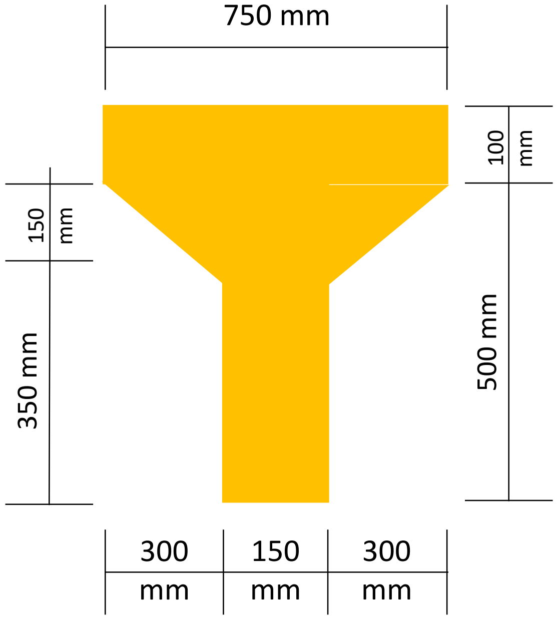
Ex. 3: Calcule o CG da figura abaixo.



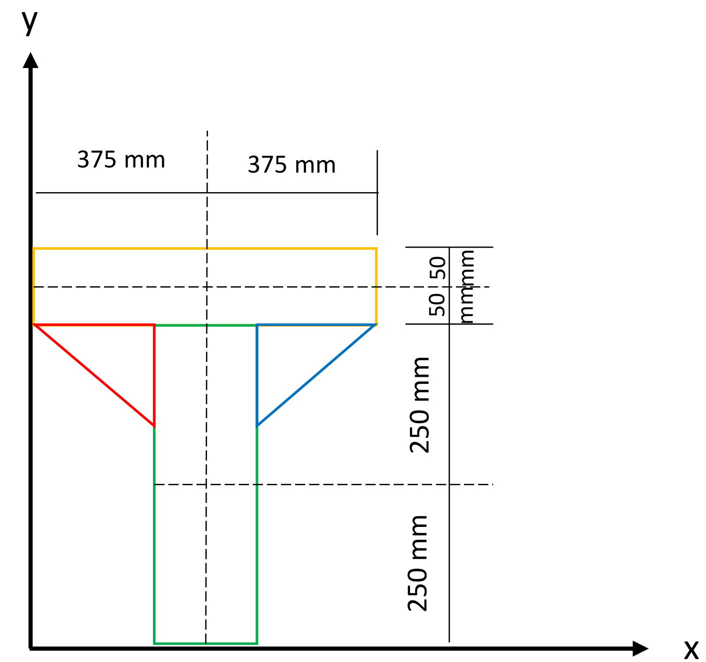


Fig.	x	y	A	x.A	y.A
1	375	550	75.000	28.125.000	41.250.000
2	100	400	22.500	2.250.000	9.000.000
3	650	400	22.500	14.625.000	9.000.000
4	375	250	75.000	28.125.000	18.750.000
		Σ	195.000	73.125.000	78.000.000

$$\bar{x} = \frac{\Sigma \bar{x} \cdot A}{\Sigma A} \qquad \bar{x} = \frac{\mathbf{73.125.000}}{195.000} \qquad \mathbf{\bar{x} = 375\ mm}$$

$$\bar{y} = \frac{\Sigma \bar{y} \cdot A}{\Sigma A} \qquad \bar{y} = \frac{78.000.000}{195.000} \qquad \bar{y} = 400\ mm$$

MECÂNICA GERAL

Momento de Inércia

Prof.ª Andressa Angelin

Aula 6

10/10/20

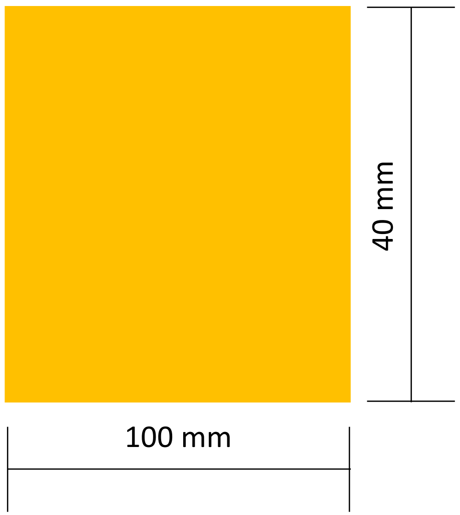
Momento de Inércia

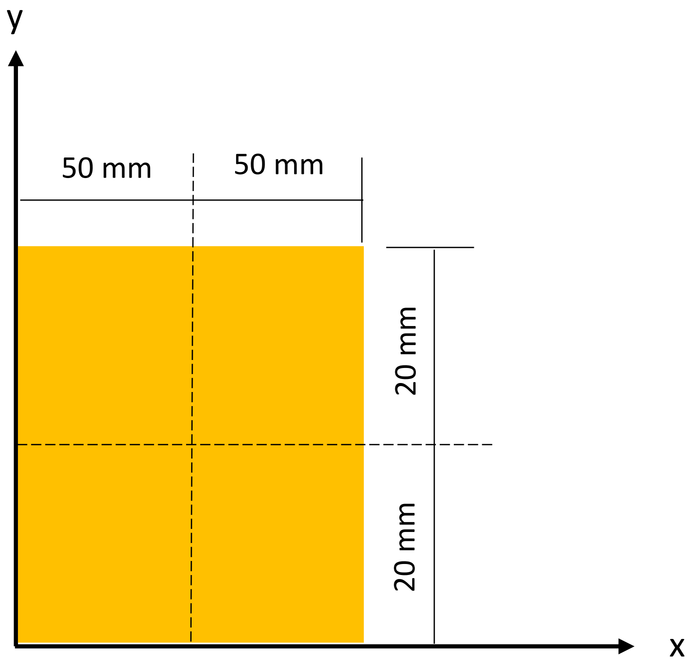
- distância da massa ao centro de rotação;
- tendência do corpo ficar parado ou entrar em movimento;
- dificuldade de giro do corpo em relação ao eixo (x ou y).

Momento de Inércia

	Σx	**Σy**
Retângulo	$\frac{b\,.\,h^3}{12}$	$\frac{h\,.\,b^3}{12}$
Círculo	$\frac{\pi\,.\,r^4}{4}$	$\frac{\pi\,.\,r^4}{4}$
Semicírculo	$\frac{\pi\,.\,r^4}{8}$	$\frac{\pi\,.\,r^4}{8}$
Quarto de círculo	$\frac{\pi\,.\,r^4}{8}$	$\frac{\pi\,.\,r^4}{16}$
Elipse	$\frac{\pi\,.\,a\,.\,b^3}{4}$	$\frac{\pi\,.\,a^3\,.\,b}{4}$

Ex. 1:





	Σx	Σy
Retângulo	$\frac{b\,.\,h^3}{12}$	$\frac{h\,.\,b^3}{12}$

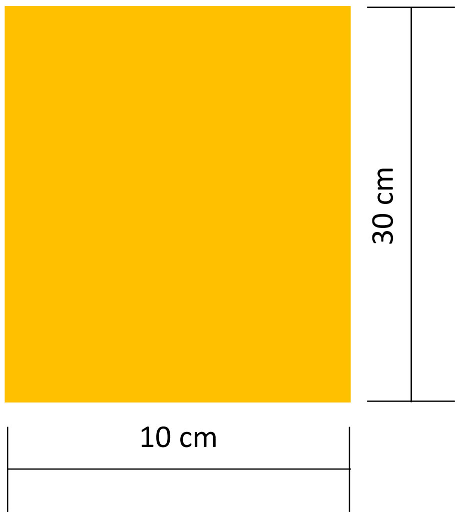
$$Ix = \frac{0{,}1\,.\,0{,}04^3}{12} = 5{,}33 \text{ x } 10^{-7}\ m^4$$

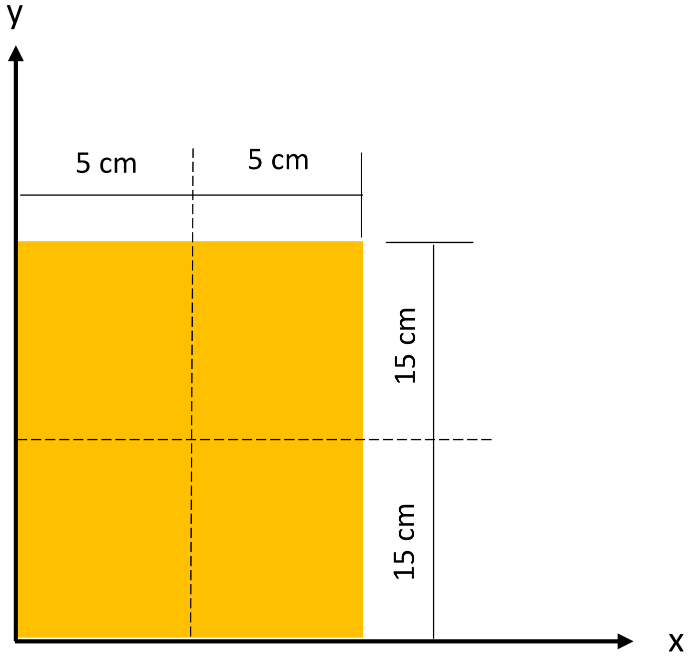
$$Iy = \frac{0{,}04\,.\,0{,}1^3}{12} = 3{,}33 \text{ x } 10^{-6}\ m^4$$

↑ I ↑ dificuldade de giro

↑ tendência de giro em x

Ex. 2:



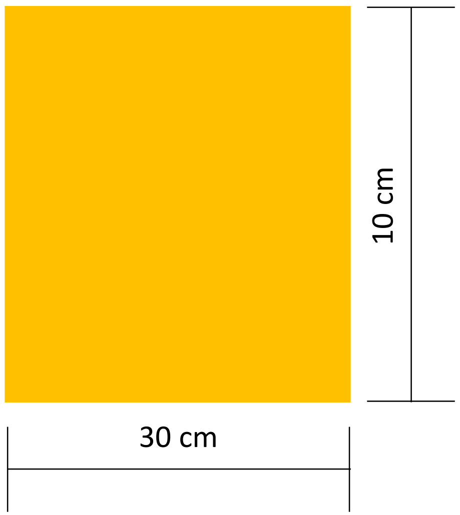


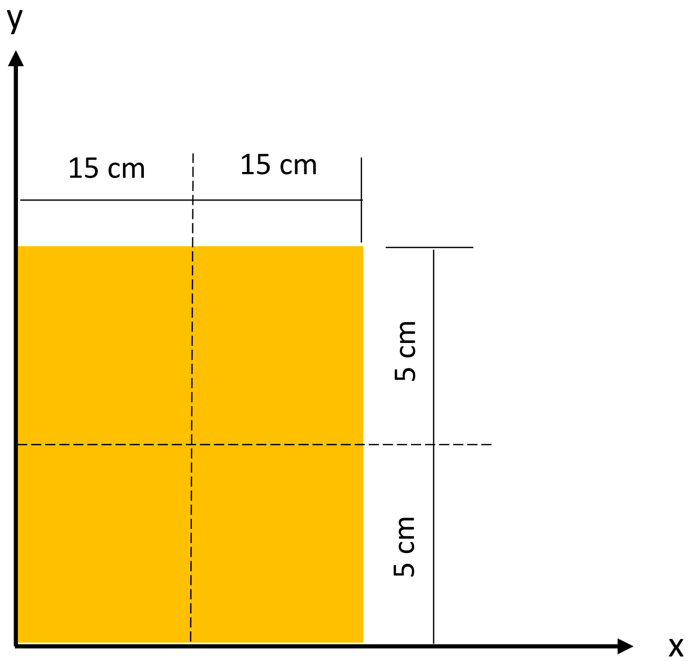
	Σx	Σy
Retângulo	$\frac{b\,.\,h^3}{12}$	$\frac{h\,.\,b^3}{12}$

$$\text{Ix} = \frac{10\,.\,30^3}{12} = 22.500\ \text{cm}^4$$

$$\text{Iy} = \frac{30\,.\,10^3}{12} = 2.500\ \text{cm}^4$$

Ex. 3:



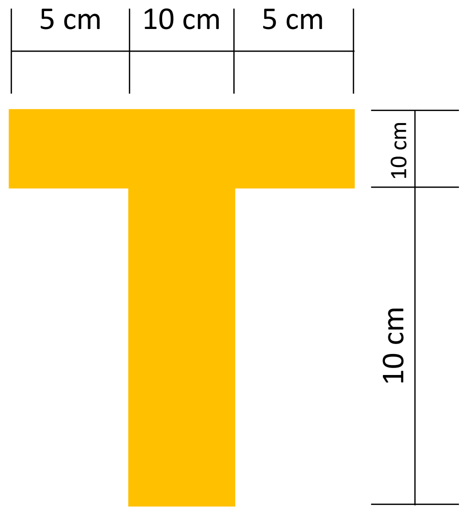


	Σx	Σy
Retângulo	$\frac{b\,.\,h^3}{12}$	$\frac{h\,.\,b^3}{12}$

$$\text{Ix} = \frac{30\,.\,10^3}{12} = 2.500\ \text{cm}^4$$

$$\text{Iy} = \frac{10\,.\,30^3}{12} = 22.500\ \text{cm}^4$$

Ex. 4:



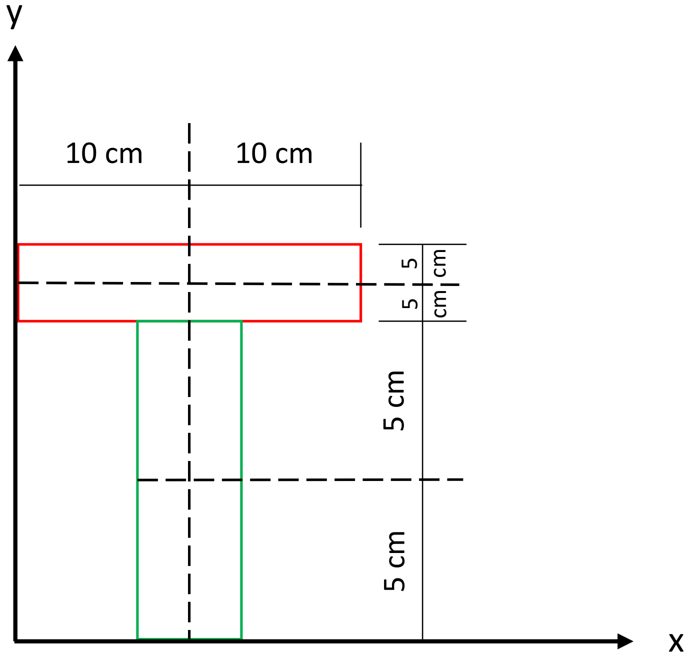


Fig.	x	y	A	x.A	y.A
1	0,1	0,15	0,02	$2x10^{-3}$	$3x10^{-3}$
2	0,1	0,05	0,01	$1x10^{-3}$	$5x10^{-4}$
		Σ	**0,03**	**$3x10^{-3}$**	**$3,5x10^{-3}$**

$$\bar{x} = \frac{\Sigma \bar{x} \cdot A}{\Sigma A} \qquad \bar{x} = \frac{3x10-3}{0,03} \qquad \bar{x} = 0,1 \text{ m}$$

$$\bar{y} = \frac{\Sigma \bar{y} \cdot A}{\Sigma A} \qquad \bar{y} = \frac{3,5x10-3}{0,03} \qquad \bar{y} = 0,1167 \text{ m}$$

$$Ix = \frac{b \,.\, h^3}{12} + A \,.\, (y - \bar{y})^2$$

$$Ix_1 = \frac{0,2 \,.\, 0,1^3}{12} + 0,02 \,.\, (0,15 - 0,1167)^2 \qquad Ix_1 = 3,8845x10^{-5} \text{ m}^4$$

$$Ix_2 = \frac{0,1 \,.\, 0,1^3}{12} + 0,01 \,.\, (0,05 - 0,1167)^2 \qquad Ix_2 = 5,28x10^{-5} \text{ m}^4$$

$$Ix = 9,1645x10^{-5} \text{ m}^4$$

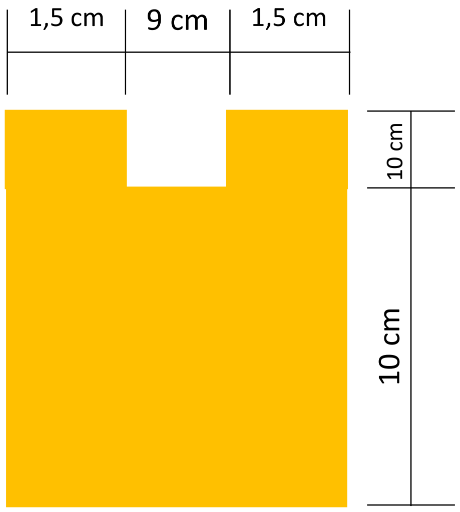
$$Iy = \frac{h \,.\, b^3}{12} + A \,.\, (x - \bar{x})^2$$

$$Iy_1 = \frac{0,1 \,.\, 0,2^3}{12} + 0,02 \,.\, (0,1 - 0,1)^2 \qquad Iy_1 = 6,6667x10^{-5} \text{ m}^4$$

$$Iy_2 = \frac{0,1 \,.\, 0,1^3}{12} + 0,02 \,.\, (0,1 - 0,1^2 \qquad Iy_2 = 8,3333x10^{-6} \text{ m}^4$$

$$Iy = 7,5x10^{-5} \text{ m}^4$$

Ex. 5:



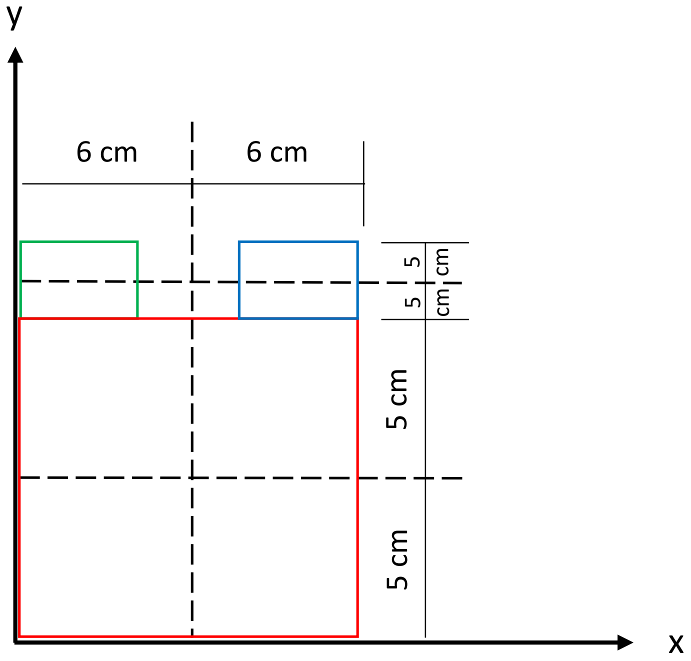


Fig.	x	y	A	x.A	y.A
1	0,75	15	15	11,25	225
2	6	5	120	720	600
3	11,25	15	15	168,75	225
		Σ	150	900	1050

$$\bar{x} = \frac{\Sigma\bar{x}\cdot A}{\Sigma A} \qquad \bar{x} = \frac{900}{150} \qquad \bar{x} = 6 \text{ cm}$$

$$\bar{y} = \frac{\Sigma\bar{y}\cdot A}{\Sigma A} \qquad \bar{y} = \frac{1050}{150} \qquad \bar{y} = 7 \text{ cm}$$

$$Ix = \frac{b\,.\,h^3}{12} + A\,.\,(y-\bar{y})^2$$

$$Ix_1 = \frac{1{,}5\,.\,10^3}{12} + 15\,.\,(15-7)^2 \qquad Ix_1 = 1.085 \text{ cm}^4$$

$$Ix_2 = \frac{12\,.\,10^3}{12} + 120\,.\,(5-7)^2 \qquad Ix_2 = 1.480 \text{ cm}^4 \qquad Ix = 3.650 \text{ cm}^4$$

$$Ix_3 = \frac{1{,}5\,.\,10^3}{12} + 15\,.\,(15-7)^2 \qquad Ix_3 = 1.082 \text{ cm}^4$$

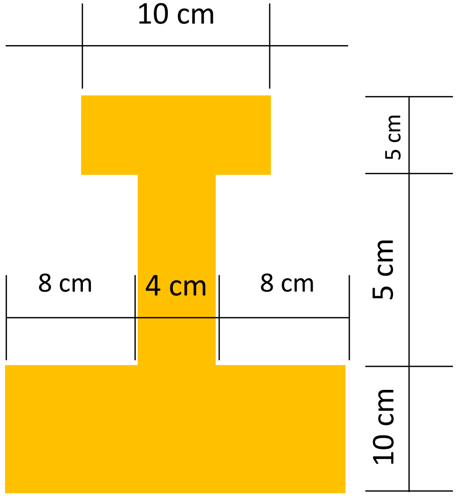
$$Iy = \frac{h\,.\,b^3}{12} + A\,.\,(x-\bar{x})^2$$

$$Iy_1 = \frac{10\,.\,1{,}5^3}{12} + 15\,.\,(0{,}75-6)^2 \qquad Iy_1 = 416{,}26 \text{ cm}^4$$

$$Iy_2 = \frac{10\,.\,12^3}{12} + 120\,.\,(6-6)^2 \qquad Iy_2 = 1.440 \text{ cm}^4 \qquad Iy = 2.272{,}52 \text{ cm}^4$$

$$Iy_3 = \frac{10\,.\,1{,}5^3}{12} + 15\,.\,(11{,}25-6)^2 \qquad Iy_3 = 416{,}26 \text{ cm}^4$$

Ex. 6:



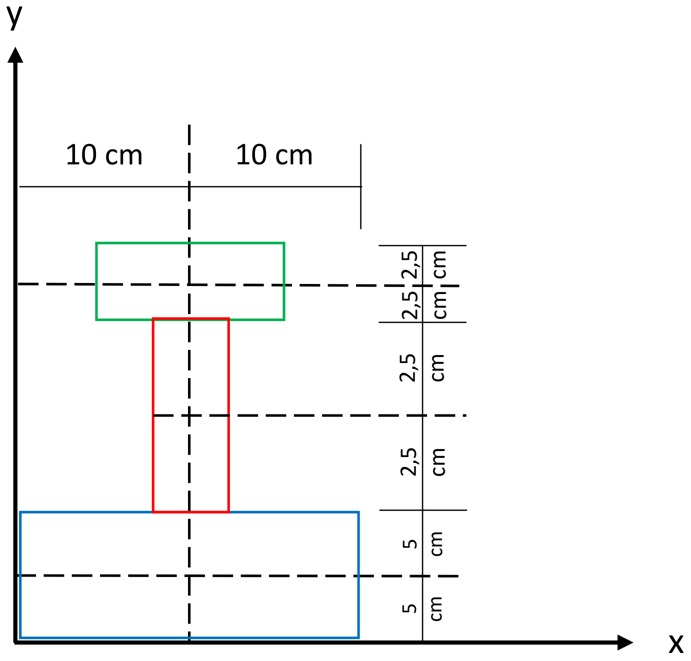


Fig.	x	y	A	x.A	y.A
1	10	17,5	50	500	875
2	10	12,5	20	200	250
3	10	5	200	2.000	100
		Σ	270	2.700	2.125

$$\bar{x} = \frac{\Sigma \bar{x} \cdot A}{\Sigma A} \qquad \bar{x} = \frac{2.700}{270} \qquad \bar{x} = 10 \text{ cm}$$

$$\bar{y} = \frac{\Sigma \bar{y} \cdot A}{\Sigma A} \qquad \bar{y} = \frac{2.125}{270} \qquad \bar{y} = 7{,}87 \text{ cm}$$

$$Ix = \frac{b\,.\,h^3}{12} + A\,.\,(y - \bar{y})^2$$

$$Ix_1 = \frac{10\,.\,5^3}{12} + 50\,.\,(17{,}5 - 7{,}87)^2 \qquad Ix_1 = 4.741{,}015 \text{ cm}^4$$

$$Ix_2 = \frac{4\,.\,5^3}{12} + 20\,.\,(12{,}5 - 7{,}87)^2 \qquad Ix_2 = 470{,}4 \text{ cm}^4$$

$$Ix_3 = \frac{20\,.\,10^3}{12} + 200\,.\,(5 - 7{,}87)^2 \qquad Ix_3 = 3.314{,}04 \text{ cm}^4$$

$$Ix = 8.525{,}45 \text{ cm}^4$$

$$Iy = \frac{h\,.\,b^3}{12} + A\,.\,(x - \bar{x})^2$$

$$Iy_1 = \frac{5\,.\,10^3}{12} + 50\,.\,(10 - 10)^2 \qquad Iy_1 = 416{,}66 \text{ cm}^4$$

$$Iy_2 = \frac{5\,.\,4^3}{12} + 20\,.\,(10 - 10)^2 \qquad Iy_2 = 26{,}66 \text{ cm}^4$$

$$Iy_3 = \frac{10\,.\,20^3}{12} + 200\,.\,(10 - 10)^2 \qquad Iy_3 = 6.666{,}66 \text{ cm}^4$$

$$Iy = 7.109{,}98 \text{ cm}^4$$

Ex. 7: Encontre Ix para a área hachurada.

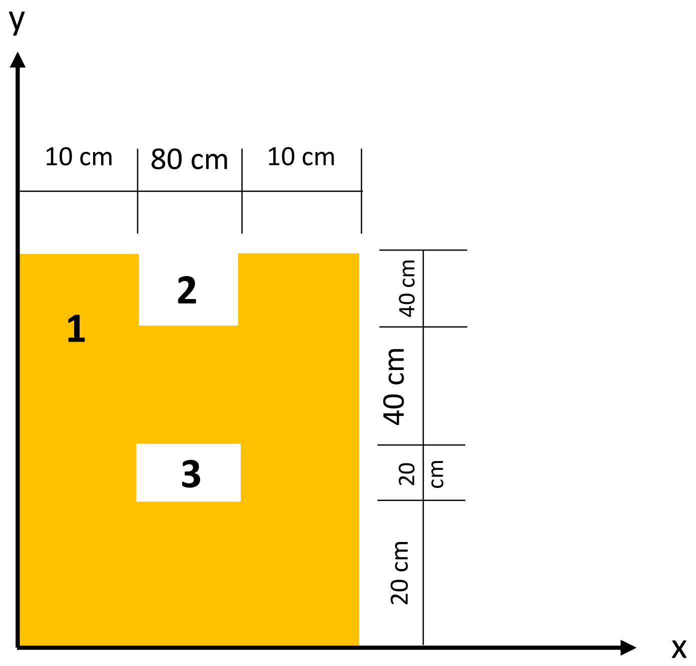


Fig.	x	y	A	x.A	y.A
1	50	60	12.000	600.000	720.000
2	50	100	3.200	160.000	320.000
3	50	30	1.600	80.000	48.000
Subtração		**-**	**7.200**	**360.000**	**352.000**

$$\bar{x} = \frac{\Sigma \bar{x} \cdot A}{\Sigma A} \qquad \bar{x} = \frac{360.000}{7.200} \qquad \bar{x} = 50 \text{ cm}$$

$$\bar{y} = \frac{\Sigma \bar{y} \cdot A}{\Sigma A} \qquad \bar{y} = \frac{352.000}{7.200} \qquad \bar{y} = 48{,}88 \text{ cm}$$

$$\mathrm{Ix} = \frac{b \,.\, h^3}{12} + A \,.\, (y - \bar{y})^2$$

$$\mathrm{Ix}_1 = \frac{100 \,.\, 120^3}{12} + 12.000 \,.\, (60 - 48{,}88)^2 \qquad \mathrm{Ix}_1 = 15.883.852{,}8 \text{ cm}^4$$

$$\mathrm{Ix}_2 = \frac{80 \,.\, 40^3}{12} + 3.200 \,.\, (100 - 48{,}88)^2 \qquad \mathrm{Ix}_2 = 8.789.080{,}75 \text{ cm}^4$$

$$\mathrm{Ix}_3 = \frac{80 \,.\, 20^3}{12} + 1.600 \,.\, (30 - 48{,}88)^2 \qquad \mathrm{Ix}_3 = 623.660{,}373 \text{ cm}^4$$

Subtração:

$$\mathrm{Ix} = 6.471.111{,}68 \text{ cm}^4$$

Bons estudos!

- 17/10 – P1