

1. A steel member 'M' has reversal of stress due to live loads, whereas another member 'N' has reversal of stress due to wind load. As per IS 800 : 2007, the maximum slenderness ratio permitted is

- (A) less for member 'M' than that of member 'N'
- (B) more for member 'M' than for member 'N'
- (C) same for both the members
- (D) not specified in the code

4. Minimum number of vertical bars in a circular column is

- (A) 6
- (B) 4
- (C) 5
- (D) 8

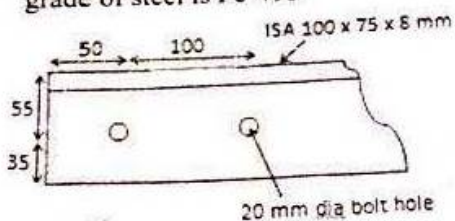
5. Minimum percentage of longitudinal reinforcement in RCC column is

- (A) 1.2
- (B) 0.6
- (C) 0.8
- (D) 1.0

6. A T-Beam behaves as a rectangular beam of width equal to its flange if its neutral axis is

- (A) coincides with centroid of reinforcement
- (B) coincides with centroid of T-section
- (C) remains within the flange
- (D) remains in the web

2. Determine block shear strength of tension member shown in figure if grade of steel is Fe-410



- (A) 309.06 kN
- (B) 216.49 kN
- (C) 258.49 kN
- (D) 326.54 kN

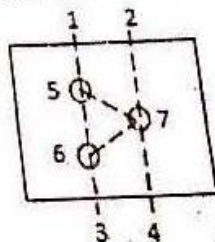
$$\frac{250}{53 \times 111} \times 15 \times 20$$

$$+ \frac{410}{1.25} \times (90 - 2 \times 20) = 111$$

3. As per IS 800 : 2007, the cross-section in which the extreme fiber can reach the yield stress, but cannot develop the plastic moment of resistance due to failure by local buckling is classified as

- (A) Plastic section
- (B) Compact section
- (C) Semi-compact section
- (D) Slender section

7. Which section to be considered in the design for the net area of flat ?



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

$$(b - n) + \frac{n^2}{4s}$$

$$s - 2d + 2r$$

$$b - 2d$$

8. The probability of failure implied in the limit state design is of the order of

- (A) 10^{-3}
- (B) 10^{-2}
- ~~(C) 10^{-5}~~
- (D) 10^{-7}

9. Gantt charts indicate

- (A) Comparison of actual progress with the scheduled progress
- ~~(B) Balance of work to be done~~
- (C) Progress cost of the project
- (D) Inventory cost

10. A serious limitation of interdependencies between various activities is generally observed in

- (A) Milestones chart
- (B) Bar charts
- (C) Job layouts
- ~~(D) Network analysis~~

11. In limit state design, the limiting depth of neutral axis for Fe-500 for beam having effective depth "d" is

- (A) $0.43d$
- (B) $0.48d$
- ~~(C) $0.46d$~~
- (D) $0.53d$

12. In PERT analysis, the time estimates of activities correspond to

- (A) Binomial distribution
- ~~(B) β distribution~~
- (C) Poisson's distribution
- (D) Normal distribution

13. Consider the following statements :

1. Fluids of low viscosity are all irrational.
2. Rotation of the fluid is always associated with shear stress.

Which of these statements is/are correct ?

- ~~(A) 1 only~~
- (B) 2 only
- (C) Both 1 and 2
- (D) Neither 1 nor 2

14. The optimistic, most likely and pessimistic estimates of time for an activity are 4 days, 11 days and 12 days respectively. The expected completion time of this activity is

- ~~(A) 10 days~~ $\frac{4 + 4 \times 11 + 12}{6}$
- (B) 11 days
- (C) 9 days
- (D) 5 days

15. A discharge of 1 cumec is flowing in a rectangular channel one metre wide at a depth of 20 cm. The bed slope of channel is

- (A) mild
- (B) critical
- (C) steep
- (D) adverse

$$y_c = \left(\frac{1}{9.81}\right)^{1/3} \left(\frac{1}{10}\right)^{2/3}$$

$$y_n = 0.2 \text{ m}$$

$\frac{10}{2.3} = 4.35$
 $\frac{6.87}{1.5} = 4.58$
 $\frac{15.625}{3.4} = 4.59$

16. If the pump head is 75 m, discharge is 0.464 m³/s and the motor speed is 1440 rpm at rated condition, the specific speed of the pump is about

- (A) 4
- (B) 26
- (C) 38
- (D) 1440

$$N_s = \frac{1440 \times \sqrt{0.464}}{75^{3/4}}$$

$$= \frac{1440 \times 0.68}{75^{3/4}}$$

$$= \frac{979.2}{45.5} = 21.5$$

17. Water flows through a 100 mm diameter pipe with a velocity of 0.015 m/sec. If the kinematic viscosity of water is $1.13 \times 10^{-6} \text{ m}^2/\text{sec}$, the friction factor of the pipe material is

- (A) 0.0015
- (B) 0.032
- (C) 0.037
- (D) 0.048

$$f = \frac{16 \mu}{\rho v D}$$

$$= \frac{16 \times 1.13 \times 10^{-6}}{1000 \times 0.015 \times 0.1}$$

$$= \frac{1.808 \times 10^{-5}}{1.5} = 1.2 \times 10^{-5}$$

18. The function of an air vessel in a reciprocating pump is to obtain

- (A) reduction of suction head
- (B) rise in delivery head
- (C) continuous supply of water at uniform rate
- (D) increase in supply of water

19. The performance of a well is measured by its

- (A) specific capacity
- (B) specific yield
- (C) storage co-efficient
- (D) permeability co-efficient

20. If a water tank, partially filled with water is being carried on a truck, moving with a constant horizontal acceleration, the level of water in the tank;

- (A) rise and fall alternately on the front side of the tank
- (B) fall on rear side of the tank
- (C) remain the same on both sides of the tank
- (D) rise on the rear side and fall on the front side of the tank

21. S-hydrograph is used to obtain unit hydrograph of

- (A) shorter duration from longer duration
- (B) longer duration from shorter duration

(C) Both (A) and (B)

(D) None of these

Suppose to be on 6 m

22. A hydraulic jump in a control metre will be formed above the control, if its original

(A) depth is more than critical depth

(B) depth is less than the critical depth

(C) depth is equal to critical depth

(D) None of these

Subsonic to supersonic

$$Fr = \frac{V}{\sqrt{gD}}$$
$$Fr < 1$$

23. The unit hydrograph theory is based on the assumption of

(A) non-linear response and time invariance

(B) linear response and non-linear time variance

(C) time invariance and linear response

(D) non-linear response and non-linear time variance

24. The probability of a flood occur at least once in the next 4 years

(A) 25%

(B) 35%

(C) 50%

(D) 65%

$$1 - \frac{1}{10}$$
$$1 - \frac{1}{10}$$
$$1 - \left(\frac{9}{10}\right)^4$$
$$1 - \frac{6561}{10000}$$
$$1 - 0.6561$$
$$0.3439$$

25. Consumptive use of a crop during growth, is the amount of

(A) Interception

(B) Transpiration

(C) Evaporation

(D) All of these

$$\left(\frac{1-1}{10}\right)^4$$
$$1 - \frac{6561}{10000}$$
$$1 - 0.6561$$
$$0.3439$$

26. The prism storage in a river reach during the passage of a flood wave is

(A) A constant

(B) A function of inflow and outflow

(C) Function of inflow only

(D) Function of outflow only

27. Pick up the correct statement from the following :

(A) Perched aquifer is found in an unconfined aquifer.

(B) The top surface of the water held in the perched aquifer is known as perched water table.

(C) Perched aquifer is formed in the unconfined aquifer if an impervious layer exists.

(D) All of these

28. Standard EDTA solution is used to determine the
- (A) turbidity in water
 - (B) dissolved oxygen in water
 - (C) residual chlorine in water
 - (D) hardness in water
29. Flocculating agent is added to the raw water in the treatment plant to remove the
- (A) floating particles
 - (B) dissolved chemicals
 - (C) fine suspended particles
 - (D) heavy metals
30. The terminal velocity of a settling particle in water medium is calculated using the equation given by
- (A) Darcy
 - (B) Stokes
 - (C) Newton
 - (D) Hoffman
31. Flowing artesian wells are expected in areas where
- (A) the water table is very close to the land surface
 - (B) the aquifer is confined
 - (C) the elevation of the piezometric head line is above the elevation of the ground surface
 - (D) the rainfall is intense

32. The filter material used in contact bed is
- (A) Sand
 - (B) Stone ballast
 - (C) Gravel
 - (D) Fine sand
33. In which pollution zone of the river, the dissolved oxygen reduced to zero?
- (A) Zone of degradation
 - (B) Zone of recovery
 - (C) Zone of clean water
 - (D) Zone of active decomposition
34. Which bacteria results in the corrosion of iron and steel pipes embedded in soil?
- (A) Escherichia coli bacteria
 - (B) Bacterium coli bacteria
 - (C) Iron bacteria
 - (D) Sulphur bacteria
35. The type of valve, which is provided on the suction pipe in the tube-well, is
- (A) air relief valve
 - (B) reflux valve
 - (C) pressure relief valve
 - (D) None of these

36. The maximum BOD removal efficiency of an oxidation pond is

- (A) 90%
- (B) 95%
- (C) 70%
- (D) 80%

37. Which one of the following parameter is not included in the routine characterization of solid waste for its physical composition?

- (A) Moisture content
- (B) Density
- (C) Particle size analysis
- (D) Energy value

38. Consider the following air pollutants :

- | | |
|------------------|--------|
| 1. NO_x | 2. PAN |
| 3. CO_2 | 4. CO |

Which of the above air pollutants is/are present in an auto exhaust gas?

- (A) 1 only
- (B) 1 and 2
- (C) 2 and 3
- (D) 1, 3 and 4

39. The decomposition of sewage takes place, causing a pungent smell. Which of the following causes the pungent smell?

- (A) CO_2
- (B) H_2SO_4
- (C) HCL
- (D) H_2S

40. In urban air pollution, the most poisonous gas is supposed to be carbon monoxide. It is hazardous because it

- (A) affects our sense of smell
- (B) is carcinogenic in nature
- (C) combines with haemoglobin
- (D) causes blindness

41. In the bearing capacity computation the water table effect may be ignored when the water table lies

- (A) at the ground surface
- (B) at the base of the footing
- (C) within the wedge zone
- (D) below the wedge zone

42. What is the critical depth of vertical cut in a saturated cohesive soil with $c = 15.5 \text{ kN/m}^2$ and $\gamma = 18 \text{ kN/m}^3$?

- (A) 0.86 m
- (B) 3.44 m
- (C) 6.88 m
- (D) 1.72 m

65

$$\frac{1.472 - 2c}{\gamma} = 1.7$$
$$\frac{1.472 - 2 \times 15.5}{18} = 1.7$$
$$\frac{1.472 - 31}{18} = 1.7$$
$$\frac{-29.528}{18} = 1.7$$
$$-1.64 = 1.7$$

3.4

43. Which of the following methods of solid waste management conserves energy most efficiently in the form of gas or oil?

- (A) Incineration with heat recovery
- (B) Combusting
- (C) Fluidized-bed incineration
- (D) Pyrolysis

a_{sa} $a_g - yD$

1. The ultimate bearing capacity of a soil is 310 kN/m^2 , the depth of foundation is 0.80 m and γ is 20 kN/m^3 . If the F.O.S. is 3, what will be the net safe bearing pressure?

- (A) 98.0 kN/m^2 $q_{ns} = \frac{q_u}{FOS} - yD$
- (B) 98.86 kN/m^2 $310 = \frac{q_{ns}}{3} + 20 \times 0.8$
- (C) 100.98 kN/m^2
- (D) 100.86 kN/m^2 $310 - 16 = \frac{20 \times 0.8 \times 3}{0.82}$

45. In a saturated soil deposit having a density of 22 kN/m^3 , the effective normal stress on a horizontal at 5.0 m depth, will be

- (A) 22 kN/m^2 $22 \times 5 = 110 - 5 \times 10 = 60$
- (B) 60 kN/m^2 $110 - 50 = 60$
- (C) 50 kN/m^2 $31 \times \frac{-10}{5} = -62$
- (D) 110 kN/m^2 $q_s = yD$ $q_{ns} = \frac{q_u - yD}{FOS}$

46. In an earth dam critical condition for which the stability has to be checked during construction with or without partial pool is/are

- (A) downstream slope $N = \frac{H}{H(K-1)}$
- (B) upstream slope
- (C) Both U/S & D/S slope
- (D) None

47. Piping in soils occur when

- (A) the effective stress becomes zero
- (B) sudden change of permeability takes place
- (C) the soil is fissured and cracked
- (D) the soil is highly porous

48. Factor of safety with respect to cohesion gives the same concept as that of factor of safety w.r.t.;

- (A) height
- (B) average shear strength
- (C) friction
- (D) None

49. The co-efficient of permeability of a soil is $5 \times 10^{-5} \text{ cm/sec}$ for a certain pore fluid. If the viscosity of the pore fluid is reduced to half, the co-efficient of permeability will be

- (A) $5 \times 10^{-5} \text{ cm/sec}$ $k = \frac{\gamma}{\mu}$
- (B) $10 \times 10^{-5} \text{ cm/sec}$ $\frac{\mu_1}{\mu_2} = \frac{K_2}{K_1}$
- (C) $2.50 \times 10^{-5} \text{ cm/sec}$ $\frac{\mu_1}{\mu_2} = \frac{K_2}{K_1}$
- (D) $1.25 \times 10^{-5} \text{ cm/sec}$

50. Theory of errors and adjustments deals with minimizing the effects of

- (A) instrumental errors
- (B) mistakes
- (C) systematic errors
- (D) personal and accidental errors

51. An invar tape is made up of an alloy of

- (A) Copper and Steel
- (B) Brass and Nickel
- (C) Brass and Steel
- (D) Nickel and Steel

52. Which one of the following is carried out by two theodolite method?

- (A) Circular curve setting
- (B) Techeometric survey
- (C) Geodetic survey
- (D) Astronomical survey

53. A fully saturated clay specimen in a consolidometer was subjected to a loading of 200 kN/m^2 . After a period of time it was found that the average pore pressure in the specimen was 70 kN/m^2 . The percentage of consolidation reached by then was

- (A) 70%
- (B) 65%
- (C) 35%
- (D) 29%

$$\frac{200 - 70}{200} \times 100 = \frac{130}{200} \times 100 = 65\%$$

$$\frac{130}{200} \times 100 = 65\%$$

25

54. For a circular curve of radius 200 m, the co-efficient of lateral friction is 0.15 and the design speed is 40 kmph, the equilibrium super elevation (for equal pressures on inner and outer wheels) would be

- (A) 21.3
- (B) 7
- (C) 6.3
- (D) 4.6

$$\frac{800}{127 \times 2.24} = 2.75$$

55. A summit curve is formed at the intersection of 3% up gradient and 5% down gradient. To provide a stopping distance of 128 m, the length of summit curve needed will be

- (A) 271 m
- (B) 298 m
- (C) 322 m
- (D) 340 m

$$\frac{128 \times 128}{2.4 \times 12} = 548.44$$

$$\frac{60 \times 60 \times 2}{2.75} = 2618.18$$

$$\frac{2.3}{10.0} = 0.23$$

56. The process of determining the location of the station (on the map) occupied by the plane table is called as

- (A) intersection
- (B) three-point-problem
- (C) traversing
- (D) resection

$$\frac{12}{3} = 4$$

64. The disease of dry rot in timber is caused by
- (A) Lack of proper ventilation
 - (B) Alternate wet and dry conditions
 - (C) Complete submergence under water
 - (D) None of these
65. What is the ratio of the elastic modulus of structural timber in longitudinal direction to that in the transverse direction?
- (A) 0.5 to 1
 - (B) 0.1 to 0.2
 - (C) 1 to 2
 - (D) 5 to 10
66. What treatment is adopted for making timber fire resistant?
- (A) Abel's process
 - (B) ASCU treatment
 - (C) Tarring
 - (D) None
67. According to the relevant IS code, the weight of timber is to be reckoned at a moisture content of
- (A) 12%
 - (B) 2%
 - (C) 5%
 - (D) 8%

68. The 'frog' of the brick in a brick masonry is kept on
- (A) bottom face
 - (B) top face
 - (C) outer side of the wall
 - (D) inner side of the wall
69. A king closure is a
- (A) Full brick
 - (B) Three fourth brick
 - (C) Crosswise half brick
 - (D) Longitudinally half brick
70. For one cubic meter of brick masonry, the number of modular bricks needed is
- (A) 500
 - (B) 400
 - (C) 600
 - (D) 350
71. The minimum compressive strength of first class bricks should be
- (A) 5 N/mm²
 - (B) 10 N/mm²
 - (C) 15 N/mm²
 - (D) 8.5 N/mm²
72. Which IS code is used for classification of timber for seasoning purposes?
- (A) IS : 1141-1958
 - (B) IS : 1708-1969
 - (C) IS : 4970-1973
 - (D) IS : 399-1963

73. For complete hydration of cement, the water cement ratio is
- (A) Less than 0.25
- (B) More than 0.25 but less than 0.35
- (C) More than 0.35 but less than 0.45
- (D) More than 0.45 but less than 0.60

74. The fineness of cement is tested by
- (A) air-content method
- (B) air-permeability method
- (C) le-chatelier
- (D) Vicat's apparatus

75. Which type of cement is recommended in large mass works, such as a dam?
- (A) OPC
- (B) High alumina cement
- (C) Low heat Portland cement
- (D) Portland pozzolana

76. When a first class brick is immersed in cold water for 24 hours, it should not absorb water by weight more than
- (A) 20%
- (B) 10%
- (C) 15%
- (D) 5%

77. The grade of cement is determined by testing cement mortar of proportion of cement to sand
- (A) 1 : 2.0
- (B) 1 : 2.5
- (C) 1 : 3.0
- (D) 1 : 3.5

78. The approximate proportion of dry cement mortar required for brick work is
- (A) 20%
- (B) 10%
- (C) 15%
- (D) 30%
- Handwritten calculations:*
 $\frac{1 \times 10 \times 10 \times 6}{200 \times 100 \times 100}$
 $\frac{1.5 \times 10 \times 10 \times 6}{200 \times 100}$
 $\frac{1.5}{20}$

79. What is the quantity of cement (in kg) and of dry sand (in cubic metre) respectively required for preparing one cubic metre of wet cement mortar of 1 : 5 proportion?
- (A) 310 and 1.05
- (B) 290 and 1.05
- (C) 280 and 1.00
- (D) 280 and 2.00
- Handwritten calculations:*
 $\frac{2250}{217}$
 $\frac{11750}{2250}$
 $\frac{4500}{0.2925}$
 $\frac{212}{0.35}$
 $\frac{1.5}{6} = 0.25$
 $\frac{1.5}{6} = 0.25$
 $\frac{28 \times 1000}{125}$

80. In cements, generally the increase in strength during a period of 14 days to 28 days is primarily due to
- (A) C₃A
- (B) C₃S
- (C) C₂S
- (D) C₄AF
- Handwritten calculations:*
 $\frac{1.5}{20}$

81. What is the amount of water required for a workable RC of mix 1 : 2 : 4 by weight when w/c ratio is 0.60 and unit weight of concrete is 2,400 kg/m³.

- (A) 165 L
- (B) 205 L
- (C) 245 L
- (D) 285 L

W/W

$$\frac{W}{24W} \quad \frac{w}{c} = 0.6$$

$$w = 24 \times 0.6$$

82. As per IS code of practice, concrete should be cured at

- (A) 35 °C
- (B) 25 °C
- (C) 27 °C
- (D) 50 °C

83. The ratio of modulus of rupture to direct tensile strength of concrete is

- (A) 4
- (B) 2
- (C) 0.75
- (D) 1.0

$$\frac{1}{66} \quad \frac{1}{33}$$

84. The approx. ratio between the strength of cement concrete at 7 days and at 28 days is

- (A) 3/4
- (B) 2/3
- (C) 1/2
- (D) 1/3

$$\frac{1}{2} \quad \frac{3}{4}$$

85. The number of independent elastic constants for a linear elastic isotropic and homogeneous material is

- (A) 4
- (B) 3
- (C) 2
- (D) 1

86. For a given material the Poisson's ratio 0.25, the ratio of Young's modulus and modulus of rigidity is

- (A) 2.5
- (B) 0.4
- (C) 2.75
- (D) 3.0

$$E = 2G(1 + \mu)$$

$$\frac{E}{G} = 2 \times (1 + 0.25)$$

$$= 2.5$$

87. The symmetry of the stress tensor at a point in a body when at equilibrium is obtained from

- (A) Conservation of energy
- (B) Moment equilibrium equations
- (C) Force equilibrium equations
- (D) None of these

88. Slump and compaction factor are two different measure of workability of concrete. For a slump of 0 to 20, what is the equivalent range of compaction factor ?

- (A) 0.4-0.7
- (B) 0.7-0.9
- (C) 0.7-0.8
- (D) 0.6-0.8

89. Shear span is defined as the zone where

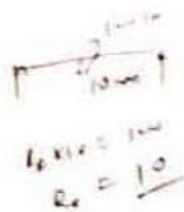
- (A) Bending moment is constant
- (B) Shear force is constant
- (C) Shear force is zero
- (D) Bending moment is zero

90. An overhanging beam on both sides is acted upon by a uniformly distributed load (kN/m) throughout. Overhanging on each side is L_1 m and clear span is L_2 m. For maximum positive moment equal to the negative moment, what is the ratio of L_1 to L_2 ?

- (A) 0.7071
- (B) 0.3535
- (C) 0.5
- (D) 0.5773

91. A simply supported beam of length 10 m is acted upon by a clockwise moment of 100 kNm at the centre of the beam, the value of shear force at left support is

- (A) 20 kN
- (B) 10 kN
- (C) Zero
- (D) 1000 kN



92. If a circular shaft is subjected to a torque T and a bending moment M , the ratio of the maximum shear stress to the maximum bending stress is given by

- (A) $2M/T$
- (B) $2T/M$
- (C) $T/2M$
- (D) M/T

93. The total (both internal and external) degree of static indeterminacy of the plane frame shown in the given figure is



- (A) 14
- (B) 16
- (C) 18
- (D) 20

94. At a point in a steel member, the major principal stress is 200 N/mm^2 (tensile) and the minor principal stress is compressive. If the uniaxial tensile yield stress 250 N/mm^2 , then according to the maximum shear stress theory, the magnitude of the minor principal stress (compressive) at which yielding will commence is

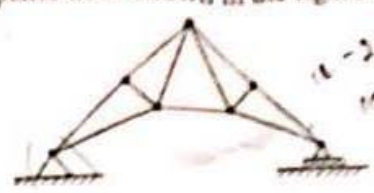
- (A) 250 N/mm^2
- (B) 150 N/mm^2
- (C) 50 N/mm^2
- (D) 200 N/mm^2

$$\frac{\sigma_1}{\sigma_y} = \frac{200}{250}$$

$$\frac{200 + \sigma_2}{\sigma_y} = \frac{250}{\sigma_y}$$

$$\sigma_2 = 250 - 200 = 50$$

95. The kinematic indeterminacy of the plane truss shown in the figure is



- (A) 11
- (B) 8
- (C) 3
- (D) 0

96. The stiffness matrix of a beam elements is $(2EI/L) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$ which one of the following is its flexibility matrix?

- (A) $(L/2EI) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
- (B) $(L/6EI) \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$
- (C) $(L/4EI) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
- (D) $(L/6EI) \begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$

97. Total degree of kinematic indeterminacy for the plane frame shown in the figure is given by



- (A) 27
- (B) 36
- (C) 54
- (D) 24

98. The figure shows a simply supported beam PQ of uniform flexural rigidity EI carrying two moments M and 2M



- The slope at P will be $\frac{1}{18}$
- (A) 0
 - (B) $ML/(9EI)$
 - (C) $ML/(6EI)$
 - (D) $ML/(3EI)$

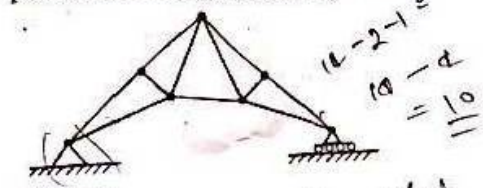
99. A propped cantilever of span L carries a vertical concentrated load at the mid-span. If the plastic moment capacity of the section is M_p , the magnitude of the collapse load is

- (A) $8 M_p L$
- (B) $6 M_p L$
- (C) $4 M_p L$
- (D) $2 M_p L$

100. Flexibility method of structural analysis starts with

- (A) Compatible deformation
- (B) Equilibrium condition
- (C) Force deformation relation
- (D) Equilibrium state of internal forces

95. The kinematic indeterminacy of the plane truss shown in the figure is

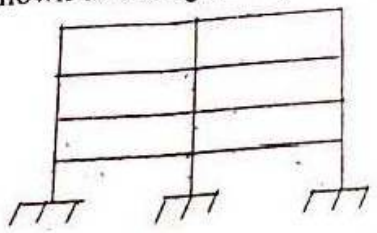


- (A) 11
- (B) 8
- (C) 3
- (D) 0

96. The stiffness matrix of a beam element is $(2EI/L) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$ which one of the following is its flexibility matrix?

- (A) $(L/2EI) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
- (B) $(L/6EI) \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$
- (C) $(L/4EI) \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
- (D) $(L/6EI) \begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$

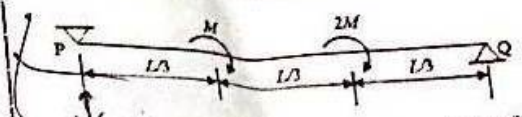
97. Total degree of kinematic indeterminacy for the plane frame shown in the figure is given by



- (A) 27
- (B) 36
- (C) 54
- (D) 24

Handwritten calculation: $31 - 2 = 29$, $45 - 9 = 36$

98. The figure shows a simply supported beam PQ of uniform flexural rigidity EI carrying two moments M and 2M



The slope at P will be $P_f \times 1 \text{ or } 9m$
 $P_f = -(3m/2)$

- (A) 0
 - (B) $ML/(9EI)$
 - (C) $ML/(6EI)$
 - (D) $ML/(3EI)$
- Handwritten calculation: $\frac{d^2y}{dx^2} = \frac{-3m}{L} \frac{x}{2} + m \left(\frac{x-L}{2} \right)$

99. A propped cantilever of span L carries a vertical concentrated load at the mid-span. If the plastic moment capacity of the section is M_p , the magnitude of the collapse load is

- (A) $8 M_p L$
- (B) $6 M_p L$
- (C) $4 M_p L$
- (D) $2 M_p L$

Handwritten calculation: $-\frac{3m}{L} \times \frac{L}{6} + m \left(\frac{L}{2} \right)$

100. Flexibility method of structural analysis starts with

- (A) Compatible deformation
- (B) Equilibrium condition
- (C) Force deformation relation
- (D) Equilibrium state of internal forces