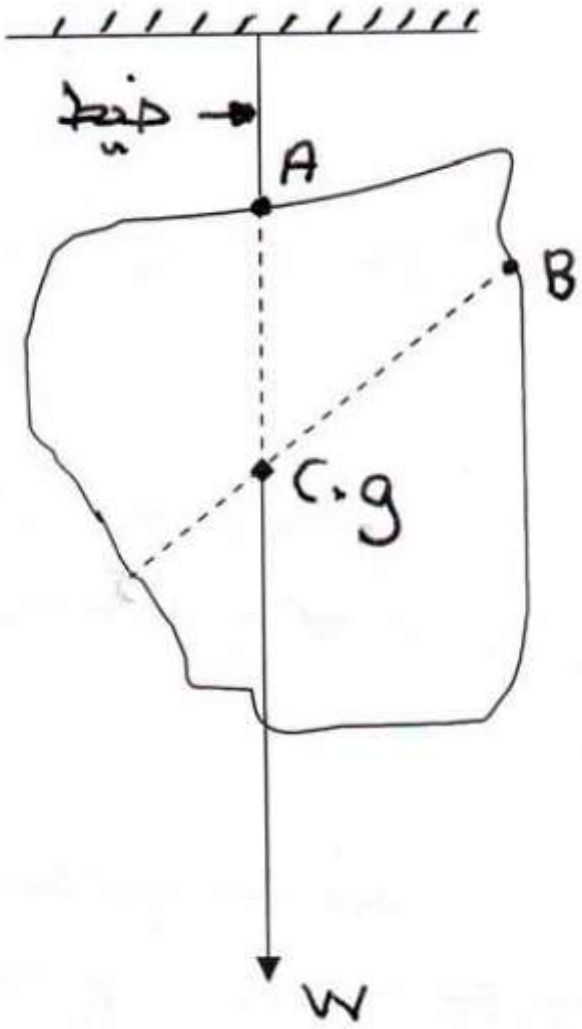
Centroide and Center of gravity مركز الثقل

A body جسم of weight وزنه (W) is supported معلق by string خيط attached at (A) as shown in Fig . the only external force القوة acting on the body المؤثر على الجسم are its weight الخارجية الوحيدة and reaction رد الفعل exerted المسلط by string على الخيط Equilibrium اتزان of the body can exist يحدث only if their two forces are equal in magnetide متساوية بالمقدار opposite in direction and collinear على خط مستقيم the line of action of the weight (W) can be deter mind يمكن ايجاد by the line of action of support على خط تأثير الخيط let the body be supported in anew position لتعلق الجسم بموقع آخر by the string now attached to (B) . the body will shift its position so that the line of action of the weight is again collinear with the string .

These two position of the line of action of the weight are deter mine experimantly هذه الخطوط توجد بالتجربة . the inter action of these two line represents تقاطع الخطين يمثل the center of gravity (c . g) where the weight pass throw it .



enter of gravity of simple area and length

مركز ثقل المساحة البسيطة والطول

We can find يمكن إيجاد the laws قوانين of center of gravity of the simple area المساحة البسيطة from the formula

$$\bar{X} = \frac{\int x dA}{A} \qquad \bar{Y} = \frac{\int y dA}{A}$$

معادلات استخراج مراكز ثقل المساحات البسيطة

Also كذلك we can find the center of qrawity of the length from these formula المعادلات

$$\bar{X} = \frac{\int X\, dL}{L} \qquad \bar{y} = \frac{\int y\, dL}{L}$$

$\bar{X}$, $\bar{y}$ **=coordinate of center of gravity احداثيات مركز الثقل**

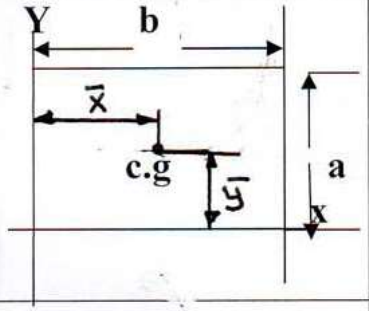
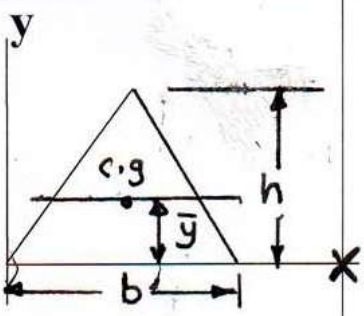
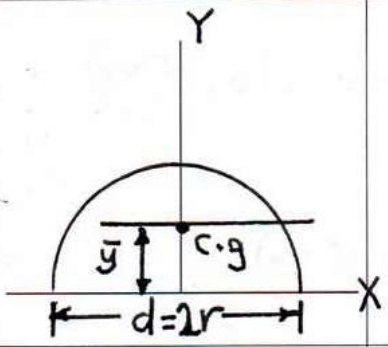
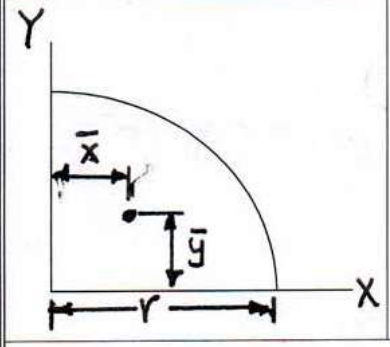
A = simple area المساحة البسيطة

L = Length الطول

dA = differentiation of area مشتقة المساحة

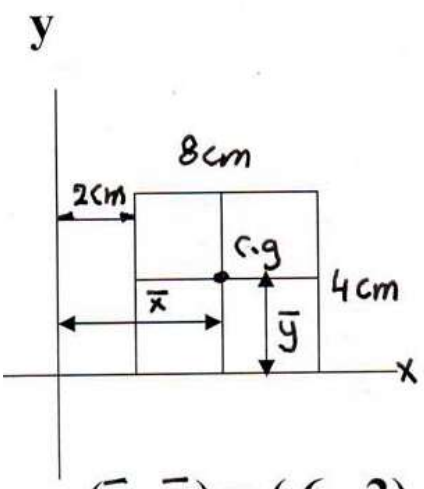
dL = = = length مشتقة الطول

The table الجدول shown الموضح the laws to find the center of gravity of simple area and length .

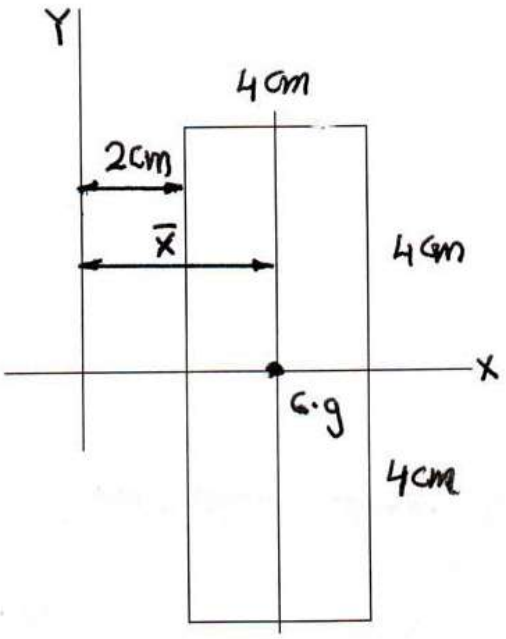
Shape الشكل	Area or length المساحة اوالطول	$\bar{X}$	$\bar{y}$
	**ab**	$\frac{b}{2}$	$\frac{a}{2}$
	$\frac{bh}{2}$	-----	$\frac{h}{3}$
	$\frac{\pi r^2}{2}$	**0**	$\frac{4r}{3\pi}=0.424r$
	$\frac{\pi r^2}{4}$	$\frac{4r}{3\pi}=0.424r$	$\frac{4r}{3\pi}=0.424r$

Q/Find the center of gravity of simple area shown in Fig .

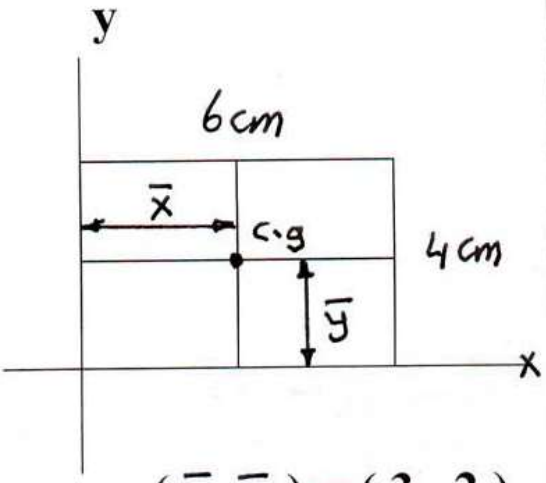
اوجد مركز ثقل المساحةةالبسيطة الموضحة في الشكل



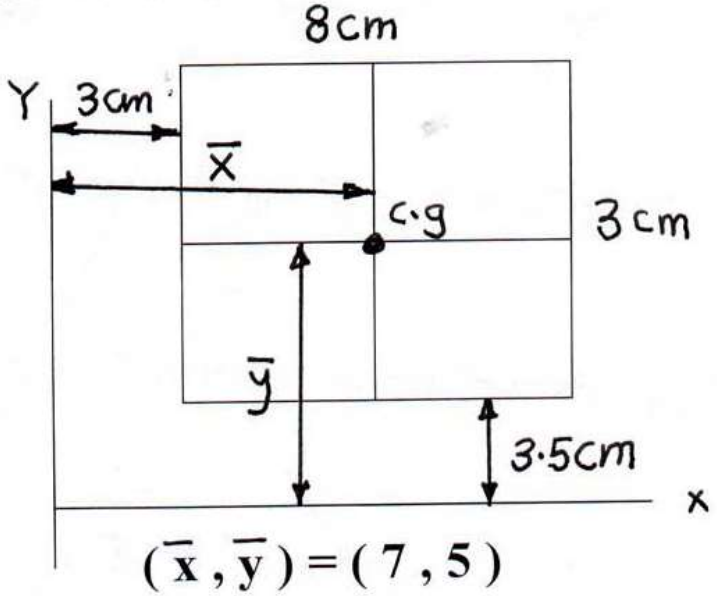
$(\bar{x}, \bar{y}) = (6, 2)$



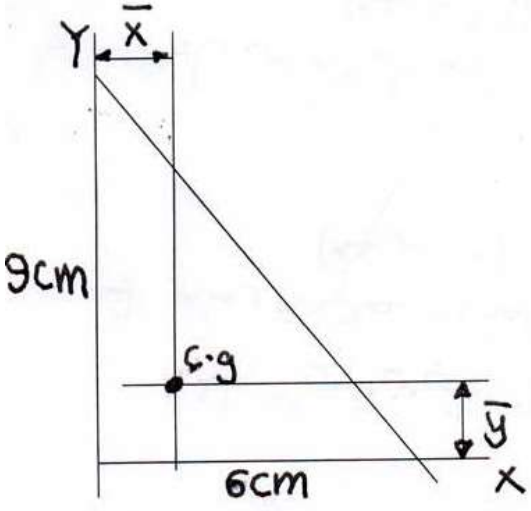
$(\bar{x}, \bar{y}) = (4, 0)$



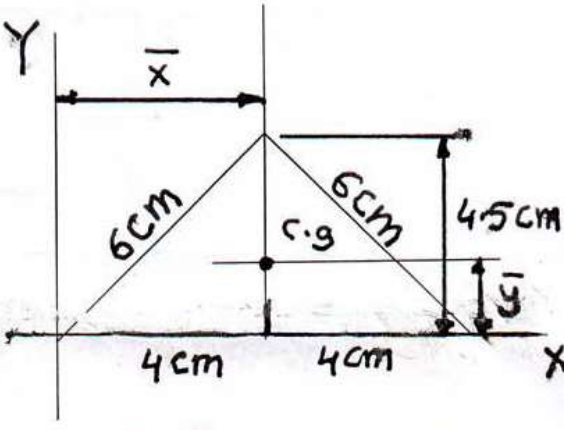
$(\bar{x}, \bar{y}) = (3, 2)$



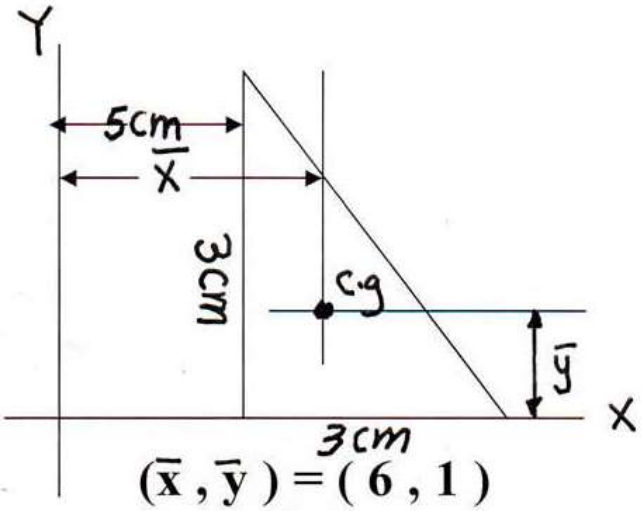
$(\bar{x}, \bar{y}) = (7, 5)$



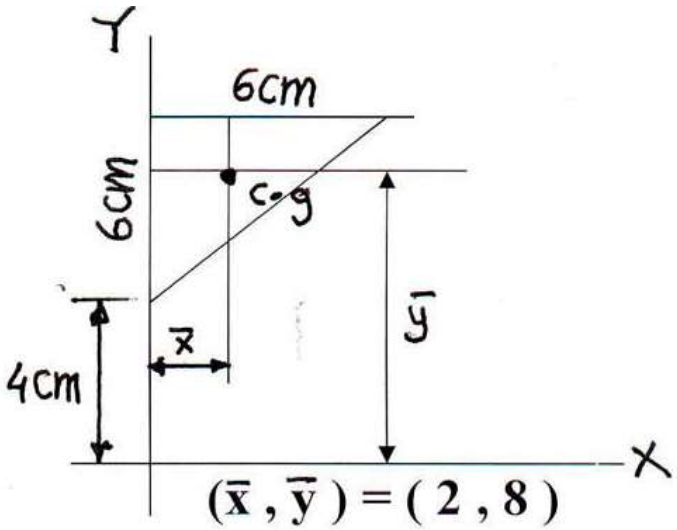
$(\bar{x}, \bar{y}) = (2, 3)$



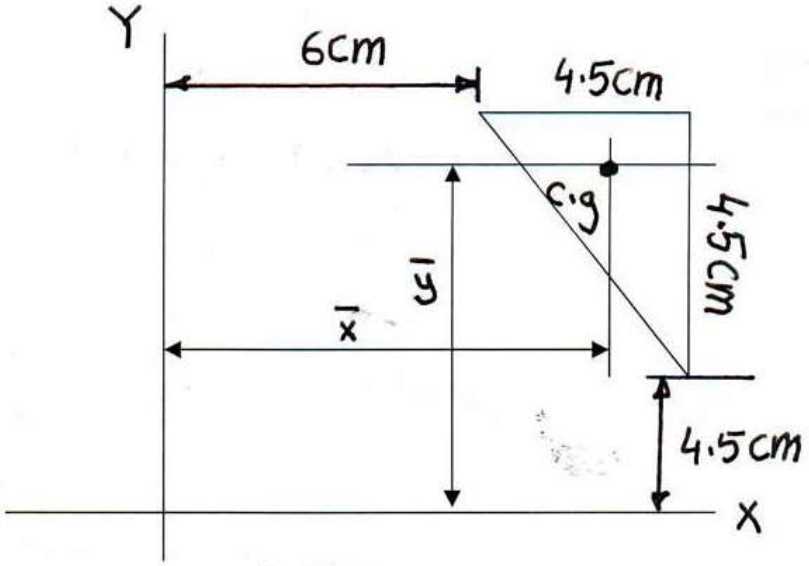
$(\bar{x}, \bar{y}) = (4, 1.5)$



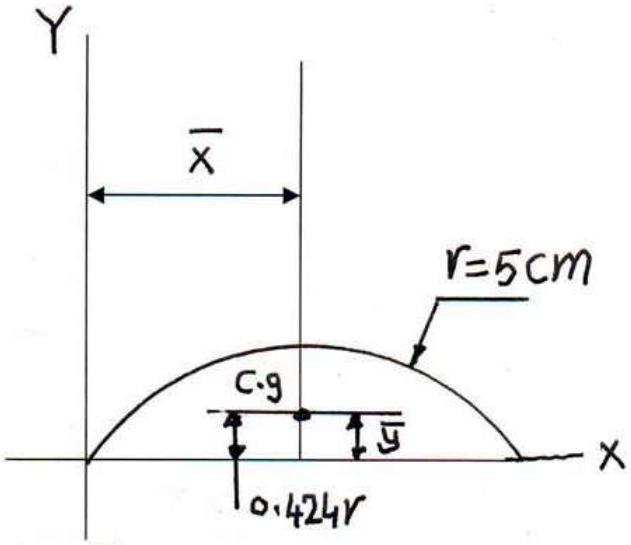
$(\bar{x}, \bar{y}) = (6, 1)$



$(\bar{x}, \bar{y}) = (2, 8)$



$(\bar{x}, \bar{y}) = (9, 7.5)$

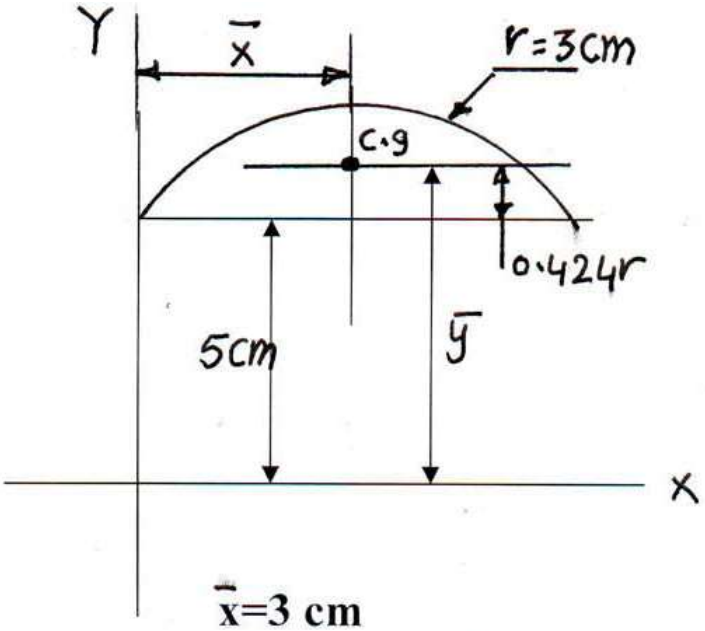


$\bar{X}$=5 cm

$\bar{Y}$= 0.424*5

$\bar{Y}$ = 2.12 cm

($\bar{x}$, $\bar{y}$) = (5, 2.12)

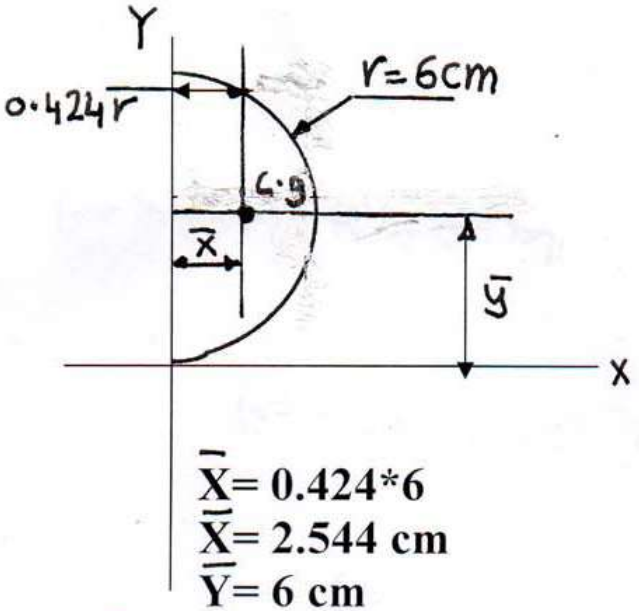


$\bar{x}$=3 cm

$\bar{y}$= 5+0.424*3

$\bar{y}$= 6.272 cm

($\bar{x}$, $\bar{y}$) = (3 , 6.272)

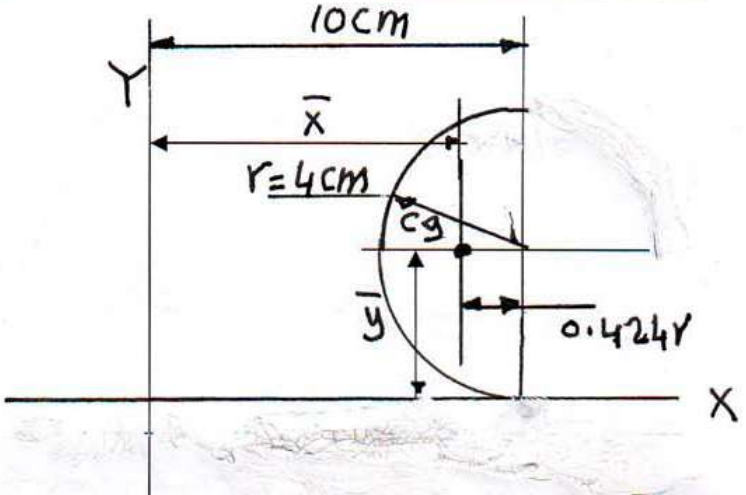


$\bar{X}$= 0.424*6

$\bar{X}$= 2.544 cm

$\bar{Y}$= 6 cm

($\bar{x}$, $\bar{y}$) = (2.544 , 6)

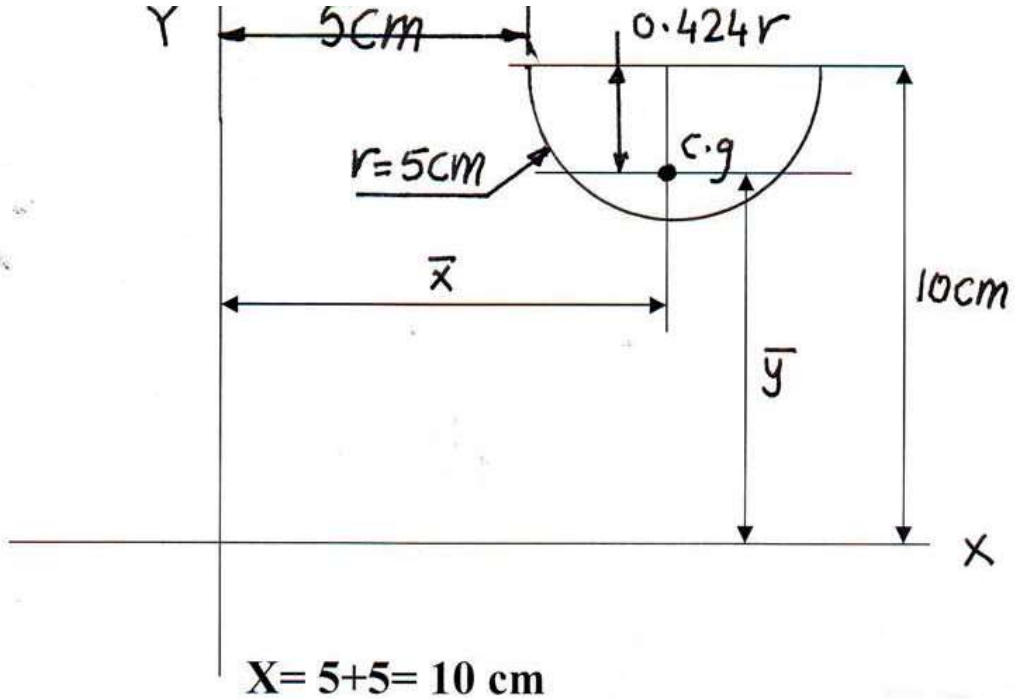


$\bar{x}$=10-0.424*4

$\bar{x}$ = 8.304 cm

$\bar{y}$=4 cm

(x , y) = (8.304 , 4)



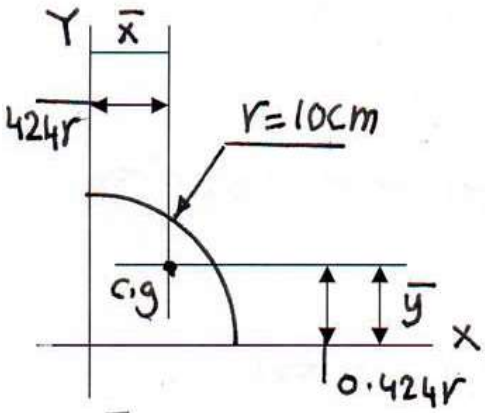
X= 5+5= 10 cm

Y=10-0.424*5

= 10-2.12

= 7.88 cm

(x , y) = (10 , 7.88)



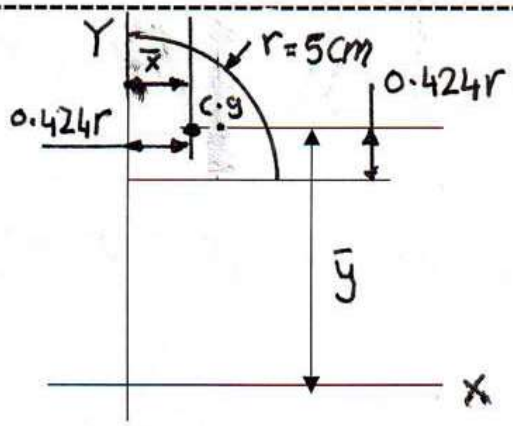
$\bar{x}$=0.424*10

$\bar{X}$ = 424 cm

$\bar{y}$=0.424*10

$\bar{Y}$ = 4.24 cm

($\bar{x}$, $\bar{y}$) = (4.24 , 4.24)



$\bar{x}$=0.424*5

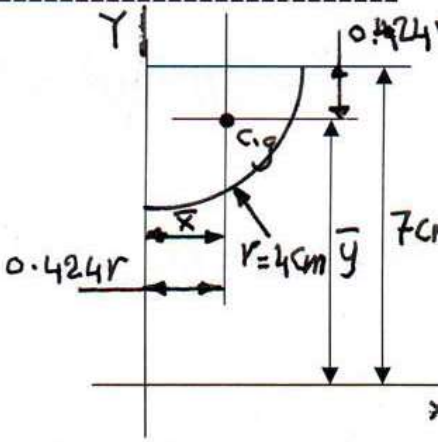
$\bar{x}$=2.12 cm

$\bar{y}$=5+0.424*5

$\bar{y}$=5+2.12

$\bar{y}$=7.12 cm

($\bar{x}$,$\bar{y}$) = (2.12 , 7.12)



$\bar{x}$=0.424*4

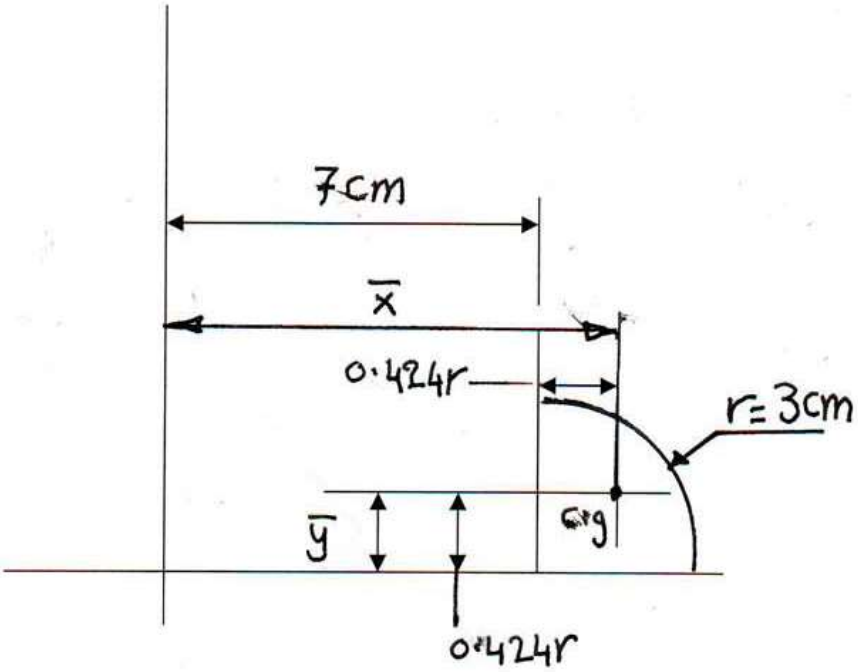
$\bar{x}$=1.696 cm

$\bar{y}$=7-0.424*4

$\bar{y}$=7-1.696

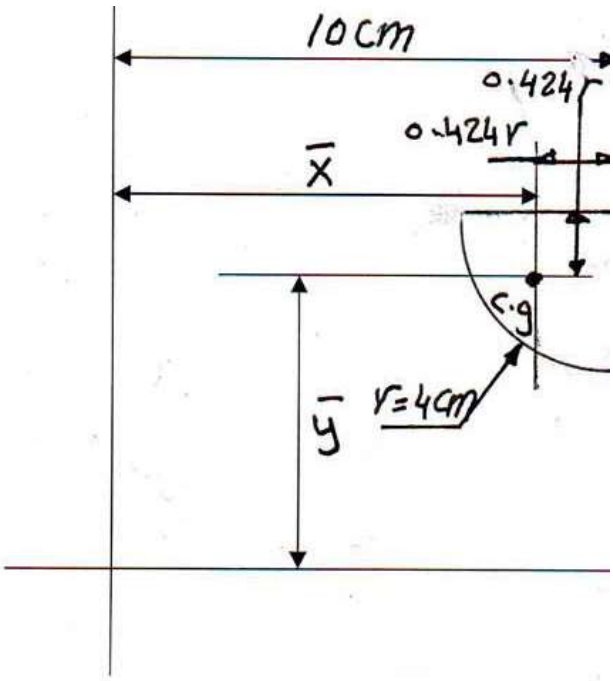
$\bar{y}$= 5.304 cm

($\bar{x}$,$\bar{y}$) = (1.696 , 5.304)



$\bar{x}$= 7+0.424*3
= 7+1.272
= 8.272 cm
$\bar{y}$= 0.424*3
$\bar{y}$= 1.272 cm

($\bar{x}$, $\bar{y}$) = (8.272 , 1.272)



$\bar{x}$=10-0.424*4
= 10-1.696
= 8.304 cm
$\bar{y}$= 9-0.424*4
$\bar{y}$=9- 1.696
= 7.304 cm
($\bar{x}$, $\bar{y}$) = (8.304 , 7.304