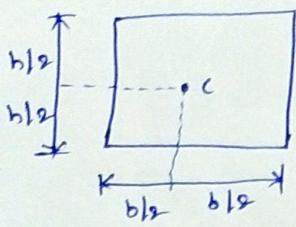


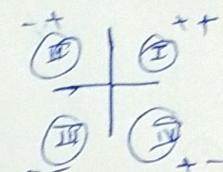
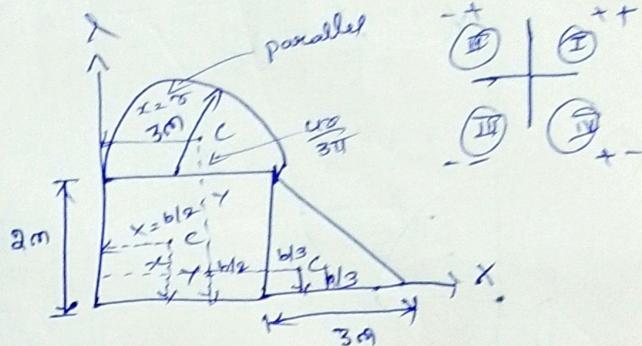
\Rightarrow

1) Rectangle:

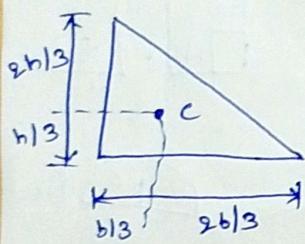


$$A = b \times h$$

① Locate the centroid for the given shape w.r.t the reference x & y axis.



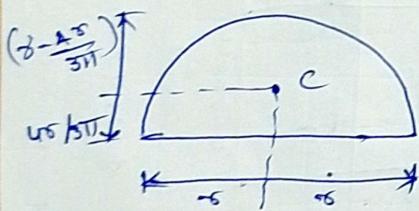
2) Right Angle Triangle:



$$A = \frac{1}{2} \times b \times h$$

Soln: Centroid $C = (\bar{x}, \bar{y})$

3) Semi Circle:



$$A = \frac{\pi r^2}{2}$$

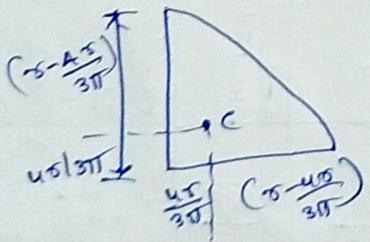
Sl No	Shape	Area A (cm^2)	\bar{x} (cm)	\bar{y} (cm)	$A\bar{x}$ (cm^3)	$A\bar{y}$ (cm^3)
1	rectangle	$b \times h = 18$	$b/2 = 3$	$h/2 = 1$	36	1.998
2	triangle	$\frac{1}{2} \times b \times h = 3$	$\frac{b+0}{2} = \frac{3}{2}$	$\frac{h}{2} = \frac{1}{2}$	4.5	0.666
3	quarter circle	$\frac{\pi r^2}{4} = \frac{14.137}{4}$	$\frac{r}{2} = \frac{3.5}{2}$	$\frac{r}{2} = \frac{3.5}{2}$	14.137	4.9311

$$\bar{x} = \frac{\sum A\bar{x}}{\sum A} = \frac{49.411}{29.137} = 3.411$$

$$\bar{y} = \frac{\sum A\bar{y}}{\sum A} = \frac{60.268}{29.137} = 2.068$$

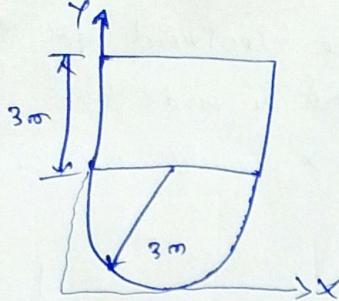
Result:
* Locate the centroid w.r.t x & y axis
* From Centre, turn \square up \rightarrow x
* $H \rightarrow x$; $V \rightarrow y$ \rightarrow x
* Centroid $C = (\bar{x}, \bar{y})$
 $C = (3.411 \text{ cm}, 2.068 \text{ cm})$

4) Quarter Circle:

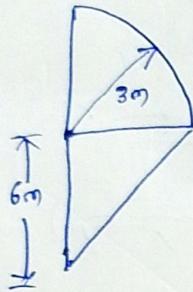


$$A = \frac{\pi r^2}{4}$$

Result:
* Locate the centroid w.r.t x & y axis
* From Centre, turn \square up \rightarrow x
* $H \rightarrow x$; $V \rightarrow y$ \rightarrow x
* Centroid $C = (\bar{x}, \bar{y})$
 $C = (3.411 \text{ cm}, 2.068 \text{ cm})$



③



④ Locate the centroid for the given shape w.r.t x & y axis.

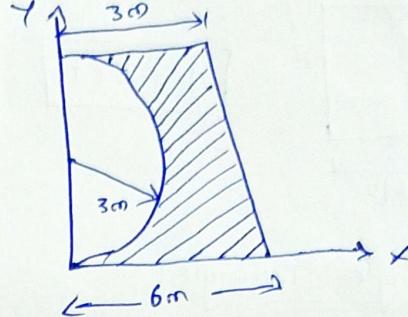
shape	Access com	com	Atm	com	Access com	com	Atm	com
circle	1800	180	Atm	180	1800	180	Atm	180
rectangle	1800	180	Atm	180	1800	180	Atm	180
square	1800	180	Atm	180	1800	180	Atm	180
triangle	1800	180	Atm	180	1800	180	Atm	180

$$\frac{43}{x+3} = \underline{\underline{0.575}}$$

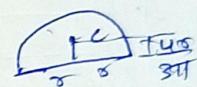
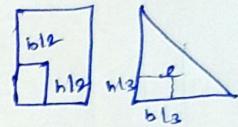
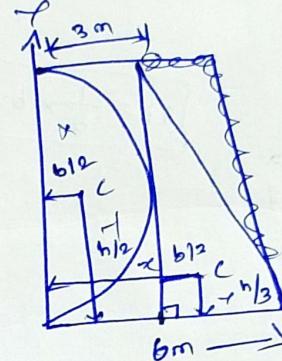
C = (us, 0.263)

Shape	Area	$\frac{\text{Area}}{\text{cm}^2}$	X	Y	$\frac{A \times Y}{\text{cm}^3}$	A-Y
①	6	1.8	1.5	3	2.7	5.4
②	9	3	4	3	36	18
③	6	2	3	3	18	18

(5) Find the centroid for the shaded part with respect to reference x & y axis.



3du



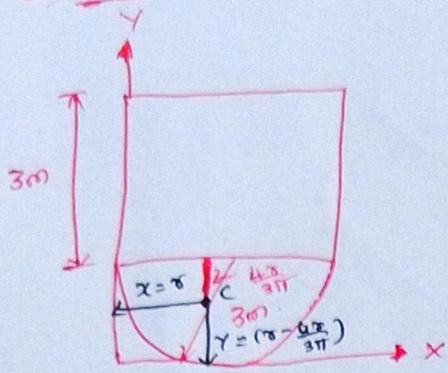
$$\text{Point of Convergence} \\ x = \frac{2Ax}{EA} = \frac{3.498}{2.30} = 1.7$$

$$\frac{d}{dt} \text{Point} = \frac{\partial X}{\partial t}$$

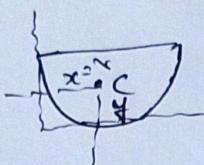
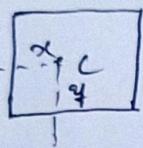
25. 4. 1

$$- \overbrace{A}^{\text{A}} \cdot \overbrace{(x)}^{B}$$

Problem 02



Solu^y:



Shape	Area (m ²)	x (m)	y (m)	Ax (m ²)	Ay (m ²)
①	3	8	3	4.5	54
②	6	11.133	3	1.786	48.041

$$\text{Area} = 38.133$$

$$\bar{x} = \frac{\sum Ax}{\sum A} =$$

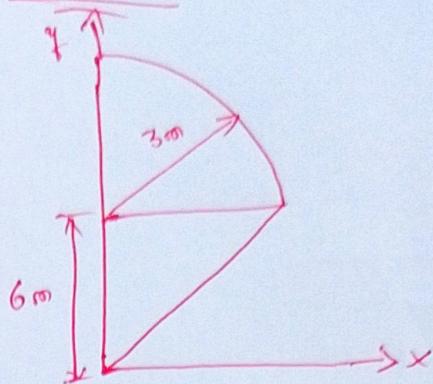
$$= \frac{3}{32}$$

$$\bar{y} = \frac{\sum Ay}{\sum A} =$$

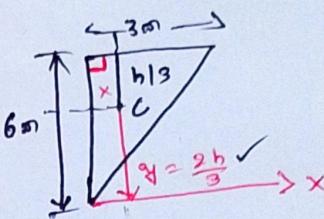
$$= 3.875$$

$$\therefore \text{Centroid}, \quad C = (\bar{x}, \bar{y}) = (3.875, 3.875)$$

Problem 03



Solu^y:



Shape	Area (m ²)	x (m)	y (m)	Ax (m ²)	Ay (m ²)
①	3	0.688	1.273	7.273	8.997
②	6	4	3	1	9

$$\text{Area} = 16.088$$

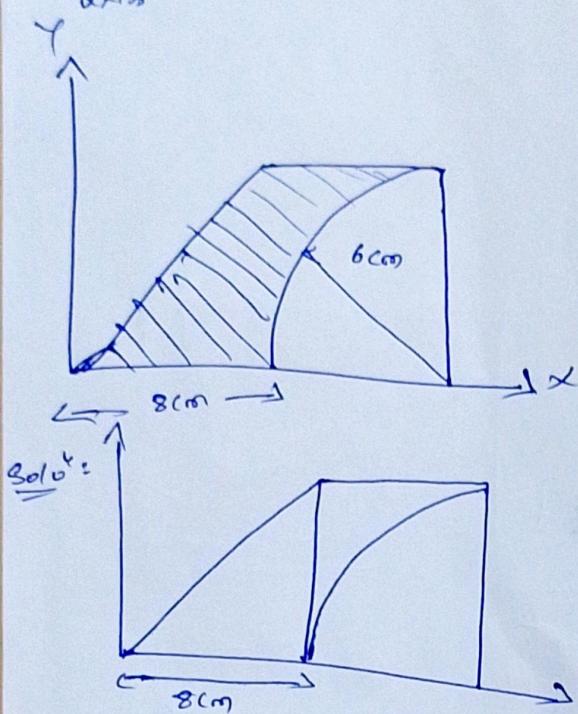
$$\therefore \text{Centroid} = C = (\bar{x}, \bar{y})$$

$$= (1.12, 5.439)$$

$$\bar{x} = \frac{\sum Ax}{\sum A} = 1.12$$

$$\bar{y} = \frac{\sum Ay}{\sum A} = 5.439$$

⑥ find the centroid for the shaded part w.r.t x & y axis

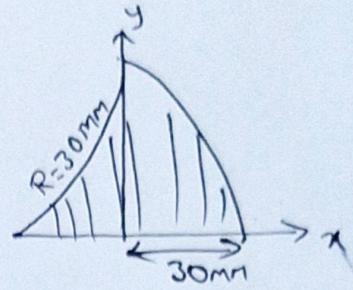


Sl No	Shape	Axes con	\bar{x}	\bar{y}	$A \bar{x}^2$	$A \bar{y}^2$	$A \bar{x} \bar{y}$	$A \bar{x}^3$	$A \bar{y}^3$
①	triangle	24	5.333	2	197.998	4.8			
②	square	36	11	3	396	10.8			
③	quarter circle				$\frac{\pi R^2}{4} = 28.274$	$\pi R^3 / 4 = 11.458$	8.546	323.829	71.985

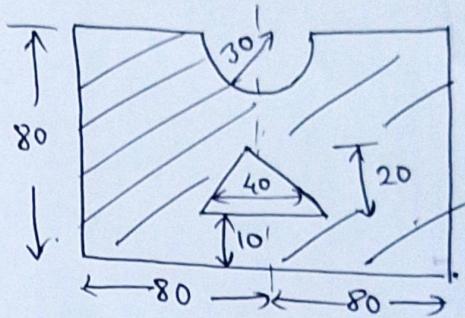
$$\begin{aligned}\bar{x} &= \frac{6.309}{2.645} \\ &\approx 2.357\end{aligned}$$

$$\therefore C = 1$$

⑦ H.W

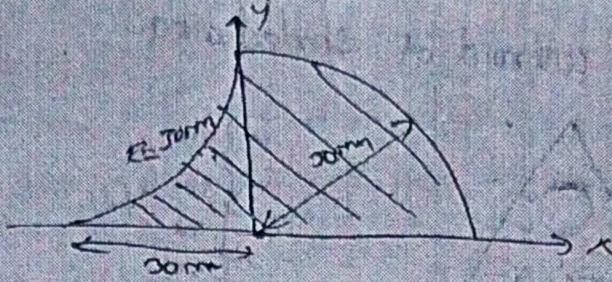


⑧

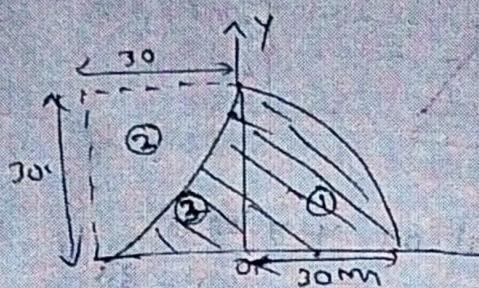


Note: All Dimensions are in (mm)

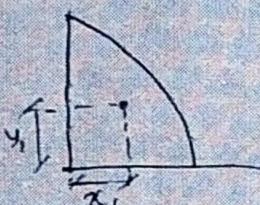
2) Locate the centroid of shaded area w.r.t
ox & oy axis.



Job:



Shape ①

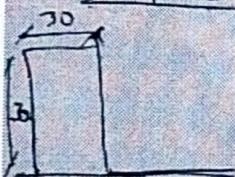


$$A_1 = \frac{\pi R^2}{4} = 706.85 \text{ mm}^2.$$

$$x_1 = R - \frac{4R}{3\pi} = \frac{4R}{3\pi} = 12.73 \text{ mm}.$$

$$y_1 = \frac{4R}{3\pi} = 12.73 \text{ mm}.$$

Shape ②

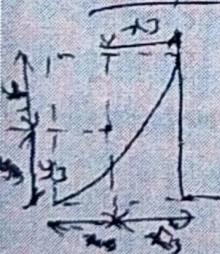


$$A_2 = 30 \times 30 = 900 \text{ mm}^2.$$

$$x_2 = -15 \text{ mm}$$

$$y_2 = +15 \text{ mm}.$$

Shape ③



$$A_3 = -\frac{\pi R^2}{4} = -\frac{\pi \times 30^2}{4} = -706.85 \text{ mm}^2$$

$$x_3 = \left(R - \frac{4R}{3\pi} \right) = \left(30 - \frac{4 \times 30}{3\pi} \right) = -17.26 \text{ mm}$$

$$y_3 = R - \frac{4R}{3\pi} = 30 - \frac{4 \times 30}{3\pi} = 17.26 \text{ mm}$$

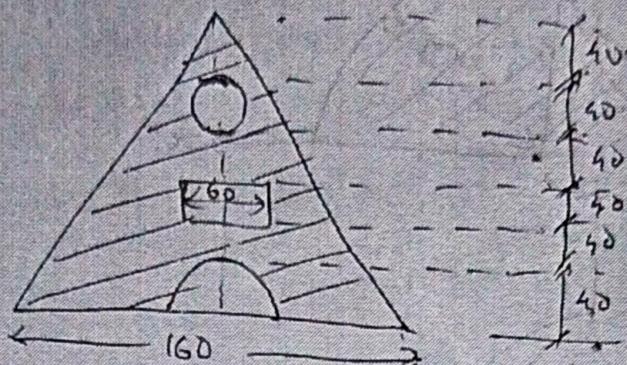
$$\bar{x} = \frac{A_1 x_1 + A_2 x_2 + A_3 x_3}{A_1 + A_2 + A_3}$$

$$= \frac{706.85 \times 12.73 + 900 \times (-15) + (-706.85)(-17.26)}{706.85 + 900 - 706.85}$$

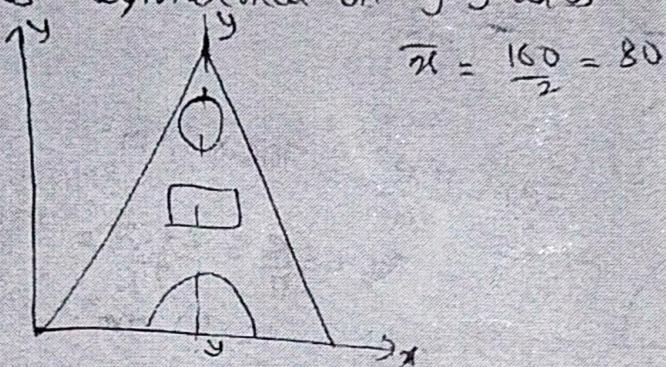
$$\bar{x} = 8.553 \text{ mm}$$

$y = 11.433 \text{ mm}$

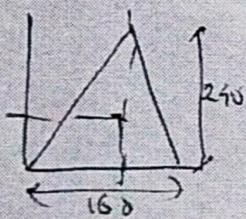
Q) Locate the centroid of shaded area



Ans: It is symmetrical on y-y axis



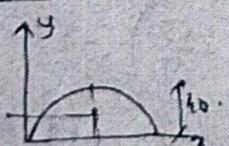
Shape ①



$$A_1 = \frac{1}{2} \times 160 \times 240 = 19200 \text{ mm}^2$$

$$y_1 = \frac{h}{3} = \frac{240}{3} = 80 \text{ mm}$$

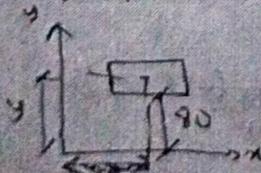
Shape ②



$$A_2 = -\frac{\pi R^2}{2} = -\frac{\pi \times 40^2}{2} = -2512 \text{ mm}^2$$

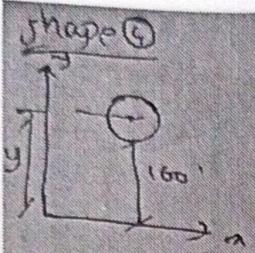
$$y_2 = \frac{4R}{3\pi} = \frac{4 \times 40}{3\pi} = 16.48 \text{ mm}$$

Shape ③



$$A_3 = -(60 \times 40) = -2400 \text{ mm}^2$$

$$y_3 = 80 + 40/2 = 100 \text{ mm}$$



$$A_4 = -\pi r^2 = -\pi \times 20^2 = -1256 \text{ mm}^2$$

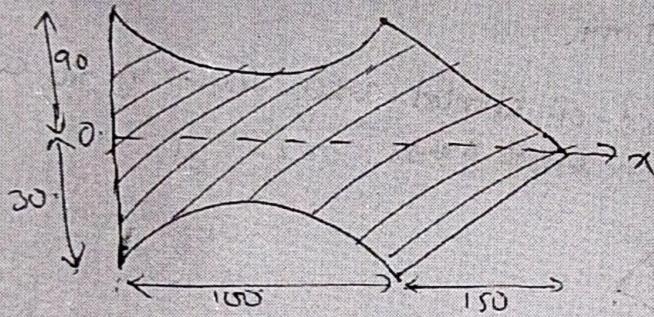
$$y_4 = 160 + 20 = 180 \text{ mm}$$

$$\bar{y} = \frac{A_1 y_1 + A_2 y_2 + A_3 y_3 + A_4 y_4}{A_1 + A_2 + A_3 + A_4}$$

$$= \frac{19200(80) - 2512(1648) - 2400(100) - 1256(180)}{19200 - 2512 - 2400 - 1256}$$

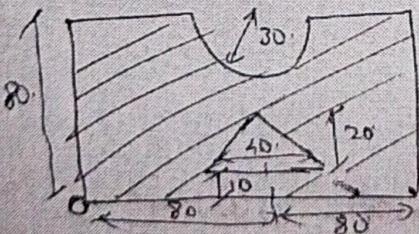
$$\bar{y} = 78.82 \text{ mm}$$

Q) Find the centroid of the shaded area wrt OX & OY axis

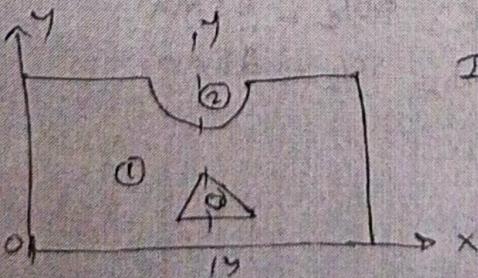


Ans: symmetrical about X-X axis $\bar{y} = \frac{120}{2} = 60$

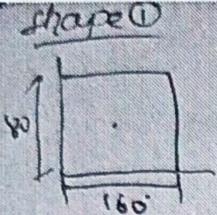
a) Find the centroid of the shaded area shown in fig wrt 'O'



Ans:

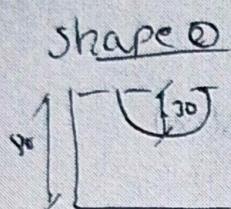


It is symmetric about Y-Y axis
 $20 \bar{x} = 80$.



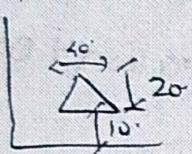
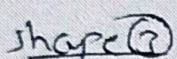
$$A_1 = 12800 \text{ mm}^2$$

$$\Rightarrow y_1 = 80/2 = 40$$



$$A_2 = -\frac{\pi R^2}{2} = -1513$$

$$y_2 = 80 - 4R/3\pi = 67.26$$

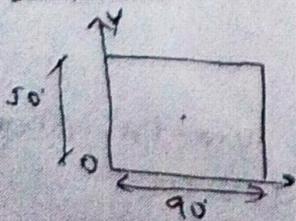
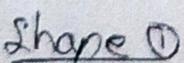
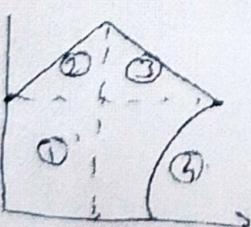
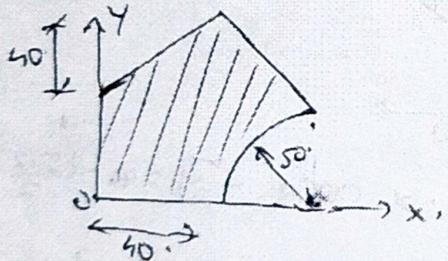


$$A_3 = -1/2 \times 60 \times 20 = -600 \text{ mm}^2$$

$$\Rightarrow y_3 = 10 + 10 \times 20 = 16.67 \text{ mm}$$

$$\bar{y} = 37.3 \text{ mm.}$$

- 10) Locate centroid of shaded area shown in fig with reference to OX & OY axis

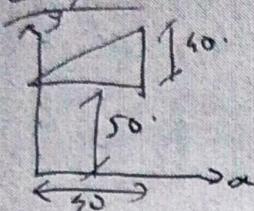


$$A_1 = 50 \times 90 = 4500 \text{ mm}^2$$

$$x_1 = 90/2 = 45 \text{ mm}$$

$$y_1 = 50/2 = 25 \text{ mm}$$

Shape 2

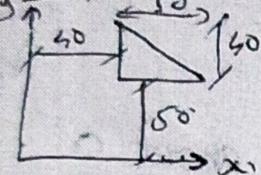


$$A_2 = \frac{1}{2} \times 40 \times 50 = 800 \text{ mm}^2$$

$$x_2 = \frac{2}{3} \times 40 = 26.67 \text{ mm}$$

$$y_2 = 50 + \frac{1}{3} \times 40 = 63.33 \text{ mm}$$

Shape 3

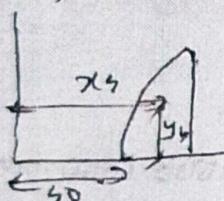


$$A_3 = \frac{1}{2} \times 40 \times 50 = 1000 \text{ mm}^2$$

$$x_3 = 40 + \frac{1}{3} \times 50 = 56.67 \text{ mm}$$

$$y_3 = 50 + \frac{1}{3} \times 30 = 63.33 \text{ mm}$$

Shape 4



$$A_4 = -\pi \frac{R^2}{2} = -\frac{\pi \times (50)^2}{2} = -1962.5$$

$$x_4 = 40 - \frac{4R}{3\pi} = 68.76 \text{ mm}$$

$$y_4 = \frac{4R}{3\pi} = 21.23 \text{ mm}$$

$$\bar{x} = \frac{4500 \times 45 + 800 \times 26.67 + 10500 \times 56.67 - 1962.5 \times 68.76}{4500 + 800 + 10500 - 1962.5}$$

$$= 33.55 \text{ mm}$$

$$\bar{y} = 42.61 \text{ mm}$$

i) Locate centroid of shaded area shown in fig
wrt ox & oy axis

