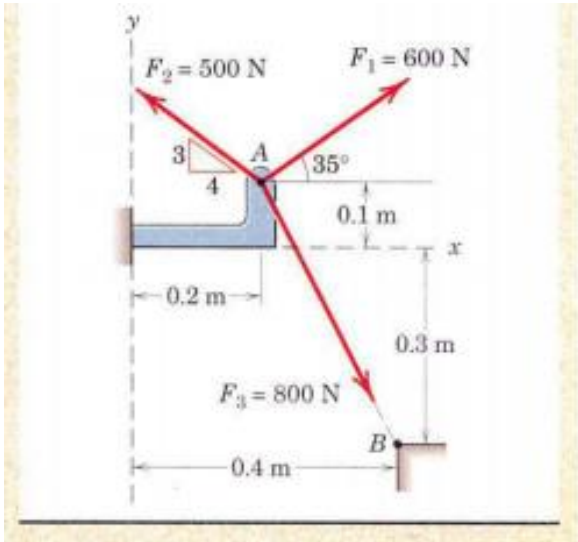
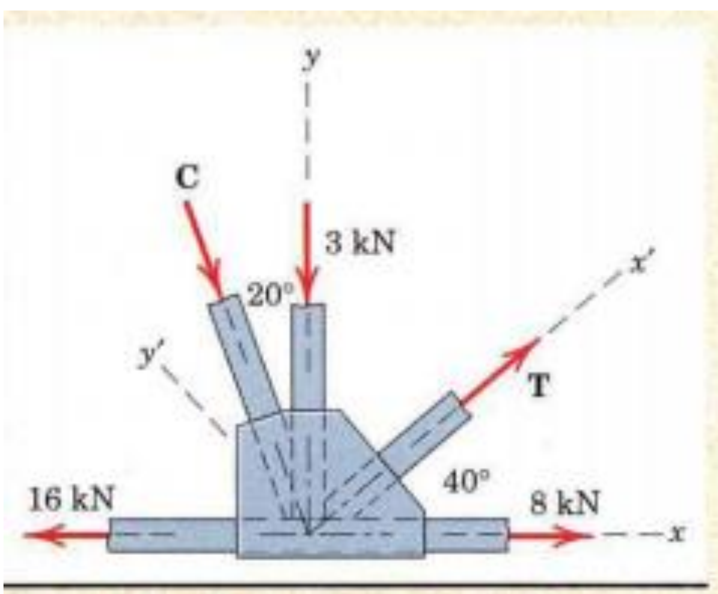
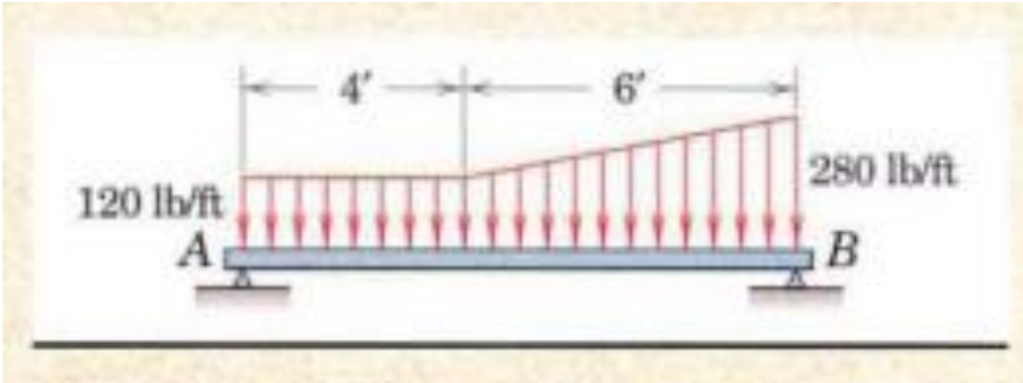
1. The forces F 1, F2, and F3, all of which act on point A of the bracket, are specified in three different ways. Determine the x and y scalar components of each of the three forces.



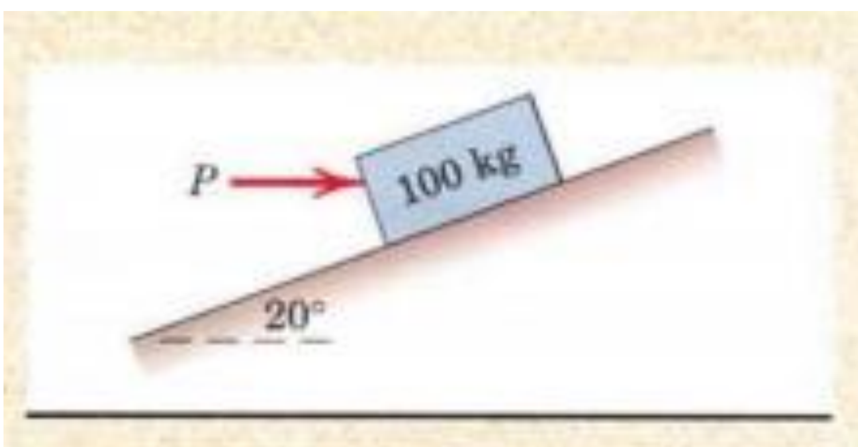

2. Determine the magnitudes of the forces C and T, which, along with the other three forces shown, act on the bridge truss joint.



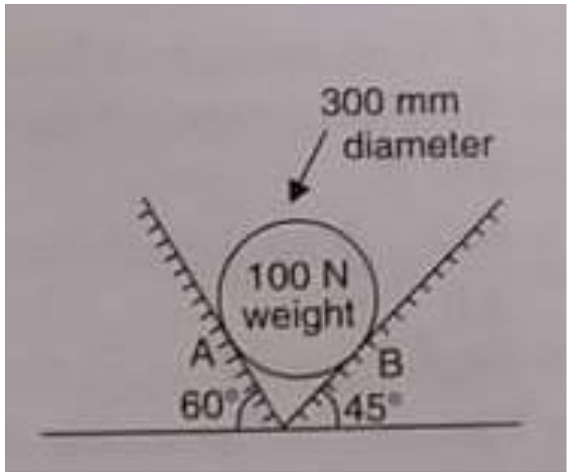
3. Determine the equivalent concentrated load(s) and external reactions for the simply supported beam which is subjected to the distributed load shown.



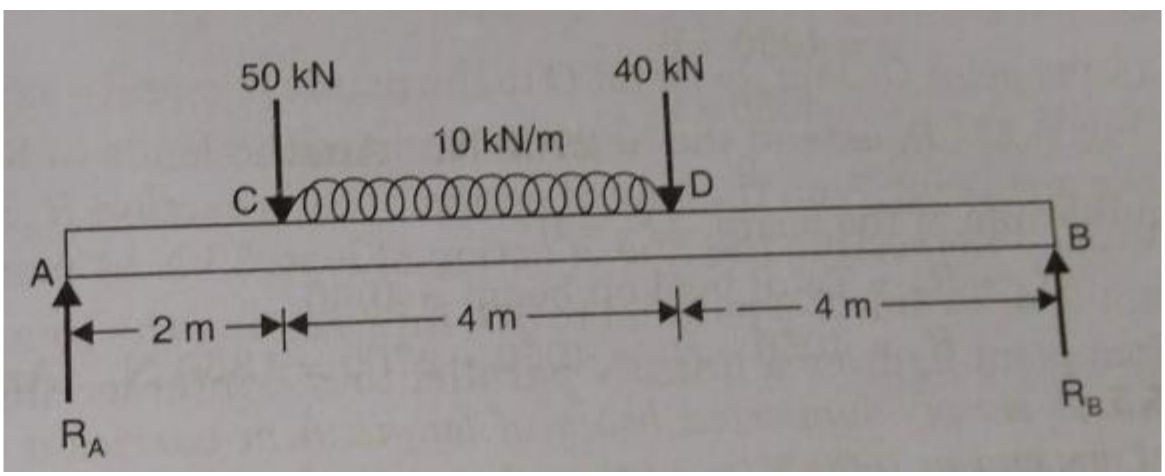

4. Determine the magnitude and direction of the friction force acting on the 100-kg block shown if, first, P = 500 N and, second, P = 100 N. The coefficient of static friction is 0.20, and the coefficient of kinetic friction is 0.17. The forces are applied with the block initially at rest.



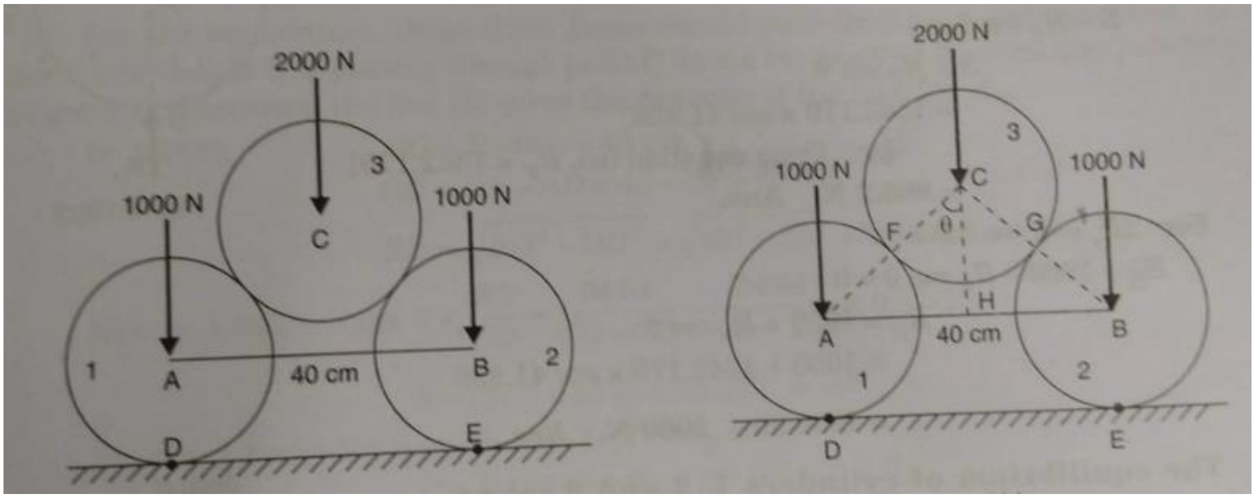
5. Determine the reactions at A and B.



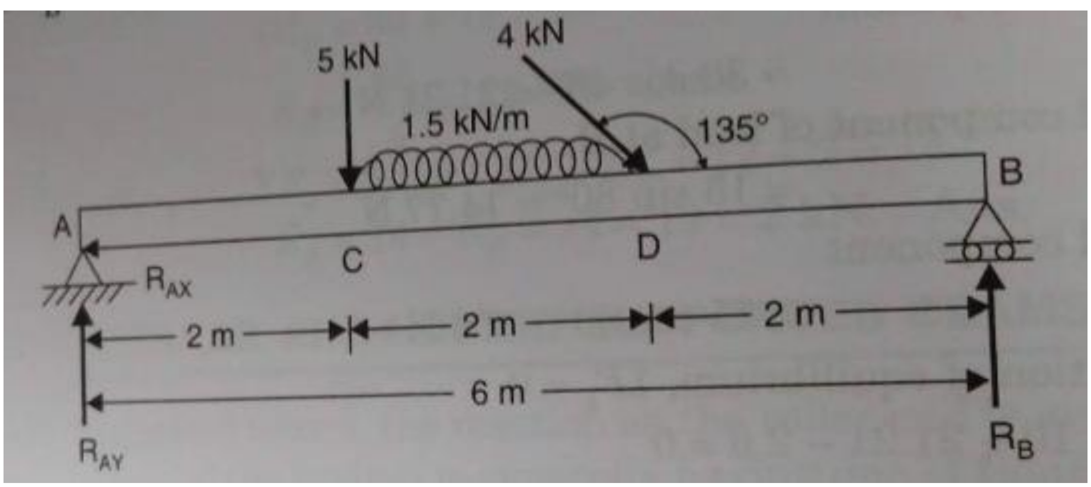

6. A simply supported beam of 10m length carries two point loads and uniformly distributed load as shown in the figure. Calculate the reaction forces.



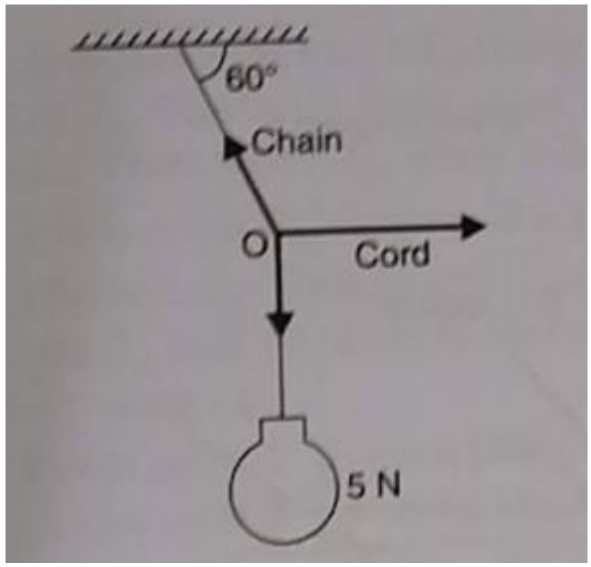
7. Two smooth circular cylinders each of weight 1000N and radius 15 cm are connected at their centre by a string AB of length 40 cm and rest upon a horizontal plane, supporting above them a third cylinder of weight 2000N and radius 15cm as shown in figure below. Find the force in the string AB and the reactions at D and E.




8. A beam AB 6 m long is loaded as shown in the figure. Determine the reactions at A and B.



9. A lamp weighing 5 N is suspended from ceiling by a chain. It is pulled aside by a horizontal cord until the chain makes an angle of $60^0$ with the ceiling as shown in the figure. Find the tension in the chain and the cord by applying *Lami's theorem*.



**1.2.6. Lami's Theorem.** It states that, "If there forces acting at a point are in equilibrium, each force will be proportional to the sine of the angle between the other two forces."

Suppose the three forces $P$, $Q$ and $R$ are acting at a point $O$ and they are in equilibrium as shown in Fig. 1.6.

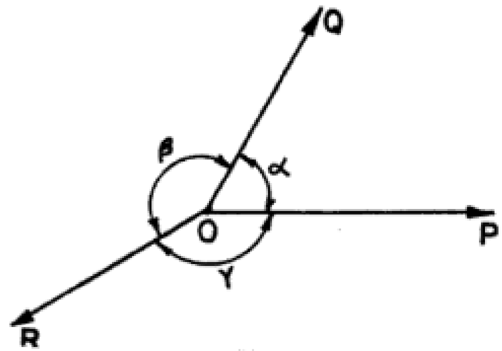


Fig. 1.6

Let $\alpha$ = Angle between force $P$ and $Q$.

$\beta$ = Angle between force $Q$ and $R$.

$\gamma$ = Angle between force $R$ and $P$.

Then according to Lami's theorem,

$P \alpha$ sine of angle between $Q$ and $R \alpha \sin \beta$.

$$\therefore \quad \frac{P}{\sin \beta} = \text{constant}$$

Similarly $$\frac{Q}{\sin \gamma} = \text{constant and } \frac{R}{\sin \alpha} = \text{constant}$$

or $$\frac{P}{\sin \beta} = \frac{Q}{\sin \gamma} = \frac{R}{\sin \alpha}$$

**Proof of Lami's Theorem.** The three forces acting on a point, are in equilibrium and hence they can be represented by the three sides of the triangle taken in the same order. Now draw the force triangle as shown in Fig. 1.6 ($a$).

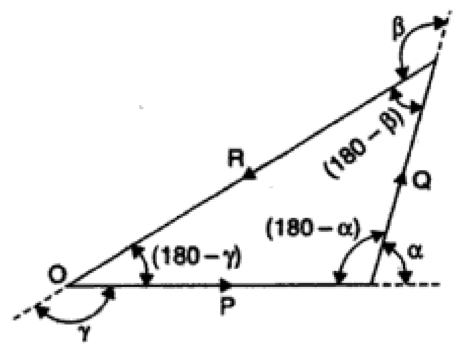


Fig. 1.6 ($a$)

Now applying sine rule, we get

$$\frac{P}{\sin (180 - \beta)} = \frac{Q}{\sin (180 - \gamma)} = \frac{R}{\sin (180 - \alpha)}$$

This can also be written

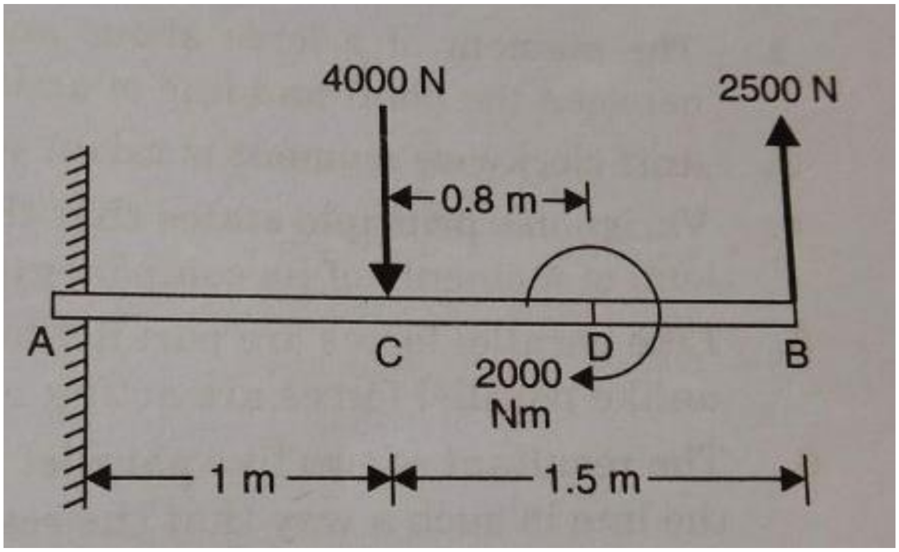
$$\frac{P}{\sin \beta} = \frac{Q}{\sin \gamma} = \frac{R}{\sin \alpha}$$

This is same equation as equation (1.5).

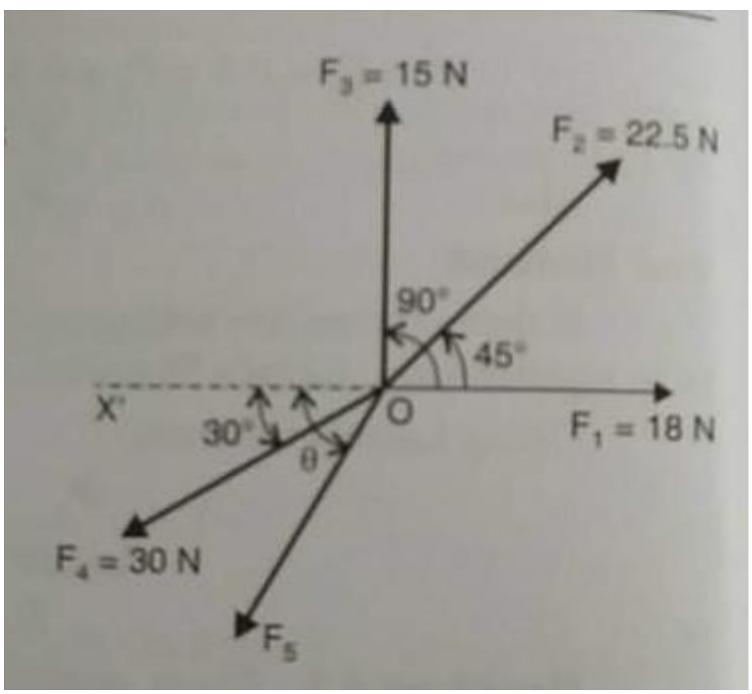
**Note.** All the three forces should be acting either towards the point or away from the point.

Source: A text book of Engineering mechanics, Dr. R.K. Bansal, page 4

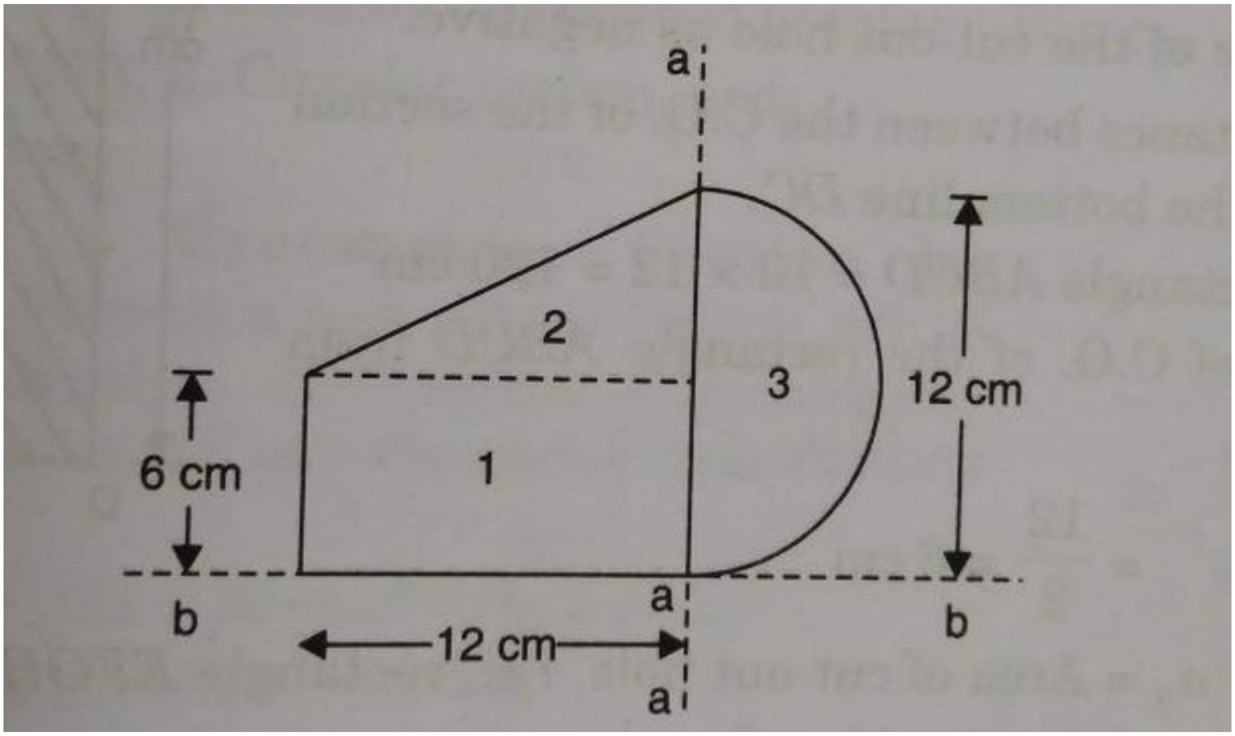
10. Two vertical forces and a Moment is acting on a horizontal rod which is fixed at end at A. Determine the resultant of the system and determine an equivalent system through A.



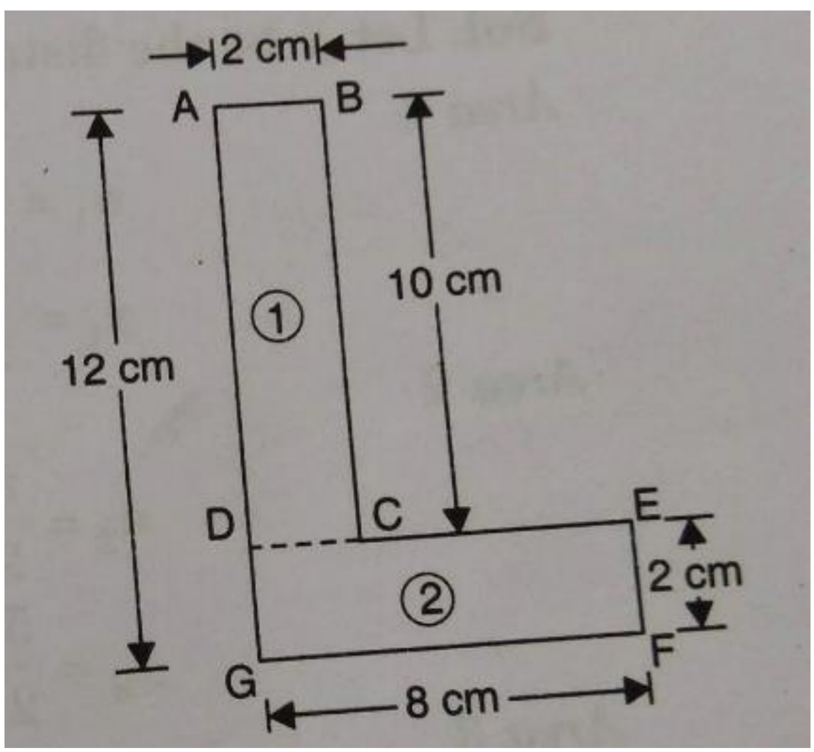

11. Five forces are acting on an equilibrium body. Find the magnitude and direction of the force F5.



12.Determine the centroid of the area shown in the figure along axis a-a and b-b.




13.Determine the Centre of Gravity of the L- section given below.



14. A steel column is 3 m long and 0.4 m diameter. It carries a load of 50 MN. Given that the modulus of elasticity is 200 GPa, Calculate the compressive stress and strain and determine how much the column is compressed.