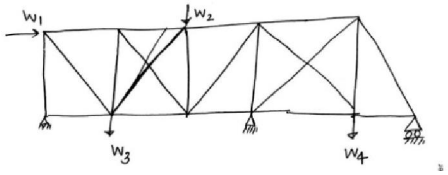
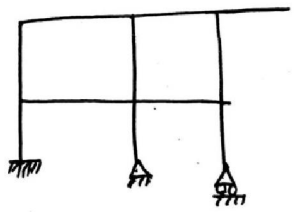
1. The degree of static indeterminacy of the pin jointed plane frame shown in figure is



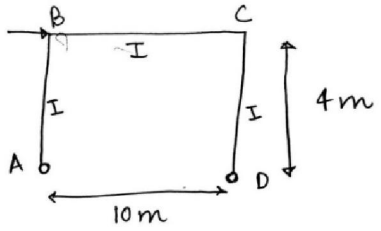
(a) 1
(b) 2
(c) 3
(d) 4

2. For the plane frame with an overhang as shown in the figure below, assuming negligible axial deformation, the degree of static indeterminacy d & degree of kinetic indeterminacy k, are



(a) d = 3 & k = 10
(b) d = 9 & k = 24
(c) d = 9 & k = 10
(d) d = 9 & k = 13

3. A portal frame is shown in figure. If $\theta_B = \theta_C = \frac{400}{EI}$ radians, then the value of moment at B will be



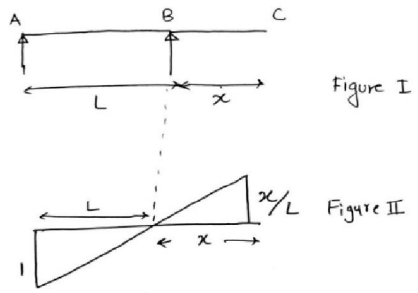
(a) 120 kNm
(b) 240 kNm
(c) 360 kNm
(d) 480 kNm

4. Which one of the following equation represents influence line of fixed end moment at B of the fixed beam AB of length l with origin at A?

(a) $\frac{x^2(l-x)}{l^2}$
(b) $\frac{x(l-x)^2}{l^2}$
(c) $\frac{x(l-x)}{l}$
(d) $\frac{x^2}{l^2}$

5. A simply supported beam is shown in figure I & figure II. An

influence line for the beam is drawn. Which of the following statements is correctly associated with the figure II?



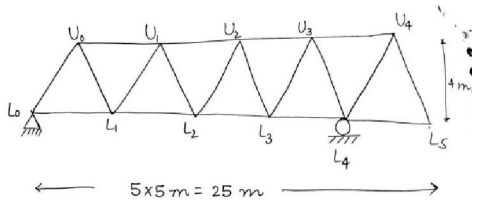
(a) Influence line for shear force at B

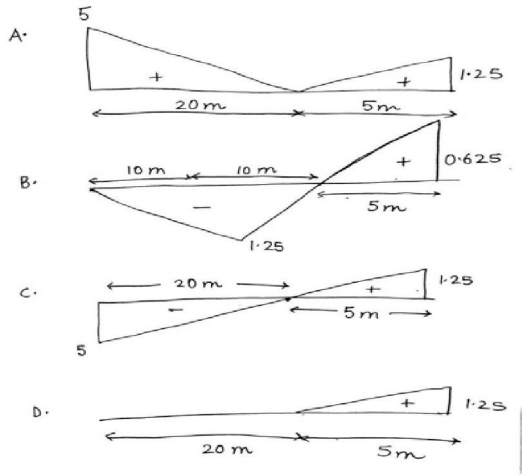
(b) Influence line for bending moment at B

(c) Influence line for vertical reaction at A

(d) Influence line for vertical reaction at B

6. A warren truss is supported as shown in the figure. Which one of the following diagrams represent the influence line for the force in member U_3U_4.





7. A cantilever is loaded as shown in the above figure. The bending moment along the length is

(a) uniform

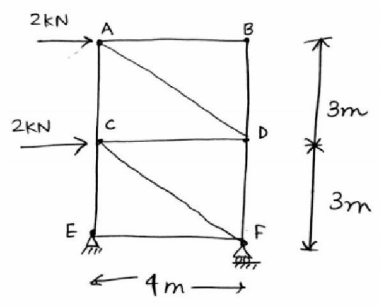
(b) uniformly varying

(c) Zero

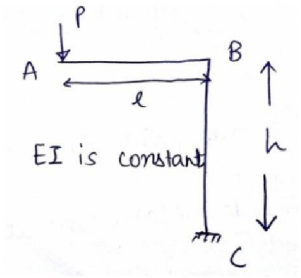
(d) concentrated at the free end

8. Consider the following statements
   1. Point of contraflexure is the point where bending moment is maximum
   2. Point of contraflexure is point where bending moment changes sign
   3. Point of contraflexure is the point where shear force is zero.

   Which of these statements is/are correct
   (a) 1, 2 & 3
   (b) 2 & 3
   (c) 2 only
   (d) 1 only
9. A pin jointed truss is loaded as shown in figure. The force induced in the member DF is



   (a) 1.5 kN (tension)
   (b) 4.5 kN (tension)
   (c) 1.5 kN (compression)
   (d) 4.5 kN (compression)
10. An elementary structural frame ABC consists of vertical member BC & a cantilever AB which carries a load P at the free end A, as shown in figure. The bending moment diagram consists of



   (a) triangle for both AB & BC
   (b) rectangle for both AB & BC
   (c) triangle for AB & rectangle for BC
   (d) rectangle for AB & triangle for BC

11. A three span continuous beam fixed at its ends and supported by 2 rigid supports in between. The order of the reduced stiffness matrix for the beam is

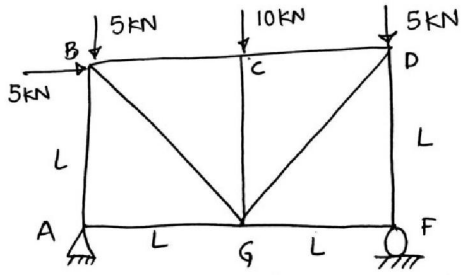
(a) [3 X 3]

(b) [1 X 1]

(c) [2 X 2]

(d) [4 X 4]

12. In the pin jointed truss as shown in figure, the horizontal deflection of roller support will be the sum of deformations in the members



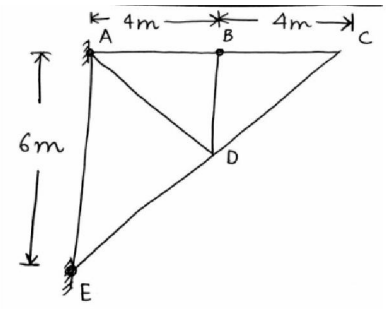
(a) BG & DG

(b) BC & CD

(c) AG & GF

(d) AB, CG & DF

13. If the member CD has been fabricated 10 mm short, by how much will point C deflect vertically in mm?



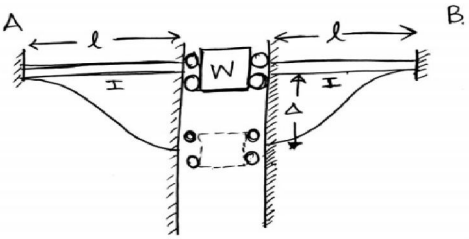
(a) 10 mm down

(b) 8.33 mm up

(c) 16.67 mm up

(d) 16.67 mm down

14. A heavy weight attached to a rod can slide in grooved support as shown. What is the equilibrium sliding distance Δ?



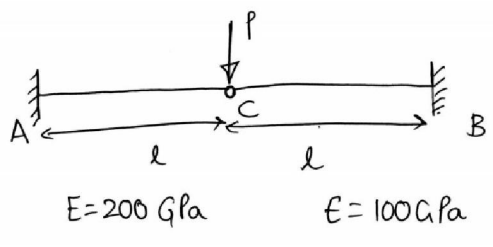
(a) $\frac{Wl^3}{3EI}$

(b) $\frac{Wl^3}{12EI}$

(c) $\frac{Wl^3}{24EI}$

(d) $\frac{Wl^3}{48EI}$

15. What is the bending moment at A for the above shown beam?



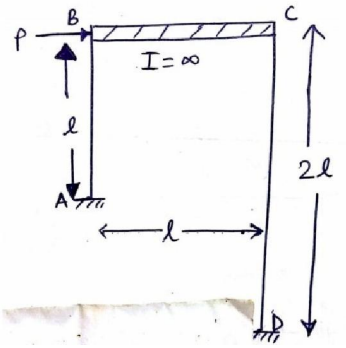
(a) $^{Pl}/_{3}$

(b) $^{3Pl}/_{2}$

(c) $^{Pl}/_{2}$

(d) $^{2Pl}/_{3}$

16. If an analysis of the frame shown in the given figure indicates final moment (-) 80 kNm at A & B of the column AB, then moment M_{CD} will be



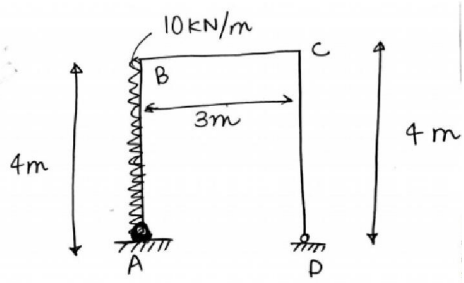
(a) -5 kNm

(b) -10 kNm

(c) -20 kNm

(d) -40 kNm

17. Consider the portal frame shown in the figure with both lower ends hinged. Which one of the following represents the equilibrium equation among horizontal forces.



(a) $M_{BC} + M_{CB} = 40$ kNm

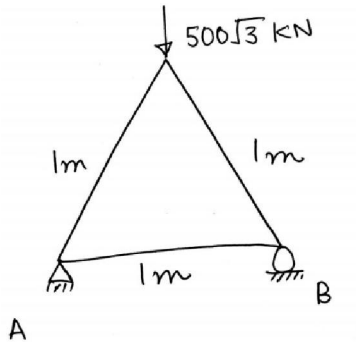
(b) $M_{BC} + M_{CB} = 20$ kNm

(c) $M_{BA} + M_{CD} = 20$ kNm

(d) $M_{BA} + M_{CD} = 40$ kNm

18. In the following pin-jointed truss the displacement of the support B due to given load?

(Cross sectional area of each member = 500 mm^2, Modulus of elasticity E = 2 X 10^5 N/mm^2)



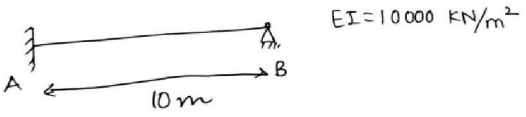
(a) 3.25 mm

(b) 2.50 mm

(c) 1.50 mm

(d) 0.50 mm

19. The beam AB shown, of the span 10 m and having uniform EI = 10000 kN/mm^2, is subjected to a rotation of 0.001 radian at end B. What is the fixed end moment at A?



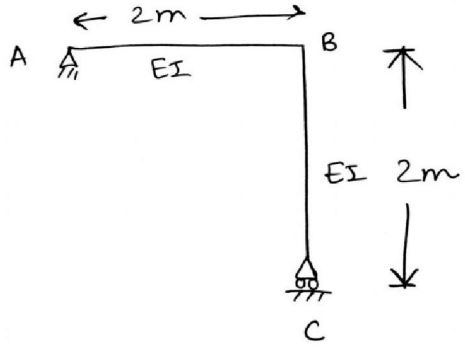
(a) 1.5 kNm

(b) 2 kNm

(c) 3 kNm

(d) 4 kNm

20. What is the force required for displaying support C horizontally through a distance Δ?



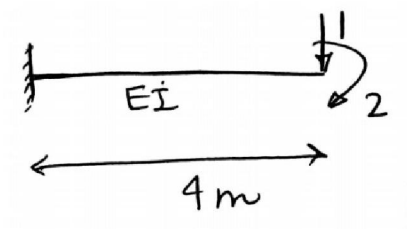
(a) $\frac{EI\Delta}{8}$

(b) $\frac{3EI\Delta}{20}$

(c) $\frac{3EI\Delta}{16}$

(d) $\frac{EI\Delta}{10}$

21. The flexibility matrix of the beam shown in the given figure is



(a) $\begin{bmatrix} \frac{64}{3EI} & \frac{-8}{EI} \\ \frac{-8}{EI} & \frac{64}{3EI} \end{bmatrix}$

(b) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{8}{EI} & \frac{-64}{3EI} \end{bmatrix}$

(c) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{8}{EI} & \frac{4}{EI} \end{bmatrix}$

(d) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{8}{EI} & \frac{4}{EI} \end{bmatrix}$

22. The stiffness matrix of the beam element is

$$\left(\frac{2EI}{l}\right)\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$$

Which one of the following is its flexibility matrix?

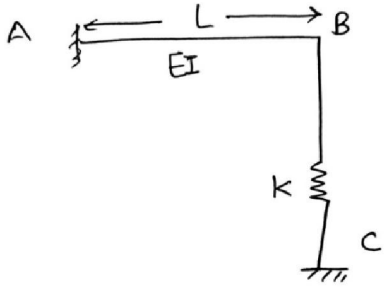
(a) $\left(\frac{L}{2EI}\right)\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

(b) $\left(\frac{L}{6EI}\right)\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

(c) $\left(\frac{L}{5EI}\right)\begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$

(d) $\left(\frac{L}{6EI}\right)\begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$

23. What is the stiffness constant associated with the system shown below when a concentrated load is placed at B?



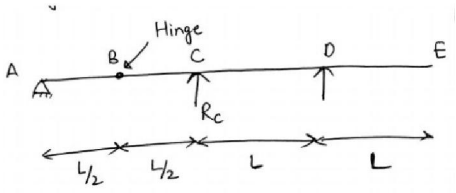
(a) $\frac{48EI}{L^3} + k$

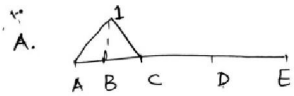
(b) $\frac{24EI}{L^3} + k$

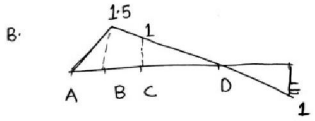
(c) $\frac{12EI}{L^3} + k$

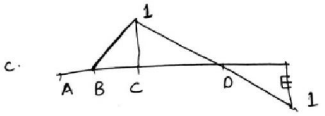
(d) $\frac{3EI}{L^3} + k$

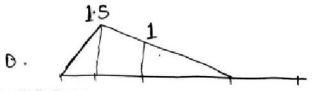
24. The influence line R_C for the beam shown in the figure will be as



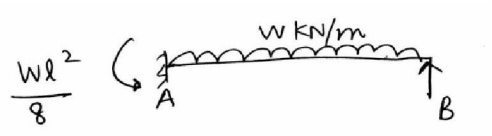








25. The propped cantilever AB carries a uniformly distributed load w kN/m. $M_A = \frac{wl^2}{8}$. What is the clockwise moment required at B to make the slope of the deflection curve equal to zero.



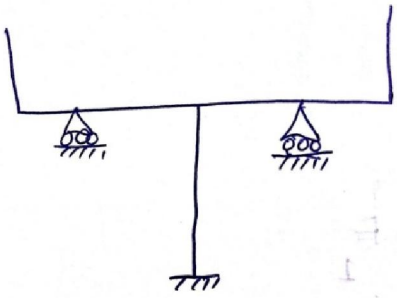
(a) $\frac{wl^2}{8}$

(b) $\frac{wl^2}{16}$

(c) $\frac{wl^2}{12}$

(d) $\frac{wl^2}{4}$

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



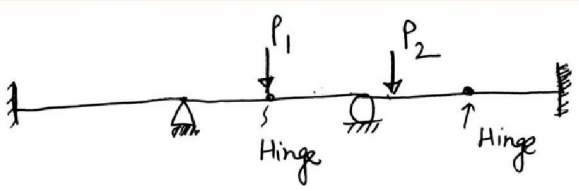
(a) 4

(b) 3

(c) 2

(d) Zero

27. What is the total degree of indeterminacy in the continuous prismatic beam shown in the given figure below.

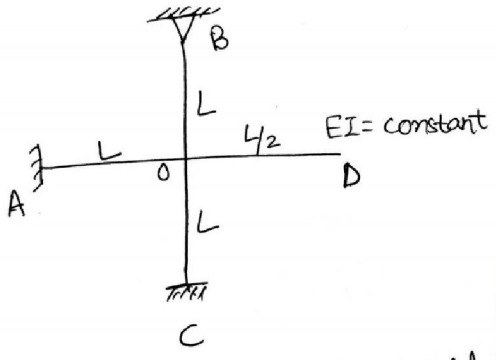


(a) 1
(b) 2
(c) 3
(d) 4

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

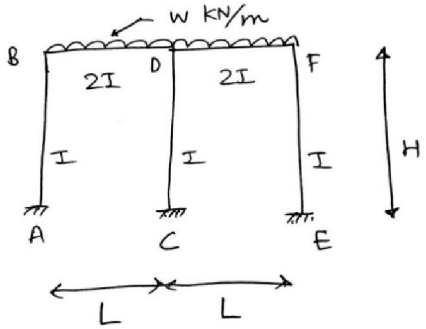
(a) $n < (2j-3)$
(b) $n = (2j-3)$
(c) $n > (2j-3)$
(d) $n = (3-2j)$

29. A steel frame is shown in the figure. If joint O of the frame is rigid, the rotational stiffness of the frame at point O is given by



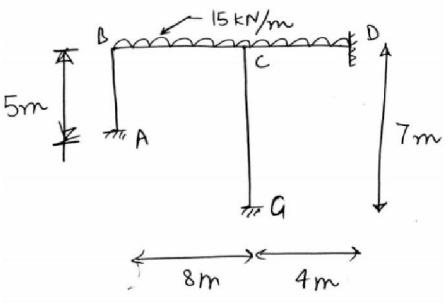
(a) $\frac{11EI}{l}$
(b) $\frac{10EI}{l}$
(c) $\frac{8EI}{l}$
(d) $\frac{6EI}{l}$

30. In the frame shown in the figure below, the value of M_{CD} will be



(a) $\frac{wl^2}{12}$
(b) $\frac{wl^2}{6}$
(c) $\frac{wH^2}{6}$
(d) zero

31. For the frame shown in the figure, the distribution factors for the members CB, CD and CG are respectively (Assume EI as constant)



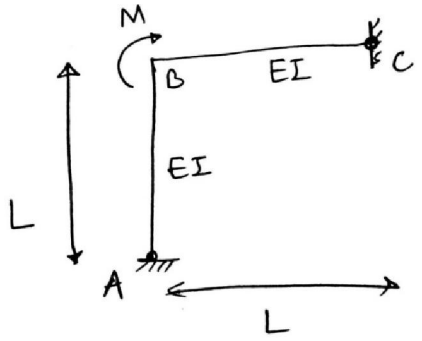
(a) $\frac{14}{29}, \frac{8}{29}$ & $\frac{7}{29}$

(b) $\frac{7}{29}, \frac{14}{29}$ & $\frac{8}{29}$

(c) $\frac{7}{29}, \frac{8}{29}$ & $\frac{14}{29}$

(d) $\frac{14}{29}, \frac{7}{29}$ & $\frac{8}{29}$

32. What is the rotation of the member at C for a frame shown in the figure below?



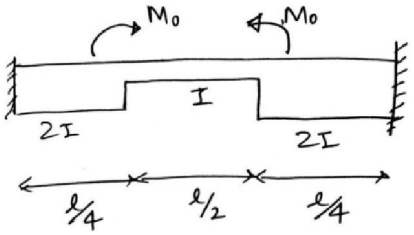
(a) $\frac{ML}{3EI}$

(b) $\frac{ML}{4EI}$

(c) $\frac{ML}{6EI}$

(d) $\frac{ML}{12EI}$

33. What is the fixed end moment for the beam shown in the given figure below?



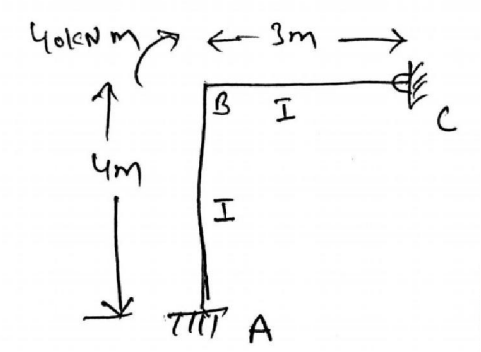
(a) M_0

(b) $\frac{2M_0}{3}$

(c) $\frac{M_0}{3}$

(d) $\frac{M_0}{6}$

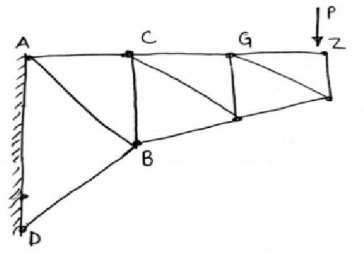
34. What is the most appropriate method of analysis of a skeletal plane frame shown in the given figure below?



(a) 5 kNm
(b) 10 kNm
(c) 12.33 kNm
(d) 15 kNm

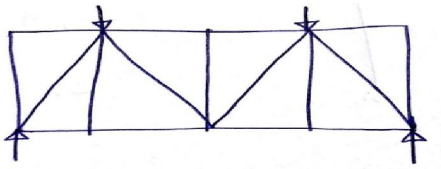
35. A cantilever pin-jointed truss carries one load P at the point Z as shown in figure. The hinges in the vertical wall are at A and D. The truss has only 3 horizontal members AC, CG & GZ.

The nature of the force in the member AB is



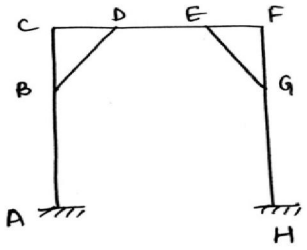
(a) Tensile
(b) Zero
(c) Compressive
(d) Cannot be predicted

36. In the plane truss shown below, how many members have zero force.



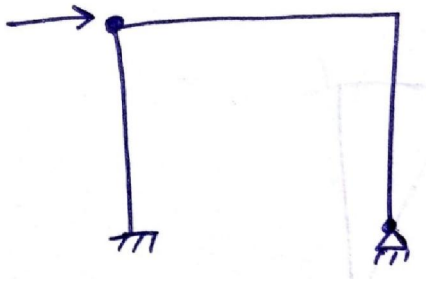
(a) 3
(b) 5
(c) 7
(d) 9

37. The degree of static indeterminacy of the rigid frame shown below is (where BD & EG are cables)



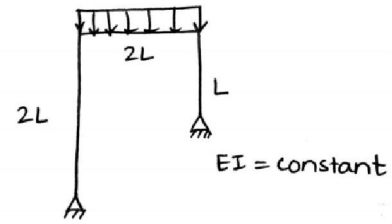
(a) 3
(b) 4
(c) 5
(d) 6

38. Kinematic indeterminacy of the frame shown below is

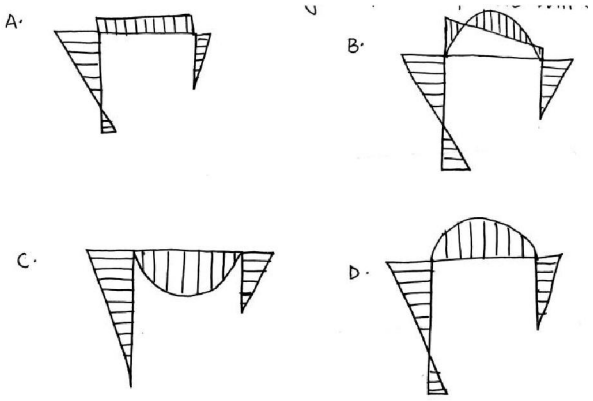


(a) 4
(b) 6
(c) 8
(d) 10

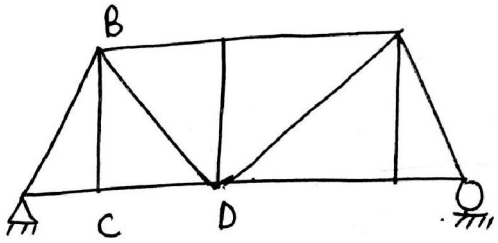
39. The given figure shows a portal frame with loads.



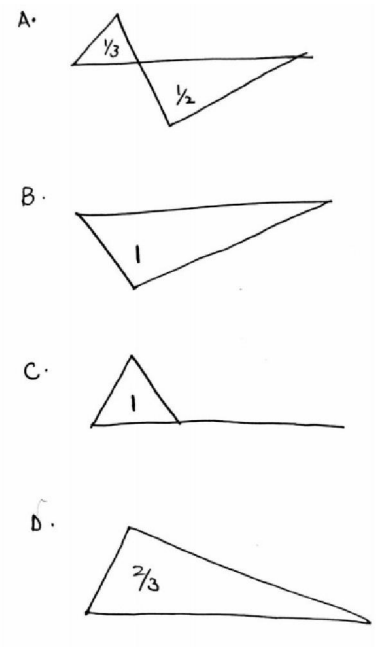
The bending moment diagram for this frame will be :



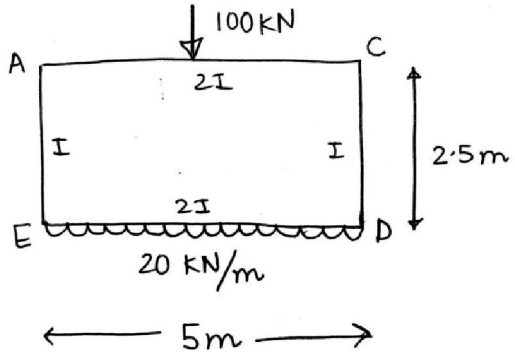
40. The given figure shows a pratt truss.



The influence line for force in the member BC will be :



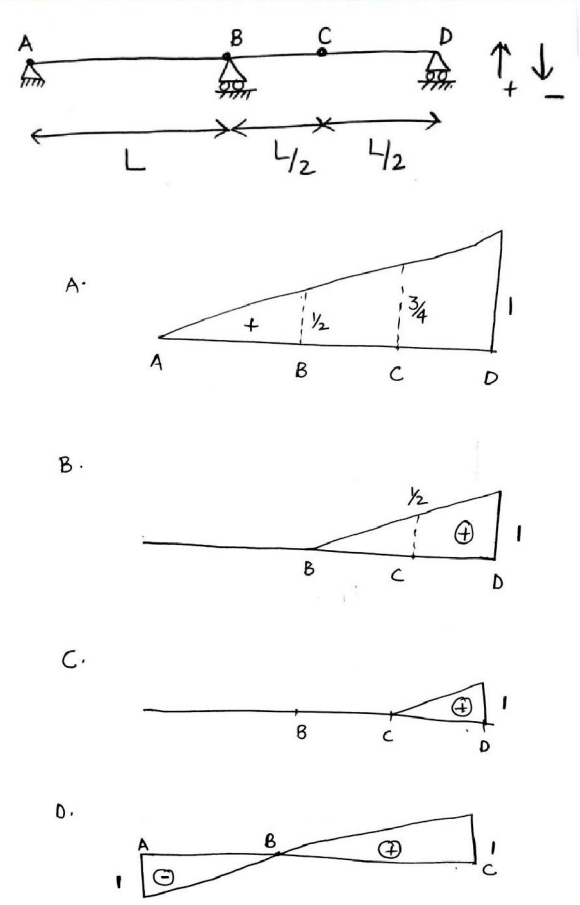
41. Which of the following gives the distribution factors for members AE and AC of the box section shown in the figure below.



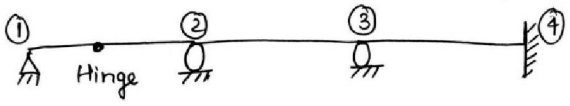
(a) 0.5 and 0.5 (b) 0.33 and 0.67

(c) 0.67 and 0.33 (d) zero and 1

42. For the continuous beam shown in figure, the influence line diagram for support reaction D is best represented as :



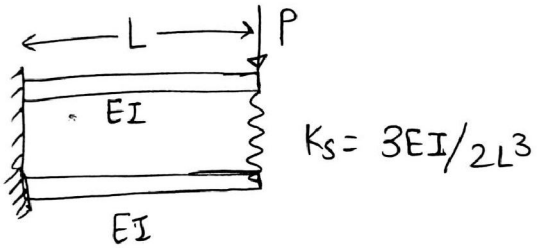
43. The kinematic indeterminacy of the beam given below is :



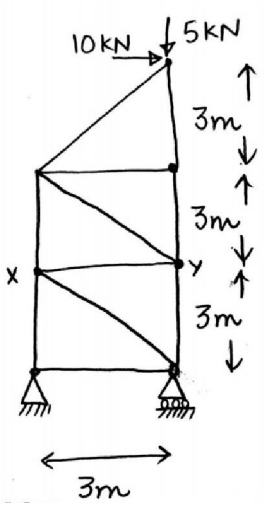
(a) 5 (b) 9

(c) 14 (d) 15.

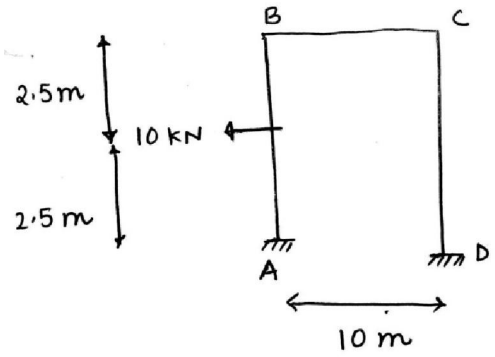
44. Two beams are connected by linear spring as shown in the following figure. For a load P as shown in the figure, the percentage of applied load P carried by the spring is _____.



45. For the 2D truss with applied loads shown below, the strain energy in the member XY is _____kNm. For member XY, assume AE=30KN, where A is the area of cross-section and E is the modulus of elasticity.



46. For the portal frame shown in the given figure below, the final end moments are:



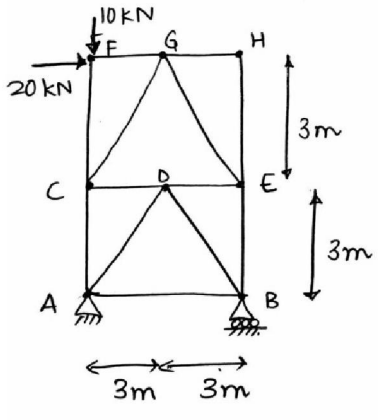
M_{AB} = 15kNm, M_{BA} = 10 kNm, M_{CD} = 20kNm

The end moment M_{DC} will be :

(a) 10kNm (b) 20kNm

(c) 30kNm (d) 40kNm

47. A loaded pin–joined truss is shown in the given figure. The forces in the member AC is :



(a) $10\sqrt{2}$ kN (tensile)

(b) $10\sqrt{2}$ kN (compressive)

(c) Zero

(d) 10kN (tensile)

48. Three wheel loads 10t, 26t, and 24t spaced 2m apart roll on a girder from left to right with the 10t load leading, the girder has a spam of 20m. for the condition of maximum bending moment at a section 8m from the left end:

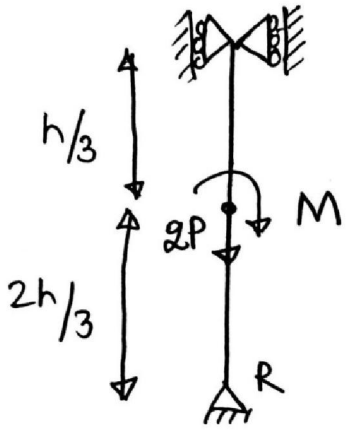
(a) the 10t load should be placed at the section.

(b) the 26t load should be placed at the section.

(c) the 24t load should be placed at the section.

(d) either 26t or 24t load should be placed at the section.

49. The sketch shows a column with a pin at the base and rollers at the top. It is subjected to an axial force P and a moment M at mid-height the reaction(s) at R is /are:



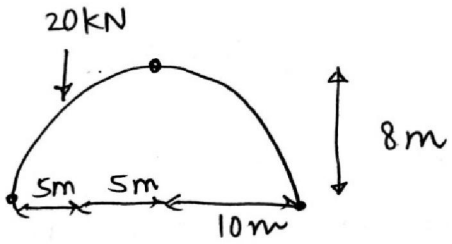
(a) Vertical force equal to $\frac{P}{3}$ and horizontal force equal to $\frac{M}{3h}$.

(b) Vertical force equal to $\frac{2P}{3}$ and horizontal force equal to $\frac{2M}{3h}$.

(c) Vertical force equal to 2P and horizontal force equal to $\frac{M}{h}$.

(d) Vertical force equal to 2p and horizontal force equal to $\frac{3M}{2h}$.

50. A 3 hinged parabolic arch having a span of 20m and a rise of 8m carries a point load of 20kN at quarter span from the left end as shown in the figure. The resultant reaction at the left support and its inclination with the horizontal are respectively.



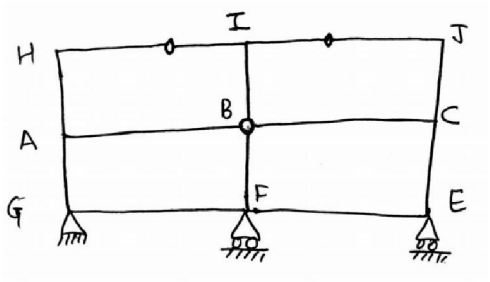
(a) 9.01 kN and 56.31°

(b) 9.01 kN and 33.69°

(c) 7.50 kN and 56.31°

(d) 16.25 kN and 67.38°

51. The degree of static indeterminacy of the rigid frame having 3 internal hinges as shown in the figure below, is:



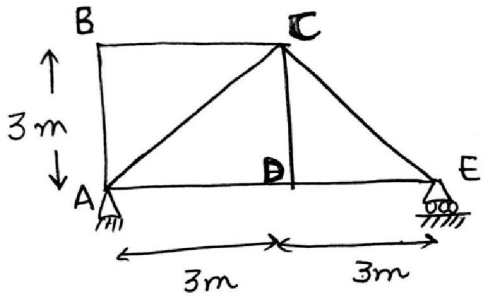
(a) 8

(b) 7

(c) 6

(d) 5

52. The member AB and BC of the truss are subjected to a temperature rise of 35°C. the coefficient of thermal expansion of steel is 0.000012 per °C unit length. The displacement of the joint B relative to joint D along the direction BD of the truss is.



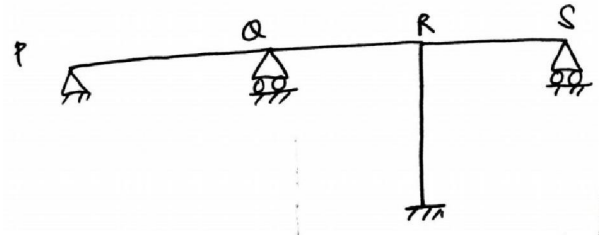
(a) 0.891 mm

(b) 0.589 mm

(c) 0.764 mm

(d) 0.255 mm

53. The spans to be loaded uniformly for maximum positive (upward) reaction at support P,as shown in the figure below is:



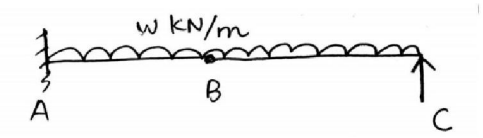
(a) PQ only

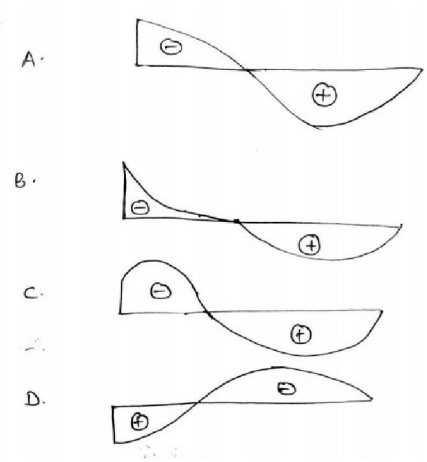
(b) PQ and QR

(c) QR and RS

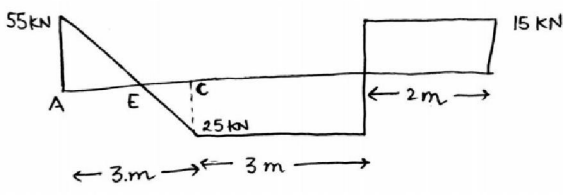
(d) PQ and RS

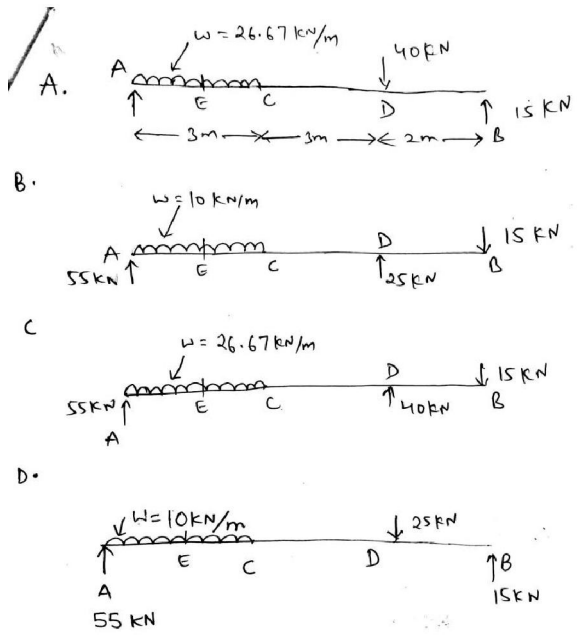
54. What is the bending moment diagram for the given loading below.





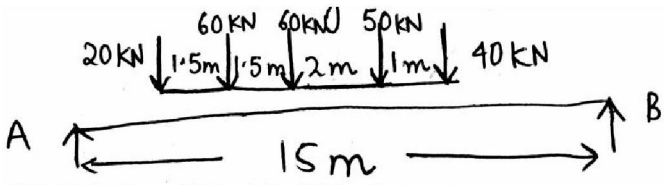
55. The shear force diagram for the beam is given above. The loading diagram for the beam is :



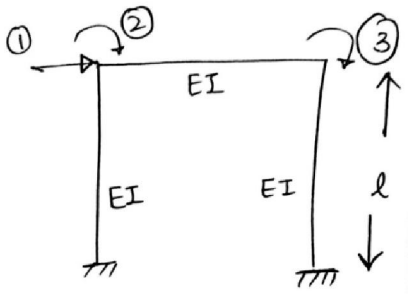


56. The system of concentrated loads shown in figure rolls from left to right on the girder of span 15m,40kN load leading. For a section 4m from left support, determine the maximum bending moment

(kNm)_____.

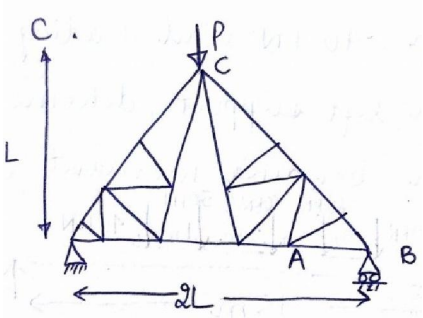


57. Stiffness matrix for the rigid frame with respect to the given coordinates is generated. What is the value of k_{23}?



(a) 8EI/l
(b) 6EI/l
(c) 4EI/l
(d) 2EI/l

58. A truss is shown in the figure. Members are of equal cross-section A and same modulus of elasticity E. A vertical force P is applied at point C.



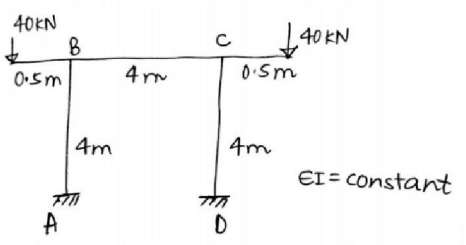
Force in the member AB of the truss is.

(a) $\frac{P}{\sqrt{2}}$
(b) $\frac{P}{\sqrt{3}}$

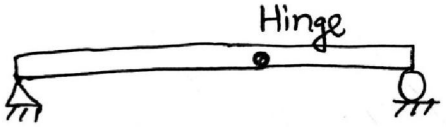
(c) $\frac{P}{2}$

(d) P

59. The bending moment at fixed support A _____kNm.



60. 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

ANSWER KEY

STRUCTURAL ANALYSIS

1	D	
2	D	
3	B	
4	A	
5	C	
6	D	
7	A	
8	C	
9	C	
10	C	
11	C	
12	C	
13	D	
14	C	
15	D	
16	C	
17	B	
18	B	
19	B	
20	C	
21	C	
22	B	
23	D	
24	B	
25	C	
26	C	
27	B	
28	B	
29	A	
30	D	
31	C	
32	A	
33	B	
34	B	
35	C	
36	D	
37	C	
38	C	
39	B	
40	C	
41	A	
42	C	
43	B	
44	25	
45	5	
46	B	
47	C	
48	B	
49	C	
50	D	
51	A	
52	A	
53	D	
54	B	
55	C	
56	(533.95)	530 to 535
57	D	
58	C	
59	(6.67)	6.5 to 6.7
60	B	