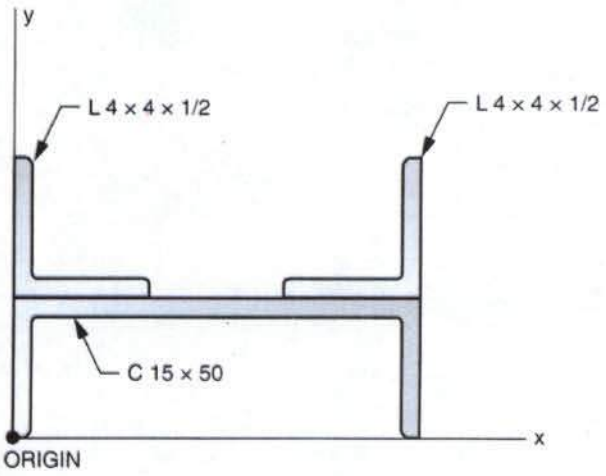
NAME: Solution

1. Find the centroid of the built-up structural steel shape shown below with respect to the origin shown.



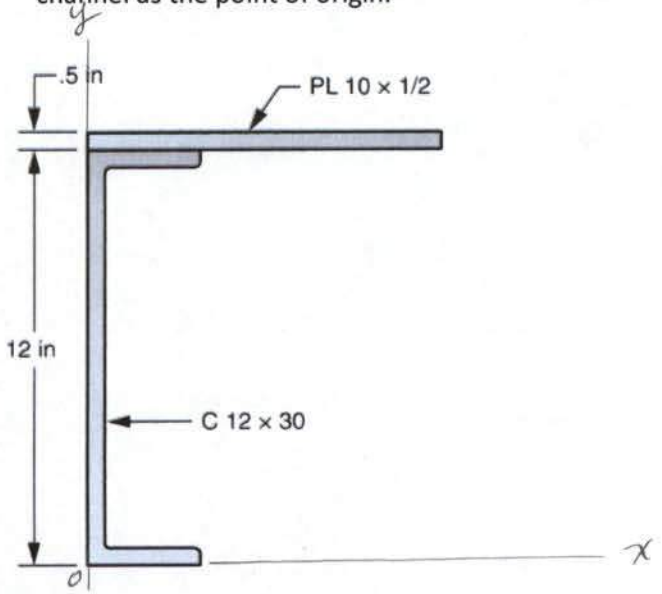
Solution.

Shape	Area (IN^2)	X (IN)	Ax (IN^3)	Y (IN)	Ay (IN^3)
L 4 X 4 X 1/2	3.75	1.18	4.425	3.716 + 1.18 = 4.896	18.36
L 4 X 4 X 1/2	3.75	15 - 1.18 = 13.82	51.825	4.896	18.36
C 15 X 50	14.7	7.5	110.25	3.716 - 0.798 = 2.918	42.89
Σ	22.2		166.5		79.61

$$\bar{x} = \frac{166.5\ in^3}{22.2\ in^2} = 7.5\ in$$

$$\bar{y} = \frac{79.61\ in^3}{22.2\ in^2} = 3.59\ in$$

2. Find the centroid of the built-up structural steel shape shown below. Use the lower left corner of the channel as the point of origin.



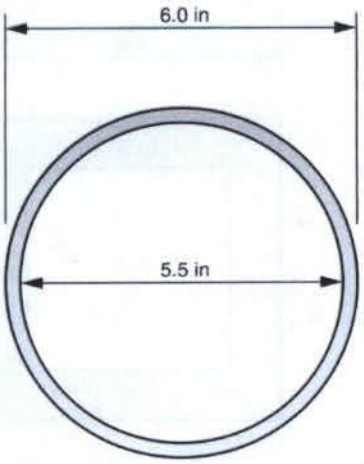
Solution.

Shape	Area (IN^2)	X (IN)	Ax (IN^3)	Y (IN)	Ay (IN^3)
PL 10 X 1/2	5	5	25	12.25	61.25
C 12 X 30	8.82	0.674	5.95	6	52.92
Σ	13.82		30.95		114.17

$$\bar{x} = \frac{30.95\ in^3}{13.82\ in^2} = 2.24\ in$$

$$\bar{y} = \frac{114.17\ in^3}{13.82\ in^2} = 8.26\ in$$

3. Calculate the moment of inertia about the centroidal *x*- and the centroidal *y*- axes for the shape shown below.



Solution.

$$\bar{I}_x = \bar{I}_y = \frac{\pi (6\text{in})^4}{64} - \frac{\pi (5.5\text{in})^4}{64}$$

$$= 63.62\ \text{in}^4 - 44.92\ \text{in}^4$$

$$= 18.7\ \text{in}^4$$

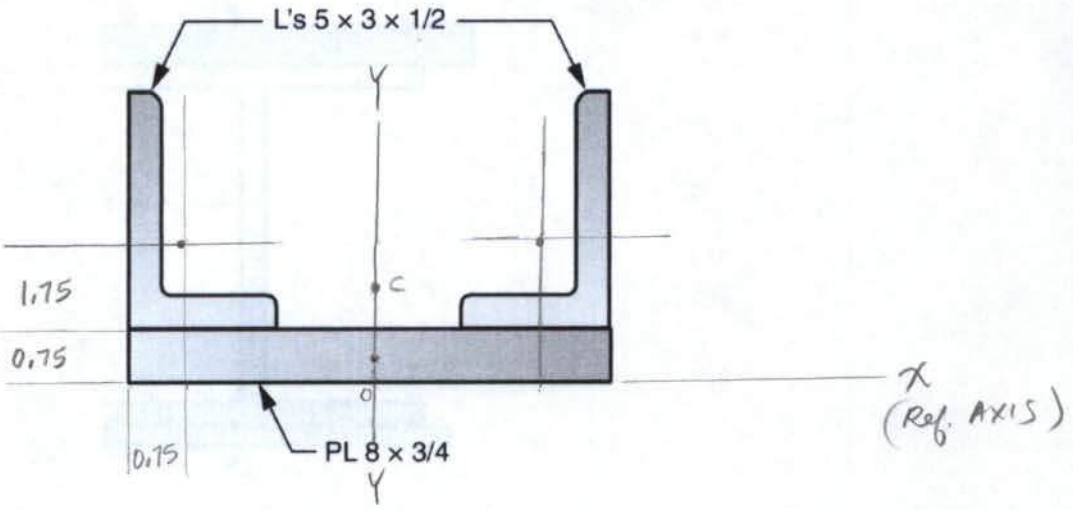
OR, Circular Ring

$$\bar{I}_x = \bar{I}_y = \frac{1}{64}\pi (6^4 - 5.5^4)$$

$$= \frac{1}{64}\pi (381\ \text{in}^4)$$

$$= 18.7\ \text{in}^4$$

4. Calculate the moment of inertia about the centroidal *x*- and the centroidal *y*- axes for the shape shown below.



Solution.
Note: You must first locate the centroid for the given shape.

Shape	Area (in^2)	X (in)	Ax (in^3)	Y (in)	Ay (in^3)	d (in)	Ad^2 (in^4)	I (in^4)
PL 8 X 3/4	6	0	0	.375	2.25	1.185	8.42535	0.28
L 5 X 3 X 1/2	3.75	-3.25	-12.1875	2.5	9.375	0.94	3.3135	9.45
L 5 X 3 X ½	3.75	3.25	12.1875	2.5	9.375	0.94	3.3135	9.45
	Σ 13.5		0		21		15.1	19.18

$$\bar{y} = \frac{21}{13.5} = 1.56$$

$$I_x = 34\ in^4$$

$$I_y = \frac{1}{12}(.75)(8)^3 + \left[2.58 + 3.75(3.25)^2\right] \times 2$$

$$42.2 \times 2$$

$$32$$

$$= 116.3\ in^4$$