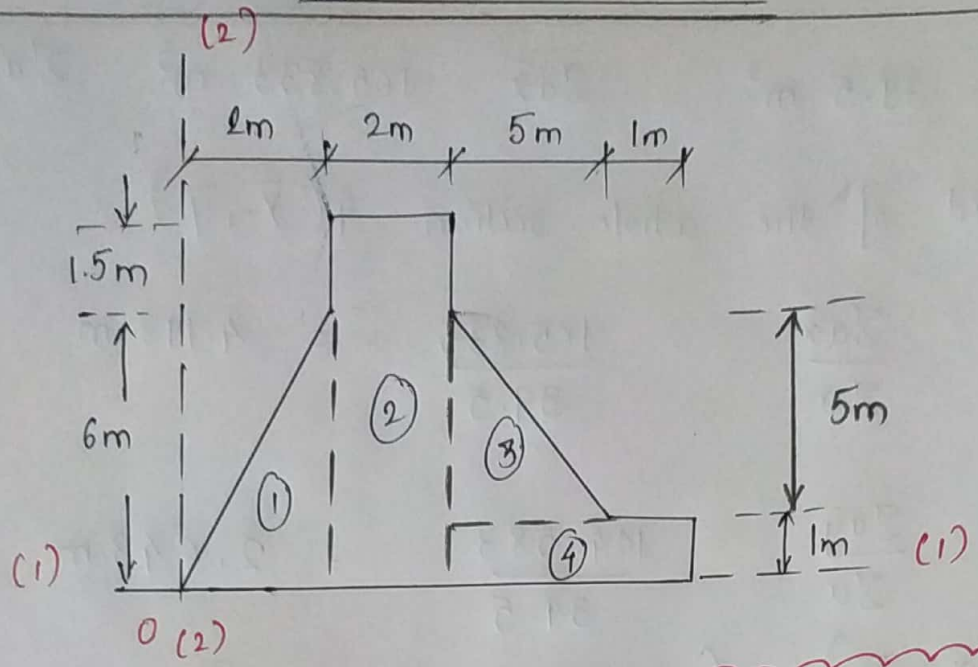
Numericals on Centroid

1.



Select the reference axes (1)-(1) and (2)-(2) such that the entire section is in I quadrant.
Divide the section into individual components as shown in the figure above.

Component	Component area 'a' m^2	$\bar{x}$ - distance of component centroid from (2)-(2) 'm'	$\bar{y}$ - distance of component centroid from (1)-(1) 'm'	$a\bar{x}$ m^3	$a\bar{y}$ m^3
① Triangle	$\frac{1}{2} \times 2 \times 6 = 6$	$\frac{2}{3} \times 2 = \frac{4}{3} = 1.33$	$\frac{1}{3} \times 6 = 2$	7.98	12
② Rectangle	$2 \times 7.5 = 15$	$2 + \frac{2}{2} = 3$	$\frac{7.5}{2} = 3.75$	45	56.2
③ $\frac{1}{2}$ Triangle	$\frac{1}{2} \times 5 \times 5 = 12.5$	$4 + \frac{1}{3} \times 5 = 5.67$	$1 + \frac{1}{3} \times 5 = 2.67$	70.875	33.37
④ Rectangle	$6 \times 1 = 6$	$4 + \frac{6}{2} = 7$	$\frac{1}{2} = 0.5$	42	03

$\Sigma a = 39.5\ m^2$ $\quad \Sigma a\bar{x} = 165.833\ m^3$ $\quad \Sigma a\bar{y} = 104.583\ m^3$

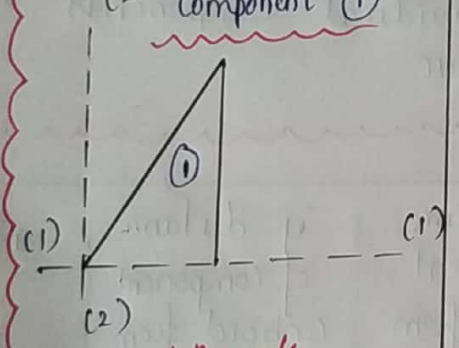
Centroid of the whole section $q(\bar{x}, \bar{y})$

$$\bar{x} = \frac{\Sigma a\bar{x}}{\Sigma a} = \frac{165.833}{39.5} = 4.198\ m$$

$$\bar{y} = \frac{\Sigma a\bar{y}}{\Sigma a} = \frac{104.583}{39.5} = 2.648\ m$$

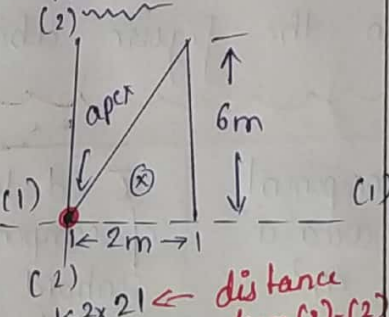
$q(\bar{x}, \bar{y}) = (4.198\ m, 2.648\ m)$

Component (1)



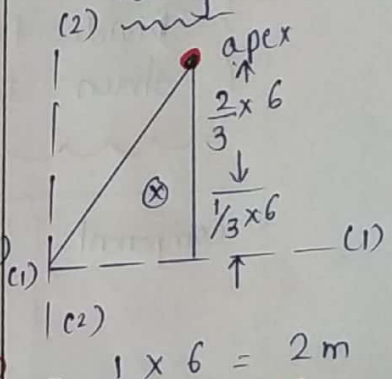
For triangle centroid is at $\frac{2}{3}$ x dimension from the apex

For $\bar{x}$



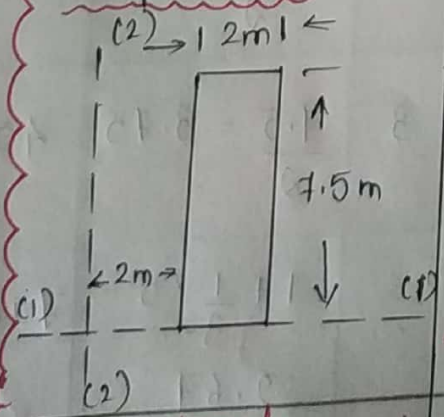
$\frac{2}{3} \times 2 = 1.33\ m$ ← distance from (2)-(2)

For $\bar{y}$



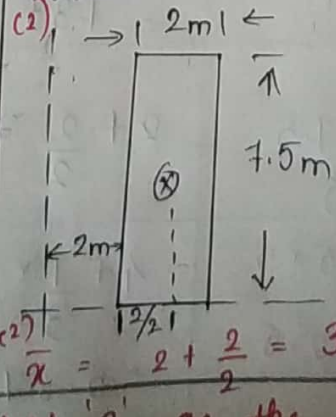
$= \frac{1}{3} \times 6 = 2\ m$ ↑ distance from (1)-(1)

Component (2)



For rectangle centroid is $b/2$ and $d/2$

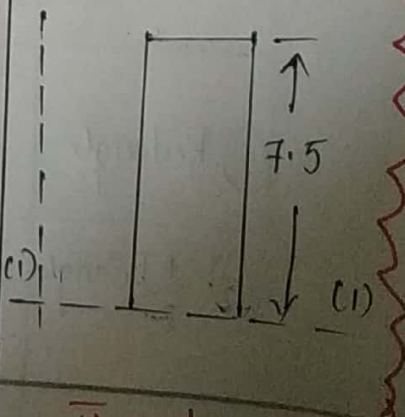
For $\bar{x}$



$\bar{x} = 2 + \frac{2}{2} = 3$

Add '2' as the component is at a distance of 2m from (2)-(2)

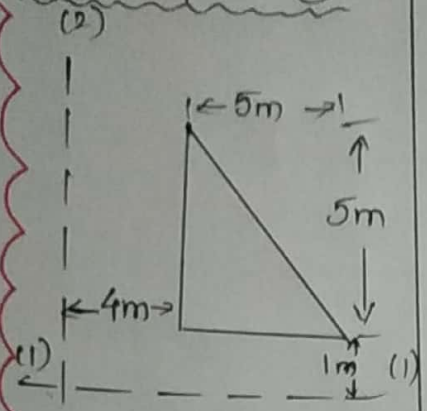
For $\bar{y}$



$\bar{y} = \frac{d}{2} = \frac{7.5}{2} = 3.75$

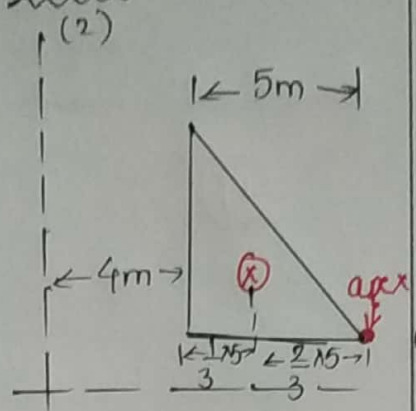
cont'd...

For componcal (3)



For triangle the centroid is at a distance of $\frac{2}{3}$ x dimension from apex

For $\bar{x}$

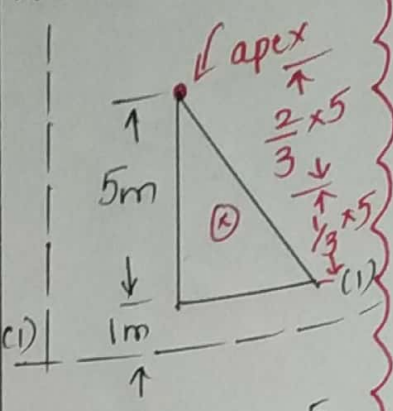


$\bar{x} = 4 + \frac{1}{3} \times 5$

$= 5.67\ m$

'4' is added as the component is at a distance of 4m from (2)-(2)

For $\bar{y}$

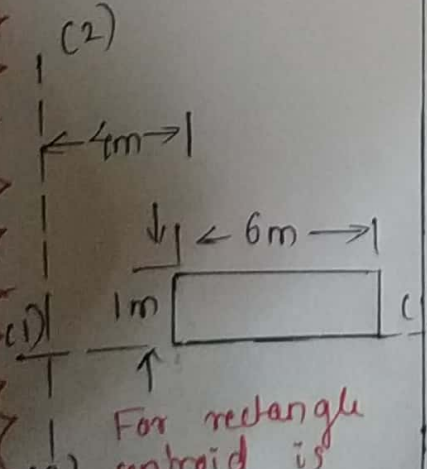


$\bar{y} = 1 + \frac{1}{3} \times 5$

$= 2.67\ m$

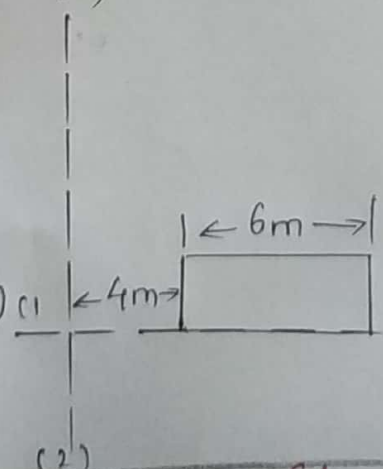
'1' is added as the component is at a distance of 1m from (1)-(1) reference axes.

For component (4)



For rectangle centroid is $b/2$ and $d/2$

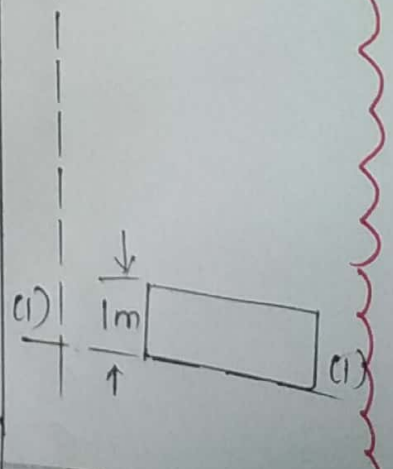
For $\bar{x}$



$\bar{x} = 4 + 6/2 = 7$

'4' is added as the component is at 4m from (2)-(2)

For $\bar{y}$



$y = \frac{d}{2} = \frac{1}{2}$

$= 0.5m$