

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY
UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM
NOVEMBER, 2023

CIVIL ENGINEERING PAPER-I

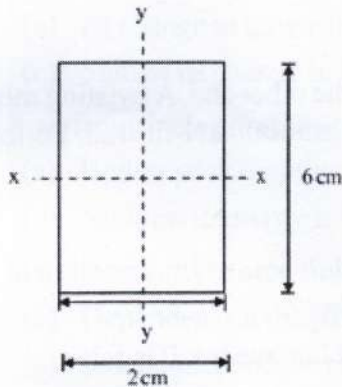
Time Allowed : 2 hours

Full Marks : 200

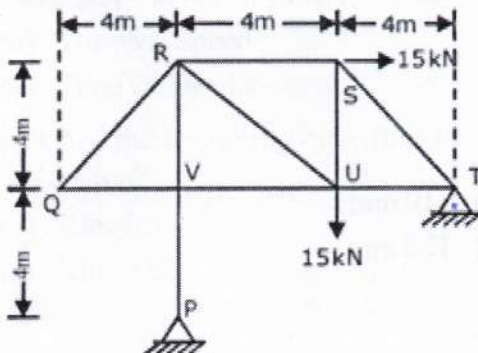
All questions carry equal mark of 2 each.

Attempt all questions.

1. Polar moment of inertia (I_p), in cm^4 , of a rectangular section having width, $b = 2 \text{ cm}$ and depth, $d = 6 \text{ cm}$ is _____

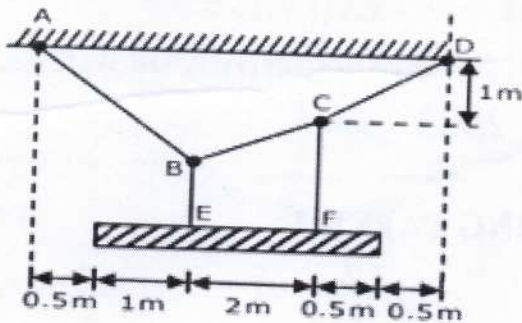


- (a) 40 cm^4 (b) 20 cm^4
(c) 10 cm^4 (d) 50 cm^4
2. Choose the correct statement about the kinetic friction and static friction.
- (a) Kinetic friction is lesser than the maximum static friction
(b) Kinetic friction is greater than maximum static friction
(c) Kinetic friction is equal to maximum static friction
(d) Kinetic friction is equal to contact force
3. A pin jointed 2-D truss is loaded with a horizontal force of 15 kN at joint S and another 15 kN vertical force at joint U as shown in figure. The force in member RS is _____

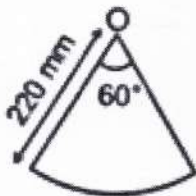


- (a) 10.25 kN (b) 13 kN
(c) 0 kN (d) 15 kN

4. A uniform beam weighing 1800 N is supported at E & F by cable ABCD. Determine the tension force in segment AB at this cable (correct to 1 decimal place). Assume the cable ABCD, BE and CF are weightless.



- (a) 1349.9 N
(b) 1579.9 N
(c) 1139.9 N
(d) 1272.9 N
5. The resultant of two concurrent forces is greatest when the angle between them is:
- (a) 0°
(b) 45°
(c) 90°
(d) 180°
6. A circular solid shaft of span $L = 5\text{m}$ is fixed at one end and free at the other end. A twisting moment $T = 100\text{ kN-m}$ is applied at the free end. The torsional rigidity Gj is $50000\text{ kN-m}^2/\text{rad}$. Following statements are made for this shaft.
- (I) The maximum rotation is 0.01 rad .
(II) The torsional strain energy is 1 kN-m
- With reference to the above statements, which of the following applies?
- (a) Both statements are true
(b) Statement I is true but II is false
(c) Statement II is true but I is false
(d) Both the statements are false
7. In dynamics, inertia is the property of a body to:
- (a) Stay at rest
(b) Stay in motion
(c) Resist change in its state of motion
(d) None of the above
8. The moment of total area of a plane lamina about its centroidal axis is equal to ____.
- (a) Zero
(b) twice the area of plane lamina
(c) area of plane lamina divided by its perimeter
(d) area of plane lamina
9. The lamina is shown in the following figure. The centroid of lamina from point O is:



- (a) 140 mm
(b) 110 mm
(c) 100 mm
(d) 120 mm

10. A curved member with a straight vertical leg is carrying a vertical load at Z, as shown in the figure. The stress resultant in the XY segment are



- (a) bending moment, shear force and axial force (b) bending moment and axial force
(c) bending moment and shear force (d) axial force
11. If P, Q and R are three points having coordinates (3,-2,1), (1,3,4), (2,1,-2) in XYZ space, then the distance from point P to plane OQR (O being the origin of the coordinate system) is given by
(a) 3 (b) 5
(c) 7 (d) 9
12. The work-energy principle states that work done on a system is equal to:
(a) Its change in kinetic energy (b) Its change in potential energy
(c) Sum of its change in kinetic and potential (d) None of the above
13. A perfectly inelastic collision is one in which:
(a) Bodies stick together after collision (b) Bodies bounce back after collision
(c) No kinetic energy is lost (d) All of the above
14. In a conservative force field, the work done on a particle moving between two points is:
(a) Dependent on the path (b) Zero
(c) Independent of the path (d) Negative
15. In kinetics, the principle of conservation of energy states that:
(a) Energy can neither be created nor destroyed (b) Kinetic energy is always conserved
(c) Potential energy is always conserved (d) All forms of energy are equivalent
16. If the displacement of an object is zero, its average velocity is:
(a) Zero (b) Constant
(c) Maximum (d) Minimum
17. A body moving with a constant speed in a circular path has:
(a) Constant velocity (b) Variable velocity
(c) Zero acceleration (d) Constant acceleration
18. Which graph gives the most information about the motion of an object?
(a) Time vs. Speed (b) Time vs. Acceleration
(c) Time vs. Displacement (d) Time vs. Velocity
19. Which of the following describes the motion of a body in terms of displacement, velocity, and acceleration?
(a) Kinetics (b) Statics
(c) Kinematics (d) Dynamics

20. A particle starts from rest and moves in a straight line whose equation of motion is given by $S = 2t^3 - t^2 - 1$. The acceleration of the particle after one second will be
(a) 4 m/s^2 (b) 6 m/s^2
(c) 8 m/s^2 (d) 10 m/s^2

21. The impact strength of a material is an index of its
(a) Toughness (b) Tensile strength
(c) Capability of being cold worked (d) Hardness

22. A body is subjected to a direct tensile stress (σ) in one plane. The shear stress is max at a section inclined at _____ to the normal of the section.
(a) 45° and 90° (b) 45° and 135°
(c) 60° and 150° (d) 30° and 135°

23. A shaft of diameter D is subjected to a twisted moment of T and Bending moment of M. If the maximum bending stress is equal to maximum shear stress developed. Then M is equal to
(a) $\left(\frac{T}{2}\right)$ (b) T
(c) 2T (d) 4T

24. Read the following statements and identify the correct combination of statements.

Statement A: A cantilever beam of constant depth carries a uniformly distributed load on the whole span. To make the maximum stress at all sections the same, the breadth of the section at a distance x from the free end should be proportional to $x^{0.5}$.

Statement B: The deflection of the conical bar due to self-weight is equal to $\frac{1}{6}$ deflection of a prismatic bar of the same length.

Statement C: Maximum strain energy theorem is applied to brittle material.

Statement D: When a thin cylindrical vessel is subjected to uniform pressure acting inside of it the hoop stress is twice the longitudinal stress.

- (a) (A) – False, (B)– False, (C) – False, (D)– True
- (b) (A) – True, (B)– False, (C) – False, (D)– True
- (c) (A) – False, (B)– True, (C) – True, (D)– False
- (d) (A) – True, (B)– True, (C) – True, (D)– False

25. Read the following statements and identify the correct answer.

Statement A: If a composite bar of steel and copper is heated, the copper bar will be subjected to compression.

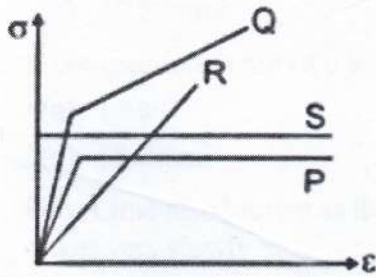
Statement B: If the Poisson's ratio is 0.333, then the ratio of bulk modulus to shear modulus is 2.66.

- (a) Both statements are correct. (b) Both statements are incorrect.
- (c) Statement A is correct but B is incorrect. (d) Statement A is incorrect but B is correct.

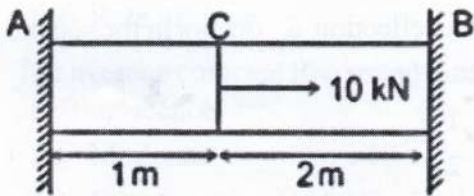
26. A tensile test is performed on a round bar. After fracture, it has been found that the diameter remains approximately same at fracture. The material under test was

- (a) Mild Steel (b) Cast iron
- (c) Copper (d) Aluminium

27. The room temperature stress (σ) – strain (ϵ) curves of four materials P, Q, R and S are shown in the figure below. The material that behaves as a rigid perfectly plastic material is

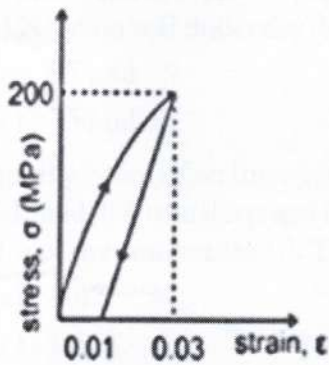


- (a) P (b) Q
(c) R (d) S
28. If a part is constrained to move and heated, it will develop
(a) Principal stress (b) Tensile stress
(c) Compressive stress (d) Shear stress
29. The reactions at the rigid supports at A and B for the bar loaded as shown in the figure are respectively:

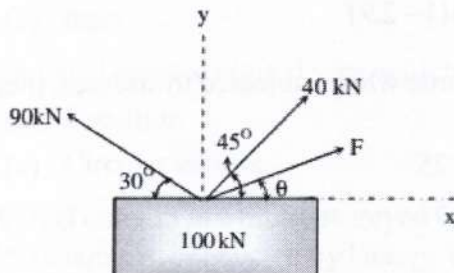


- (a) $20/3$ kN, $10/3$ kN (b) $10/3$ kN, $20/3$ kN
(c) 5 kN, 5 kN (d) None of these
30. Maximum energy that a given component can absorb without undergoing any permanent deformation upto elastic limit is known as:
(a) Proof Resilience (b) Resilience
(c) Hardness (d) Toughness
31. A steel cube, with all faces free to deform, has Young's modulus, E , Poisson's ratio, ν and coefficient of thermal expansion, α . The pressure (hydrostatic stress) developed within the cube, when it is subjected to a uniform increase in temperature, ΔT , is given by
(a) 0 (b) $\frac{\alpha(\Delta T)E}{1-2\nu}$
(c) $\frac{-\alpha(\Delta T)E}{1-2\nu}$ (d) $\frac{\alpha(\Delta T)E}{3(1-2\nu)}$
32. If a piece of material neither expands nor contracts in volume when subjected to stresses, then the Poisson's ratio must be
(a) Zero (b) 0.25
(c) 0.33 (d) 0.5

33. The loading and unloading response of a metal is shown in the figure. The elastic and plastic strains corresponding to 200 MPa stress, respectively are



- (a) 0.02 and 0.01
 (b) 0.02 and 0.02
 (c) 0.01 and 0.01
 (d) 0.01 and 0.02
34. Engineering strain of a mild steel sample is recorded as 0.100%. The true strain is
 (a) 0.010%
 (b) 0.055%
 (c) 0.099%
 (d) 0.101%
35. A rigid body is very slowly dropped on another body and a deflection δ_{st} occurs in the second body. If the rigid body be placed suddenly, the value of the impact factor will be:
 (a) 0
 (b) 1
 (c) ∞
 (d) 2
36. A cantilever beam of span L is subjected to a downward load of 800 kN uniformly distributed over its length and a concentrated upward load P , at its free end. For vertical displacement to be zero at the free end, the value of P is
 (a) 800 kN
 (b) 500 kN
 (c) 300 kN
 (d) 1000 kN
37. _____ promotes hardness, toughness, and corrosion resistance in steel.
 (a) Manganese
 (b) Molybdenum
 (c) Tungsten
 (d) Chromium
38. The property of metal by which it can be drawn into wires under tensile stress is called _____
 (a) malleability
 (b) ductility
 (c) tensile strength
 (d) viscosity
39. Which one of the following materials is highly elastic?
 (a) Rubber
 (b) Brass
 (c) Steel
 (d) Glass
40. A box of weight 100 kN shown in the figure is to be lifted without swinging. If all forces are coplanar, the magnitude and direction (θ) of the force (F) with respect to x-axis should be

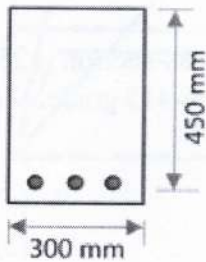


- (a) $F = 56.389 \text{ kN}$ and $\theta = 28.28^\circ$
 (b) $F = -56.389 \text{ kN}$ and $\theta = -28.28^\circ$
 (c) $F = 9.055 \text{ kN}$ and $\theta = 1.414^\circ$
 (d) $F = -9.055 \text{ kN}$ and $\theta = -1.414^\circ$

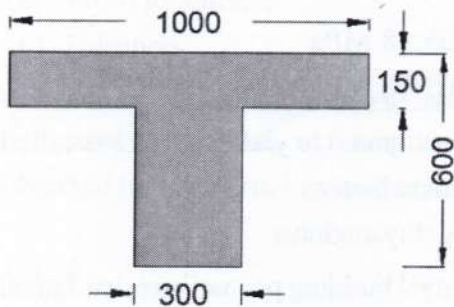
41. The minimum crushing strength for first class bricks is
(a) 10 N/mm² (b) 20 N/mm²
(c) 30 N/mm² (d) 40 N/mm²
42. A compaction factor of 0.95 represents flowing concrete having _____ workability
(a) Low (b) High
(c) Medium (d) Poor
43. Poor Lime also known as the impure or lean lime contains more than _____ of clay and it slakes very slowly
(a) 10% (b) 20%
(c) 30% (d) 40%
44. The compressive strength of 33 grade OPC at 3 days, 7 days and 28 days is
(a) 16 Mpa, 29Mpa and 33Mpa (b) 16 Mpa, 22Mpa and 38Mpa
(c) 16 Mpa, 22Mpa and 33Mpa (d) 11 Mpa, 22Mpa and 33Mpa
45. Attrition test on stone is done to find out
(a) Compressive strength (b) Hardness
(c) Rate of wear (d) Toughness
46. The average compressive strength of burnt clay brick is less than 12.5 N/mm². The allowable rating of efflorescence is
(a) Moderate (b) Serious
(c) Heavy (d) Zero
47. The moisture content achieved after drying of timber is
(a) 5% (b) 10%
(c) 15% (d) 20%
48. The main constituent of varnish is
(a) Turpentine oil (b) Petrol
(c) Resin (d) Solvent
49. The specific gravity of plastic generally lies between
(a) 0.1 to 0.5 (b) 0.5 to 1.0
(c) 1.0 to 1.3 (d) 1.3 to 1.4
50. The strength of the timber is maximum
(a) Parallel to the grain (b) Perpendicular to the grain
(c) 45° to the grain (d) Same in all direction
51. A joint in the masonry parallel to the face of the wall is known as
(a) Bonded joint (b) Wall joint
(c) Cross joint (d) Bed joint
52. In a flat roofed building, the roof is made water proof by coating hot bitumen and this coating is done at the rate of
(a) 1.00 kg/m² (b) 1.67 kg/m²
(c) 1.71 kg/m² (d) 2.5 kg/m²
53. The angular steps used for changing direction of stair are called
(a) Angular steps (b) Radial steps
(c) Winders (d) Spandrils

54. The roughening of solid background to provide suitable key for plastering is called
- (a) Preparing
 - (b) Facing
 - (c) Grounding
 - (d) Hacking
55. The vertical member used in a door frame is called
- (a) Post
 - (b) Sill
 - (c) Hanging style
 - (d) Rail slide
56. The maximum size of aggregate used in the damp proof course is about
- (a) 6 mm
 - (b) 10 mm
 - (c) 15 mm
 - (d) 20 mm
57. The corner or the external angle on the face side of a wall is known as
- (a) Bevelled edge
 - (b) Edge
 - (c) Corner
 - (d) Quoin
58. When percentage of mica present in sand is large, it
- (a) Reduces the strength of mortar or concrete
 - (b) Increases the strength of mortar or concrete
 - (c) Has no effect on mortar or concrete strength
 - (d) Enhances the strength of mortar or concrete but only marginally
59. In air-conditioned building the glass recommend for use is
- (a) Plate glass
 - (b) Wired glass
 - (c) Sheet glass
 - (d) Foam glass
60. LEED gives rating in form
- (a) 1 star, 2 star, 3 star, 4 star, 5 star
 - (b) Platinum, Gold, Silver
 - (c) Both (a) and (b)
 - (d) None
61. The modulus of rupture of concrete gives
- (a) the direct tensile strength of the concrete
 - (b) the direct compressive strength of the concrete
 - (c) the tensile strength of the concrete under bending
 - (d) the characteristic strength of the concrete
62. The span to depth ratio limit is specified in IS 456:1978 for the reinforced concrete beam, in order to ensure that the
- (a) tensile crack width is below a limit
 - (b) shear failure is avoided
 - (c) stress in the tension reinforcement is less than the allowable value
 - (d) deflection of the beam is below a limiting value
63. The target mean strength f_{cm} for concrete mix design obtained from the characteristic strength f_{ck} and standard deviation σ , as defined in IS 456:200, is
- (a) $f_{ck} + 1.65 \sigma$
 - (b) $f_{ck} + 1.45 \sigma$
 - (c) $f_{ck} + 1.55 \sigma$
 - (d) $f_{ck} + 1.35 \sigma$

64. The singly reinforced concrete beam section shown in the figure (not drawn to the scale) is made of M25 grade concrete and Fe500 grade reinforcing steel. The total cross-sectional area of the tension steel is 942 mm^2 . As per Limit State design of IS 456: 2000, the design moment capacity (in kN-m round off to two decimal places) of the beam section

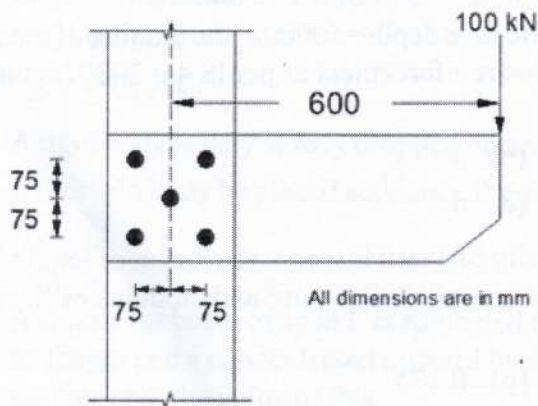


- (a) 100.36 kN-m
(b) 158.28 kN-m
(c) 400.17 kN-m
(d) 263.32 kN-m
65. For a beam of cross-section, width = 230 mm and effective depth = 500 mm, the number of rebars of 12 mm diameter required to satisfy minimum tension reinforcement as per IS 45: 2000 (assuming grade of steel reinforcement as Fe500) is
- (a) 2
(b) 3
(c) 1
(d) 4
66. The percentage loss of prestress due to anchorage slip of 3 mm in a concrete beam of length 30 m which is post-tensioned by a tendon with an initial stress of 1200 N/mm^2 and modulus of elasticity equals to $2.1 \times 10^5 \text{ N/mm}^2$ is
- (a) 0.0175
(b) 0.175
(c) 1.75
(d) 17.5
67. An isolated T-beam is used as a walkway. The beam is simply supported with an effective span of 6 m. The effective width of flange, for the cross-section shown in figure is



- (a) 1000 mm
(b) 900 mm
(c) 1259 mm
(d) 2200 mm
68. A rectangular column section of 250 mm x 400 mm is reinforced with five steel bars of grade Fe-500, each of 20 mm diameter. Concrete mix is M30. Axial load on the column section with minimum eccentricity as per IS 456-2000 using limit state method can be applied upto
- (a) 1903.7 kN
(b) 1805.30 kN
(c) 1806.4 kN
(d) 1707.37 kN

69. A concrete column carries an axial load of 450 kN and a bending moment of 60 kN-m at its base. An isolated footing of size 2 m x 3 m side along the plane of bending moment, is provided under the column. Centres of gravity of column and footing coincide. The net maximum and the minimum pressures in kN/m^2 on soil under the footing are respectively
- (a) 95 and 75 (b) 95 and 55
(c) 75 and 55 (d) 100 and 80
70. Top ring beam of an Intze tank carries a hoop tension of 120 kN. The beam cross-section is 250 mm wide and 400 mm deep and it is reinforced with 4 bars of 20 mm diameter of Fe-415 grade. Modular ratio of the concrete is 10. The tensile stress in N/mm^2 in the concrete is
- (a) 1.07 (b) 1.02
(c) 1.32 (d) 1.20
71. A bracket plate connected to a column flange transmits a load of 100 kN as shown in the following figure. The maximum force for which the bolts should be designed is

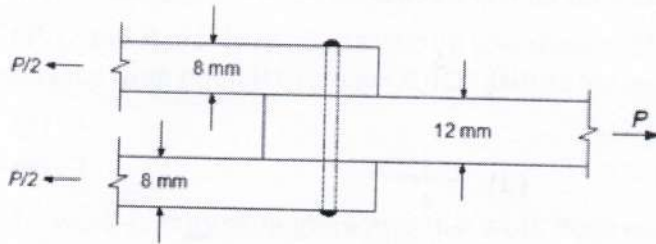


- (a) 101.3 kN (b) 250.0 kN
(c) 214.5 kN (d) 156.2 kN
72. In a fillet weld, the direct shear stress and bending tensile stress are 50 MPa and 150 MPa, respectively. As per IS 800:2007, the equivalent stress will be
- (a) 173.21 MPa (b) 105.98 MPa
(c) 154.32 MPa (d) 203.78 MPa
73. In the theory of plastic bending of beams, the ratio of plastic moment to yield moment is called
- (a) plastic section modulus (b) shape factor
(c) modulus of resilience (d) rigidity modulus
74. Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to the ridge?
- (a) bracings (b) purlins
(c) truss (d) columns
75. For equal cross-sectional area, which of the following section is most efficient for a column is
- (a) I-section (b) Channel section
(c) Circular section (d) Hollow circular section
76. A steel column in a multi-storeyed building carries an axial load of 125 kN. It is built up of 2 ISMC 350 channels, connected by lacing. The lacing carries a load of
- (a) 125 kN (b) 12.5 kN
(c) 3.125 kN (d) 31.25 kN

77. The plastic section modulus for a rectangular section of width b and depth d is

- (a) $\frac{bd^3}{3}$ (b) $\frac{bd^2}{6}$
(c) $\frac{bd^2}{4}$ (d) $\frac{bd^2}{12}$

78. A 12 mm thick plate is connected to two 8 mm thick plates, on either side through a 16 mm diameter power driven field rivet as shown in the figure below. Assuming permissible shear stress as 90 MPa and permissible bearing stress as 270 MPa in the rivet, the rivet value of the joint is



- (a) 56.70 kN (b) 21.65 kN
(c) 36.19 kN (d) 43.29 kN

79. A strut in a steel truss is composed of two equal angles ISA 150 mm x 150 mm of thickness 10 mm connected back-to-back to the same side of a gusset plate. The cross-sectional area of each angle is 2921 mm² and moment of inertia ($I_{xx} = I_{yy}$) is 6335000 mm⁴. The distance of the centroid of the angle from its surface ($C_{xx} = C_{yy}$) is 40.8 mm. The minimum radius of gyration of the strut is

- (a) 46.6 mm (b) 62.7 mm
(c) 93.2 mm (d) 29.8 mm

80. The critical bending compressive stress in the extreme fibre of a structural steel section is 1000 MPa. It is given that yield strength of the steel is 250 MPa, width of flange is 250 mm and thickness of flange is 15 mm. As per the provisions of IS: 800-2007, the non-dimensional slenderness ratio of the steel cross-section is

- (a) 0.25 (b) 0.50
(c) 0.75 (d) 2.00

81. The moment area theorems in the structural analysis fall in the category of

- (a) Force method (b) Displacement method
(c) Stiffness method (d) Iterative method

82. The Muller-Breslau principle in structural analysis is used for

- (a) Drawing influence line diagram for any force function
(b) Superimposition of load effects
(c) Writing virtual work equation
(d) None of the above

83. When a load is applied to a structure with rigid joints

- (a) There is no rotation or displacement of joint
(b) There is no rotation of joint
(c) There is no displacement of joint
(d) There can be rotation and displacement of joint but the angle between the members connected to the joint remains same even after application of load

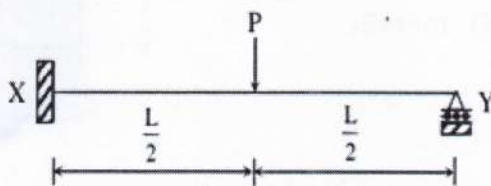
84. A statically indeterminate structure is the one which
- (a) cannot be analysed at all
 - (b) can be analysed using equations of statics only
 - (c) can be analysed using equations of statics and compatibility equations
 - (d) can be analysed using equations of compatibility only
85. In moment distribution method the sum of distribution factors of all the members meeting at any joint is always
- (a) zero
 - (b) <1
 - (c) >1
 - (d) $=1$
86. The carry over factor for prismatic members with far end fixed is
- (a) $-\frac{1}{2}$
 - (b) $\frac{1}{2}$
 - (c) $\frac{1}{4}$
 - (d) $-\frac{1}{4}$
87. Bending moment at any section in a conjugate beam gives in the actual beam
- (a) Slope
 - (b) Curvature
 - (c) Deflection
 - (d) None of the above
88. If M is the external moment which rotates the near end of a prismatic beam without translation, the far end being fixed, then the moment induced at the far end is
- (a) Zero
 - (b) $M/2$ in the same direction as M
 - (c) $M/2$ in the opposite direction as M
 - (d) None of the above
89. The moment distribution method in structural analysis can be treated as
- (a) Force method
 - (b) Displacement method
 - (c) Flexibility method
 - (d) None of the above
90. If the free end of a cantilever of span L and flexure rigidity EI undergoes a unit displacement (without rotation), what is the bending moment induced at the fixed end?
- (a) $\frac{3EI}{L^2}$
 - (b) $\frac{4EI}{L^2}$
 - (c) $\frac{5EI}{L^2}$
 - (d) $\frac{6EI}{L^2}$
91. What is the area of influence line diagram for the reaction at the hinged end of a uniform propped cantilever beam of span L ?
- (a) $\frac{L}{8}$
 - (b) $\frac{L}{2}$
 - (c) $\frac{L}{4}$
 - (d) $\frac{3L}{8}$
92. The number of simultaneous equations to be solved in the slope deflection method is equal to
- (a) The degree of statical indeterminacy
 - (b) The degree of kinematics indeterminacy
 - (c) The number of joints in the structure
 - (d) None of the above

93. The following methods are used for structural analysis:

- i. Macaulay method
- ii. Column analogy method
- iii. Kani's method
- iv. Method of sections

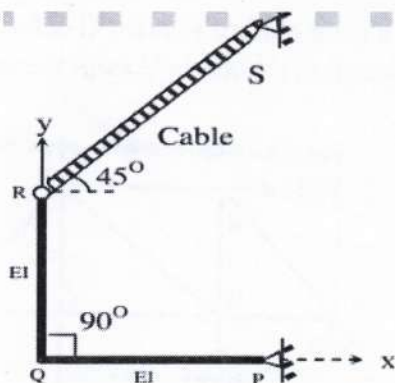
Those used for indeterminate structural analysis would include.

- (a) I and II
 - (b) I and III
 - (c) II and III
 - (d) II, III and IV
94. A load 'W' is moving from left to right support on a simple supported beam of span 'L'. The maximum bending moment at 0.4L from the left support is
- (a) 0.16 WL
 - (b) 0.20WL
 - (c) 0.24 WL
 - (d) 0.25 WL
95. A cantilever beam AB, fixed at A and carrying a load W at the free end B, is found to deflect by δ at the mid-point of AB. The deflection of B due to load W/2 at the mid-point will be
- (a) 2δ
 - (b) δ
 - (c) $\frac{\delta}{2}$
 - (d) $\frac{\delta}{4}$
96. The ultimate collapse load (P) in terms of plastic moment M_p by kinematic approach for a propped cantilever of length L with P acting at its mid-span as shown in the figure, would be



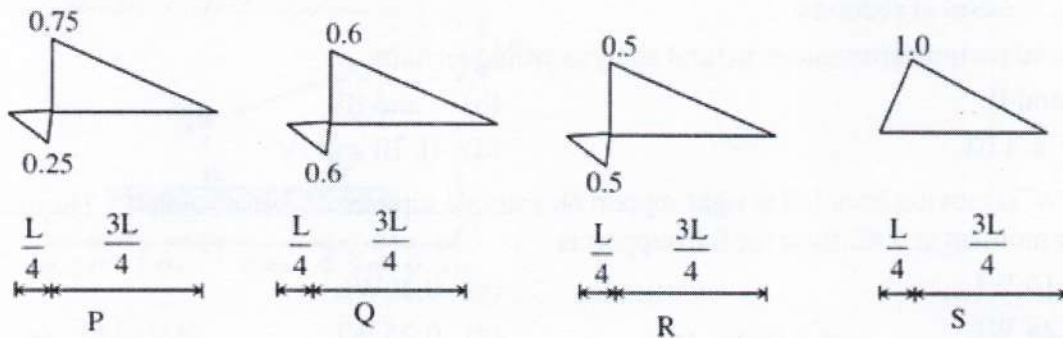
- (a) $P = \frac{2M_p}{L}$
- (b) $P = \frac{4M_p}{L}$
- (c) $P = \frac{6M_p}{L}$
- (d) $P = \frac{8M_p}{L}$

97. The degree of static indeterminacy of a rigid jointed frame PQR supported as shown in the figure is



- (a) Zero
- (b) One
- (c) Two
- (d) Unstable

98. In a beam of length L , four possible influence line diagrams for shear force at a section located at a distance $\frac{L}{4}$ from the left end support (marked as P, Q, R and S) are shown below. The correct influence line diagram is



- (a) P (b) Q
(c) R (d) S

99. What advantage is obtained, if the load is applied through shear centre in a beam cross – section?

- (a) There is no shear in the beam (b) There is no axial force in the beam
(c) There is no twisting moment in the beam (d) There is no bending moment in the beam

100. If there are m unknown member forces, r unknown reaction components and j number of joints, then the degree of static indeterminacy of a pin-jointed plane frame is given by:

- (a) $m+r-3j$ (b) $m-r+2j$
(c) $m+r-2j$ (d) $m+r+2j$
