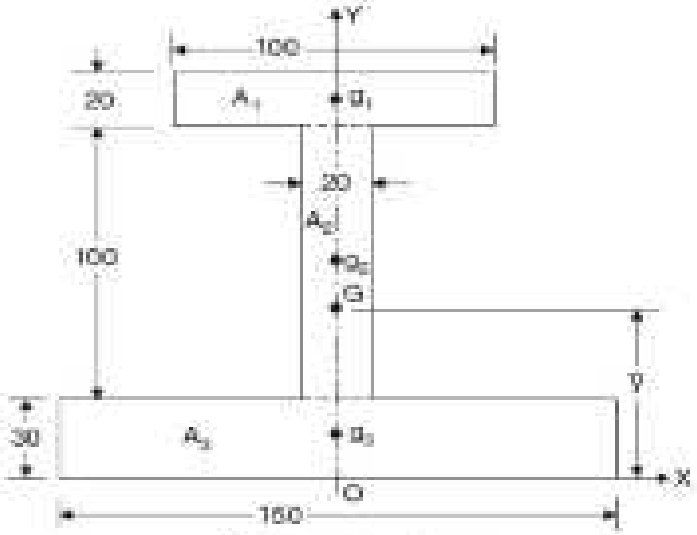
Locate the centroid of the I-section shown in Fig.



All dimensions in mm

Solution: Selecting the coordinate system as shown in Fig. , due to symmetry centroid must lie on y axis,

i.e., $\bar{x} = 0$

Now, the composite section may be split into three rectangles

$$A_1 = 100 \times 20 = 2000 \text{ mm}^2$$

Centroid of A_1 from the origin is

$$y_1 = 30 + 100 + \frac{20}{2} = 140 \text{ mm}$$

Similarly $$A_2 = 100 \times 20 = 2000 \text{ mm}^2$$

$$y_2 = 30 + \frac{100}{2} = 80 \text{ mm}$$

$$A_3 = 150 \times 30 = 4500 \text{ mm}^2,$$

and $$y_3 = \frac{30}{2} = 15 \text{ mm}$$

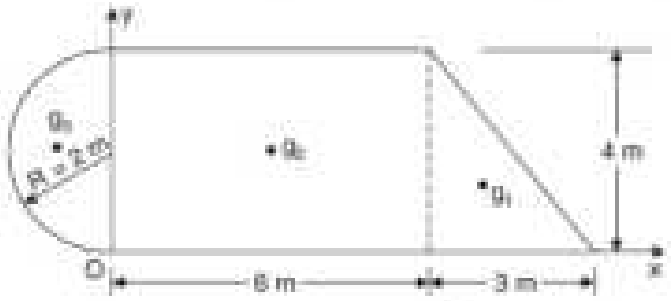
$$\therefore \quad \bar{y} = \frac{A_1 y_1 + A_2 y_2 + A_3 y_3}{A}$$

$$= \frac{2000 \times 140 + 2000 \times 80 + 4500 \times 15}{2000 + 2000 + 4500}$$

$$= 59.71 \text{ mm}$$

Thus, the centroid is on the symmetric axis at a distance 59.71 mm from the bottom as shown in Fig.

Determine the centroid of the area shown in Fig. with respect to the axis shown.



Solution: The composite section is divided into three simple figures, a triangle, a rectangle and a semicircle

Now, area of triangle $A_1 = \frac{1}{2} \times 3 \times 4 = 6\ m^2$

Area of rectangle $A_2 = 6 \times 4 = 24\ m^2$

Area of semicircle $A_3 = \frac{1}{2} \times \pi \times 2^2 = 6.2832\ m^2$

$\therefore$ Total area $A = 36.2832\ m^2$

The coordinates of centroids of these three simple figures are:

$$x_1 = 6 + \frac{1}{3} \times 3 = 7\ \text{m}$$

$$y_1 = \frac{4}{3}\ \text{m}$$

$$x_2 = 3\ \text{m}$$

$$y_2 = 2\ \text{m}$$

$$x_3 = \frac{-4R}{3\pi} = -\frac{4 \times 2}{3\pi} = -0.8488\ \text{m}$$

$$y_3 = 2\ \text{m} \qquad \text{(Note carefully the sign of } x_3\text{)}$$

$$\bar{x} = \frac{A_1x_1 + A_2x_2 + A_3x_3}{A}$$

$$= \frac{6 \times 7 + 24 \times 3 + 6.2832 \times (-0.8488)}{36.2832}$$

i.e., $\bar{x} = 2.995\ \text{m}$

$$\bar{y} = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A}$$

$$= \frac{6 \times \frac{4}{3} + 24 \times 2 + 6.2832 \times 2}{36.2832}$$

i.e., $\bar{y} = 1.890\ \text{m}$