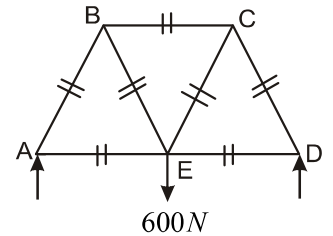
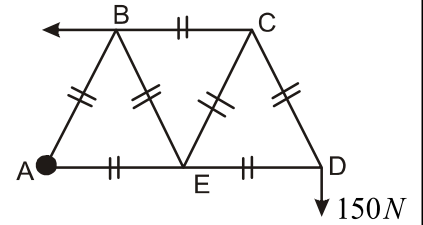


Bow's Notation

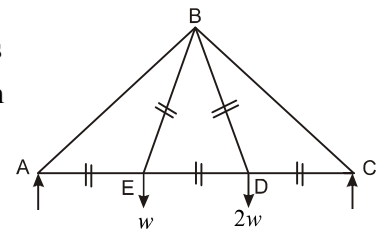
1. The frame work given below consists of seven light rods. Find the external forces and find the forces in each rod using Bow's notation distinguishing between tension and thrust.



2. The frame work given below consists of seven light rods. It is hinged at A to a vertical wall and a horizontal force is applied at B . Find the horizontal and vertical components of the reaction at A and force acting at B . Find the forces in each rod using Bow's notation distinguishing between tension and thrust.



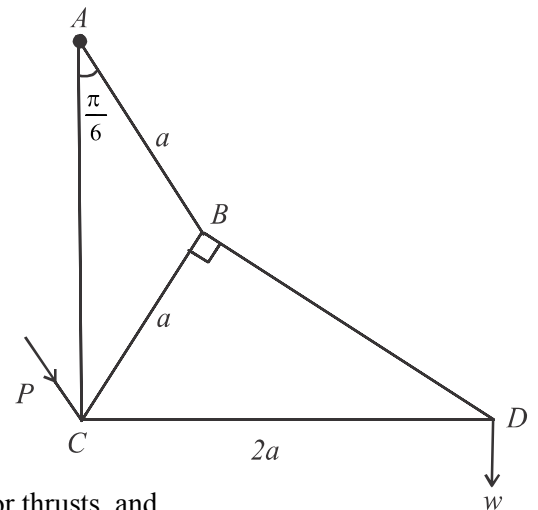
3. The frame work given below consists of seven light rods. Find the external forces and find the forces in each rod using Bow's notation distinguishing between tension and thrust.



4. Framework shown in the figure consists of five light rods AB , BC , BD , DC and AC smoothly jointed at their ends. Here, it is given that

$$AB = CB = a, CD = 2a \text{ and } \hat{BAC} = \frac{\pi}{6}.$$

Framework is smoothly hinged at A to a fixed point. A load W is suspended at the joint D , and the framework is kept in equilibrium in a vertical plane with AC vertical and CD horizontal by a force P parallel to the rod AB , applied at the joint C in the direction shown in the figure. Draw a stress diagram, using Bow's notation, for the joints D , B , and C .



Hence, find

- i. the stresses in the five rods, stating whether they are tensions or thrusts, and
- ii. the value of P .

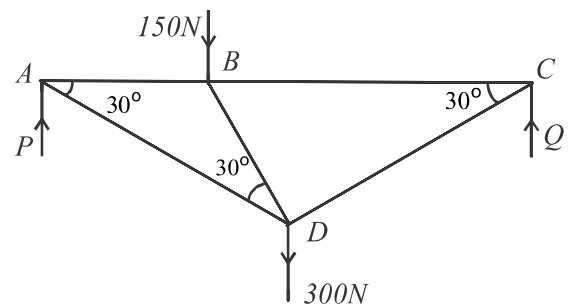
5. The figure shows a framework consisting of five light rods AB , BC , AD , BD and CD freely jointed at their ends.

$$AB = a \text{ metres and } BC = 2a \text{ metres, and } \hat{BAD} = \hat{BDA} = \hat{BCD} = 30^\circ.$$

The framework is loaded with weights $150N$ at B and $300N$ at D . It is in equilibrium in a vertical plane supported by two vertical forces P and Q at A and C respectively, so that AB and BC are horizontal.

Show that $P = 250N$.

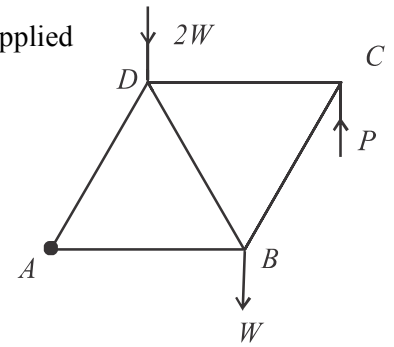
Draw a stress diagram using Bow's notation and hence, find the stresses in all the rods and state whether they are tensions or thrusts.



6. The framework shown in the adjoining figure is made from light rods AB , BC , CD , DA and BD , each of length $2a$ freely jointed at A , B , C and D . There are loads W and $2W$ at B and D respectively. The framework is smoothly hinged

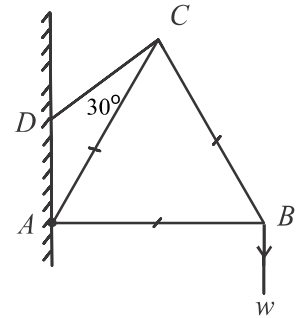
at A to a fixed point and kept in equilibrium with AB horizontal by a vertical force P applied to it at C , as shown in the figure. Find the value of P in terms of W .

Draw a stress diagram using Bow's notation and hence, find the stresses in the rods stating whether they are tensions or thrusts.

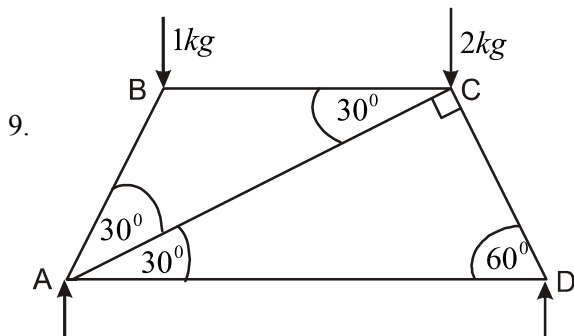
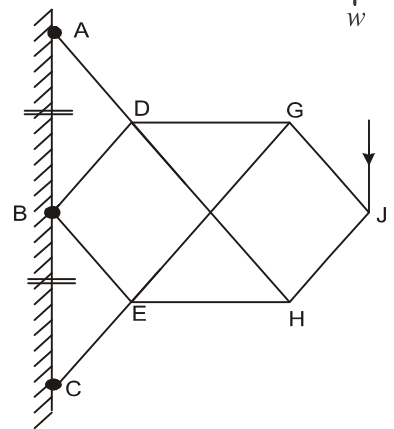


7. The adjoining figure represent a framework of four light rods smoothly hinged to a vertical wall at A and D carries a weight W at B so that AB is horizontal.

Draw a stress diagram using Bow's notation and hence determine the stresses in the rods, indicating whether they are tensions or thrusts. Hence determine the reactions at point A and D .



8. Find the stresses of the rods of the framework given below. All the inclined rods are at 45° with the horizontal.

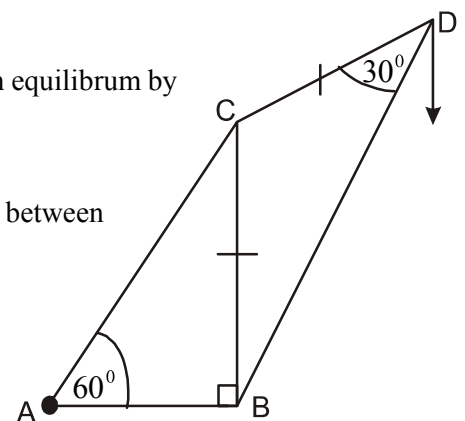


9.

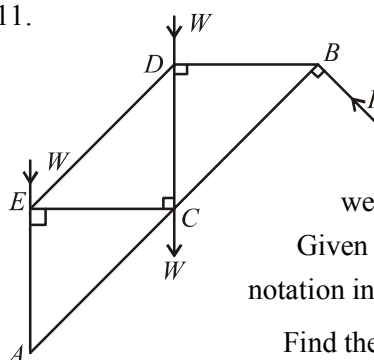
The adjacent figure shows a framed structure. The structure carries vertical loads as shown. Find the forces in the members of the structure and tabulate the results stating whether they are in tension or thrusts.

10. The frame work shown in the diagram, carries a weight W at D and is kept in equilibrium by vertical forces acting at A and B .

1. Find the magnitude and direction of the vertical forces at A and B .
2. Determine the stresses of the rods, using bow's notation distinguishing between tensions or thrusts.



11.



In the framework of light rods shown in the figure, horizontal and vertical rods are equal

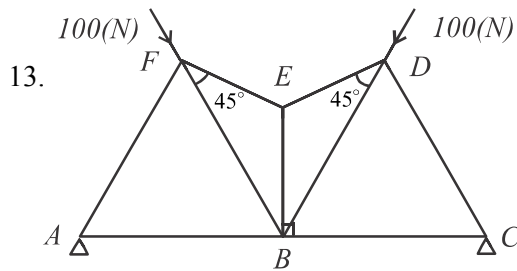
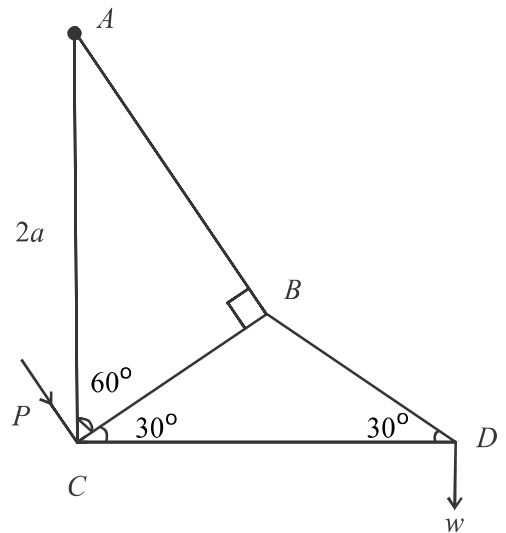
in length and all angles are 90° or 45° . It is in a vertical plane, smoothly pivoted at A and supported at B by a force P perpendicular to AB , and is loaded with weights W newtons at C , D , E . Find the value of P in terms of W .

Given further that the stress in the rod CD is zero, draw a stress diagram, using Bow's notation in order to find the stresses in the rods BD , BC and DE .

Find these stresses and state whether these stresses are tensions or thrusts.

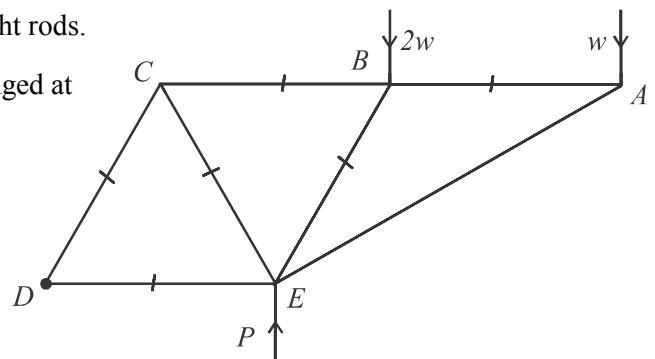
12. A framework made by light rods AB, BC, BD, CD, AC is shown in the figure. Point A is hinged at a stationary point. A force P is applied at C parallel to AB and a weight W is hanged at D . CD is horizontal. Sketch a stress diagram for the joints using Bow's notation. Hence,

- i. Find the stresses in all rods. State whether these are tensions or thrusts.
- ii. Find the value of P from stress diagram ?

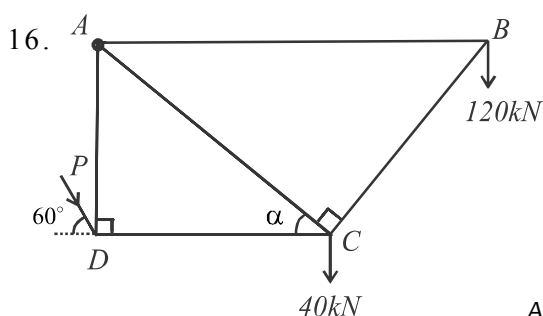
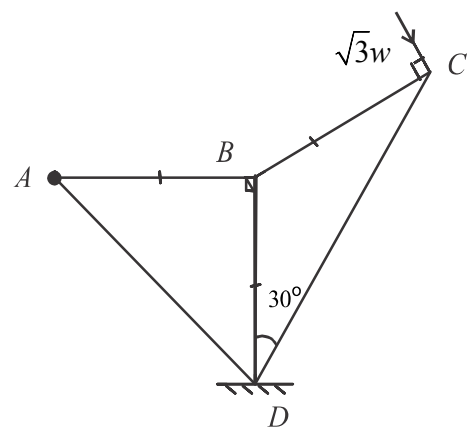


A framework formed with nine light rods is shown in the figure. The frame work is symmetric about BE . The triangles ABF and BCD are equilateral triangles. Frame work is in equilibrium in a vertical plane on two smooth supports at A and C subject to two forces acting at D and F along DB and FB respectively. Using Bow's notation draw a stress diagram. Hence find the stresses in the rods.

14. The framework shown in the figure is formed with seven light rods. Except the rod AE the rest rods are equal. The framework is hinged at D and loads w and $2w$ are applied at A and B respectively. The framework is in equilibrium in a vertical plane DE and ABC horizontal by applying a vertical force P at E . Using Bow's notation draw a stress diagram. Hence find the reaction at D and the force P . Also find the stresses of all rods distinguishing between tensions and thrusts.



15. A framework consists of five light rods is shown in the figure. The framework is hinged at A and D is on a smooth plane and it is kept in equilibrium in a vertical plane with AB horizontal and BD vertical by a force of magnitude $\sqrt{3}w$ acting at C perpendicular to BC . Find the reactions at A and D . Using Bow's notation by drawing a stress diagram find the stresses in the rods indicating tensions and thrusts.

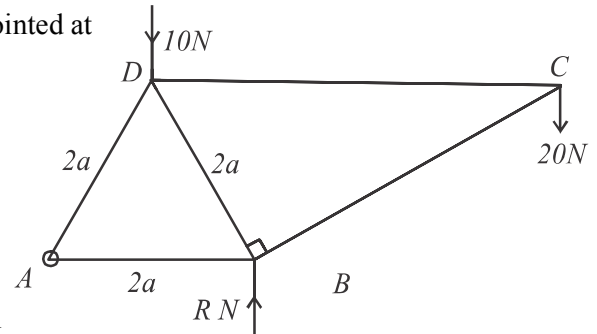


A framework made with five light rods AB, BC, AC, AD and CD is shown in the figure. The framework is smoothly hinged at A and weights $120kN$ and $40kN$ are attached to B and C respectively. The framework is kept in equilibrium by a force P

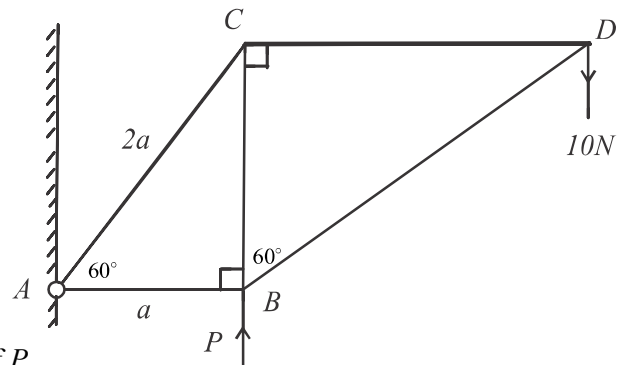
acting at D at an inclination 60° to the horizontal. Here $\angle ACD = \alpha$ and $\tan \alpha = \frac{4}{3}$. Draw the stress diagram using Bow's notation to determine the stresses in the rods and show that $P = 560 \text{ kN}$. Also, find the stresses in the rods and state whether these stresses are tensions or thrusts.

17. A frame work of five light rods, AB, BC, CD, AD and BD freely jointed at their ends as shown in the figure.

$AB = AD = BD = 2a$ and $\hat{C}BD = 90^\circ$. A load of weight $20N$ is hung at C and the framework is in equilibrium in a vertical plane with the rods AB and DC are horizontal, supported by two vertical forces R and 10 Newtons act at B and D respectively as the direction indicated in the figure. Find the value of R . Draw a stress diagram using Bow's notation and hence, find the stress in the five rods and state whether these stress are tensions or thrusts.

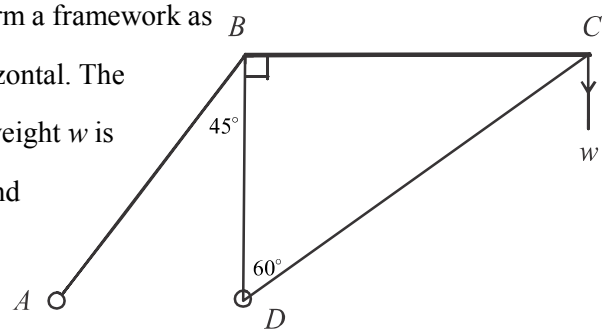


18. The framework shown in the following figure is made by joining five light rods AB, BC, AC, CD and BD freely at their ends. It is given that $AB = a$ and $\hat{C}AB = \hat{C}BD = 60^\circ$. A weight of $10N$ is suspended from D and the framework is hinged to a vertical wall at A . The framework is kept in equilibrium in a vertical plane by a vertical force applied at B , so that rods AB and CD are horizontal and the rod BC is vertical. Find the value of P .



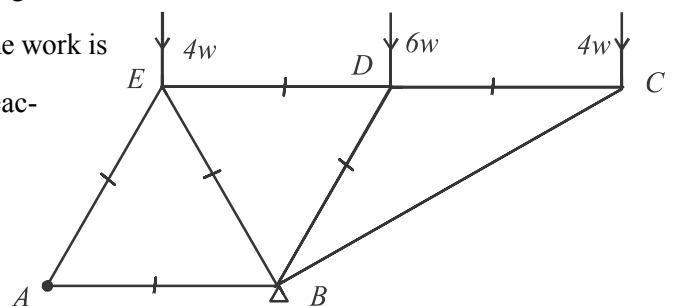
Draw a stress diagram using Bow's notation. Hence find the stresses in the five rods stating whether they are tensions or thrusts.

19. a. Four light rods AB, BC, CD and BD are smoothly joined to form a framework as shown in the figure. the rod BD is vertical while the rod BC is horizontal. The framework is hinged to the horizontal ground at A and D , while a weight w is hung at C . By using Bow's notation, find the stresses in each rod and distinguish whether they are tensions or thrusts.

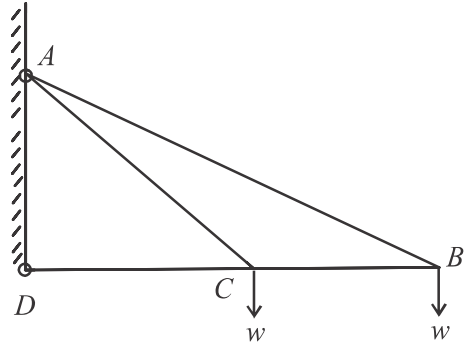


20. The figure shows the frame work made by seven light rods jointed at their ends. The rods AB, CD and DE are horizontal. The all rods except BC are equal length. Three weights of $4W, 6W, 4W$ are hung from C, D and E respectively. The frame work is hinged at A and beared on a smooth peg at B . Show that the reaction at B is $21W$ and find the components of the reaction at A .

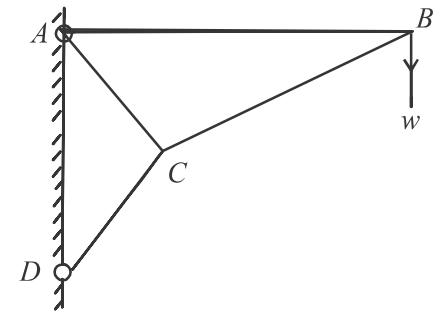
Using the Bow's notation draw the stress diagram, find the stress on each rod and distinguish whether they're tension or thrust.



21. The framework shown in the figure consisting of four light rods, is hinged to two points A and D on a vertical plane. $BD = 2AD$ and DCB is in horizontal. C is the mid point of DB and two weights each W are suspended at B , C . By using Bow's notation, find the stresses of each rod and the reaction at A , D . Determine also whether they are tensions or thrusts.



22. Figure shows a framework, consisting of four light smoothly jointed rods, which is hinged to a vertical wall at A and D . The rod AB is in horizontal, $\hat{CAD} = \hat{CDA} = \hat{ABC} = \frac{\pi}{6}$ and $\hat{ACB} = \frac{\pi}{2}$.

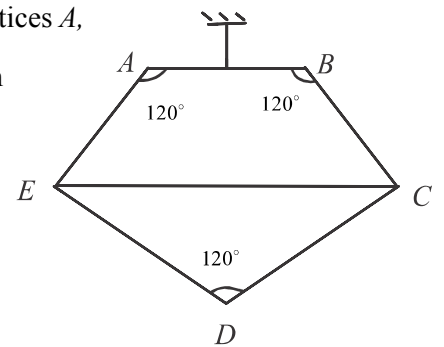


A weight W is hung from B and the framework is in a vertical plane.

Using Bow's notation, find

- i. the magnitude of the force acting in each rod and distinguishing between tensions and thrusts
- ii. the force exerted on the framework by the hinge at D ,
- iii. the magnitude and the direction of the force exerted on the framework by the hinge at A .

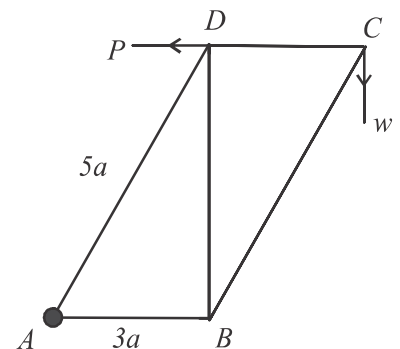
23. The figure represents a frame in the form of a pentagon $ABCDE$ formed of five uniform rods of weight w per unit length jointed at their ends. $AE = BC = 2a$, and $ED = CD = 2b$. The angles at vertices A , B and D are 120° each. The frame is suspended from the mid-point of AB and is in equilibrium with the symmetrical shape maintained by a light rod CE of length $2b\sqrt{3}$ connecting the joints C and E . Show that the reaction at the joint D is of magnitude $b\sqrt{3}w$ and find the thrust in the light rod CE .



24. The figure represents a framework of light rods AB , BC , CD , DA and DB freely jointed at their ends, and movable in a vertical plane about the joint A . Here

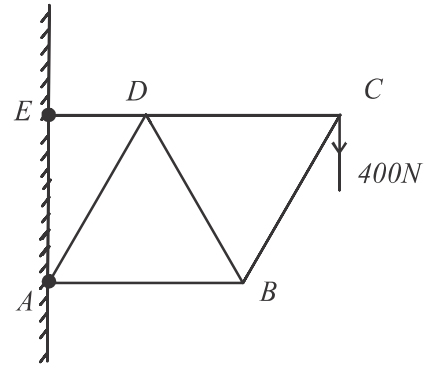
$AB = CD = 3a$, $BC = DA = 5a$ and $DB = 4a$. It carries a weight W at the joint C and equilibrium is maintained with AB and DC horizontal and BD vertical by a horizontal force P applied along CD at the joint D . Find P in terms of W .

Sketch a stress diagram using Bow's notation and hence find the stresses in all the rods. State whether these are tensions or thrusts.



25. The figure shows a framework consists six light rods AB, BC, CD, DE, AD and BD have equal length except DE . There is a load of $400N$ hanging at the joint C .

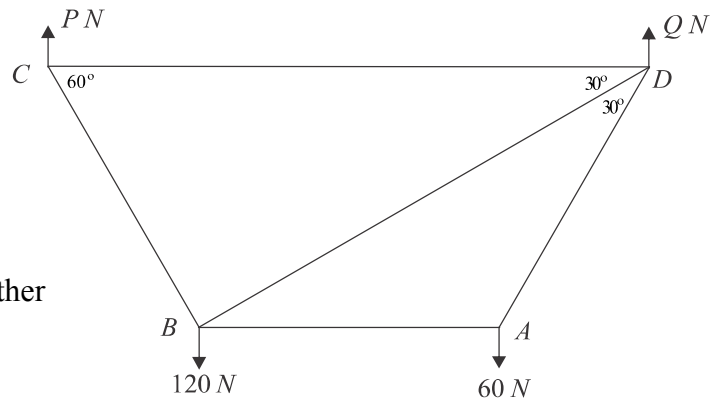
Sketch the stress diagram, applying Bow's notation to the joints B, C and D . Hence, find the stresses in all rods indicating whether they are tensions or thrust.



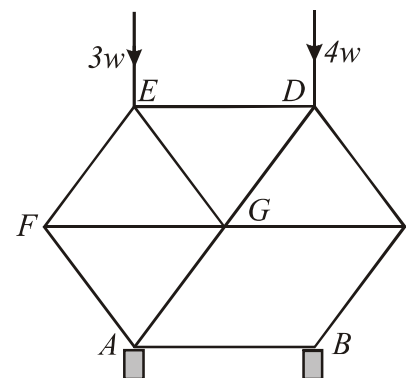
26. The given figure represents a framework of five rods AB, AD, BC, BD and CD smoothly jointed at the ends. The framework carries loads $60N$ and $120N$ at A and B respectively, and is kept in equilibrium with the rods AB and CD horizontal, by two vertical forces $P N$ and $Q N$ applied at C and D respectively.

Draw a stress diagram using Bow's notation.

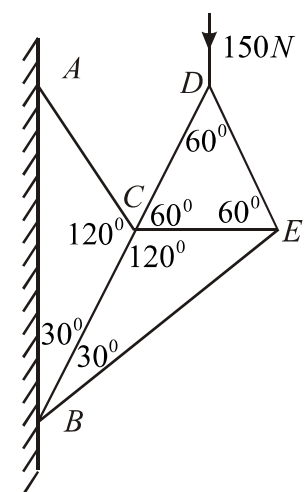
Hence, find the stresses in all five rods stating whether they are tensions or thrusts.



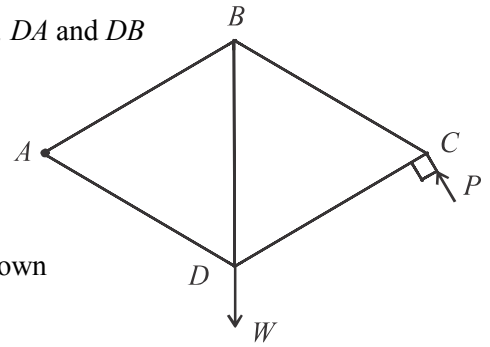
27. A framework $ABCDEF$ of the regular hexagonal form, formed with eleven light rods is shown in the adjoint diagram. The framework is in equilibrium in a vertical plane on two smooth supports at A and B . Find stresses in rods and state whether they are tension or thrusts.



28. The adjoining figure represents a framework of six light rods smoothly jointed at the ends. It is smoothly hinged to a vertical wall at A and B and carries a load $150 N$ at D . Draw a stress diagram using Bow's notation and hence, determine the stresses in the rods, indicating whether they are tensions or thrusts.



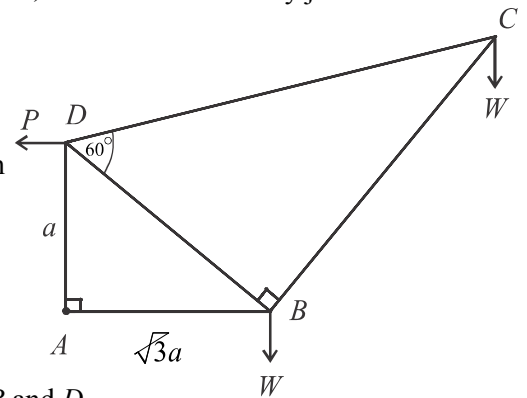
29. The framework shown in the figure consists of five light rods AB, BC, CD, DA and DB of equal lengths smoothly jointed at their ends. A load W is suspended at the joint D and the framework is smoothly hinged at A to a fixed point and kept in equilibrium in a vertical plane with BD vertical by a force P applied to it at the joint C and perpendicular to the rod CD in the direction shown in the figure.



- i. Find the value of P .
- ii. Draw a stress diagram using Bow's notation for the joints C, B and D .

Hence, find the stresses in the rods, stating whether they are tensions or thrusts.

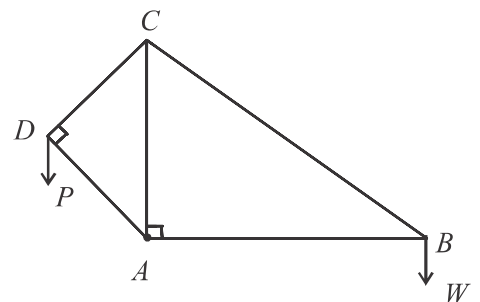
30. The framework shown in the figure consists of five light rods AB, BC, CD, DA and DB smoothly jointed at their ends. It is given that $AD = a, AB = \sqrt{3}a, \hat{BAD} = 90^\circ, \hat{CBD} = 90^\circ$ and $\hat{BDC} = 60^\circ$. At each of the joints B and C , a load W is suspended and the framework is smoothly hinged at A to a fixed point and kept in equilibrium in a vertical plane with AB horizontal by a horizontal force P applied to it at the joint D .



- i. Find the value of P .
- ii. Draw the stress diagram using Bow's notation for the joints C, B and D .

Hence, find the stresses in the rods, stating whether they are tensions or thrusts.

31. The framework shown in the figure consists of five light rods AB, BC, CD, DA and AC that are smoothly jointed at the ends. It is given that $AC = 2a, \hat{BAC} = 90^\circ, \hat{CDA} = 90^\circ, \hat{ABC} = 30^\circ$ and $\hat{CAD} = 30^\circ$. A load W is suspended at the joint B and the framework is smoothly hinged at A to a fixed point and the system is kept in equilibrium in a vertical plane with AC vertical by a force P applied vertically downwards to it at the joint D .



- (i) Find the value of P .
- (ii) Draw a stress diagram using Bow's notation for the joints B, C and D .

Hence, find the stresses in the rods, stating whether they are tensions or thrusts.

