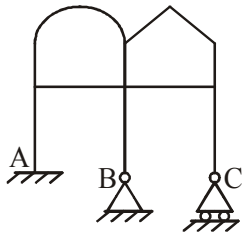
QUESTION BANK

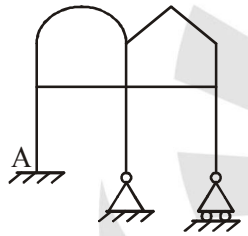
1. The static indeterminacy of the structure shown below



(a) 3 (b) 6

(c) 9 (d) 12

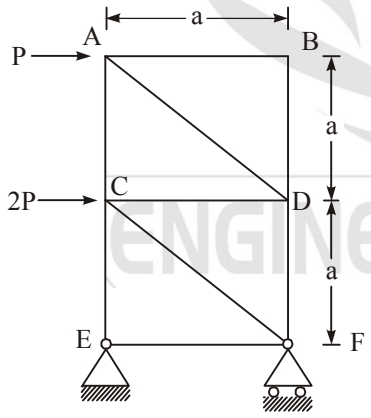
2. Determine the degree of freedom of the following frame



(a) 13 (b) 24

(c) 27 (d) 18

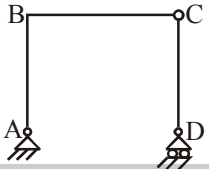
3. The force in the member 'CD' of the truss in fig is



(a) Zero (b) 2P (Compression)

(c) P (Compression) (d) P (Tensile)

4. The plane frame shown below is :



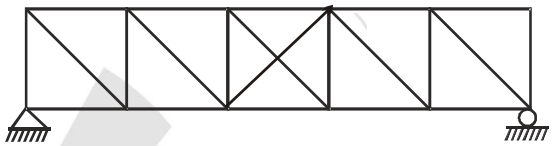
(a) statically indeterminate but unstable

(b) unstable

(c) determinate and stable

(d) none of the above

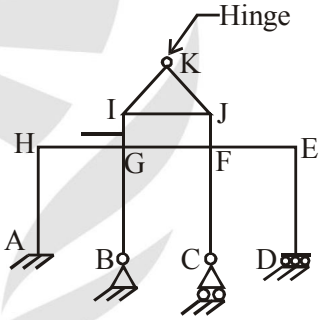
5. Determine static and kinematic indeterminacies for trusses



(a) 1, 21 (b) 2, 20

(c) 1, 22 (d) 2, 22

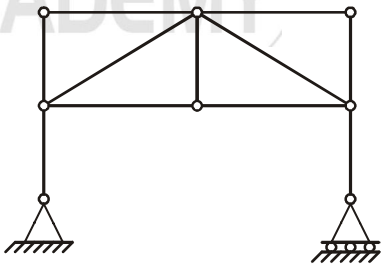
6. The static Indeterminacy of the structure shown below is.



(a) 4 (b) 6

(c) 8 (d) 10

7. The structure shown below is



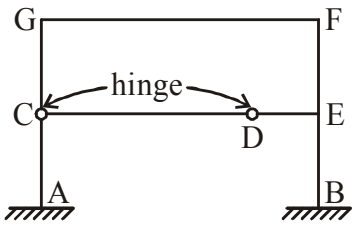
(a) externally indeterminate

(b) internally indeterminate

(c) determinate

(d) mechanism

8. The static Indeterminacy of the structure shown below is



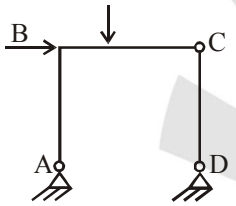
(a) unstable

(b) stable, determinate

(c) stable, indeterminate to 5^{th} degree

(d) stable, indeterminate to 3^{rd} degree

9. The plane figure shown below is



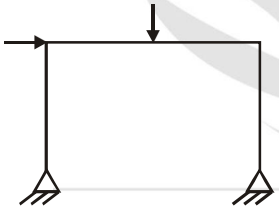
(a) Stable and statically determinate

(b) unstable and statically determinate

(c) stable and statically indeterminate

(d) unstable and statically indeterminate

10. The degrees of freedom of the following frames is.



(a) 3 (b) 4

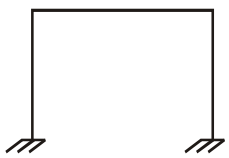
(c) 5 (d) 6

11. The kinematic indeterminacy of single bay portal frame fixed at the base is.

(a) One (b) Two

(c) Three (d) Zero

12. The kinematic indeterminacy of plane frame shown below is.



(a) 1 (b) 2

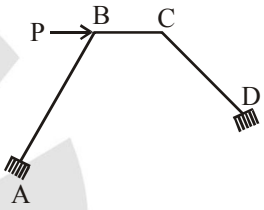
(c) 3 (d) zero

13. A beam fixed at the ends and subjected to lateral loads only is statically indeterminate and the degree of indeterminacy is

(a) One (b) Two

(c) Three (d) Four

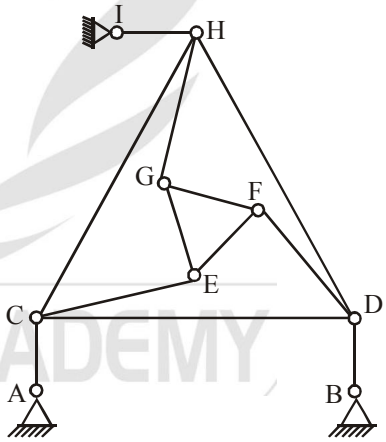
14. The degree of kinematic indeterminacy of the rigid frame with clamped ends at A and D shown in the figure is



(a) 4 (b) 3

(c) 2 (d) Zero

15. The following two statements are made with reference to the planar truss shown below:



I. The truss is statically determinate

II. The truss is kinematically determinate.

With reference to the above statements, which of the following applies?

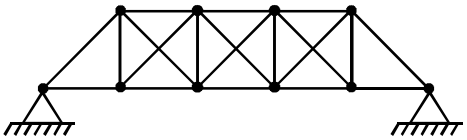
(a) Both statements are true

(b) Both statements are false

(c) II is true but I false

(d) I is true but II is false

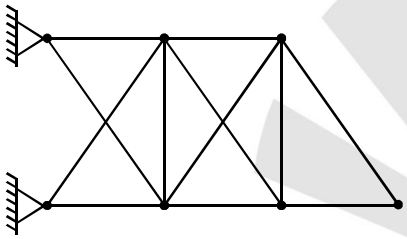
16. The total degree of indeterminacy (both internal and external) for the bridge truss shown in the given figure is



(a) 4 (b) 5

(c) 6 (d) 3

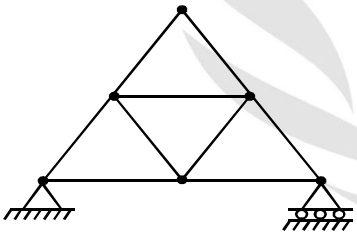
17. What is the degree of indeterminacy (both internal and external) of the cantilever plane truss shown in the figure below?



(a) 2 (b) 3

(c) 4 (d) 5

18. Consider the following statements with respect to the figure below of a typical articulated frame:



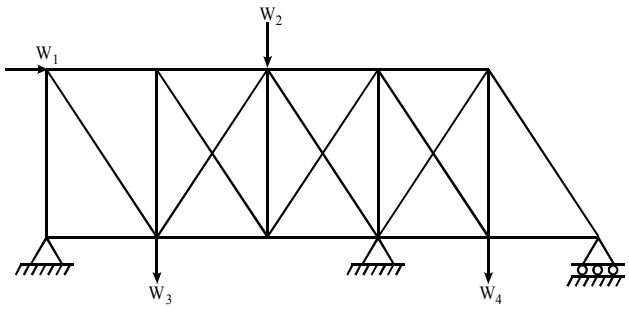
1. The frame is internally determinate and externally indeterminate.
2. The frame is internally indeterminate and externally determinate.
3. The frame is internally as well as externally determinate.
4. The frame is internally as well as externally indeterminate.

Which of these statements is/are correct?

(a) 1 only (b) 1 and 2

(c) 3 only (d) 3 and 4

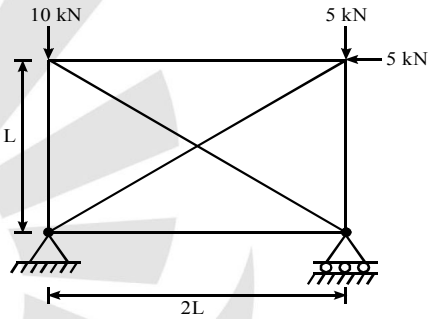
19. The degree of static indeterminacy of the pin-jointed plane frame shown in figure is



(a) 1 (b) 2

(c) 3 (d) 5

20. The frame shown below is redundant to



(a) single degree (b) two degree

(c) three degree (d) four degree

21. Match List-I (Type of structure) with List-II (Statical indeterminacy) and select the correct answer using the codes given below the lists

Number of member = m

Number of joints = n

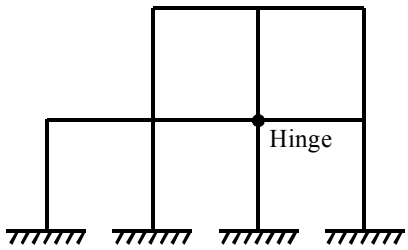
Number of external reaction elements = r

List-I	List-II
(A) Plane frame	1. m + r – 3n
(B) Space truss	2. 6m + r – 6n
(C) Space frame	3. 6m + r – 3n
	4. 3m + r – 3n

Codes :

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

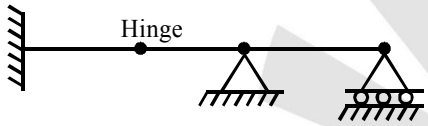
22. Total degree of indeterminacy (both internal and external) of the plane frame shown in the given figure is



(a) 10 (b) 11

(c) 12 (d) 15

23. The degree of indeterminacy of the beam given below is



(a) zero (b) one

(c) two (d) three

24. Which one of the following is true example of a statically determinate beam?

(a) One end is fixed and the other end is simply supported

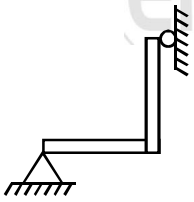
(b) Both the ends are fixed

(c) The beam overhangs over two supports

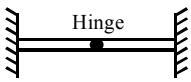
(d) The beam is supported on three supports

25. Which one of the following structures is statically determinate and stable?

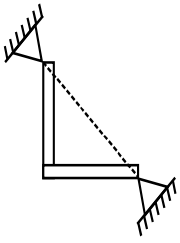
(a)



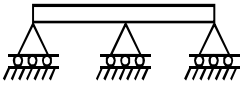
(b)



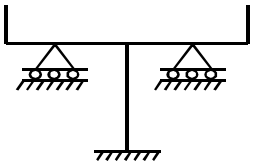
(c)



(d)



26. What is the degree of indeterminacy of the frame shown in the figure given below?



(a) 4 (b) 3

(c) 2 (d) zero

27. A determinate structure

(a) cannot be analyzed without the correct knowledge of modulus of elasticity

(b) must necessarily have roller support at one of its ends

(c) requires only statical equilibrium equations for its analysis

(d) will have zero deflection at its ends

28. A statically indeterminate structure is the one which

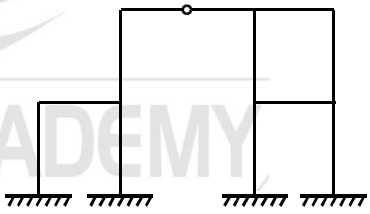
(a) cannot be analyzed at all

(b) can be analyzed using equations of statics only

(c) can be analyzed using equations of statics and compatibility equations

(d) can be analyzed using equations of compatibility only

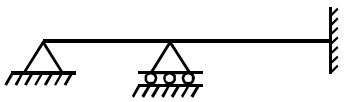
29. What is the statical indeterminacy for the frame shown below?



(a) 12 (b) 15

(c) 11 (d) 14

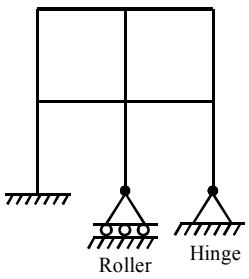
30. What is the number of independent degrees of freedom of the two-span continuous beam of uniform section shown in the figure below?



(a) 1 (b) 2

(c) 3 (d) 4

31. What is the kinematic indeterminacy for the shown below? (members are inextensible)



(a) 6 (b) 11

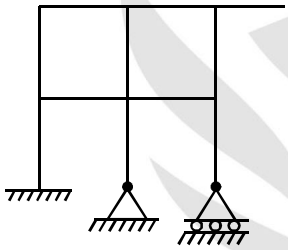
(c) 12 (d) 21

32. If the axial deformation is neglected, what is the kinematic indeterminacy of a single bay portal frame fixed at base?

(a) 2 (b) 3

(c) 4 (d) 6

33. For the plane frame with an overhang as shown below, assuming negligible axial deformation the degree of static indeterminacy 'd' and the degree of kinematic indeterminacy 'k' are



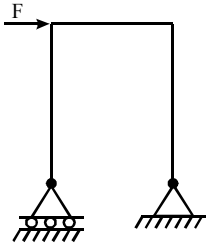
(a) d = 3 and k = 10

(b) d = 3 and k = 13

(c) d = 9 and k = 10

(d) d = 9 and k = 13

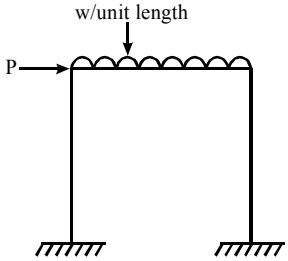
34. Considering beam as axially rigid, the degree of freedom of a plane frame shown below is



(a) 9 (b) 8

(c) 7 (d) 6

35. The frame shown in the given figure has



(a) one unknown reaction component

(b) two unknown reaction components

(c) three unknown reaction components

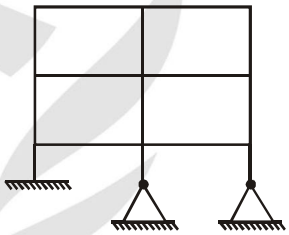
(d) six unknown reaction components

36. A perfect plane frame having n number of members and j number of joints should satisfy the relation

(a) $n < (2j-3)$ (b) $n = (2j-3)$

(c) $n > (2j-3)$ (d) $n = (3-2j)$

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



(a) 18 (b) 16

(c) 14 (d) 13

38. Statical indeterminacy for 2D truss is

(a) m + r – 2 j (b) m + r – 3 j

(c) m + j – 2 r (d) m – j + 2 j

39. Statical indeterminacy for 3D truss is

(a) m + r – 3 j (b) m + r – 2 j

(c) m + 3 j – r (d) m + j – 3 r

40. Statical indeterminacy for 2D beams & frames is

(a) 2(m – j) + r – f (b) 3(m – j) + r – f

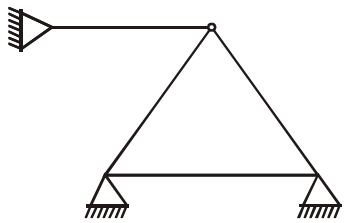
(c) 3(m – j) + f – r (d) 3(m – r) + j – f

41. Statical indeterminacy for 3D beams & truss is

(a) 3(m – j) + r – f (b) m + r – 3 j

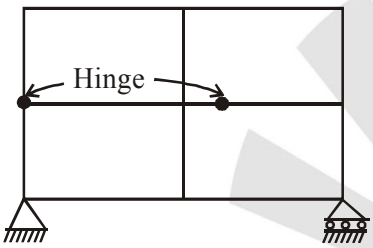
(c) 6(m – j) + r – f (d) 6(m – r) + j – f

42. Determine statical indeterminacy for following 2D truss



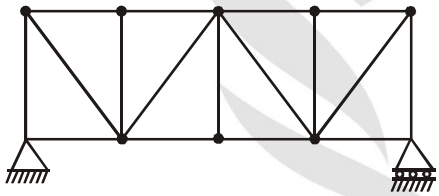
(a) 0 (b) 4
(c) 2 (d) 3

43. Find statical indeterminacy for following 2D frames



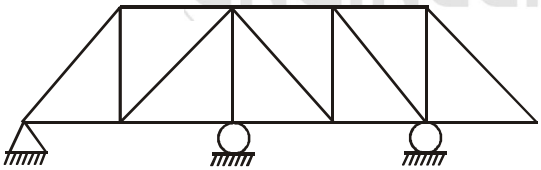
(a) 6 (b) 9
(c) 10 (d) 8

44. Determine Kinematic indeterminacy for following 2D truss



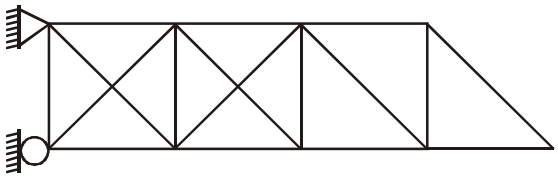
(a) 18 (b) 16
(c) 17 (d) 19

45. Determine statical and kinematic indeterminacies for trusses



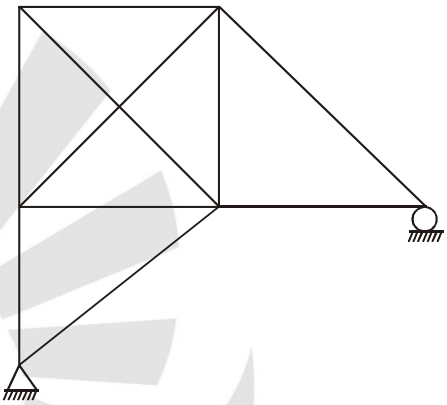
(a) 1, 17 (b) 3, 14
(c) 1, 14 (d) 1, 16

46. Determine statical and kinematic indeterminacies for trusses



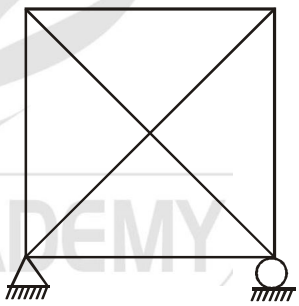
(a) 3, 14 (b) 2, 14
(c) 2, 15 (d) 2, 16

47. Determine statical and kinematic indeterminacies for trusses



(a) 1, 9 (b) 2, 8
(c) 1, 10 (d) 1, 8

48. Determine statical and kinematic indeterminacies for trusses



(a) 1, 5 (b) 1, 4
(c) 1, 6 (d) 2, 4

❍❍❍

ANSWERS AND EXPLANATIONS

1. ***Ans. (c)***

Reactions at A = 3,

Reactions at B = 2

Reaction at C = 1

Total no. of reactions = 6

No. of equilibrium equations = 3

$$D_{se} = r - \text{equilibrium equations}$$
$$= 6 - 3 = 3$$

$D_s = 3C$ for rigid jointed plane frames

Where

C = no. of closed boxes

$\therefore \quad D_{si} = 3 \times 2 = 6$

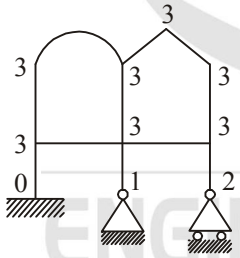
$\therefore \quad D_s = D_{se} + D_{si} = 3 + 6 = 9$

2. ***Ans. (a)***

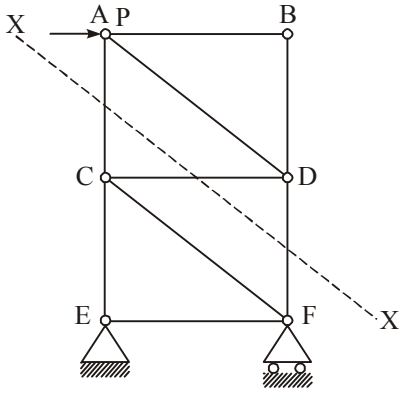
Degrees of freedom of various supports (or) joints are shown in figure

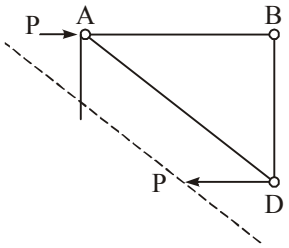
$$D_k = 0 + 3 \times 7 + (1 + 2)$$
$$= 24 \text{ (with axial deformation)}$$
$$= 24 - 11 = 13$$

(neglecting axial deformation)



3. ***Ans. (d)***





Consider the section 'XX'.

Consider upper part of section 'XX'.

$$F_{CD} = P(\text{Tensile})$$

4. ***Ans. (b)***

Without the hinge at 'C', the structure is stable and determinate. With the hinge at 'C', static indeterminacy is negative, column CD will have failure. Hence the structure is unstable.

5. ***Ans. (a)***

6. ***Ans. (d)***

Reactions at A = 3

Reactions at B = 2

Reaction at C = 1

Reactions at D = 2

Total reactions (r) = 8

$$D_{se} = r - \text{equilibrium equations}$$
$$= r - 3 = 5$$
$$D_{Si} = 3C = 3 \times 2 = 6$$

At 'k' a moment hinge exists. Force release at a joint moment hinge = no. of members connected to hinge – 1

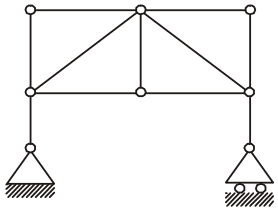
$$= 2 - 1 = 1$$

$\therefore D_s = D_{se} + D_{si} - \text{no. of force release}$

$$= 5 + 6 - 1 = 10$$

7. ***Ans. (d)***

The Structure shown is unstable. Unstable Structures are called 'Mechanism'.



8. ***Ans. (d)***

$D_{Se} = 6 - 3 = 3$

$D_{Si} = 3C = 3 \times 1 = 3$

Force Releases @ C = 3 – 1 = 2

Force Releases @ D = 2 – 1 = 1

$\therefore \quad D_S = D_{Se} + D_{Si} - \text{release}$

$= 3 + 3 - (2 + 1)$

$= 3$

9. ***Ans. (a)***

$D_{Se} = 4 - 3 = 1$

$D_{Si} = 0$

Force Release at C = 1

$\therefore \quad D_S = 1 + 0 - 1$

$= 0$

10. ***Ans. (c)***

Degree of freedom (D_k)

= No. of unknown joint displacements

At pinned support DOF = 1 (rotation)

At rigid joint of plane frame = 3

$\therefore \quad D_k = 1 + 3 + 3 + 1 = 8$

(Considering axial deformations)

$D_k = 8 - \text{no. of members}$

(neglecting axial deformations)

$= 8 - 3 = 5$

11. ***Ans. (c)***

At fixed support DOF = 0

$D_k = 0 + 3 + 3 + 0 = 6$

(Considering axial deformation)

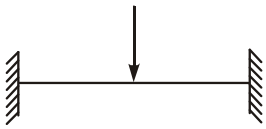
$= 6 - 3 = 3$

(neglecting axial deformation)

12. ***Ans. (c)***

Similar to question no. 02

13. ***Ans. (b)***



Total number of reactions = 2 + 2 = 4

Equilibrium equation with lateral load only = 2

D_{Se} = External indeterminacy

$= R_e$ – equilibrium equation

$= 4 - 2 = 2$

D_{Si} = Internal indeterminacy = 0

$\therefore$ Total static indeterminacy

$D_S = D_{Se} + D_{Si}$

$= 2 + 0$

$= 2$

14. ***Ans. (b)***

$D_k = 0 + 3 + 3 + 0$

$= 6$ (with axial deformation)

$= 6 - 3 = 3$

(neglecting axial deformation)

15. ***Ans. (d)***

$D_S = R_e + m - 2j$

$= 6 + 12 - 2 \times 9$

$= 0$

The supports A, B, I will give stability to the given truss. For the central portion 'HCD'

No. of members m = 12

No. of joints = 9

$D_k = 2j - R_e$

$= 2 \times 9 - 6 = 12$

Hence the given truss is statically determinate. As different joints have Degrees of freedom it is kinematically indeterminate.

16. ***Ans. (a)***

17. ***Ans. (a)***

18. ***Ans. (c)***

19. ***Ans. (d)***

20. ***Ans. (a)***

21. ***Ans. (d)***

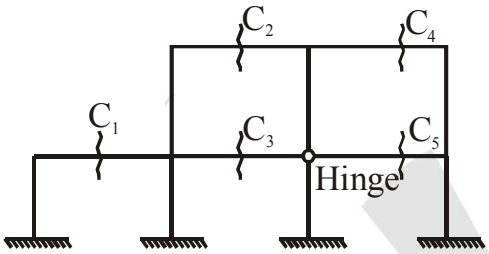
Statical indeterminancy D_s = No. of unknown force – No. of equations

For plane frame, $D_s = (3m + r) - 3n$

For space trus, $D_s = (m + r) - 3n$

For space frame $D_s = (6m + r) - 6n$

22. ***Ans. (c)***



The degree of indeterminacy

$$D_S = R_e + (3m - r_r) - 3(j + j')$$

Number of external reactions

$$R_e = 3 + 3 + 3 + 3 = 12$$

Number of rigid joints,

$$j = 10$$

Number of joints at which releases are located,

$$j' = 1$$

Number of members,

$$m = 12$$

As the hinge is located at a point where 4 members meet. Hence it is equivalent to three hinges. Therefore number of releases, $r_r = 3$.

$$\therefore \quad D_S = 12 + (3 \times 12 - 3) - 3(10 + 1)$$
$$= 12 + 33 - 33 = 12$$

23. ***Ans. (c)***

24. ***Ans. (c)***

25. ***Ans. (a)***

26. ***Ans. (c)***

27. ***Ans. (c)***

28. ***Ans. (c)***

29. ***Ans. (c)***

30. ***Ans. (c)***

31. ***Ans. (b)***

32. ***Ans. (b)***

33. ***Ans. (d)***

34. ***Ans. (d)***

35. ***Ans. (d)***

36. ***Ans. (b)***

37. ***Ans. (b)***

$$D_S = R_e + (3m - r_r) - 3(j + j')$$
$$R_e = 3 + 2 + 2 = 7$$
$$m = 15$$
$$r_r = 0$$
$$j = 12$$
$$j' = 0$$
$$\therefore \quad D_S = 7 + 3 \times 15 - 3 \times 12$$
$$= 16$$

38. ***Ans. (a)***

39. ***Ans. (a)***

40. ***Ans. (b)***

41. ***Ans. (c)***

42. ***Ans. (c)***

43. ***Ans. (b)***

44. ***Ans. (c)***

45. ***Ans. (d)***

46. ***Ans. (c)***

47. ***Ans. (a)***

48. ***Ans. (a)***

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