STRUCTURAL ANALYSIS 1

(4th SEMESTER)

1. If in a pin-jointed plane frame (m + r) > 2j, then the frame is

(A) Stable and statically determinate

(B) Stable and statically indeterminate

(C) Unstable

(D) None of the above

Answer: Option B

2. Principle of superposition is applicable when

(A) Deflections are linear functions of applied forces

(B) Material obeys Hooke's law

(C) The action of applied forces will be affected by small deformations of the structure

(D) None of the above

Answer: Option A

3. The Castigliano's second theorem can be used to compute deflections

(A) In statically determinate structures only

(B) For any type of structure

(C) At the point under the load only

(D) For beams and frames only

Answer: Option B

4. When a uniformly distributed load, longer than the span of the girder, moves from left to right, then the maximum bending moment at mid-section of span occurs when the uniformly distributed

load occupies

(A) Less than the left half span

(B) Whole of left half span

(C) More than the left half span

(D) Whole span

Answer: Option D

5. Which of the following methods of structural analysis is a force method?

(A) Slope deflection method

(B) Column analogy method

(C) Moment distribution method

(D) None of the above

Answer: Option B

6. Which of the following is not the displacement method?

(A) Equilibrium method

(B) Column analogy method

(C) Moment distribution method

(D) Kani's method

Answer: Option B

7. The principle of virtual work can be applied to elastic system by considering the virtual work of

(A) Internal forces only

(B) External forces only

(C) Internal as well as external forces

(D) None of the above

Answer: Option C

8. If in a rigid-jointed space frame, $(6m + r) < 6j$, then the frame is

(A) Unstable

(B) Stable and statically determinate

(C) Stable and statically indeterminate

(D) None of the above

Answer: Option A

9. The three moments equation is applicable only when

(A) The beam is prismatic

(B) There is no settlement of supports

(C) There is no discontinuity such as hinges within the span

(D) The spans are equal

Answer: Option C

10. Which of the following methods of structural analysis is a displacement method?

(A) Moment distribution method

(B) Column analogy method

(C) Three moment equation

(D) None of the above

Answer: Option A

11. The fixed support in a real beam becomes in the conjugate beam a

(A) Roller support

(B) Hinged support

(C) Fixed support

(D) Free end

Answer: Option D

12. A point load 'W ,maximum bending moment at 0.4 L from the left support is

(A) 0.16 WL

(B) 0.20 WL

(C) 0.24 WL

(D) 0.25 WL

Answer: Option C

13. In the displacement method of structural analysis, the basic unknowns are

(A) Displacements

(B) Force

(C) Displacements and forces

(D) None of the above

Answer: Option A

14. A rigid-jointed plane frame is stable and statically determinate if

(A) (m + r) = 2j

(B) (m + r) = 3j

(C) (3m + r) = 3j

(D) (m + 3r) = 3j

Where m is number of members, r is reaction components and j is number of joints

Answer: Option C

15. When a uniformly distributed load, shorter than the span of the girder, moves from left to right,

then the conditions for maximum bending moment at a section is that

(A) The head of the load reaches the section

(B) The tail of the load reaches the section

(C) The load position should be such that the section divides it equally on both sides

(D) The load position should be such that the section divides the load in the same ratio as it

divides the span

Answer: Option D

16. Muller Breslau's principle for obtaining influence lines is applicable to

(i) Trusses

(ii) Statically determinate beams and frames

(iii) Statically indeterminate structures, the material of which is elastic and follows Hooke's law

(iv) Any statically indeterminate structure

The correct answer is

(A) (i), (ii) and (iii)

(B) (i), (ii) and (iv)

(C) (i) and (ii)

(D) Only (i)

Answer: Option A

17. The degree of static indeterminacy of a rigid-jointed space frame is

(A) m + r – 2j

(B) m + r – 3j

(C) 3m + r – 3j

(D) 6m + r – 6j

Where m, r and j have their usual meanings

Answer: Option D

18. Degree of kinematic indeterminacy of a pin-jointed plane frame is given by

(A) 2j – r

(B) j – 2r

(C) 3j – r

(D) 2j + r

Answer: Option A

19. The number of independent equations to be satisfied for static equilibrium of a plane structure is

(A) 1

(B) 2

(C) 3

(D) 6

Answer: Option C

20. The degree of static indeterminacy of a pin-jointed space frame is given by

(A) m + r – 2j

(B) m + r – 3j

(C) 3m + r – 3j

(D) m + r + 3j

Answer: Option B

21. While using three moments equation, a fixed end of a continuous beam is replaced by an additional span of

(A) Zero length

(B) Infinite length

(C) Zero moment of inertia

(D) None of the above

Answer: Option A

22. Study the following statements.

(i) The displacement method is more useful when degree of kinematic indeterminacy is

greater than the degree of static indeterminacy.
(ii) The displacement method is more useful when degree of kinematic indeterminacy is less than the degree of static indeterminacy.
(iii) The force method is more useful when degree of static indeterminacy is greater than the degree of kinematic indeterminacy.
(iv) The force method is more useful when degree of static indeterminacy is less than the degree of kinematic indeterminacy.
The correct answer is
(A) (i) and (iii)
(B) (ii) and (iii)
(C) (i) and (iv)
(D) (ii) and (iv)
Answer: Option D

23. Bending moment at any section in a conjugate beam gives in the actual beam
(A) Slope
(B) Curvature
(C) Deflection
(D) Bending moment
Answer: Option C

24. The number of independent displacement components at each joint of a rigid-jointed space frame is
(A) 1
(B) 2
(C) 3
(D) 6
Answer: Option D

25. Independent displacement components at each joint of a rigid-jointed plane frame are
(A) Three linear movements
(B) Two linear movements and one rotation
(C) One linear movement and two rotations

(D) Three rotations

Answer: Option B

26. 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 + 2j

(B) m – r + 2j

(C) m + r – 2j

(D) m + r – 3j

Answer: Option C

27. The degree of kinematic indeterminacy of a pin-jointed space frame is

(A) 2j – r

(B) 3j – r

(C) j – 2r

(D) j – 3r

Where j is number of joints and r is reaction components

Answer: Option B

28. The maximum bending moment due to a train of wheel loads on a simply supported girder

(A) Always occurs at centre of span

(B) Always occurs under a wheel load

(C) Never occurs under a wheel load

(D) None of the above

Answer: Option B

29. When a series of wheel loads crosses a simply supported girder, the maximum bending moment under any given wheel load occurs when

(A) The centre of gravity of the load system is midway between the centre of span and wheel load under consideration

(B) The centre of span is midway between the centre of gravity of the load system and the wheel load under consideration

(C) The wheel load under consideration is midway between the centre of span and the

centre of gravity of the load system

(D) None of the above

Answer: Option B

30. Castigliano's first theorem is applicable

(A) For statically determinate structures only

(B) When the system behaves elastically

(C) Only when principle of superposition is valid

(D) None of the above

Answer: Option C

31. Number of unknown internal forces in each member of a rigid jointed plane frame is

(A) 1

(B) 2

(C) 3

(D) 6

Answer: Option C

32. The number of independent equations to be satisfied for static equilibrium in a space structure is

(A) 2

(B) 3

(C) 4

(D) 6

Answer: Option D

33. A pin-jointed plane frame is unstable if

(A) $(m + r) < 2j$

(B) $(m + r) = 2j$

(C) $(m + r) > 2j$

(D) None of the above

Where m is number of members, r is reaction components and j is number of joints

Answer: Option A

34. Degree of static indeterminacy of a rigid-jointed plane frame having 15 members, 3 reactions
components and 14 joints is
(A) 2
(B) 3
(C) 6
(D) 8
Answer: Option C

35. A single rolling load of 8 kN rolls along a girder of 15 m span. The absolute maximum bending
moment will be
(A) 8 kN.m
(B) 15 kN.m
(C) 30 kN.m
(D) 60 kN.m
Answer: Option C

36. If an axial force N is applied gradually to a bar which is linear elastic and has a constant cross sectional area A and length L, what will be Δ?

a) ¼ NL/AE

b) ⅓ NL/AE

c) ½ NL/AE

d) NL/AE

Answer: Option d

37. If an axial force N is applied gradually to a bar which is linear elastic and has a constant cross sectional area A and length L, what will be the value of U_i ?

a) ¼ N^2L/AE

b) ⅓ N^2L/AE

c) ½ N^2L/AE

d) N^2L/AE

Answer: Option c

38. How many equilibrium equations are used in method of sections?

a) 2

b) 4

c) 3

d) 5

Answer: Option c

39. Conjugate-Beam method was developed by:-

a) Hooke

b) Otto mohr

c) Charles E.greene

d) H.muller-Breslau

Answer: Option d

40. If L is length of conjugate beam and l is length of real beam then:

a) L > l

b) L < l

c) L = l

d) Can’t say

Answer: Option c

41. Pin joint is replaced by _____ in conjugate beam.

a) Roller

b) Pin

c) Fixed support

d) Link

Answer: Option b

42. Internal pin is replaced by _____ in conjugate beam.

a) Roller

b) Pin

c) Fixed support

d) Hinge

Answer: Option d

43. Identify the incorrect statement from the following regarding applicability of Maxwell's reciprocal theorem.

a) It is applicable for elastic member's only

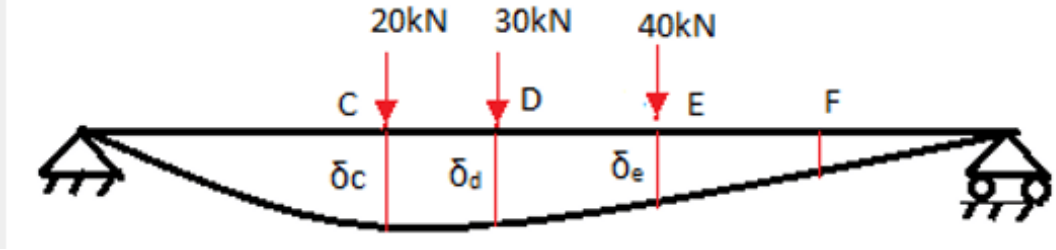
b) The temperature must remain constant throughout

c) Supports of the member should be unyielding

d) It is applicable for prismatic member only

Answer: Option d

44. The beam shown in the figure carries loads of 20kN, 30kN and 40kN at point C, D and E respectively and produces a deflection of 5mm at point F. To produce a deflection of 6mm, 8mm and 6mm at C, D, and E respectively, the load required at F would be



a) 30kN

b) 60kN

c) 90kN

d) 120kN

Answer: Option d

45. Find the tension in cable CD.

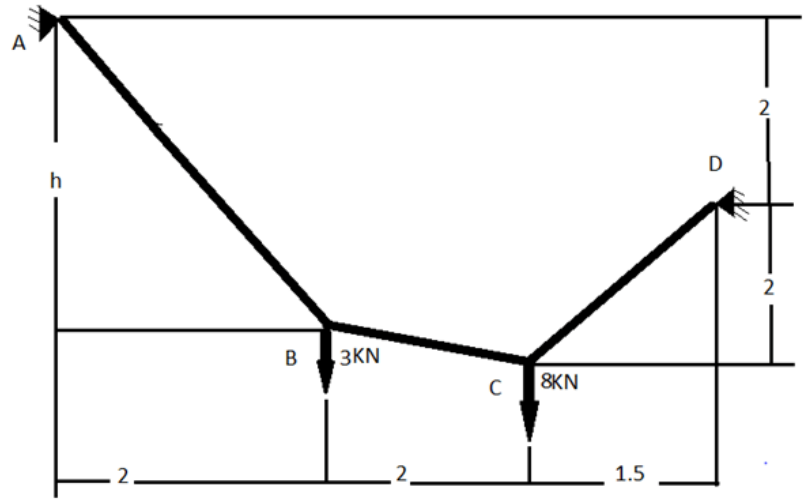
a) 4.79

b) 5.79

c) 6.79

d) 7.79

Answer: Option c



46. What will be the tension in cable BC?

a) 4.82

b) 5.82

c) 6.82

d) 7.82

Answer: Option a

47. What will be the tension in cable AB?

a) 4.9

b) 5.9

c) 6.9

d) 7.9

Answer: Option c

48. What will be the value of h?

a) .74

b) 1.74

c) 2.74

d) 3.74

Answer: Option c

49. $\theta_{B/A}$ refers to: -

a) Angle of tangent at B measured wrt the tangent at A

b) Angle of tangent at A measured wrt the tangent at B

c) Angle of tangent at A measured wrt x axis

d) Angle of tangent at A measured wrt y axis

Answer: Option a

50. If area of M/EI diagram between points A and B is –ve, then angle from tangent A to tangent B will be measured :-

a) Counterclockwise

b) Clockwise

c) Can be anything

d) Angle will be 0

Answer: Option b

51. What should be the area that should be considered if we want to find slope at point B wrt initial beam? In the below figure

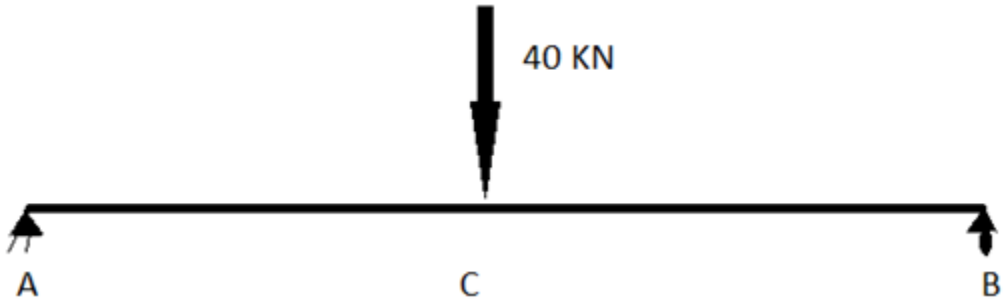
a) from A to C

b) from A to B

c) from C to B

d) depends upon the loading condition

Answer: Option c



52. What is the value of slope at point B wrt initial beam?

a) 10/EI

b) 20/EI

c) 30/EI

d) 40/EI

Answer: Option d

53. To calculate maximum deformation in the deflected beam, which part of the area should be considered?

a) from A to B

b) from A to C

c) from B to C

d) can't say

Answer: Option b

54. To calculate maximum deformation in deflected beam, about which point should we take moment of the required part of area?

a) A

b) B

c) C

d) can’t say

Answer: Option a

55. What is the value of maximum deformation in this case?

a) 80/3EI

b) 120/3EI

c) 180/3EI

d) 40/3EI

Answer: Option a

56. To convert indeterminate structure to a determinate structure, number of force release to be provided equals to _____

a) Number of equilibriums equations for the respective structures available

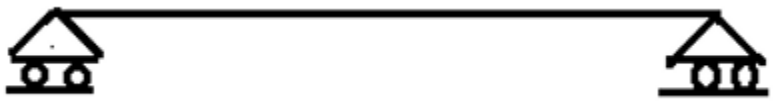
b) External Static Indeterminacy only

c) Internal Static Indeterminacy only

d) Static Indeterminacy

Answer: Option d

57. The following structure is __



a) Stable

b) Statically Unstable

c) Geometrically Unstable

d) Internally Unstable

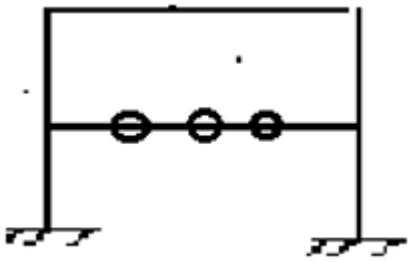
58. The following structure is __

a) Stable

b) Statically Unstable

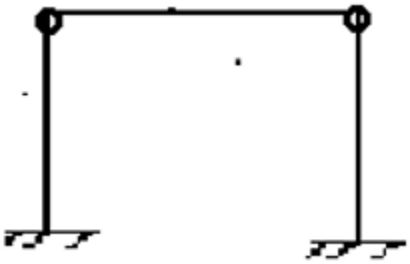
c) Geometrically Unstable

d) Internally Unstable



Answer: Option d

59. The following structure is __



a) Stable

b) Statically Unstable

c) Geometrically Unstable

d) Internally Unstable

Answer: Option a

60. Force releases by Vertical Shear Hinge is __

a) Number of member – 1

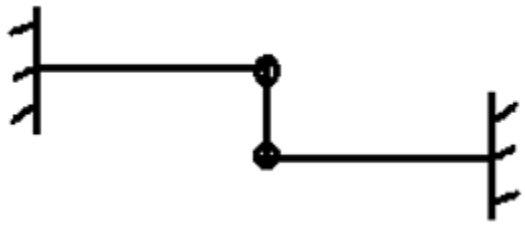
b) 3*(Number of member-1)

c) 2

d) 1

Answer: Option d

61. Force releases by Link is __



a) Number of member – 1

b) 3*(Number of member-1)

c) 2

d) 1

Answer: Option c

62. In a truss it is assumes that the members are joined by:-

a) Rough pins

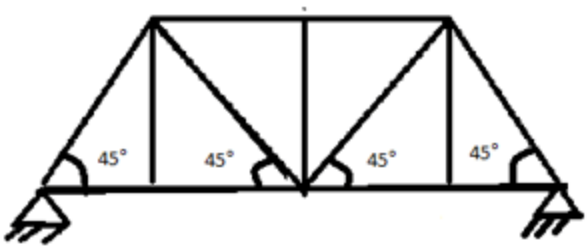
b) Smooth pins

c) Either of them

d) Neither of them

Answer: Option b

63. Calculate the kinematic indeterminacy of the following pin jointed plane frame



a) 2

b) 6

c) 12

d) 18

Answer: Option c

64. How many possible sets of forces does a statically determinate truss has?

a) 0

b) 1

c) 2

d) 3

Answer: Option b

65. In method of sections, what is the maximum no. of unknown members through which the imaginary section can pass?

a) 1

b) 2

c) 3

d) 4

Answer: Option c

66. Which of the following is not a valid assumption in analysis of truss?

a) Members are subjected to axial forces only

b) Loads and reactions will act directly or indirectly at the members only

c) Member varies linearly only

d) All joints are smooth and frictionless hinges

Answer: Option b

67. Which of the following is not true for the method of joints?

a) Equilibrium of joints is considered in method of joints

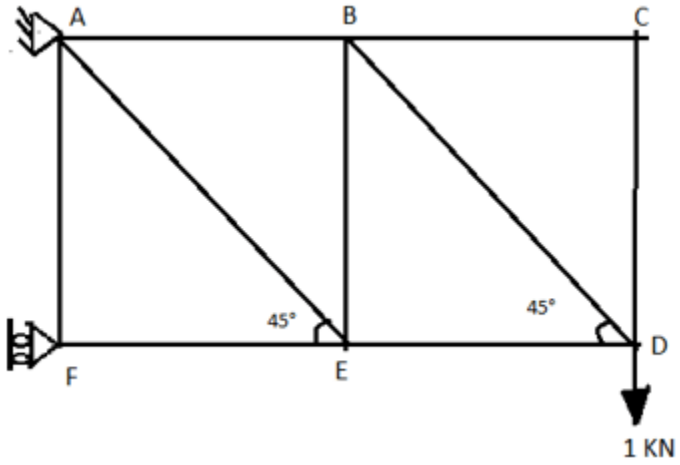
b) Number of equilibrium equations are 2 for method of joints

c) Method of joints can be used to solve for up to 3 unknowns at a joint

d) Forces in prior member are to be calculated first, for calculating internal forces in any chosen member

Answer: Option c

68. Calculate the force in member BC.



a) 1KN (COMPRESSIVE)

b) 1KN (TENSILE)

c) $2-\sqrt{}$ KN (TENSILE)

d) 0KN

Answer: Option d

69. Find the force in member ED? (in the above figure)

a) 1KN (COMPRESSIVE)

b) 1KN (TENSILE)

c) $2-\sqrt{}$ KN (TENSILE)

d) 0KN

Answer: Option a

70. Find the force in member BD? (in the above figure)

a) 1KN (COMPRESSIVE)

b) 1KN (TENSILE)

c) $2-\sqrt{}$ KN (TENSILE)

d) 0KN

Answer: Option c

71. How many equilibrium equations do we need to solve generally on each joint of a truss?

a) 1

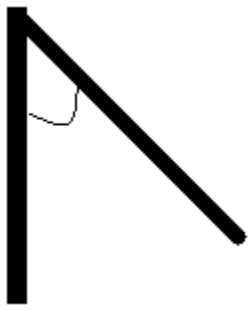
b) 2

c) 3

d) 4

Answer: Option b

72. What should be the angle (in degrees) in the given system (part of a bigger system) if both of the members have to be a zero force member?



a) 22.5

b) 45

c) 67.5

d) 90

Answer: Option d

73. How many rotations are possible in case of 3-dimensional frame/beam?

a) 1

b) 2

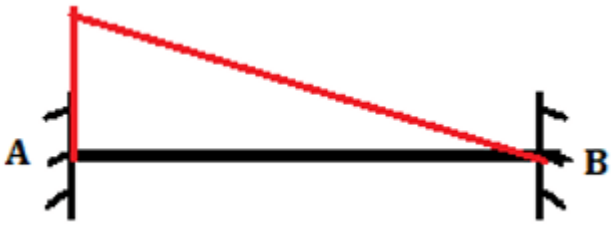
c) 3

d) 4

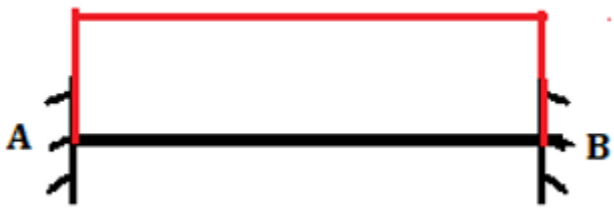
Answer: Option c

74. Which one the following is the ILD for the vertical reaction at A for the given fixed beam?

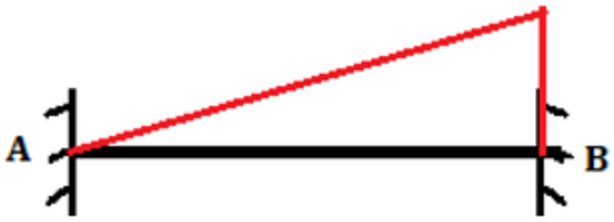
a)



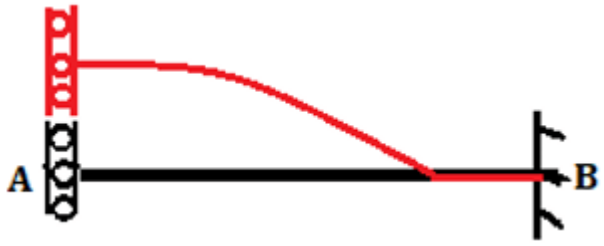
b)



c)



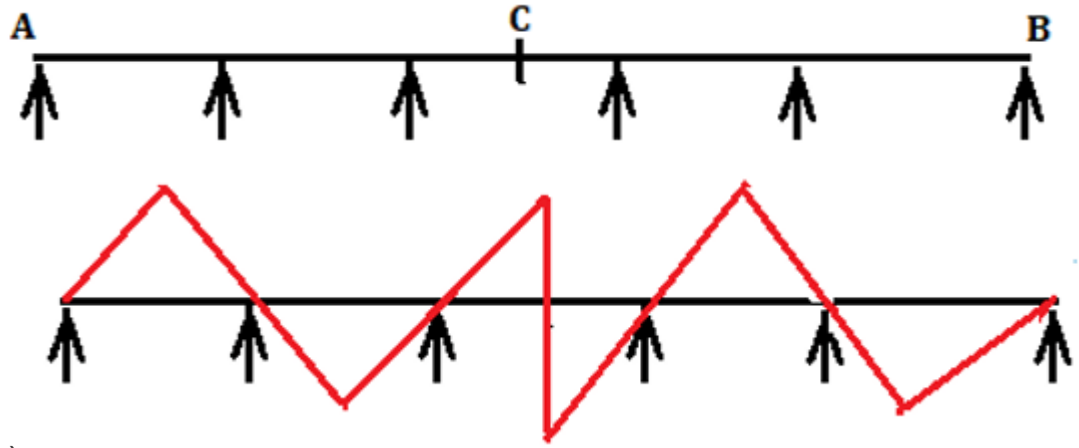
d)



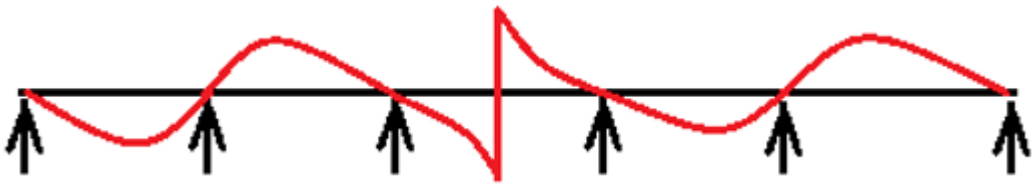
Answer: Option d

75. ILD for the shear force at section C for the continuous beam is ____

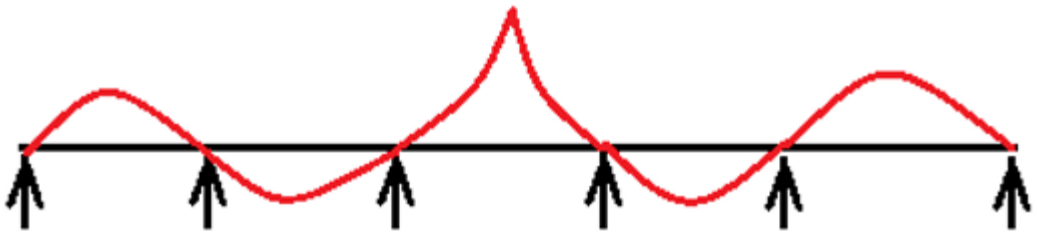
a)



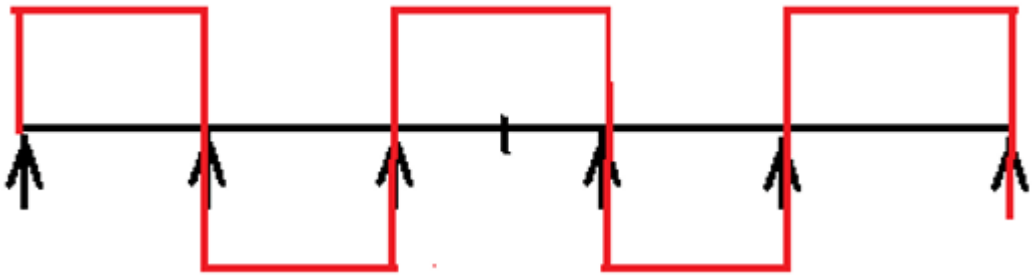
b)



c)

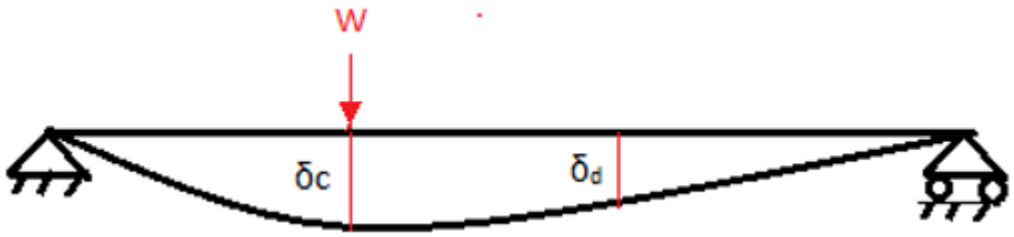


d)



Answer: Option b

76. For the given figure, if a load of 25kN placed at a position C produces a displacement of 25mm at position D. Find the displacement of position C if a load of 25kN is placed at position D.



a) 6.25mm

b) 12.5mm

c) 25mm

d) Insufficient data

Answer: Option d

77. Law of reciprocal deflections was given by _____

a) E. Betti

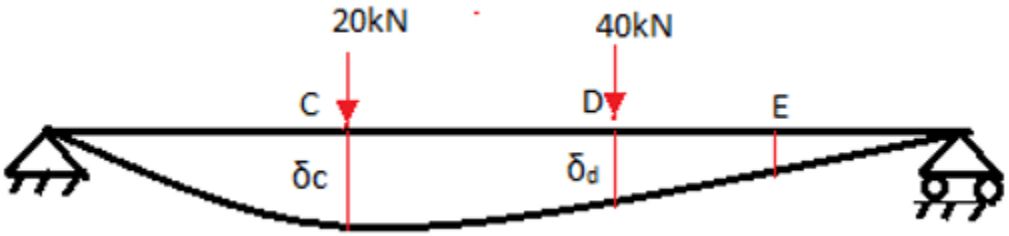
b) James Clerk Maxwell

c) Alberto Castigliano

d) Clayperon

Answer: Option b

78. The beam shown in the figure carries loads of 20kN and 40kN at point C and D respectively and produces a deflection of 6mm at point E. To produce a deflection of 8mm and 5mm at C and D respectively, the load required at E would be _____



a) 20kN

b) 40kN

c) 50kN

d) 60kN

Answer: Option d

79. Betti's Theorem is based on _____

a) Balancing of external and internal forces

b) Balancing of work done produced by external and internal loadings

c) Balancing of external and internal moments

d) Balancing of strain energy produced by external and internal loadings

Answer: Option b

80. Top most part of an arch is called _____

a) Sofit

b) Crown

c) Center

d) Abutment

Answer: Option b

81. Internal bending moment generated in a three hinged arch is always:-

a) 0

b) Infinite

c) Varies

d) Non zero value but remains constant

Answer: Option a

82. Identify the incorrect statement according to the hinged arches.

a) Three hinged arch is a statically determinate structure

b) To analyze three hinged arch, equlibrium equations are sufficient

c) For three hinged parabolic arch subjected to u.d.l over the entire span, the bending moment is constant throughout the span

d) For two hinged parabolic arch subjected to u.d.l over the entire span, the bending moment is zero throughout the span

Answer: Option c

83. What is the relation between work done by external loads and work done by internal loads.

a) They are unequal

b) They are equal

c) Can't say

d) Depends upon load

Answer: Option b

84. To apply virtual work method it is :-

a) Compulsory for external and internal forces to be in equilibrium

b) Not compulsory for external and internal forces to be in equilibrium

c) Compulsory for external and internal forces to be in equilibrium in higher loads

d) Compulsory for external and internal forces to be in equilibrium in lesser loads

Answer: Option a

85. What is the shape of load-deformation curve for a linear elastic member?

a) Straight line with constant slope

b) Straight line with varying slope

c) Curve

d) Sine wave

Answer: Option a

86. What is the SI unit of stiffness coefficient?

a) M/KN

b) KN/M

c) KN

d) M

Answer: Option b

87. According to maxwell's theorem:-

a) fab = faa

b) fbb = faa

c) fba = fab

d) fba = fbb

Answer: Option c