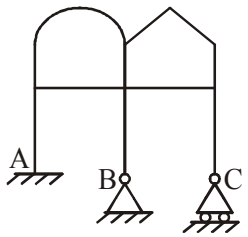
# QUESTION BANK

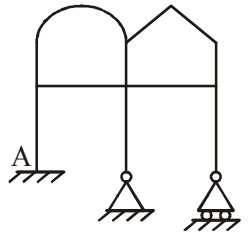
**1.** The static indeterminacy of the structure shown below




(a) 3 (b) 6

(c) 9 (d) 12

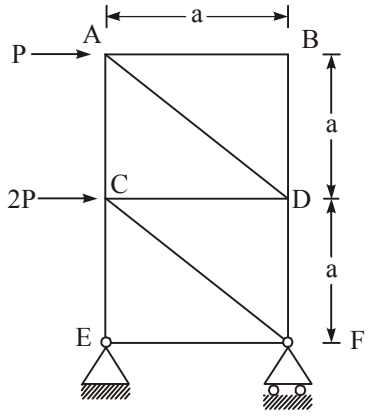
**2.** Determine the degree of freedom of the following frame




(a) 13 (b) 24

(c) 27 (d) 18

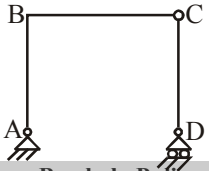
**3.** The force in the member 'CD' of the truss in fig is




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

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

**4.** The plane frame shown below is :



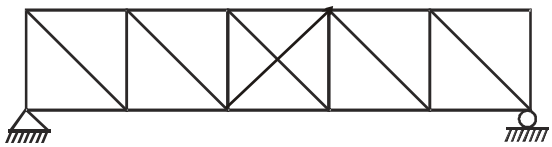

(a) statically indeterminate but unstable

(b) unstable

(c) determinate and stable

(d) none of the above

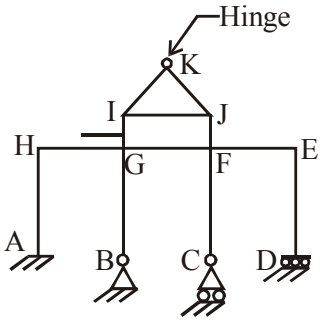
**5.** Determine static and kinematic indeterminacies for trusses



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

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

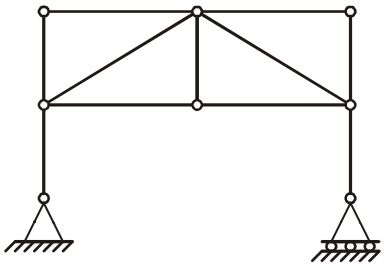
**6.** The static Indeterminacy of the structure shown below is.




(a) 4 (b) 6

(c) 8 (d) 10

**7.** The structure shown below is



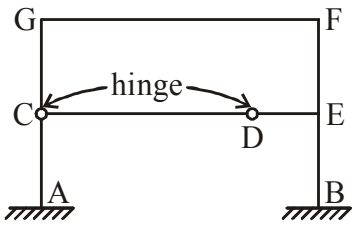
(a) externally indeterminate

(b) internally indeterminate

(c) determinate

(d) mechanism

**8.** The static Indeterminacy of the structure shown below is



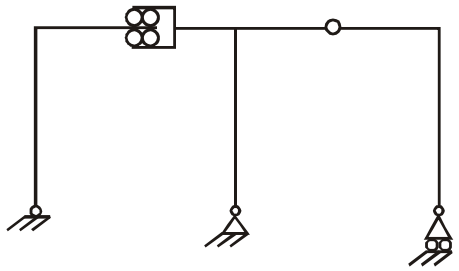

(a) unstable

(b) stable, determinate

(c) stable, indeterminate to 5th degree

(d) stable, indeterminate to 3rd degree

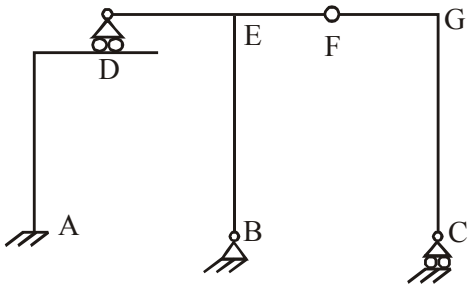
**9.** Determine the degrees of freedom of the following frame.



(a) 10 (b) 11

(c) 12 (d) 9

**10.** The plane structure shown below is



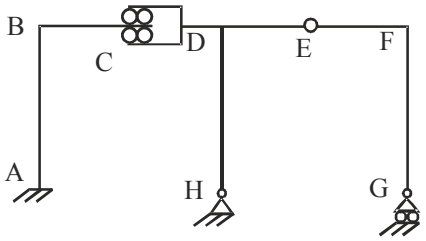

(a) stable and determinate

(b) stable and indeterminate

(c) unstable and indeterminate

(d) unstable and determinate

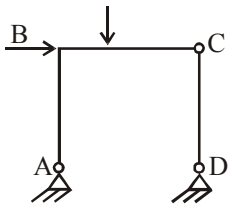
**11.** A plane frame ABCDEFGH shown in figure below has clamp supports at A and axial force release (horizontal sleeve) at 'C' and moment release (hinge) at E. The static indeterminacy of the frame is.




(a) 4 (b) 3

(c) 2 (d) 1

**12.** The plane figure shown below is



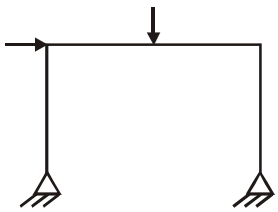

(a) Stable and statically determinate

(b) unstable and statically determinate

(c) stable and statically indeterminate

(d) unstable and statically indeterminate

**13.** The degrees of freedom of the following frames is.



(a) 3 (b) 4

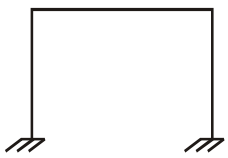
(c) 5 (d) 6

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

(a) One (b) Two

(c) Three (d) Zero

**15.** The kinematic indeterminacy of plane frame shown below is.



(a) 1 (b) 2

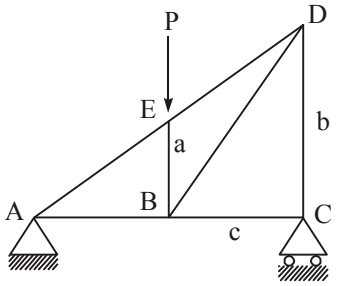
(c) 3 (d) zero

**16.** 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

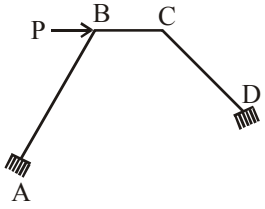
**17.** The forces in members a, b and c in the truss shown




(a) P, $\frac{P}{2}$, 0 (b) $\frac{P}{2}$, P, 0

(c) P, P, P (d) $\frac{P}{2}$, $\frac{P}{2}$, 0

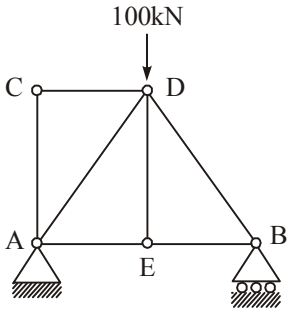
**18.** The degree of kinematic indeterminacy of the rigid frame with clamped ends at A and D shown in the figure is




(a) 4 (b) 3

(c) 2 (d) Zero

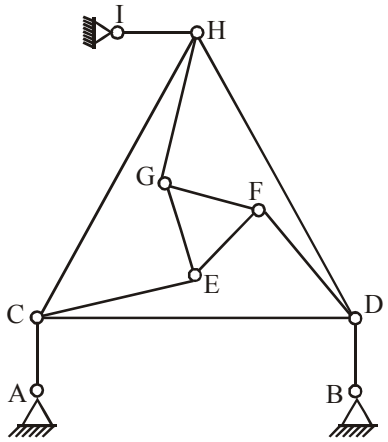
**19.** The force in the member DE of the truss shown in the figure is




(a) 100.0 kN (b) zero

(c) 35.5 kN (d) 25.0 kN

**20.** 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?

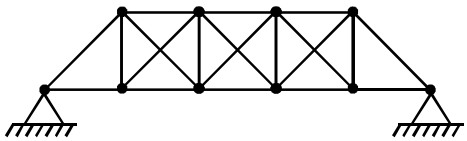
(a) Both statements are true

(b) Both statements are false

(c) II is true but I false

(d) I is true but II is false

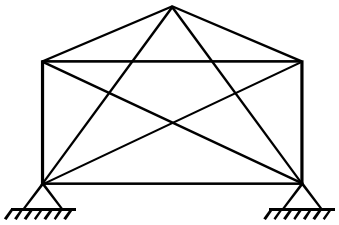
**21.** The total degree of indeterminacy (both internal and external) for the bridge truss shown in the given figure is



(a) 4 (b) 5

(c) 6 (d) 3

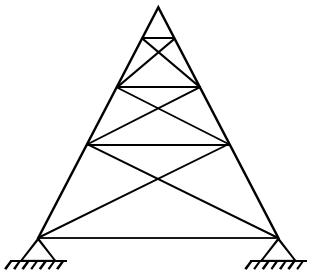
**22.** What is the degree of static indeterminacy of the plane structure as shown in the figure below?



(a) 3 (b) 4

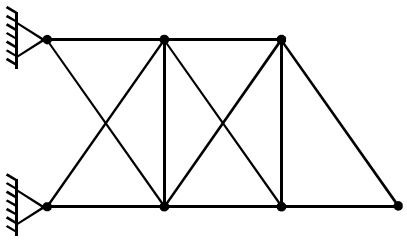
(c) 5 (d) 6

**23.** What is the total degree of indeterminacy (both internal and external) of the triangular planar truss shown in the figure below?



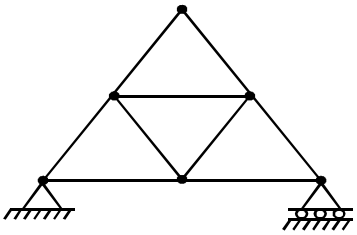
(a) 2 (b) 4
(c) 5 (d) 6

**24.** 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

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

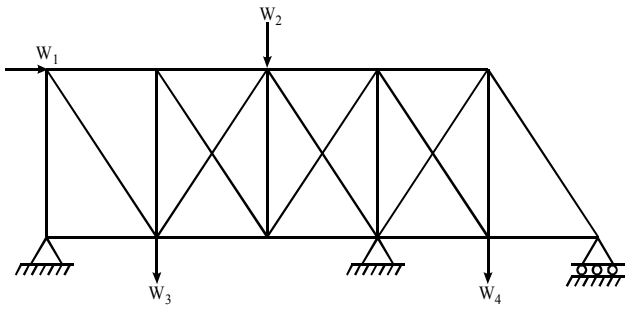


1. The frame is internally determinate and externally indeterminate.
2. The frame is internally indeterminate and externally determinate.
3. The frame is internally as well as externally determinate.
4. The frame is internally as well as externally indeterminate.

Which of these statements is/are correct?

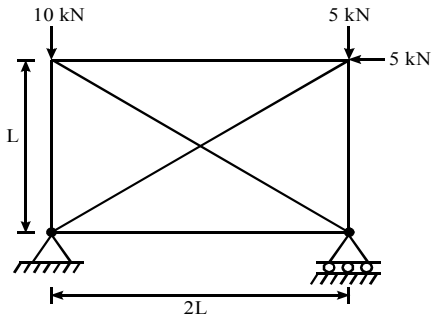
(a) 1 only (b) 1 and 2
(c) 3 only (d) 3 and 4

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




(a) 1 (b) 2
(c) 3 (d) 5

**27.** The frame shown below is redundant to




(a) single degree (b) two degree
(c) three degree (d) four degree

**28.** 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

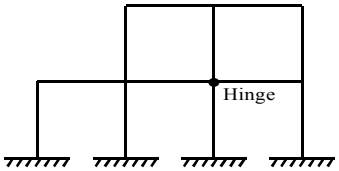
Number of external reaction elements = r

| 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 :**

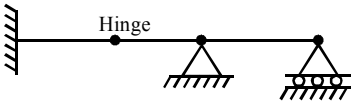
| | A | B | C |
|---|---|---|---|
| (a) | 1 | 2 | 3 |
| (b) | 4 | 3 | 2 |
| (c) | 2 | 1 | 3 |
| (d) | 4 | 1 | 2 |

**29.** 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

**30.** The degree of indeterminacy of the beam given below is




(a) zero (b) one
(c) two (d) three

**31.** Consider the following statements :

1. An indeterminate structure is not economical from material stand point in comparison to a determinate structure.
2. If 'n' redundant in a statically indeterminate structure of 'n' degree indeterminacy are removed the structure will become statically determinate but unstable.
3. In the rigid frame analysis, the axial effects are ignored as influence is negligibly small compared to bending and shear effects.

Which of these statement is /are correct?

(a) 1 only (b) 1 and 2
(c) 3 only (d) 2 and 3

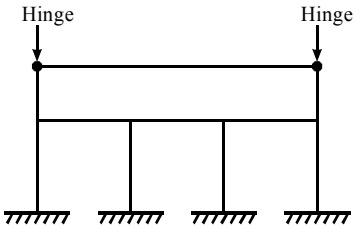
**32.** Which one of the following is true example of a statically determinate beam?

(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

**33.** The number of unknowns to be determined in the stiffness method is equal to

(a) the static indeterminacy
(b) the kinematic indeterminacy
(c) the sum of kinematic indeterminacy and static indeterminacy
(d) two times the number of supports

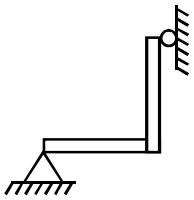
**34.** What is the total degree of indeterminacy both internal and external of the plane frame shown below?



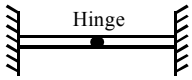

(a) 10 (b) 11
(c) 12 (d) 14

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

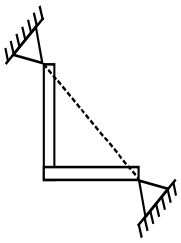
(a)



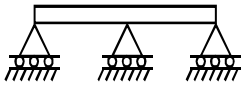
(b)



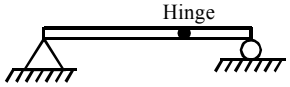

(c)



(d)



**36.** A prismatic beam is shown in the figure given below.



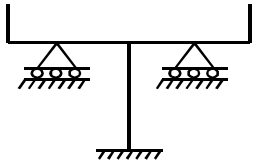

Consider the following statements :

1. The structure is unstable.
2. The bending moment is zero at supports and internal hinge.
3. It is a mechanism.
4. It is statically indeterminate.

Which of these statements are correct?

(a) 1, 2, 3 and 4 (b) 1, 2 and 3
(c) 1 and 2 (d) 3 and 4

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



(a) 4 (b) 3

(c) 2 (d) zero

**38.** 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

**39.** A statically indeterminate structure is the one which

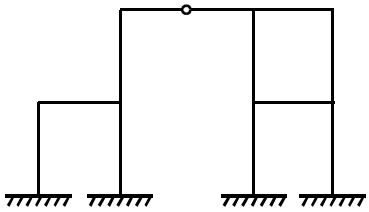
(a) cannot be analyzed at all

(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

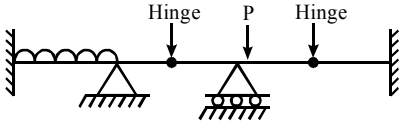
**40.** What is the statical indeterminacy for the frame shown below?



(a) 12 (b) 15

(c) 11 (d) 14

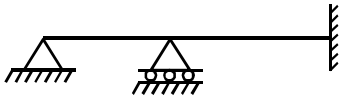
**41.** What is the total degree of indeterminacy in the continuous prismatic beam shown in the figure below?




(a) 1 (b) 2

(c) 3 (d) 4

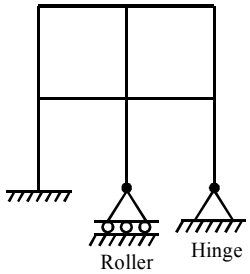
**42.** What is the number of independent degrees of freedom of the two-span continuous beam of uniform section shown in the figure below?



(a) 1 (b) 2

(c) 3 (d) 4

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




(a) 6 (b) 11

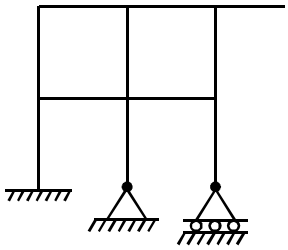
(c) 12 (d) 21

**44.** 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

**45.** 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



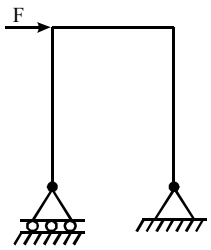
(a) d = 3 and k = 10

(b) d = 3 and k = 13

(c) d = 9 and k = 10

(d) d = 9 and k = 13

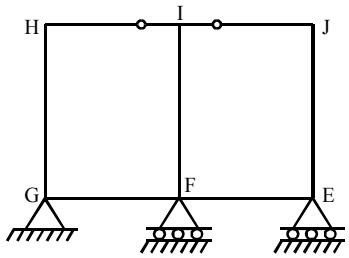
**46.** Considering beam as axially rigid, the degree of freedom of a plane frame shown below is




(a) 9 (b) 8

(c) 7 (d) 6

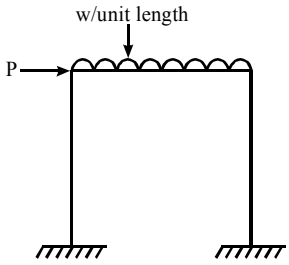
**47.** The degree of static indeterminacy of the rigid frame having two internal hinges as shown in the figure below, is




(a) 8 (b) 7

(c) 6 (d) 5

**48.** The frame shown in the given figure has




(a) one unknown reaction component

(b) two unknown reaction components

(c) three unknown reaction components

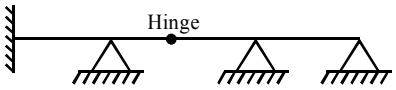
(d) six unknown reaction components

**49.** Match **List-I** (Structure) with **List-II** (Degree of static indeterminacy) and select the correct answer using the codes given below the lists :

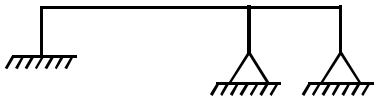
**List-I**

(A)

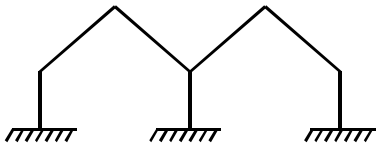
(B)




(C)



(D)



**List-II**

1. Three
2. Six
3. Two
4. Four

**Codes :**

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

**50.** 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) $n = (3-2j)$

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## 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

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

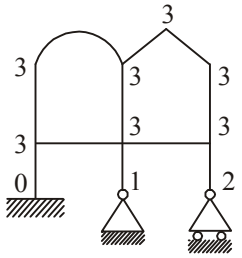
$\therefore \quad D_s = D_{se} + D_{si} = 3 + 6 = 9$

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

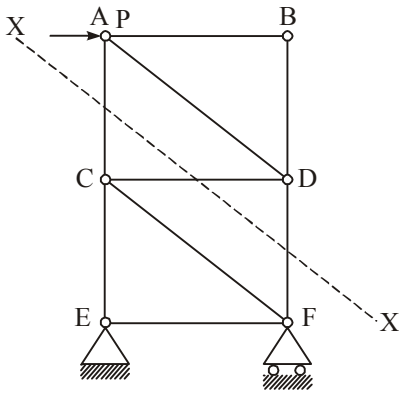
Degrees of freedom of various supports (or) joints are shown in figure

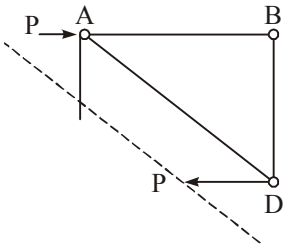
$$D_k = 0 + 3 \times 7 + (1 + 2)$$
$$= 24 \text{ (with axial deformation)}$$
$$= 24 - 11 = 13$$

(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

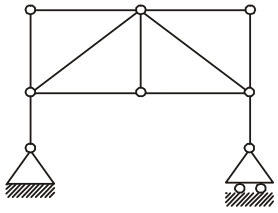
$$= 2 - 1 = 1$$

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

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

**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)***

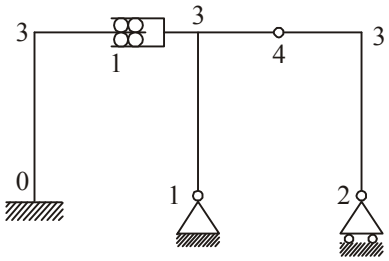
Degrees of freedom of joints are shown in figure

$D_k = 17$ (with axial deformation)

$= 17 - 7$

= 10 (neglecting axial deformation)

$D_k = 10$




**10.** ***Ans. (a)***

$D_{Se} = 3 + 2 + 1 - 3 = 3$

$D_{Si} = 0$

Force Releases at 'D' = 2

Force Releases at F = 1

$D_S = 3 + 0 - 2 - 1 = 0$

**11.** ***Ans. (d)***

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

$D_{Si} = 0$

Force release at C = 1

Force release at E = 1

$D_S = D_{Se} + D_{Si} - \text{releases}$

$= 3 + 0 - 1 - 1 = 1$

**12.** ***Ans. (a)***

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

$D_{Si} = 0$

Force Release at C = 1

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

**13.** ***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)

$= 8 - 3 = 5$

**14.** ***Ans. (c)***

At fixed support DOF = 0

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

(Considering axial deformation)

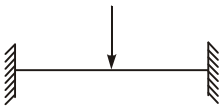
$= 6 - 3 = 3$

(neglecting axial deformation)

**15.** ***Ans. (c)***

Similar to question no. 02

**16.** ***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

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

$= 2 + 0 = 2$

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

At E, the load 'P' and member 'a' are in the same line

$\therefore \quad F_a = P$

The reaction at support 'C' is vertical

$\Rightarrow \quad F_c = 0$

**18.** ***Ans. (b)***

$$D_k = 0 + 3 + 3 + 0$$
$$= 6 \text{ (with axial deformation)}$$
$$= 6 - 3 = 3$$

(neglecting axial deformation)

**19.** ***Ans. (b)***

Analyse at joint 'E' Members AE and BE are in the same line. Hence the third force $F_{ED} = 0$.

**20.** ***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.

**21.** ***Ans. (a)***

**22.** ***Ans. (b)***

**23.** ***Ans. (b)***

**24.** ***Ans. (a)***

**25.** ***Ans. (c)***

**26.** ***Ans. (d)***

**27.** ***Ans. (a)***

**28.** ***Ans. (d)***

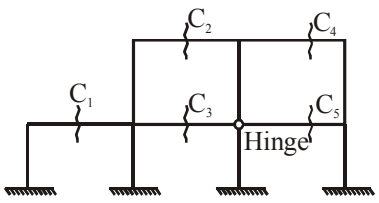
Statical indeterminancy $D_s$ = No. of unknown force – No. of equations

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

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

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

**29.** ***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, $r_r = 3$.

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

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

**31.** ***Ans. (c)***

**32.** ***Ans. (c)***

**33.** ***Ans. (b)***

**34.** ***Ans. (a)***

**35.** ***Ans. (a)***

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

**37.** ***Ans. (c)***

**38.** ***Ans. (c)***

**39.** ***Ans. (c)***

**40.** ***Ans. (c)***

**41.** ***Ans. (b)***

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

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

**44.** ***Ans. (b)***

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

**46.** ***Ans. (d)***

**47.** ***Ans. (c)***

**48.** ***Ans. (d)***

**49.** ***Ans. (d)***

**50.** ***Ans. (b)***

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