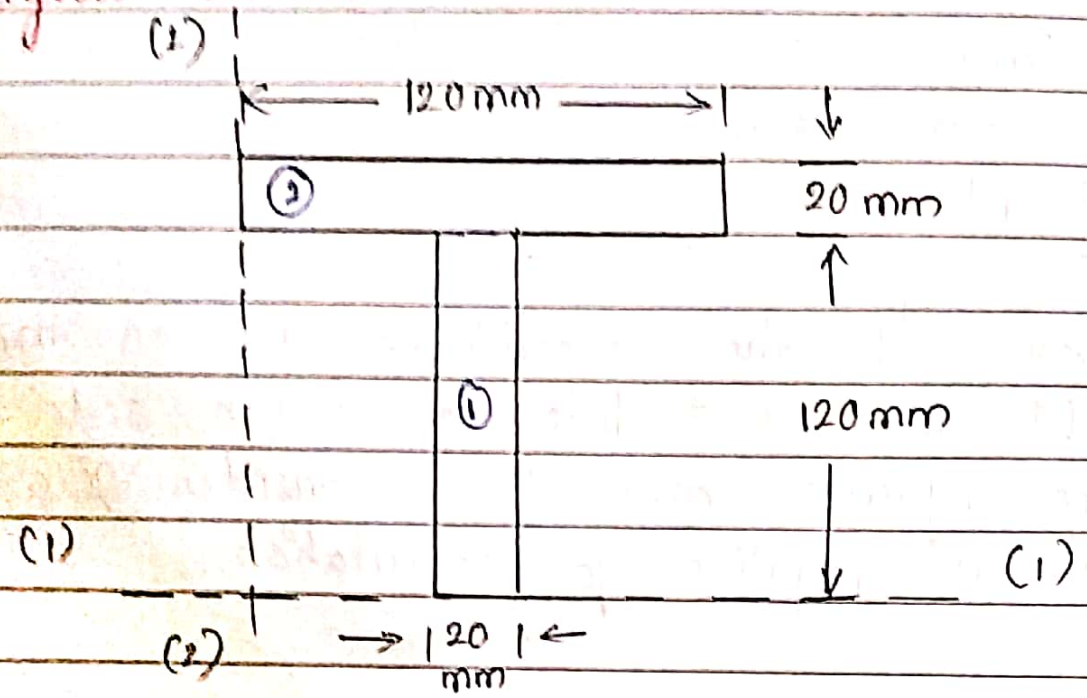
(*) Locate the centroid of the T. section shown in figure below:



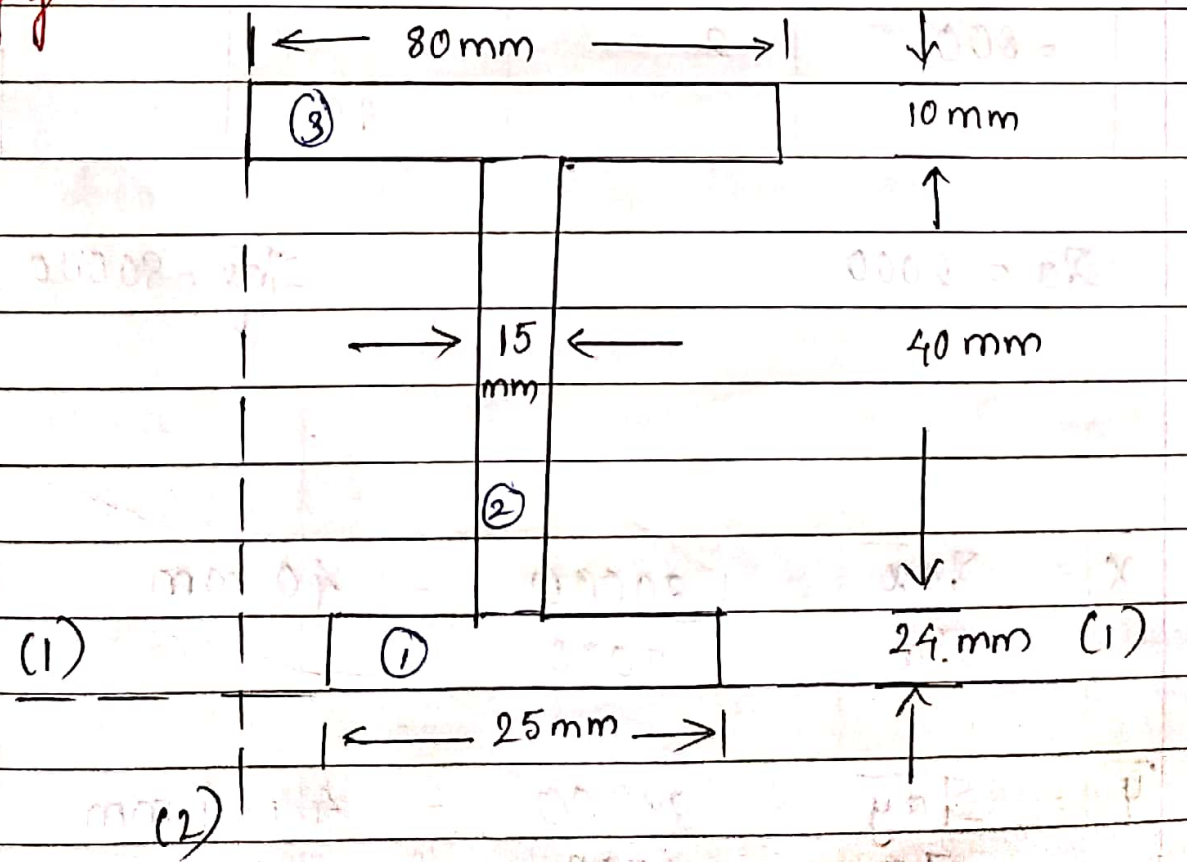
Component	Area 'a' mm^2	Distance of centroid from (2)-(2) axis $\bar{x}$ 'mm'	Distance of centroid from (1)-(1) axis $\bar{y}$ 'mm'	$a\bar{x}$ mm^3	$a\bar{y}$ mm^3
(1)	$20 \times 120 = 2400$	$\frac{120}{2} = 60$	$\frac{120}{2} = 60$	1.44×10^5	1.44×10^5
(2)	$120 \times 20 = 2400$	$\frac{120}{2} = 60$	$\frac{120+20}{2} = 130$	1.44×10^5	3.12×10^5
	$\Sigma a = 4800$			2.88×10^5	4.56×10^5

$$\bar{x} = \frac{\Sigma a\bar{x}}{\Sigma a} = \frac{2.88 \times 10^5}{4800} = 60\,mm$$

$$\bar{y} = \frac{\Sigma a\bar{y}}{\Sigma a} = \frac{4.56 \times 10^5}{4800} = 95\,mm.$$

$$G(\bar{x}, \bar{y}) = (60, 95)\ mm.$$

(*) Locate the centroid of I-section shown in figure.



Component	Area 'a' mm^2	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
①	$25 \times 24 = 600$	$\frac{80}{2} = 40$	$\frac{24}{2} = 12$	24000	7200
②	$15 \times 40 = 600$	$\frac{80}{2} = 40$	$24 + \frac{40}{2} = 44$	24000	26400
③	$80 \times 10 = 800$	$\frac{80}{2} = 40$	$24 + 40 + \frac{10}{2} = 69$	32000	55200

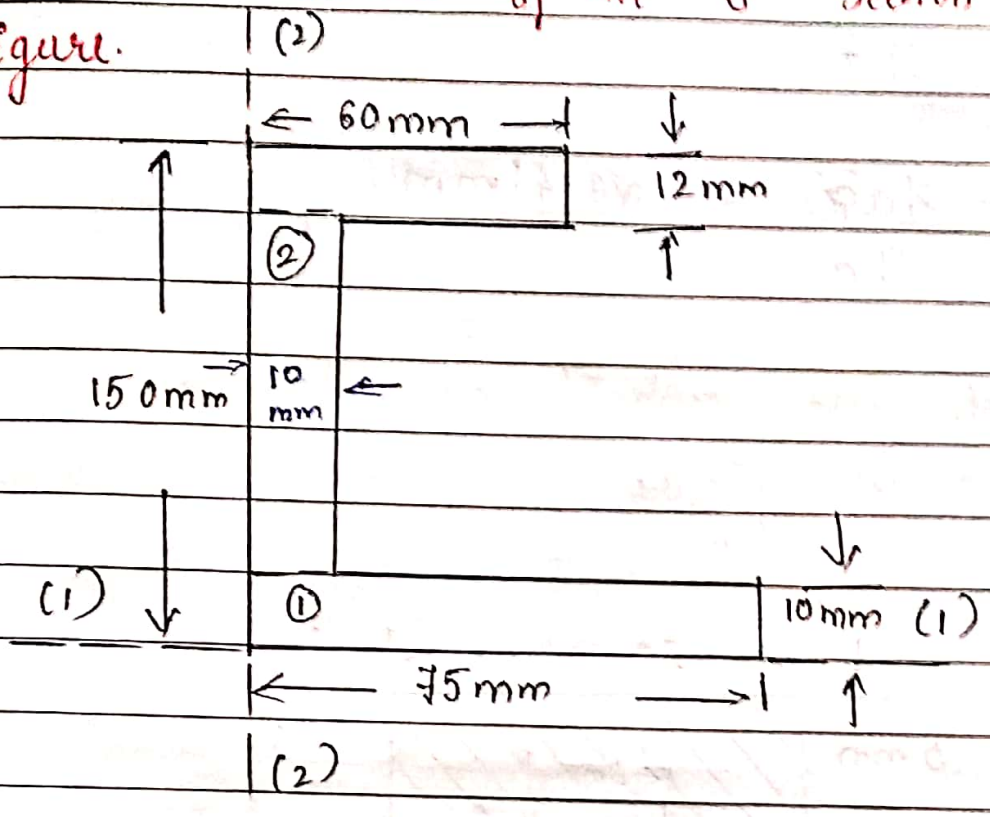
$\Sigma a = 2000$ $\Sigma a\bar{x} = 80000$ $\Sigma a\bar{y} = 88800$.

$$\bar{X} = \frac{\Sigma a\bar{x}}{\Sigma a} = \frac{80000}{2000} = 40 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma a\bar{y}}{\Sigma a} = \frac{88800}{2000} = 44.4 \text{ mm}$$

$\bar{X}, \bar{Y} = (40, 44.4)$ mm

(*) Locate the centroid of the 'C' section shown in figure.

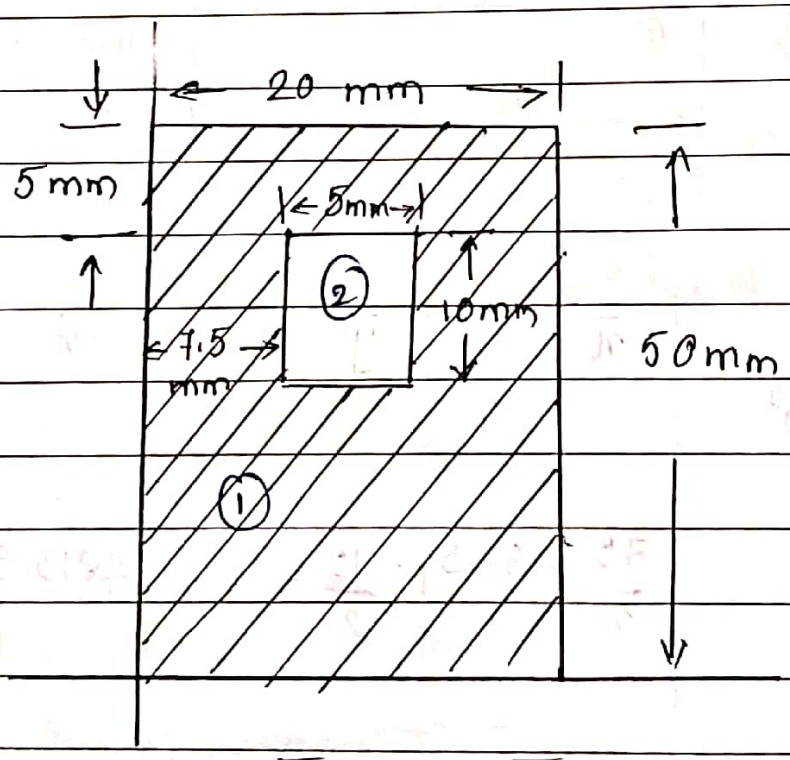


Component	Area 'a' mm^2	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
(1)	$75 \times 10 = 750$	$\frac{75}{2} = 37.5$	$\frac{10}{2} = 5$	28125	3750
(2)	$128 \times 10 = 1280$	$\frac{10}{2} = 5$	$10 + \frac{128}{2} = 74$	6400	94720
(3)	$60 \times 12 = 720$	$\frac{60}{2} = 30$	$10 + 128 + \frac{12}{2} = 144$	21600	103680
	$\Sigma a = 2750$			56125	202150

$$\bar{x} = \frac{\sum a\bar{x}}{\sum a} = 13.51 \text{ mm}$$

$$\bar{x} = \frac{\sum a\bar{x}}{\sum a} = 20.41 \text{ mm}$$

(*) Locate the centroid of the shaded area shown in figure.

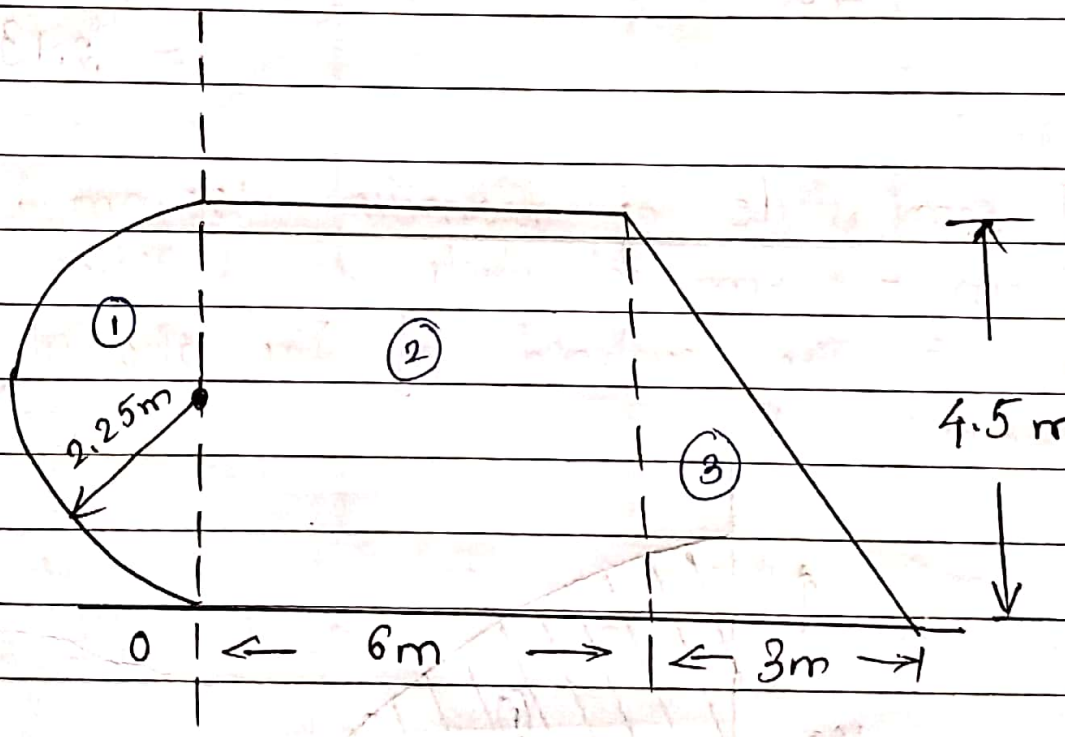


Component	Area 'a'	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
1	$20 \times 50 = 1000$	$\frac{20}{2} = 10$	$\frac{50}{2} = 25$	10000	25000
2	$-5 \times 10 = -50$	$7.5 + 2.5 = 10$	$50 - 5 - 5 = 40$	-500	-2000

$\Sigma a = 950$ $\Sigma a\bar{x} = 9500$ $\Sigma a\bar{y} = 23000$

$\bar{x} = \frac{\Sigma a\bar{x}}{\Sigma a} = 10$ $\bar{y} = \frac{\Sigma a\bar{y}}{\Sigma a} = 24.21 \text{ mm}.$

* Locate the centroid of the area shown in figure wrt to the axis shown in figure.

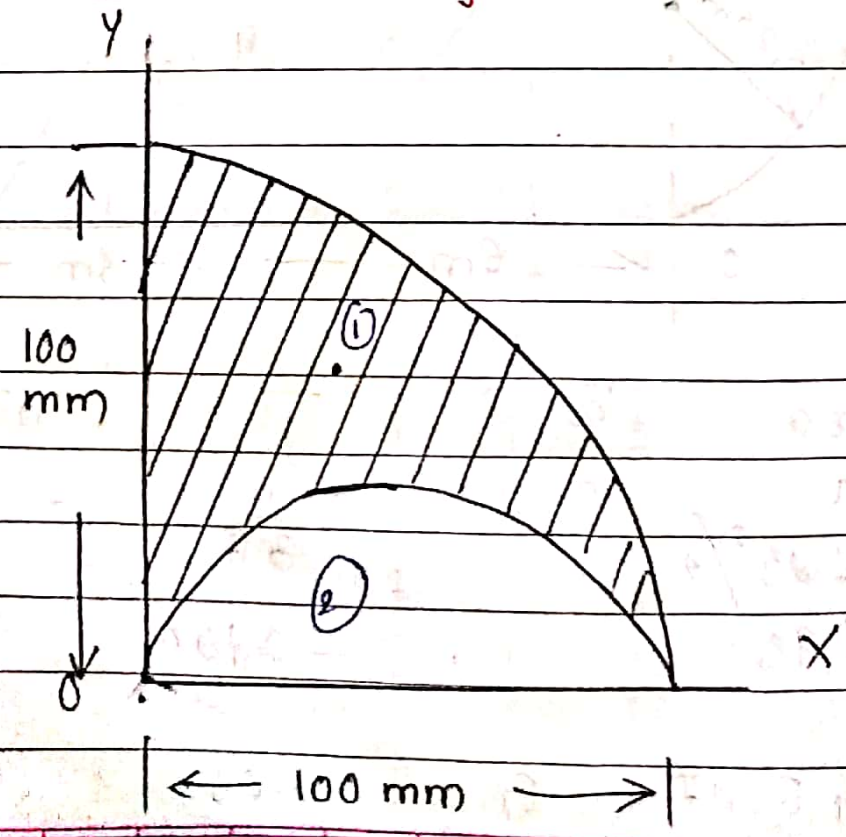


Component	Area 'a'	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
①	$\pi \times 2.25^2/2$ $= 7.95$	2.25	$-\frac{4r}{3\pi}$ $= -0.954$	-7.58	17.89
②	$6 \times 4.5 = 27$	3	2.25	81	60.75

(3)	$\frac{1}{2} \times 3 \times 4.5$ $= 6.75$	7	1.5	47.25	10.12
	$\Sigma a = 41.7$			$\Sigma ax = 120.67$	Σay $= 88.7$

$$\bar{x} = \frac{\Sigma ax}{\Sigma a} = 2.89 \text{ m}, \quad \bar{y} = \frac{\Sigma a\bar{y}}{\Sigma a} = 2.13 \text{ m}.$$

* A semi-circle of diameter 100 mm is cutout from a quarter circle of radius 100 mm. Locate the centroid of the shaded area below.



Component	Area 'a' mm^2	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
(1)	$\frac{\pi r^2}{4}$	$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	333052	333052
	$= \frac{\pi (100)^2}{4}$	$= 42.4$	$= 42.4$		
	$= 7855$				
(2)	$-\frac{\pi r'^2}{2}$	r	$\frac{4r'}{3\pi}$	-196437	
	$= -\frac{\pi (50)^2}{2}$	$= 50$			-83368
	$= -3928.75$		$= 21.22$		
	Σa			$\Sigma a\bar{x}$	$\Sigma a\bar{y}$
	$= 3926.25$			$= 136615$	$= 249684$

$$\bar{X} = \frac{\Sigma a\bar{x}}{\Sigma a} = 34.79 \text{ mm}$$

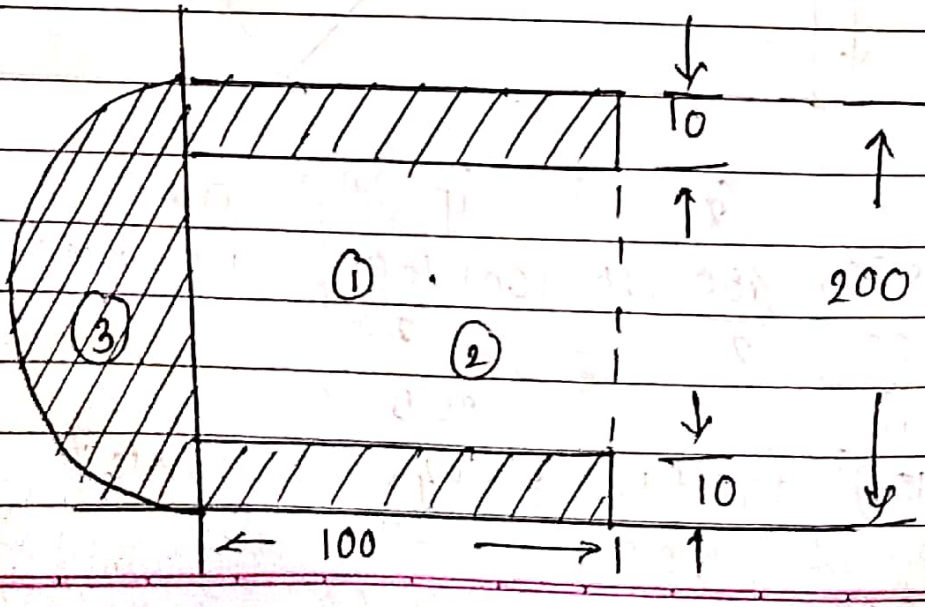
$$\bar{Y} = \frac{\Sigma a\bar{y}}{\Sigma a} = 63.59 \text{ mm}$$

(3)	$\frac{\pi \times 150^2}{4}$	513.6	213.6	9.076×10^6	3.775×10^6
	$= 17671.5$				
(4)	$\frac{1}{2} \times 300 \times 150$	$\frac{150+300}{2}$	$\frac{2}{3} \times 150$	6.75×10^6	2.25×10^6
	$= 22500$	$= 300$	$= 100$		

$\sum a$	$\sum a\bar{x}$	$\sum a\bar{y}$
143014.5	4.163×10^7	3.401×10^7

$$\bar{x} = \frac{\sum a\bar{x}}{\sum a} = 291 \text{ mm} \qquad \bar{y} = 238.3 \text{ mm}$$

* Locate the centroid of shaded area.



Comp.	'a'	$\bar{x}$	$\bar{y}$	$a\bar{x}$	$a\bar{y}$
(1)	100×200 $= 20,000$	$\frac{100}{2}$ $= 50$	$\frac{200}{2}$ $= 100$	1000000	2000000
(2)	$\pi \frac{(100)^2}{2}$ $= 15708$	$-\frac{40\cancel{8}}{3\pi}$ $= -42.4$	100	-666019.2	1570800
(3)	-100×180 $= -18000$	50	100	-900000	1800000

$\Sigma a = 17708$

$\Sigma a\bar{x} = -566019.2$

$\Sigma a\bar{y} =$

$\bar{x} = -31.96$ mm.

$\bar{y} = 100$ mm.