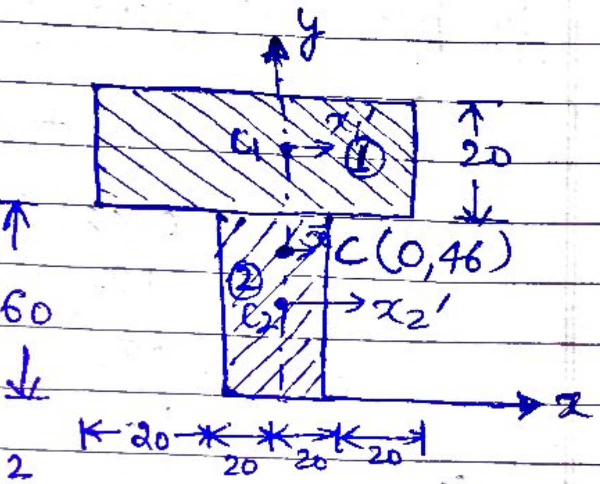
Que. 1 :- Determine the MOI of area of T-section as shown in fig wrt the centroidal x-axis



$C_1 (0, 70)$

$C_2 (0, 30)$

$x_{C_1} = 0$ mm

$y_{C_1} = 70$ mm

$A_1 = 20 \times 80 = 1600\ mm^2$

$x_{C_2} = 0$ mm

$y_{C_2} = 30$ mm

$A_2 = 40 \times 60 = 2400\ mm^2$

$$x_C = \frac{(x_{C_1} A_1) + (x_{C_2} A_2)}{A_1 + A_2}$$

$$= \frac{0 \times 1600 + 0 \times 2400}{4000}$$

$$\boxed{x_C = 0}$$

$$y_C = \frac{y_{C_1} A_1 + y_{C_2} A_2}{A_1 + A_2} = \frac{70 \times 1600 + 30 \times 2400}{4000}$$

$= 46$ mm.

$$I_{x_1}' = \frac{bh^3}{12} = \frac{80 \times 20^3}{12} \; mm^4$$

$$I_{x_2}' = \frac{bh^3}{12} = \frac{40 \times 60^3}{12} \; mm^4$$

By parallel axis theorm :-

$$\overline{I_{x_1}} = I_{x_1}' + A_1 d_1^2$$

$$= \frac{80 \times 20^3}{12} + 1600 \times (y_c - y_{c_1})^2$$

$$= \frac{80 \times 20^3}{12} + 1600 \times (70 - 46)^2$$

$$I_{x_1} = \quad \times 10^6 \; mm^4$$

$$\overline{I_{x_2}} = I_{x_2}' + A_2 d_2^2$$

$$= \frac{40 \times 60^3}{12} + 2400 \times (46 - 30)^2$$

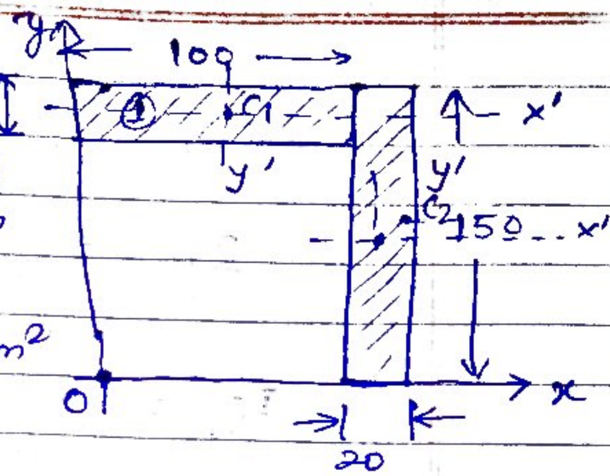
$$= \quad \times 10^6 \; mm^4$$

$$I_{\bar{x}} = I_{\bar{x}_1} + I_{\bar{x}_2}$$

$$= 2.31 \times 10^3 \; mm^4$$

$$= 0.00231 \times 10^6 \; mm^4$$

Que: Find MOI of the area of L-section about the centroidal x and y axis as shown in fig.



$x_1 = 50$ mm | $x_2 = 110$ mm
$y_1 = 140$ mm | $y_2 = 75$ mm
$A_1 = 100 \times 20$ | $A_2 = 150 \times 20$
$= 2000 mm^2$ | $= 3000 mm^2$

$$x_c = \frac{x_{c_1} A_1 + x_{c_2} A_2}{(A_1 + A_2)} = 86 mm$$

$$y_c = \frac{y_{c_1} A_1 + y_{c_2} A_2}{A_1 + A_2} = 101 mm$$

$$I_{x_1'} = \frac{bh^3}{12} = \frac{100 \times 20^3}{12} mm^4$$

$$I_{x_2'} = \frac{bh^3}{12} = \frac{20 \times 150}{12} mm^4$$

① by parallel axis theorm

$$I_{\bar{x}_1} = I_{x_1'} + A_1 \cdot (y_c - y_{c_1})^2$$

$$I_{\bar{x}_2} = I_{x_2'} + A_2 (y_c - y_{c_2})^2$$

$$I_{\bar{x}} = I_{\bar{x}_1} + I_{\bar{x}_2}$$

similary for y-axis.

$$I_{y_1'} = \frac{hb^3}{12} = \frac{20 \times 150^3}{12}$$

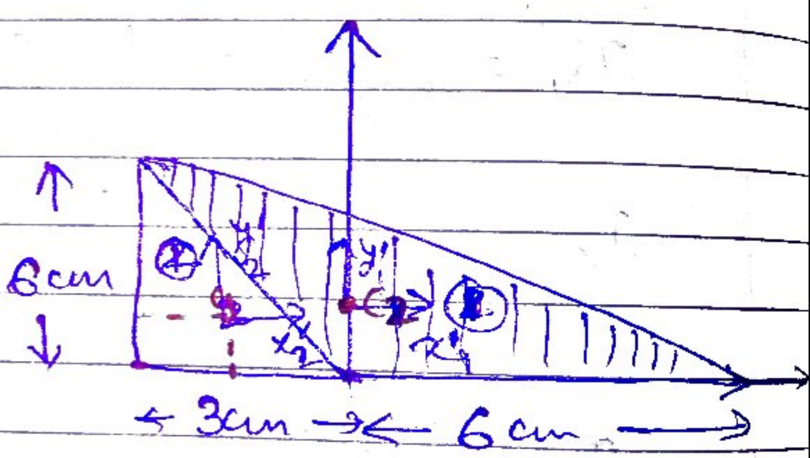
$$I_{y_2'} = \frac{hb^3}{12} = \frac{150 \times 20^3}{12}$$

$$I_{\bar{y}_1} = I_{y_1'} + A_1 (x_c - x_{c_1})^2$$

$$I_{\bar{y}_2} = I_{y_2'} + A_2 (x_c - x_{c_2})^2$$

$$I_{\bar{y}} = I_{\bar{y}_1} + I_{\bar{y}_2} = 6.08 \times 10^6 \text{ mm}^4$$

Que: Find MOI



$x_{c_1} = 0$ cm

$y_{c_1} = 2$ cm

$A_1 = \frac{1}{2} \times 9 \times 6 = 27 \text{ cm}^2$

$x_{c_2} = -2$ cm

$y_{c_2} = 2$ cm

$A_2 = \frac{1}{2} \times 3 \times 6$

PAGE
DATE / /

$$x_c = \frac{x_{c1}A_1 - x_{c2}A_2}{A_1 - A_2} = 1\,cm$$

$$y_c = \frac{y_{c1}A_1 - y_{c2}A_2}{A_1 - A_2} = 2\,cm$$

$$I_{x_1'} = \frac{bh^3}{36} = \frac{9\times6^3}{36}\ cm^4$$

$$I_{x_2'} = \frac{bh^3}{36} = \frac{3\times6^3}{36}\ cm^4$$

11-axis theorm:

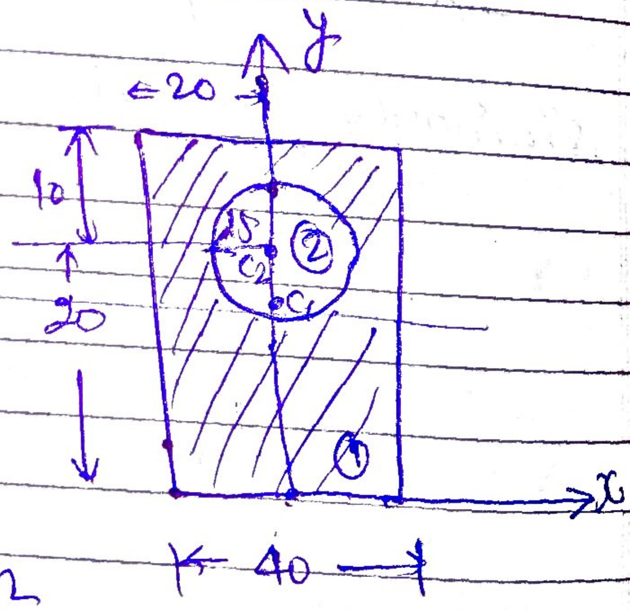
$$I_{\bar{x}_1} = I_{x_1'} + A_1 (y_c - y_{c1})^2$$

$$I_{\bar{x}_2} = I_{x_2'} + A_2 (y_c - y_{c2})^2 =$$

$$I_{\bar{x}} = I_{\bar{x}_1} - I_{\bar{x}_2}$$

Similarly y-axis.

Que 1. Find MOI



$x_1 = 0$ mm ; $x_2 = 0$

$y_1 = 15$ mm ; $y_2 = 20$

$A_1 = 40 \times 30$

$= 1200 \text{ mm}^2$

$A_2 = \frac{\pi}{4} D^2 = 176.714$

$= \frac{\pi}{4} \times 7 \times 15^2 = \frac{22}{7} \times 15 \times 15$

$= 32.12 \times 22$

176.64

$$x_c = \frac{x_1A_1 - x_2A_2}{A_1 - A_2} \; ; \; y_c = \frac{y_1A_1 - y_2A_2}{A_1 - A_2}$$

$$= \frac{0 - 0}{A_1 - A_2} \; ; \; y_c = \frac{15 \times 1200 - 20 \times 176.714}{1200 - 176.714}$$

$$= 0 \; ;$$

$$= 14.1365 \text{ mm}$$

MOI of body 1 about its centroid (0,15).

$$I_{x_1} = \frac{40 \times 30^3}{12} = 90000 \text{ mm}^4$$

$$I_{y_1} = \frac{30 \times 40^3}{12} = 160000 \text{ mm}^4$$

MOI of body 2 about its centroid (0, 20)

$$I_{y_2} = I_{x_2} = \frac{\pi}{64} D^4 = \frac{\pi}{64} \times 15^4 = 2485.05 \text{ mm}^4$$

apply parallel axis to find MOI about (x_c, y_c) i.e. (0, 14.1365)

$$I_{\bar{x}_1} = I_{x_1} + A_1 \cdot (y_c - y_1)^2$$

$$= 90000 + 1200 \, (14.1365 - 15)^2$$

$$I_{\bar{x}_1} = 90894.76 \text{ mm}^4$$

$$I_{\bar{x}_2} = I_{x_2} + A_2 (y_c - y_2)^2$$

$$= 2485.05 + 176.714 (14.1365 - 20)^2$$

$$= 8560.59 \text{ mm}^4$$

$$I_x = I_{\bar{x}_1} - I_{\bar{x}_2} = 82334.171 \text{ mm}^4$$

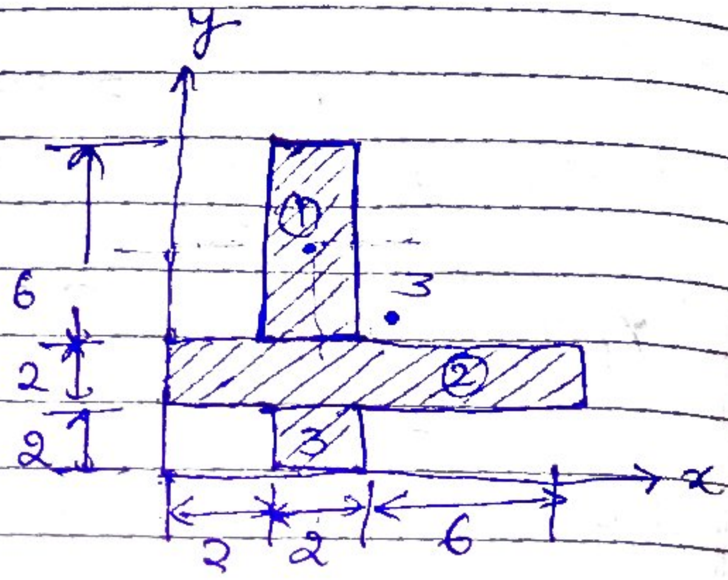
MOI about x-axis is $(I_x) = 82334.171 \text{ mm}^4$

Ans:

$x_1 = 3\,cm \quad y_1 = 7\,cm$

$x_2 = 5\,cm \quad y_2 = 3\,cm$

$x_3 = 3\,cm \quad y_3 = 1\,cm$



(all in cm)

$A_1 = 12\,cm^2;\ A_2 = 20\,cm^2$
$A_3 = 4\,cm^2$

$$x_c = \frac{A_1x_1 + A_2x_2 + A_3x_3}{A_1+A_2+A_3} \qquad y_c = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1+A_2+A_3}$$

$$= \frac{12\times 3 + 20\times 5 + 4\times 3}{24+12} \qquad = \frac{12\times 7 + 20\times 3 + 4\times 1}{24+12}$$

$$= 4.111 \qquad = 4.111$$

$$I_{x_1} = \frac{2\times 6^3}{12} = 36\,cm^4 \qquad I_{\bar{x}_1} = I_{x_1} + A_1(y_c - y_1)^2 = 136.16\,cm^4$$

$$I_{x_2} = \frac{10\times 2^3}{12} = 6.67\,cm^4 \qquad I_{\bar{x}_2} = I_{x_2} + A_2(y_c - y_2)^2 = 31.356\,cm^4$$

$$I_{x_3} = \frac{2\times 2^3}{12} = 1.33\,cm^4 \qquad I_{\bar{x}_3} = I_{x_3} + A_3(y_c - y_3)^2 = 40.0432\,cm^4$$

$$I_x = I_{\bar{x}_1} + I_{\bar{x}_2} + I_{\bar{x}_3} = 207.56\,cm^4$$