# Test

## Structural Analysis

**Time: 60 Minutes**

**1.** Which of the following statements regarding statically determinate structures are correct?

I. Can be analyzed by equilibrium equations.

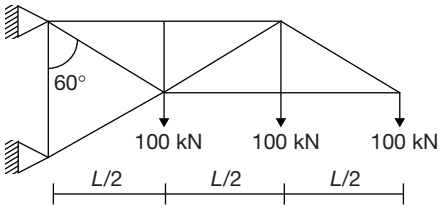
II. Stresses are caused due to temperature changes.

III. BM at a section does not depend on material or sectional properties of structure.

(A) I, II, III are correct (B) I, II are correct

(C) I, III are correct (D) II, III are correct

**2.** The pin jointed frame shown in the figure is




(A) perfect frame. (B) redundant frame.

(C) deficit frame. (D) None of these

**3.** Which of the following method comes under the category of displacement method to analyze statically indeterminate structure?

(A) Elastic center method

(B) Minimum strain energy theorem

(C) Moment distribution method

(D) Column analogy method

**4.** The cantilever beam $AB$ of length '$L$' fixed at $A$ and free at $B$ is subjected to a concentrated load '$W$' at its free end. The strain energy ($U$) stored in a beam is ($EI$: Constant)

(A) $\frac{W^2L^2}{4EI}$ (B) $\frac{WL^3}{6EI}$

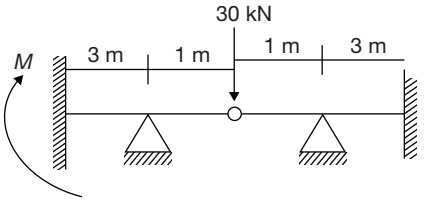
(C) $\frac{W^2L^3}{6EI}$ (D) $\frac{WL}{EI}$

**5.** The bending moment induced at fixed end of cantilever beam of span '$L$', if the free end undergoes a unit displacement without rotation, is

(A) $\frac{3EI}{L^2}$ (B) $\frac{5EI}{L^2}$

(C) $\frac{6EI}{L^2}$ (D) $\frac{4EI}{L^2}$

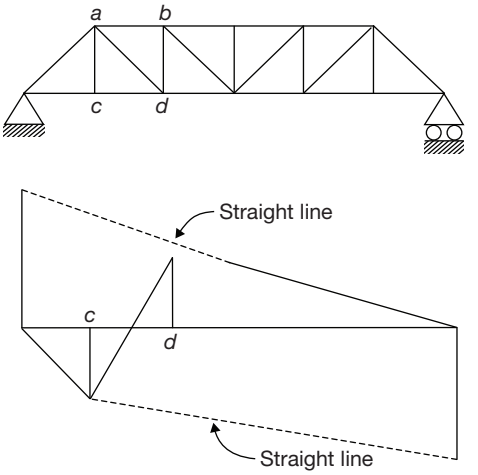
**6.** The value of support moment $M$ for the beam shown in the figure is (in kN-m)




(A) 12.5 (B) 7.5

(C) 15 (D) None of these

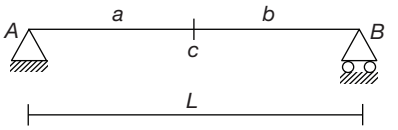
**7.** The Influence line diagram (ILD) shown is for the member _____.



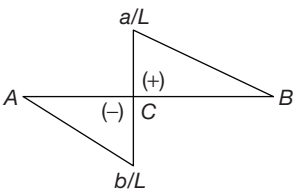

(A) $ab$ (B) $ac$

(C) $cd$ (D) $ad$

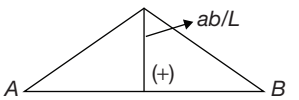
**8.** The ILD for shear force at a section '$c$' of simply supported beam of length '$L$', when unit load moves from one end to other is



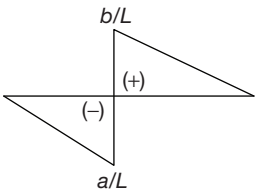

(A)



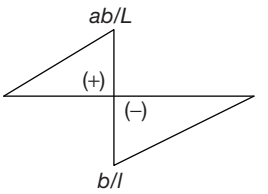

(B)




(C)




(D)



**9.** Which of the following statements are correct?

I. The stiffness coefficient $k_{ji}$ indicates force at $j$ due to a unit deformation at $i$.

II. Stiffness matrix is a square symmetric matrix.

III. Stiffness matrix is possible for both stable and unstable structures also.

(A) I, II, III are correct (B) I, II are correct

(C) I, III are correct (D) II, III are correct

**10.** Which of the following statements are correct?

I. The internal forces at any cross-section of an arch are SF, BM only.

II. The effect of arching a beam is to reduce BM in the span.

III. A two hinged arch is indeterminate by one degree.

IV. The internal forces at any cross-section of an arch are SF, BM and normal thrust also.

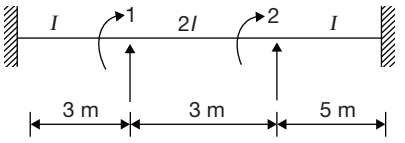
(A) I, II, III, IV are correct

(B) I, II, III are correct

(C) II, III, IV are correct

(D) I, III, IV are correct

**11.** Determine the stiffness matrix for a beam for the given coordinates shown in the figure.




(A) $\begin{bmatrix} 4EI & \frac{4EI}{3} \\ \frac{4EI}{5} & 52EI \end{bmatrix}$ (B) $\begin{bmatrix} 4EI & \frac{4EI}{3} \\ \frac{4EI}{3} & \frac{52EI}{15} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{52EI}{15} & \frac{-4EI}{3} \\ \frac{-4EI}{3} & 4EI \end{bmatrix}$ (D) $\begin{bmatrix} 4EI & \frac{+4EI}{3} \\ \frac{4EI}{3} & 4EI \end{bmatrix}$

**12.** A cable carrying a load of 40 kN/m run of horizontal span, is stretched between supports 150 m apart. The supports are at same level and the central dip is 15 m. The greatest tension and least tension in cable are

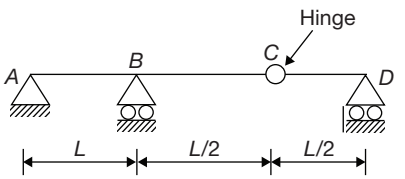
(A) 8100 kN, 7500 kN

(B) 10,000 kN, 7500 kN

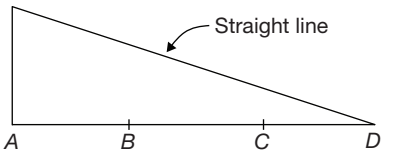
(C) 9500 kN, 6000 kN

(D) None of these

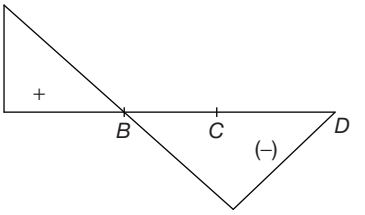
**13.** For the continuous beam shown in the figure, the ILD for reaction at $A$ is



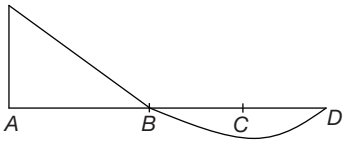

(A)




(B)




(C)



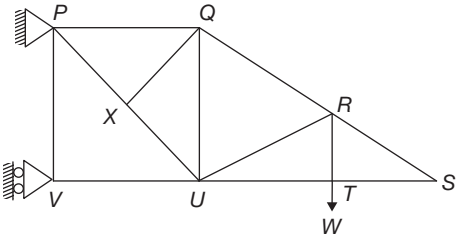

(D)


**14.** A beam $ABCD$ is 15 m long and is simply supported at $B$ and $C$, 8 m apart. Overhangs $BA$ and $CD$ are 3 m and 4 m respectively. A train of two point loads of 150 kN and 100 kN, 3 m apart, crosses the beam from left to right with 100 kN load leading. The maximum sagging BM under 150 kN load anywhere is

(A) 150 kN-m (B) 250 kN-m

(C) 360 kN-m (D) 400 kN-m

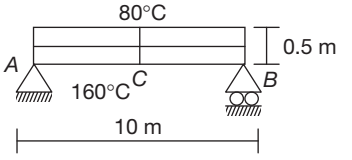
**15.** In the truss shown below, indicate how many number of members with zero forces.




(A) 4 (B) 5

(C) 6 (D) None of these

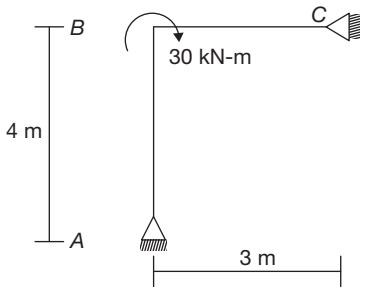
**16.** A simply supported beam of length $L = 10$ m and depth = 0.5 m is subjected to a temperature differential of 80°C at top and 160°C at bottom. Determine the vertical deflection of beam at its mid point (c) due to temperature gradient take $\alpha = 10 \times 10^{-6}$/°C.




(A) 25 mm (B) 30 mm

(C) 40 mm (D) None of these

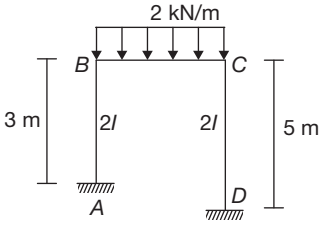
**17.** What is the rotation of the member at '*C*' for a frame as shown in the figure?




(A) $\frac{30}{3EI}$ (B) $\frac{60}{7EI}$

(C) $\frac{90}{EI}$ (D) $\frac{75}{EI}$

**18.** In the portal frame shown in the given figure, the ratio of sway moments in column *AB* and *CD* will be equal to




(A) 25/9 (B) 3/5

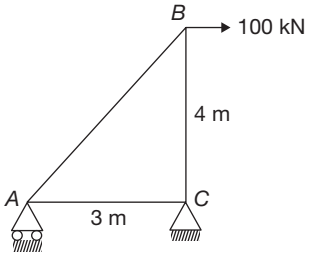
(C) 2/3 (D) 15/8

**19.** $U_1$ and $U_2$ are the strain energies stored in a prismatic bar due to axial tensile force $w_1$ and $w_2$ respectively. The strain energy '*U*' stored in the same bar due to combined action of $w_1$ and $w_2$ is

(A) $U = U_1\, U_2$ (B) $U > U_1 + U_2$

(C) $U < U_1 + U_2$ (D) $U = U_1 + U_2$

**20.** The right triangular truss is made of members having equal cross-sectional area of 1000 mm$^2$ and Youngs modulus of $2 \times 10^5$ MPa. The horizontal deflection at *B* is




(A) 15 mm (B) 20 mm

(C) 12 mm (D) None of these

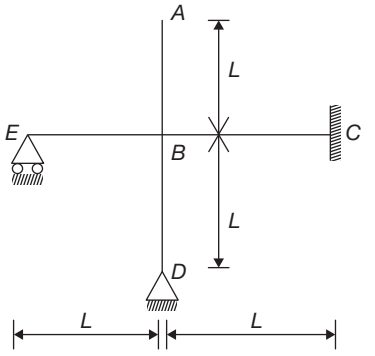
**21.** A two spans continuous beam having equal spans each of length *L*/2 is subjected to a uniformly distributed load 2*w* per unit length. The beam has constant flexural rigidity. The reaction at middle support is

(A) $\frac{3wl}{4}$ (B) $\frac{3wl}{8}$ (C) $\frac{5wl}{4}$ (D) $\frac{5wl}{8}$

**22.** Using the data in Q No 21; find the bending moment at the middle support.

(A) $\frac{wl^2}{16}$ (B) $\frac{wl^2}{4}$ (C) $\frac{wl^2}{8}$ (D) $\frac{3wl^2}{16}$

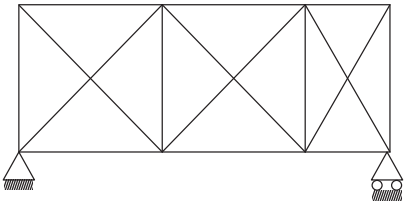
**23.** In the frame shown below; what are the distribution factors for members *BA*, *BC* and *BD* respectively?




(A) 0, 0.4, 0.6 (B) 0, 0.3, 0.7

(C) 0, 0.4, 0.3 (D) None of these

**24.** Examine the given truss below.



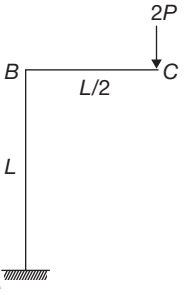
(A) Statically determinate

(B) Statically indeterminate but kinematically determinate

(C) Statically indeterminate and kinematically indeterminate

(D) Statically determinate and kinematically indeterminate

**25.** The horizontal deflection at *C* for the following frame shown below is




(A) $\frac{PL^2}{2EI}$ (B) $\frac{PL^3}{3EI}$ (C) $\frac{PL^3}{2EI}$ (D) $\frac{2PL^2}{EI}$

## Answer Keys

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** C | **2.** A | **3.** C | **4.** C | **5.** C | **6.** B | **7.** D | **8.** C | **9.** B | **10.** C |
| **11.** B | **12.** A | **13.** B | **14.** C | **15.** B | **16.** C | **17.** B | **18.** A | **19.** B | **20.** C |
| **21.** C | **22.** A | **23.** C | **24.** C | **25.** C | | | | | |