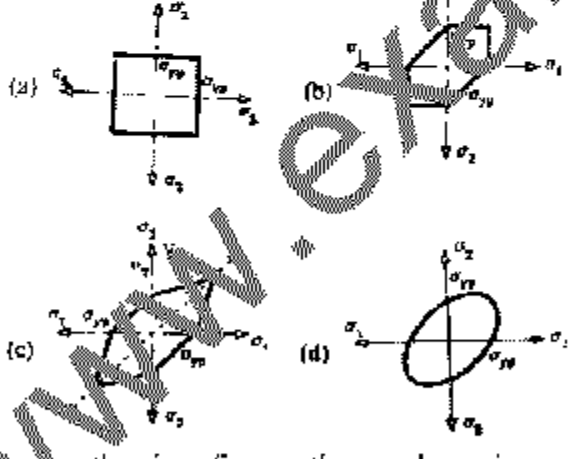
a. $\sigma_n = \sigma \cos\theta$

b. $\sigma_n = \sigma = \cos^2\theta$

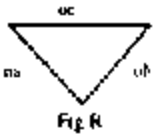
c. $\sigma_n = \dfrac{\sigma}{\cos\theta}$

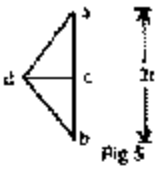
d. $\sigma_n = \sigma \sin^2\theta$

99. Which one of the following diagrams correctly represents the Rankine or the maximum stress theory of failure?



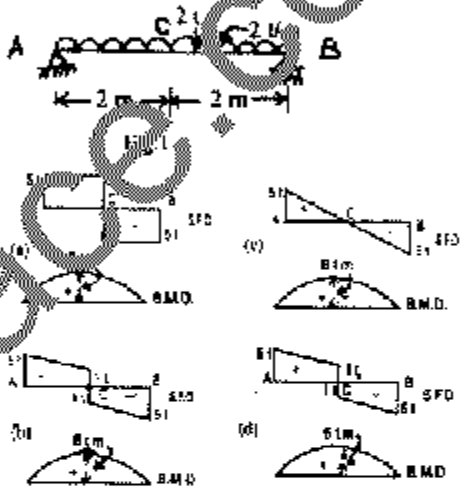
100. Referring the given figures, the one shown in Fig. Q represents





a. Force diagram
b. Loading diagram
c. Funicular polygon
d. Polar diagram

101. A simply-supported beam AB of span 4m carriers loads as shown in Fig. I. The corresponding SFD and BMD for the beam will be as shown



102. A cantilever beam of span L carries a concentrated load 'W' at the free end. If the width b of the beam is constant throughout the span, then for the beam to have uniform strength, the depth 'd' at the free end should be

a. $\dfrac{6WL}{bf}$

b. $\dfrac{3WL}{bf}$

c. $\sqrt{\dfrac{3WL}{bf}}$

d. $\sqrt{\dfrac{6WL}{bf}}$

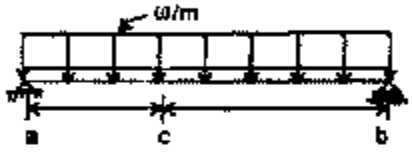
103. Consider the following statements:
The theory of simple bending assumes that
1. The material of the beam is homogeneous, isotropic and obeys Hooke's law.
2. Plane sections of the beam remain plane after bending.

3. Each cross-section of the beam is symmetric about the loading plane
4. Young's moduli are the same for tension and compression

Of these statements

a. 1 and 2 are correct
b. 1,3 and 4 are correct
c. 2,3 and 4 are correct
d. 1,2,3 and 4 are correct

104. In a simply-supported beam shown in the figure, if dimensions ac and ab are doubled, then the bending moment and the shear force at 'c' will be such that



a. Both SF and BM are double
b. SF is half and BM is double
c. SF is double and BM is half
d. SF is double and BM is four times

105. A rectangular beam 10 cm wide, is subjected to a maximum shear force of 50000 N, the corresponding maximum shear stress being 3 N/mm^2. The depth of the beam is

a. 25 cm
b. 22 cm
c. 16.67 cm
d. 30 cm

106. Match List-I (Deflection) with List-II (Expressions for deflection in different types of beams / man' (subjected to total load 'W') and select the correct answer using the codes given below the lists

List I

A. Central deflection in a fixed beam subject to uniformly distributed
B. Central deflection in a simply-supported beam subject to uniformly distributed load
C. Central deflection in a simply-supported beam subject to concentrated load at mid-span
D. Deflection at free end of a cantilever subject to concentrated load at free and

List II

1. $\frac{Wl^3}{3EI}$
2. $\frac{Wl^3}{48EI}$
3. $\frac{5Wl^3}{384EI}$
4. $\frac{Wl^3}{384EI}$

Codes:

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

107. A 4-meter long beam, simply supported at its ends, carries a point load 'W' at its venture. If the slope at the ends of the beam is , then the deflection at the centre of the beam will be

a. 0.56
b. 8.32 mm
c. 23.27 mm
d. 9.37 mm

108. Consider the following statements about fletched beams

1. A flitched beam has a composite section made of two or more materials joined together in such a manner that they behave as a unit piece and each material bends to the same radius of curvature.
2. The total moment of resistance of a fletched beam is equal to the sum of the moments of resistance of individual sections.
3. Flitched beams are used when a beam of one material: if used alone, would requite a large cross-sectional area

Of these statements

a. 1,2 and 3 are correct
b. 1 and 2 are correct
c. 1 and 3 are correct
d. 2 and 3 are correct

109. Match List-I (Euler load formulae for different end restraints) with List-II (conditions of end restraint) and select the correct answer using the codes given below the lists:

List 1

A. $\frac{4\pi^2 EI}{L^2}$

B. $\frac{\pi^2 EI}{4l^2}$

C. $\frac{\pi^2 EI}{l^2}$

D. $\frac{2\pi^2 EI}{l^2}$

List II

1. Pin ended at both ends
2. Fixed at one end and pinned at the other end
3. Fixed at both ends
4. Fixed at one end and free at the other end

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

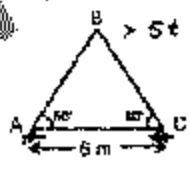
110 In order that tension is not developed, the load line must fall within the core of the cross-section. The shapes of the core in respect of a rectangular section, an I-section and a circular section will be respectively

a. A square, a rhombus and a circle
b. A rhombus, a rhombus and a circle
c. A square, a rectangle and a rhombus
d. A circle, a rectangle and a circle

111 The influence line for horizontal thrust of a two-hinged parabolic arch of span 'l' and rise h will be as shown in

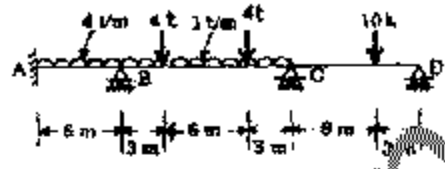
(d) None of the above

112. Force in the member BC of the truss shown in the given figure is



a. 5t,tensile
b. Zero
c. 2.88 t, compressive
d. 5t, compressive

113. In respect of the beam and the given loading shown in the figure, match List-I (Span fixed-end moments) with List-II (values) and select the correct answer using the codes given below the lists



List I

A. $M_{BA} = -M_{CB}$

B. $M_{BC} = -M_{CB}$

C. M_{BA}

D. M_{CB}

List II

1. 21 t m
2. [illegible] t.m
3. 13.3 [illegible]
4. [illegible] t.m

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

114 In order to produce a maximum shearing stress of 75 MN/m^2 in the material of a hollow circular shaft of 25 cm outer diameter and 17.5 cm inside diameter, the torque that should be applied to the shaft is

a. 87.4 kN m
b. 17.49 kN.m
c. 174.9 kN.m
d. 349.7 kN.m

115. Strain energy in a member is

a. Directly proportional to strain
b. Directly proportional to changes in strain
c. A function of strains as well as stresses
d. A function of loads only

116 Consider the following statements:

1. The deflection of a closed helical spring due to an axial load is inversely proportional to the modulus of rigidity of the spring material.
2. The stiffness of a closed helical spring with axial load is directly proportional to the modulus of rigidity of the spring material.

3. The stiffness of a closed helical spring with axial load increases with increase in the radius of the spring.

Of these statements

a. 1 alone is correct
b. 1 and 2 are correct
c. 1 and 3 are correct
d. 2 and 3 are correct

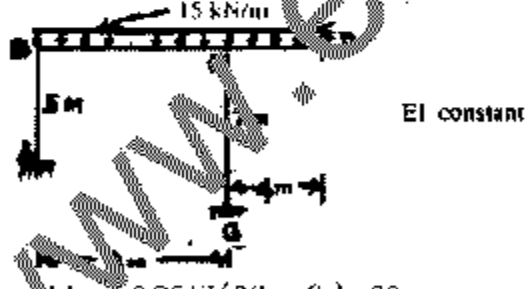
117. Which of the following statements regarding thin cylindrical shells are correct?

1. If the thickness of the wall of the shell is less than 1/10 to 1/15 of diameter of the shell, then it is treated as a thin shell.
2. It is assumed that the normal stress (tensile or compressive) is uniformly distributed through the thickness of the wall.
3. The intensity of longitudinal stress is one –half of the intensity of the hoop stress.

Select the correct answer using the codes given below:

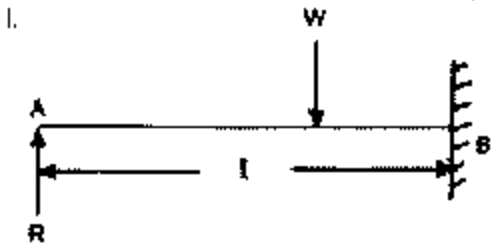
a. 1,2 and 3
b. 1 and 2
c. 2 and 3
d. 1 and 3

118. The slope deflection equation of the member BC of the frame shown in the figure is given by



a. $M_{BC} = 0.25EI(2\theta_B + \theta_C) - 80$
b. $M_{BC} = 0.5EI(\theta_B - 2\theta_C) - 80$
c. $M_{BC} = 0.25EI(\theta_B + 2\theta_C) - 40$
d. $M_{BC} = 0.25EI(2\theta_B + \theta_C) \quad 20$

119. The following steps are involved in determining the reaction 'R' of the beam shown in the figure, using moment distribution method.



1. Writing down the equation for BM at B and equating to M_{BA}.
2. Determining FEM at A and carrying one half of its negative value to the end B.
3. Adding the value obtained in 2 to FEM at B to get M_{BA}.

The correct sequence of these steps is

a. 2,3,1 not being relevant
b. 1,2,3
c. 2,3,1
d. 1,2,3 not being relevant

120. A simply supported beam with overhangs shown in Fig. I. The influence line diagram for shear in respect of a section just to the right of the support 'A' will be as in

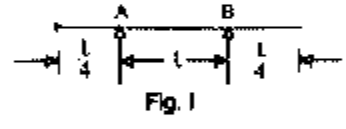


Fig. I