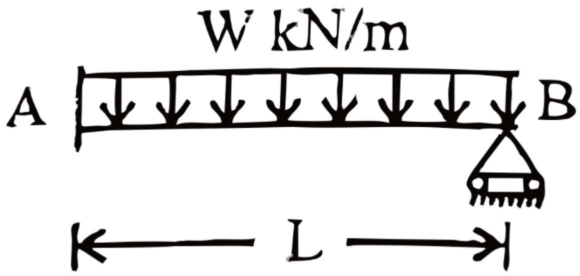
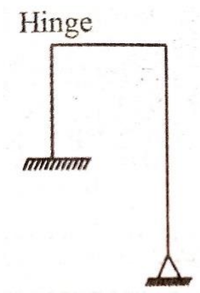
Q1. In the propped cantilever beam carrying a uniformly distributed load of W kN/m, shown in the following figure, the reaction at the support B is-



(a) $\frac{5}{8}\ WL$
(b) $\frac{3}{8}\ WL$
(c) $\frac{1}{2}\ WL$
(d) $\frac{3}{4}\ WL$

Q2. Maxwell's reciprocal theorem in structural analysis
(a) is true for any structure obeying hook's law
(b) can be applied to the rotations caused by flexure, shear or torsion
(c) is useful in analyzing indeterminate structure
(d) all of these

Q3. For the plane frame as shown in the figure, the degree of kinematic indeterminacy neglecting axial deformation,



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

Q4. The conditions required to be satisfied for the analysis of indeterminate structure are-
(a) Equilibrium
(b) compatibility
(c) Force-displacement
(d) all of these

Q5. The total strain energy of a beam of length L, having moment of inertia of its section I, when subjected to a bending moment M is

(a) $\left(\frac{M^2}{EI}\right)^* \delta x$

(b) $\int \left(\frac{M^2}{2EI}\right)^* \delta x$

(c) $\int_0^L \left(\frac{M^2}{2EI}\right)^* \delta x$

(d) None of these

Q6. Which method not fall under the category of displacement method?

(a) Moment distribution method

(b) Slope deflection method

(c) Method of consistent deformation

(d) Kani's method

Q7. The magnitude of fixed end moment in a fixed beam of span 'l' subject to a uniformly distributed load 'W' per unit length is

(a) $W\ell/96$

(b) $W\ell^2/24$

(c) $W\ell^2/20$

(d) $W\ell^2/12$

Q8. The maximum deflection of a fixed beam carrying a central load W is equal to:

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

(b) $\frac{Wl^3}{96EI}$

(c) $\frac{Wl^3}{192EI}$

(d) $\frac{5\ Wl^3}{384\ EI}$

Q9. Static indeterminacy of a beam fixed at both the ends is:

(a) 6

(b) 3

(c) 2

(d) 1

Q10. Find the horizontal thrust in tonnes when a symmetrical parabolic arch of span 25 meters rise to 3 meters is hinged at the springing.

Given uniformly distributed load = 5 tonnes per meter run of the span.

(a) 129 t

(b) 130 t

(c) 131 t

(d) 132 t

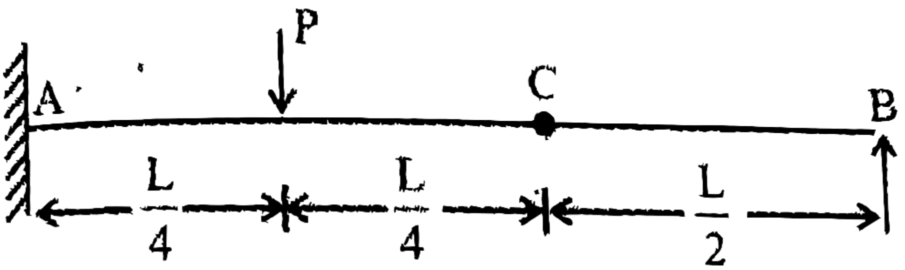
Q11. A fixed beam of length L, carries a point load W at the center. The deflection at the center is

(a) one-fourth of the deflection of simply supported beam

(b) half of the deflection for simply supported beam
(c) double the deflection for a simply supported beam
(d) none of the above

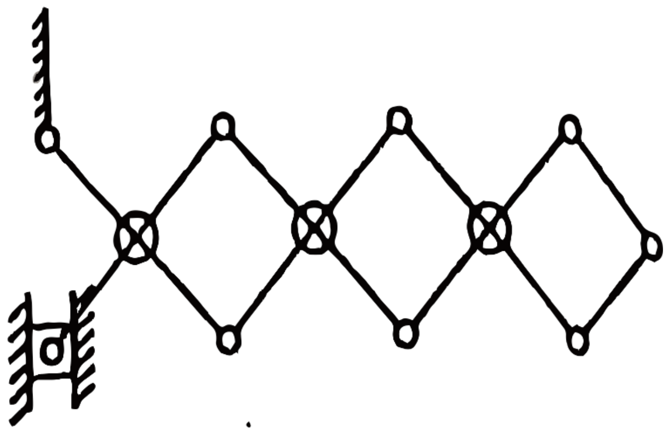
Q12. A three hinged semicircular arch of radius R carries a uniformly distributed load w per unit length on the whole span. The horizontal thrust is:
(a) wR
(b) $\frac{wR}{2}$
(c) $\frac{4}{3\pi}wR$
(d) $\frac{2}{3\pi}\ wR$

Q13. The propped cantilever beam shown in the figure is provided with a hinge at C. A and B are at the same level. The reaction at fixed end A will be:



(a) $\frac{4}{3}P$
(b) P
(c) $\frac{3}{4}P$
(d) $\frac{P}{2}$

Q14. The kinematic chain shown in the figure below is a-



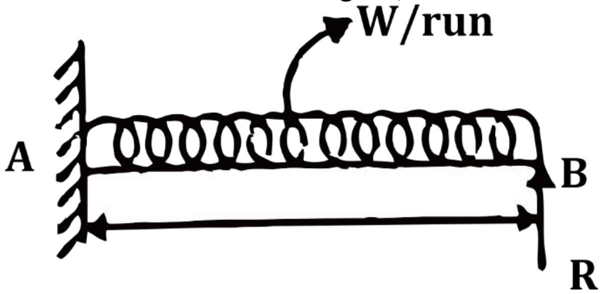
(a) Structure.
(b) Mechanism with one degree of freedom
(c) Mechanism with two degrees of freedom
(d) Mechanism with more than two degrees of freedom

Q15. The end moment of a beam of length L fixed at both ends and carrying a point load at midspan will be:
(a) 0.125 WL
(b) 0.25 WL
(c) 0.75 WL
(d) WL

Q16. A uniform beam of span 2L carrying uniformly distributed load of 3W per unit length, is rigidly fixed at both supports. Calculate it's bending moment at mid span.
(a) $WL^2/24$
(b) $WL^2/2$
(c) $WL^2/12$
(d) $WL^2/18$

Q17. The fixed support in a real beam becomes ……… support in the conjugate beam-
(a) fixed
(b) pinned
(c) roller
(d) free

Q18. For the propped cantilever beam shown in figure, the reaction R at B will be



(a) Wl/2
(b) Wl/4
(c) $\frac{5}{8}\ Wl$
(d) $\frac{3}{8}\ Wl$

Q19. If a three hinged parabolic arch carries a uniformly distributed load on its entire span, every section of the arch resists
(a) Tensile force
(b) Shear force
(c) Compressive force
(d) Bending moment

Q20. The maximum bending moment due to an isolated load in a three-hinged parabolic arch (span, l, rise h) having one of its hinges at the crown, occurs on either side of the crown at a distance
(a) $\frac{\ell}{4}$

(b) $\frac{h}{4}$
(c) $\frac{\ell}{(2\sqrt{3})}$
(d) $\frac{\ell}{(3\sqrt{2})}$

Q21. A two hinged parabolic arch of span l and rise h carries a load varying from zero at the left end to W per unit run at the right end. The horizontal thrust is:
(a) $\frac{(wl^2)}{4h}$
(b) $\frac{(wl^2)}{8h}$
(c) $\frac{(wl^2)}{12h}$
(d) $\frac{(wl^2)}{16h}$

Q22. The locus of reaction of a two-hinged semi-circular arch is
(a) Straight line
(b) parabola
(c) circle
(d) Hyperbola

Q23. There are two hinged semicircular arches A, B and C of radii 5m, 7.5 m, and 10 m respectively and each carries a concentrated load W at their crowns. The horizontal thrust at their support will be in the ratio of:
(a) 1:1½ :2
(b) 2:1½ :1
(c) 1 : 1 : 2
(d) None of these

Q24. If a three-hinged parabolic arch, (span l, rise h) is carrying a uniformly distributed load W/unit length over entire span, then
(a) horizontal thrust is $(Wl^2)/8h$
(b) shear force will be zero throughout
(c) Bending moment will be zero throughout
(d) All option are correct

Q25. The horizontal thrust on the ends of a two hinged semicircular arch of radius R carrying
(a) a uniformly distributed load w per unit run over its right half span is $(2/3)^*\ (wR/\pi)$
(b) a uniformly distributed load w per unit run over its entire span is $(4/3)^*\ (wR/\pi)$
(c) a distributed load varying from zero at the left end to w per unit horizontal run at the right end, is $(2/3)^*\ (wR/\pi)$
(d) All option are correct

Q26. A three-hinged arch is generally hinged at its supports and
(a) at one quarter span
(b) at the crown
(c) anywhere in the rib

(d) None of these

Q27. An isolated load W is acting at a distance ‘a’ from the left-hand support of a three-hinged arch of span ‘2l’ and rise ‘h’ hinged at the crown. The vertical reaction of the arch is:
(a) $\frac{Wa}{2l}$
(b) $\frac{Wl}{a}$
(c) $\frac{Wa}{l}$
(d) $\frac{W^2}{2l}$

Q28. Moment distribution method of structural analysis is applicable to:
(a) Stable but statically indeterminate structure
(b) Stable but statically determine structures
(c) unstable but statically indeterminate structure
(d) Unstable but statically determinate structures

Q29. If a point load acting at the mid span of a fixed beam of uniform section produces fixed end moment of 60 kNm, then same load spread uniformly over the entire span will produce fixed end moments equal to:
(a) 20 kNm
(b) 30 kNm
(c) 40 kNm
(d) 45 kNm

Q30. The number of plastic hinges which will cause the overall total collapse of a structure is:
(a) one more than the order of statically indeterminacy
(b) equal to order of statically indeterminacy
(c) one less than the order of statically indeterminacy
(d) non determinable

Q31. What does the influence line for Bending moment indicate?

A. Bending moment at any section on the structure for a given oppositions of load.
B. Bending moment at a given section for any position of a point load.

(a) Only A
(b) Only B
(c) Both A and B
(d) Neither A nor B

Q32. Influence line diagrams can be drawn for
(a) only beams
(b) Beams arches, trusses etc.
(c) Only arches
(d) Only trusses

Q33. The maximum bending moment in a beam under a wheel load caused by a train of moving load is

(a) when this wheel and the C.G. of the total system are equidistant from the supports of the beam.
(b) always at the center
(c) closet to CG of loads
(d) None of above

Q34. A single load of 100 kN rolls along a girder of 20 m simply supported span, the maximum bending moment is -
(a) 100 kNm
(b) 500 kNm
(c) 150 kNm
(d) 600 kNm

Q35. The maximum bending moment due to moving load on a simply supported beam, occurs
(a) at the mid span
(b) at the supports
(c) under the load
(d) everywhere along the beam

Q36. A single rolling load of 8t rolls along a girder of 15 m span. The absolute maximum bending moment will be
(a) 8t-m
(b) 15t-m
(c) 30t-m
(d) 60t-m

Q37. Influence lines usually represent the effect of which load among the following, only at a specified point on structural member?
(a) Concentrated load
(b) Uniformly distributed load
(c) Uniformly varying load
(d) moving load

Q38. The moment required to rotate the near end of a prismatic beam through unit angle, without translation, the far end being fixed is
(a) EI/L
(b) 2 EI/L
(c) 3 EI/L
(d) 4 EI/L

Q39. In slope deflection method, the joints are considered rigid when-
(a) no change in value of the angles between members
(b) 90° angle between the member in frame
(c) 180° angle between the members in beams
(d) all of these

Q40. When one end of a fixed beam deflects by δ then the bending moment at deflected end is

(a) $\frac{2EI\delta}{L^2}$

(b) $\frac{3EI\delta}{L}$

(c) $\frac{3EI\delta}{L^2}$

(d) $\frac{6EI\delta}{L^2}$

Q41. While applying moment distribution method, the sum of distribution factors of all the members meeting at any joint is always:

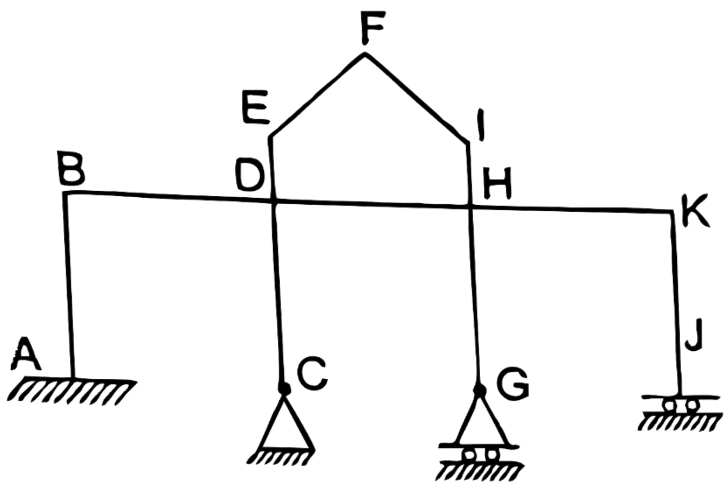
(a) Zero

(b) One

(c) Two

(d) Three

Q42.



Neglecting axial deformation, the kinematic indeterminacy of the structure shown in the above figure is

(a) 12

(b) 14

(c) 20

(d) 22

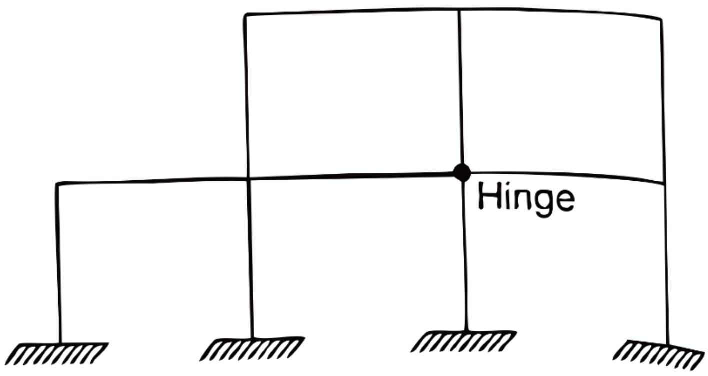
Q43. Match list I (Type of structure) with list II (Statically indeterminacy) and select the correct answer: (No. of members 'm', No of joints 'n' No. of reaction element 'r')

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

Code:

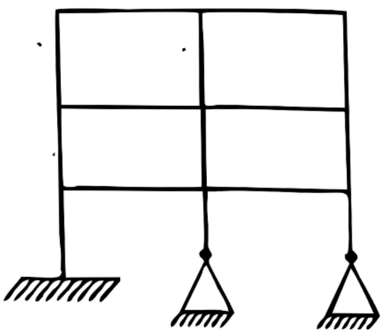
	A	B	C
(a)	1	2	3
(b)	4	3	2
(c)	2	1	3
(d)	4	1	2

Q44. Total degree of indeterminacy (both internal and external) of the plane frame shown in the given figure is



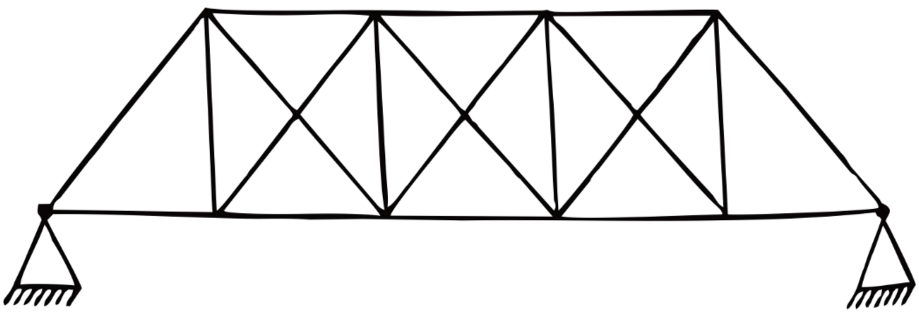
(a) 10
(b) 11
(c) 12
(d) 15

Q45. The total (both internal and external) degree of static indeterminacy of the plane shown in the given figure is



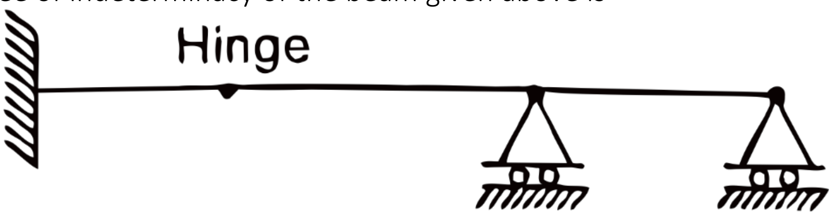
(a) 18
(b) 16
(c) 14
(d) 13

Q46. 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

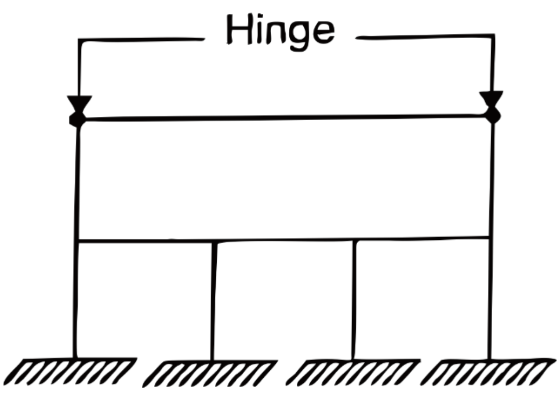
Q47. The degree of indeterminacy of the beam given above is



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

Q48. Which one of the following statement is correct? An indeterminate building frame may be converted to a determinate one by assuming
(a) hinges at mid-height of columns
(b) hinges at mid-span of the beams
(c) hinges at both mid-height of columns and midspan of beams
(d) one support as fixed at base and other support on rollers

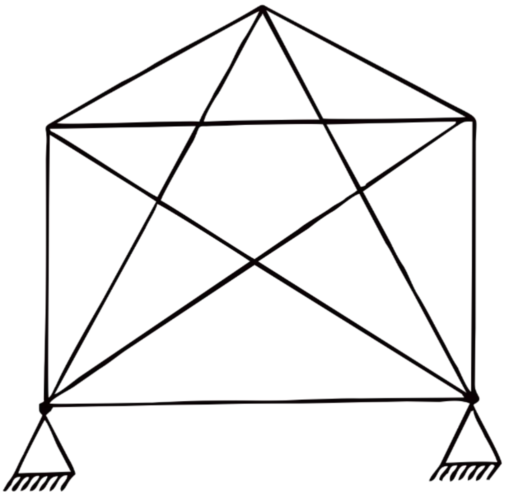
Q49. What is the total degree of indeterminacy, both internal and external of the plane frame shown below?



(a) 10
(b) 11

(c) 12
(d) 14

Q50. What is the degree of static indeterminacy of the plane structure as shown in the figure?

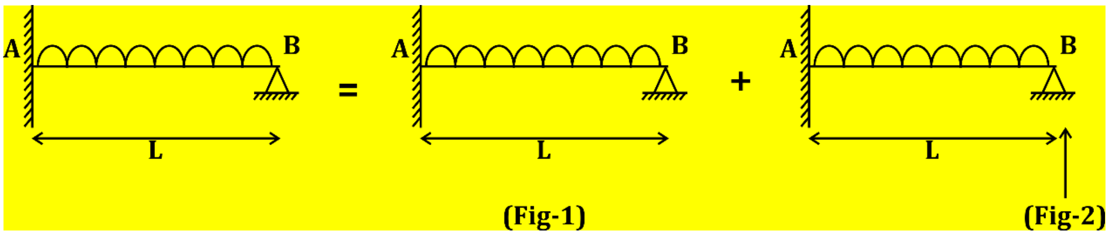


(a) 3
(b) 4
(c) 5
(d) 6

Solutions

S1. Ans.(b)

Sol.



Deflection at free end in fig(1) = $\frac{WL^4}{8EI} = \delta_1$

Deflect at support B in fig(2) = $\frac{R_B \times L^3}{3EI} = \delta_2$

For zero deflection

$$\delta_1 = \delta_2$$

$$\frac{WL^4}{8EI} = \frac{RBL^3}{3EI}$$

$$\boxed{RB = \frac{3WL}{8}}$$

S2. Ans.(d)
Sol. Maxwell's reciprocal theorem in structural analysis is true for any structure obeying Hook's law and is useful in analyzing indeterminate structure and can be applied to the rotations caused by flexure, shear or torsion.

S3. Ans.(b)
Sol. Joints (J) = 4
External Reactions (r_e)=5
Members (m) = 3
Internal hinged reaction (r_r) = 1
Degree of kinematic indeterminacy (D_k) = ?

$$D_K = 3j - r_e - m + r_r$$
$$= (3 \times 4) - 5 - 3 + 1$$
$$\boxed{D_K = 5}$$

S4. Ans.(d)
Sol. The condition required to be satisfied for the analysis of indeterminate structure are equilibrium, compatibility and force-displacement relationship.

S5. Ans.(c)
Sol. Strain energy stored due to axial load (W) is given by-

$$\boxed{u = \int_0^L \frac{W^2 dx}{2EI}}$$

Strain energy stored due to bending moment (M) is given by-

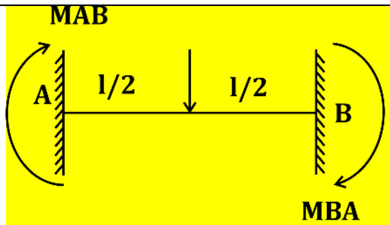
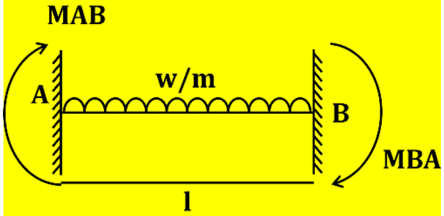
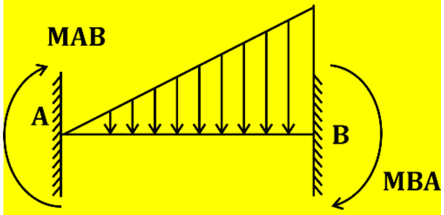
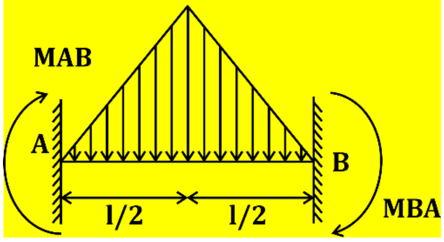
$$\boxed{U = \int_0^L \frac{M^2 dx}{2EI}}$$

dx = elemental length
EI = flexural rigidity
L = length of beam

S6. Ans.(c)
Sol. Method comes under displacement methods are-
→ slope deflection method
→ moment distribution method
→ Kani's method
→ Minimum potential energy method.

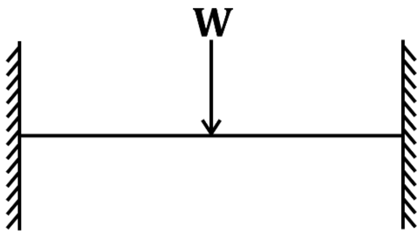
S7. Ans.(d)
Sol.

S.No.	Type of beam	Fixed end moments	
		$\overline{MAB}$`	$\overline{MBA}$

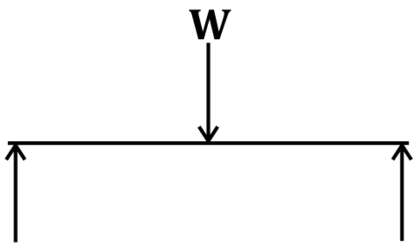
1.		$\frac{-wl}{8}$	$\frac{wl}{8}$
2.		$\frac{-wl^2}{12}$	$\frac{wl^2}{12}$
3.		$\frac{-wl^2}{30}$	$\frac{wl^2}{20}$
4.		$\frac{-5}{96}wl^2$	$\frac{5}{96}wl^2$

S8. Ans.(c)

Sol.

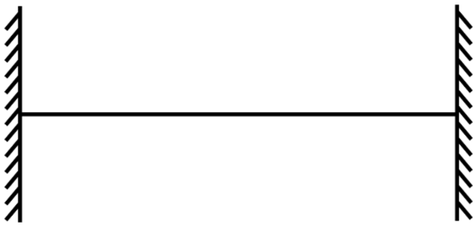


$$\boxed{Maximum\ deflection\ (\delta) = \frac{Wl^3}{192EI} = \frac{1}{4} \times deflection\ of\ simply\ supported\ beam}$$



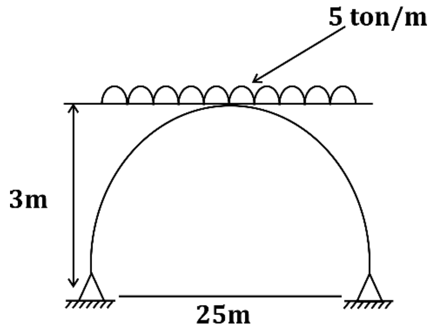
$$\boxed{Maximum\ deflection\ (\delta) = \frac{Wl^3}{48EI}}$$

S9. Ans.(b)
Sol. Fixed beam→



Static indeterminacy $(D_i) = r - 3$
$= 6 - 3$
$\boxed{D_i = 3}$

S10. Ans.(b)
Sol.



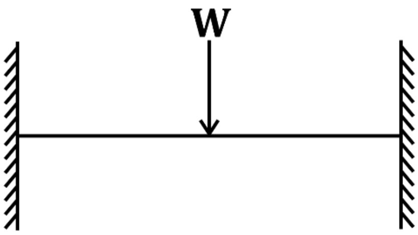
Horizontal thrust (H) in three hinged parabolic arch →

$$H = \frac{wl^2}{8h}$$

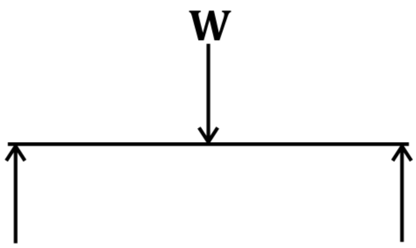
$w = 5\ ton/m$
$l = 25\ m$
$h = 3m$
$H = ?$

$$H = \frac{5 \times (25)^2}{8 \times 3}$$
$$= 130.20\ Ton$$
$$\boxed{H \approx 130\ Ton}$$

S11. Ans.(a)
Sol.

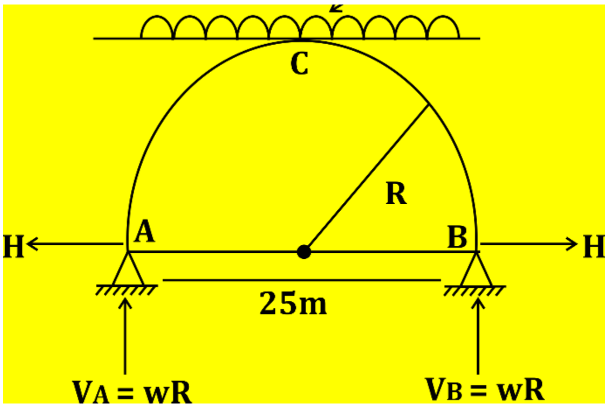


$$\boxed{Maximum\ deflection\ (\delta) = \frac{Wl^3}{192EI} = \frac{1}{4} \times deflection\ of\ simply\ supported\ beam}$$



$$\boxed{Maximum\ deflection\ (\delta) = \frac{Wl^3}{48EI}}$$

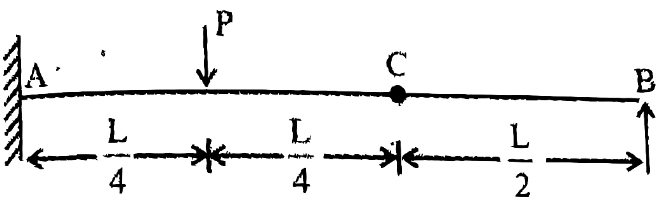
S12. Ans.(b)
Sol.



A three hinged semi-circular arch of radius R carrying a UDL over the whole span, the horizontal thrust (H) will be-

$$\boxed{H = \frac{WR}{2}}$$

S13. Ans.(b)
Sol.



We know that bending moment at internal hinge will be zero.

$$\Sigma M_C = 0$$

Right side moment about point C

$$R_B \times \frac{L}{2} = 0$$

$$\boxed{R_B = 0}$$

$$\Sigma fy = 0$$

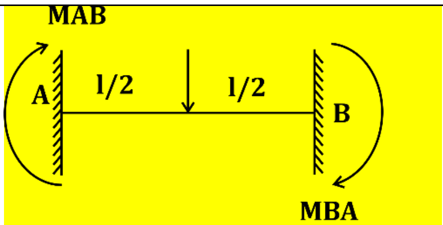
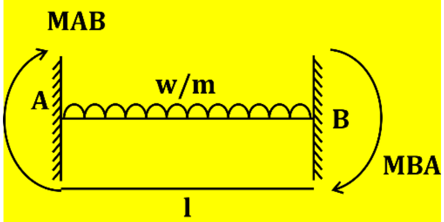
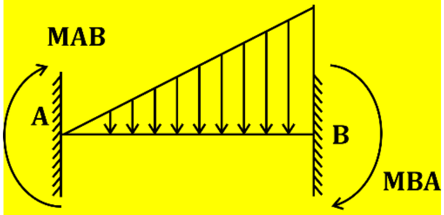
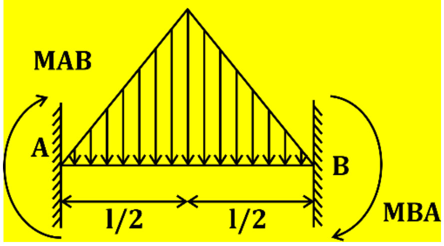
$$-P + R_A + R_B = 0$$
$$\boxed{R_A = +P}$$

S14. Ans.(b)

Sol. The kinematic chain shown in the figure is a mechanism with one degree of freedom.

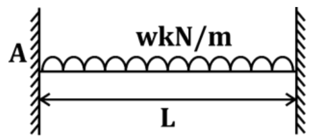
S15. Ans.(a)

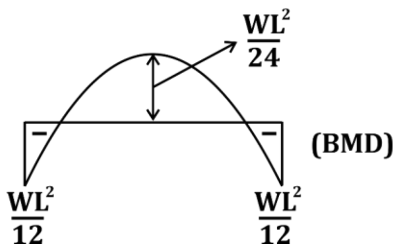
Sol.

S.No.	Type of beam	Fixed end moments	
		$\overline{MAB}$`	$\overline{MBA}$
1.		$\frac{-wl}{8}$	$\frac{wl}{8}$
2.		$\frac{-wl^2}{12}$	$\frac{wl^2}{12}$
3.		$\frac{-wl^2}{30}$	$\frac{wl^2}{20}$
4.		$\frac{-5}{96}wl^2$	$\frac{5}{96}wl^2$

S16. Ans.(b)

Sol.





Bending moment at mid span (BM) = $\frac{WL^2}{24}$

Given, $W = 3W$and L = 2L

$$BM = \frac{3W \times (2L)^2}{24}$$

$$= \frac{3W \times 4L^2}{24}$$

$$\boxed{BM = \frac{WL^2}{2}}$$

S17. Ans.(d)

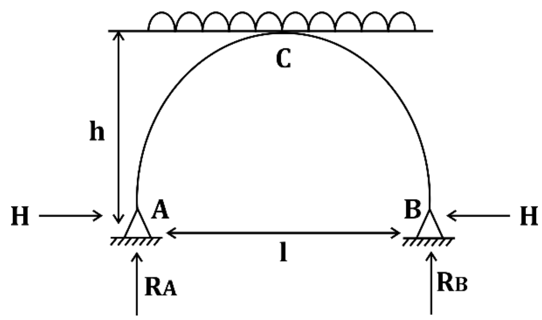
Sol. The fixed support in a real beam becomes free support in the conjugate beam.

S18. Ans.(d)

Sol. Refer sol. No. 1

S19. Ans.(c)

Sol. A three hinged parabolic arch carries a uniformly distributed load on its entire span then every section of the arch resist compressive force because there is no shear force and bending moment acting on the arch.



$$\boxed{H = \frac{wl^2}{8h}}$$

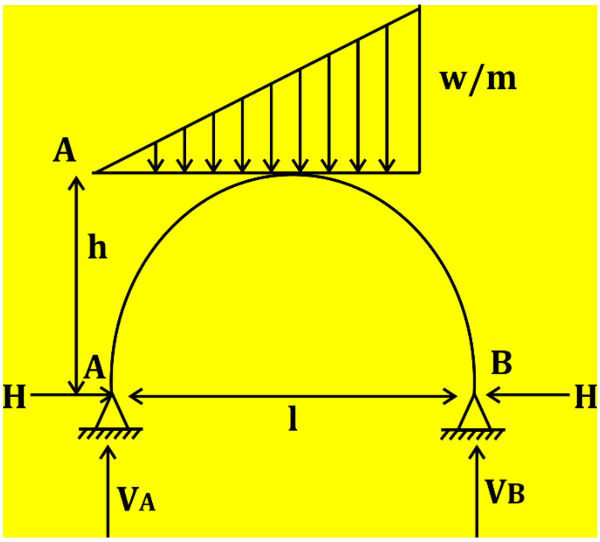
(three hinge parabolic arch)

S20. Ans.(c)

Sol. The maximum bending moment due to an isolated load in a three-hinged parabolic arch (span l, rise h) having one of its hinges at the crown, occurs on either side of the crown at a distance of $\frac{l}{2\sqrt{3}}$.

S21. Ans.(d)

Sol. When a two hinged parabolic arch carrier UVL, from zero at left end to w per unit run at the right end then horizontal thrust is given by-



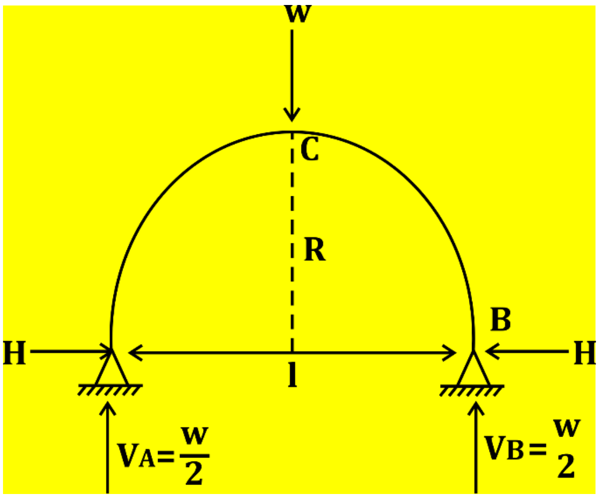
$$\boxed{H = \frac{wl^2}{16h}}$$

S22. Ans.(a)

Sol. The locus reaction of a two-hinged semi-circular arch is straight line parallel to the line joining abutments and height at $\frac{\pi R}{2}$.

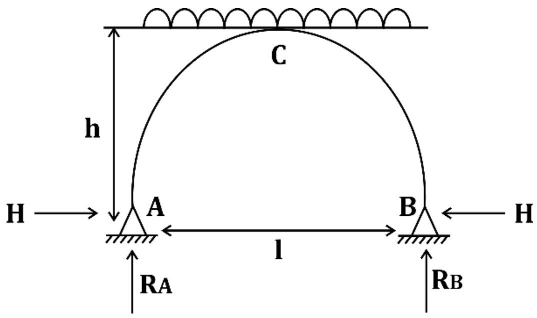
S23. Ans.(d)

Sol. If a two hinged semicircular arch of radius R carrying concentrated load 'w' at the crown then horizontal thrust is given by –



$$\boxed{H = \frac{W}{\pi}} \quad (it\ is\ independent\ from\ radius\ of\ arch)$$

S24. Ans.(d)
Sol. A three hinged parabolic arch carries a uniformly distributed load on its entire span then every section of the arch resist compressive force because there is no shear force and bending moment acting on the arch.

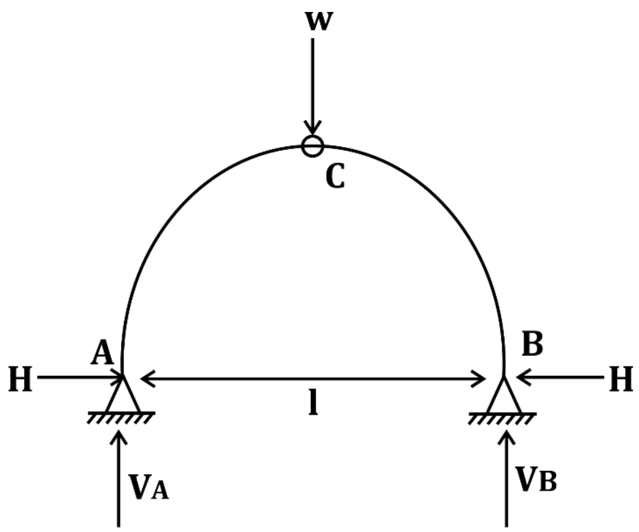


$$\boxed{H = \frac{wl^2}{8h}}$$

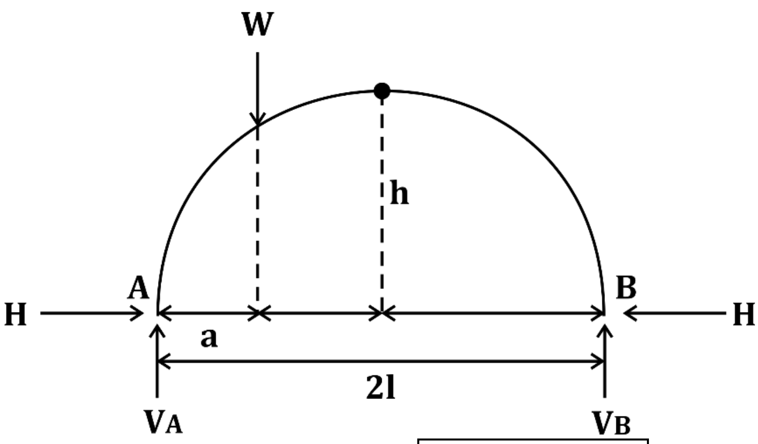
(three hinge parabolic arch)

S25. Ans.(d)
Sol. The horizontal thrust on the ends of a two hinged semicircular arch of radius R carrying
(a) a uniformly distributed load w per unit run over its right half span is $(2/3)^* \ (wR/\pi)$
(b) a uniformly distributed load w per unit run over its entire span is $(4/3)^* \ (wR/\pi)$
(c) a distributed load varying from zero at the left end to w per unit horizontal run at the right end, is $(2/3)^* \ (wR/\pi)$

S26. Ans.(b)
Sol. A three hinged arch is generally hinged at its supports and at the crown



S27. Ans.(a)
Sol.



$\boxed{V_B = \frac{wa}{2l}}$ $\boxed{V_A = \frac{W(2l - a)}{2l}}$

S28. Ans.(a)
Sol. Moment distribution method of structural analysis is applicable to stable but statically indeterminate structures.

S29. Ans.(c)
Sol. If a point load acting at the mid span of a fixed beam then fixed end moment will be

$$M = \frac{wl}{8} = 60\ kN.m\ (given) - - - (1)$$

Give, same load spread as UDL then fixed end moment will be –

$$M' = \frac{wl^2}{12}$$
$$= \frac{w \times l \times l}{12}$$
$$= \frac{Wl}{12}\ (\because W = w \times l)$$
$$\frac{1}{12} \times \frac{wl}{8} \times 8$$
$$= \frac{1}{12} \times 60 \times 8\ (\frac{wl}{8} = 60\ from\ eq^n\ (1)$$
$$\boxed{M' = 40\ kn.M}$$

S30. Ans.(a)
Sol. The number of plastic hinges is one more than the order of statically indeterminacy which will cause the overall total collapse of a structure.

S31. Ans.(b)
Sol. The influence line for bending moment indicates bending moment at a given section for any position of a point load.

S32. Ans.(b)
Sol. The influence line diagram is the graphical representation for reaction, shear force and bending moment due to moving load. It can be drawn for beams, arches, trusses etc.

S33. Ans.(a)
Sol. The maximum bending moment in a beam under a wheel load caused by a train of moving load is when this wheel and the C.G. of the total system are equidistant from the supports of the beam.

S34. Ans.(b)
Sol. The maximum bending moment due to moving load on a simply supported beam occurs under the load and it will be maximum at mid span, hence
Maximum bending moment $(M_{\max})$ = wl/4.
Given $W = 100\ kN, l = 20\ m$

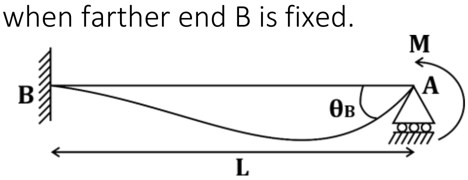
$$M_{max} = \frac{100 \times 20}{4}$$
$$\boxed{M_{max} = 500\ kN - m}$$

S35. Ans.(c)
Sol. The maximum bending moment due to moving load on a simply supported beam occurs under the load and it will be maximum at mid span, hence
Maximum bending moment $(M_{\max})$= wl/4.

S36. Ans.(c)
Sol. Given, W = 8t
L = 15 m
Maximum bending moment $(M_{max}) = \frac{wl}{4}$
$$= \frac{8 \times 15}{4}$$
$$\boxed{M_{max} = 30\ t.m}$$

S37. Ans.(d)
Sol. The influence line diagram is the graphical representation for reaction, shear force and bending moment due to moving load. It can be drawn for beams, arches, trusses etc.

S38. Ans.(d)
Sol. Stiffness of member AB when farther end B is fixed.



$$\boxed{K = \frac{4EI}{L}}$$

EI = flexural rigidity
L = Length of beam
M = moment at A
K = stiffness of AB at joint A, when farther end is fixed.

S39. Ans.(a)
Sol. In slope deflection method, the joints are considered rigid when-

(a) no change in value of the angles between members.
(b) 90° angle between the member in frame.
(c) 180° angle between the members in beams.

S40. Ans.(d)
Sol. When one end of a fixed beam deflects by δ then the bending moment at deflected end is $\frac{6EI\delta}{L^2}$.

S41. Ans.(b)
Sol. While applying moment distribution method, the sum of distribution factors of all the members meeting at any joint is always one.

S42. Ans.(b)
Sol. No. of joints (j) = 11
No. of external reactions (r_e) = 8
No. of inextensible members (m) = 11
Kinematic indeterminacy (D_k) = 3j $- r_e$ $-$m
= (3×11) – 8 – 11
$\boxed{D_k = 14}$

S43. Ans.(d)
Sol.

Type of structure	Static indeterminacy
Plane frame	3m+r-3n
Space truss	m+r-3n
Space frame	6m-r-6n

m = no. of members
n = no. of joints
r = no. of reaction element

S44. Ans.(c)
Sol. No. of members (m) = 12
No. of joints (j) = 11
No. of external reactions (r_e) = 12
Internal hinged reactions (r_r) = 3
Degree of static indeterminacy (D_S) = (3m+re) $-$3j$-r_r$
$= [(3 \times 12) + 12] - (3 \times 11) - 3$
= 48 – 36
$\boxed{D_S = 12}$

S45. Ans.(b)
Sol. No. of members (m) = 15

No. of joints (j) = 12

No. of external reactions (r_e) = 7

Internal hinged reactions (r_r) = 0

$$\text{Degree of static indeterminacy } (D_S) = (3m + r_e) - 3j - r_r$$
$$= (3 \times 15) + 7 - (3 \times 12) - 0$$
$$\boxed{D_S = 16}$$

S46. Ans.(a)

Sol.

$$\text{No. of members } (m) = 20$$
$$\text{No. of external reactions} (r_e) = 4$$
$$\text{No. of joints} (j) = 10$$
$$\text{Degree of static indeterminacy } (D_s) = m + r_e - 2j$$
$$= 20 + 4 - (2 \times 10)$$
$$\boxed{D_S = 4}$$

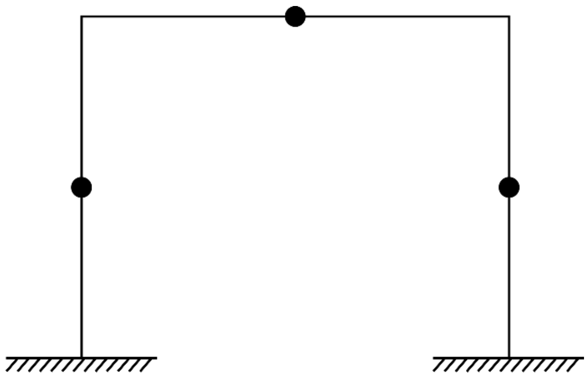
S47. Ans.(b)

Sol.

$$\text{No. of external reactions} (r_e) = 5$$
$$\text{Internal hinged reactions } (r_r) = 1$$
$$\text{Degree of static indeterminacy} (D_s) = r_e - 3 - r_r$$
$$= 5 - 3 - 1$$
$$\boxed{D_s = 1}$$

S48. Ans.(c)

Sol. an indeterminate building frame is statically indeterminate to third degree hence to make it determinate we assume hinges at both mid – height of column and midspan of beams.



S49. Ans.(a)

Sol.

$$\text{No. of members } (m) = 10$$
$$\text{No. of joints} (j) = 10$$
$$\text{No. of external reactions } (r_e) = 12$$
$$\text{Internal hinged reactions } (r_r) = 2$$
$$\text{Degree of static indeterminacy} (D_s) = (3m + r_e) - 3j - r_r$$
$$= [(3\times10) + 12] - (3\times10) - 2$$
$$= 42 - 32$$

$$\boxed{D_S = 10}$$

S50. Ans.(b)
Sol.

No. of members $(m) = 10$
No. of external reactions $(r_e) = 4$
No. of joints$(j) = 5$
Degree of static indeterminacy$(D_s) = m + r_e - 2j$
$= 10 + 4 - (2 \times 5)$
$\boxed{D_S = 4}$