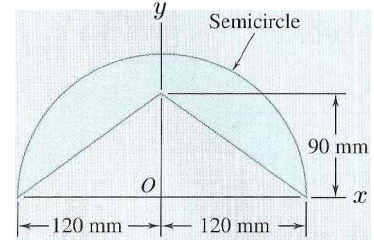


[9.2절]

9.45 ① 반원, ② 삼각 구멍



$$(a) (J_O)_1 = \frac{1}{4} \pi (120 \text{ mm})^4 = 162.86 \times 10^6 \text{ mm}^4$$

$$(\bar{I}_x)_2 = \frac{1}{12} (240 \text{ mm})(90 \text{ mm})^3 = 14.58 \times 10^6 \text{ mm}^2$$

$$(\bar{I}_y)_2 = 2 \frac{1}{12} (90 \text{ mm})(120 \text{ mm})^3 = 25.92 \times 10^6 \text{ mm}^2$$

$$(J_O)_2 = (\bar{I}_x)_2 + (\bar{I}_y)_2 = (25.92 + 14.58) \times 10^6 \text{ mm}^2 = 40.50 \times 10^6 \text{ mm}^2$$

$$J_O = (J_O)_1 - (J_O)_2 = (162.86 - 40.50) \times 10^6 \text{ mm}^4 = 122.36 \times 10^6 \text{ mm}^4$$

$$\Rightarrow J_O = 122.4 \times 10^6 \text{ mm}^4$$

$$(b) \textcircled{1} A = \frac{\pi}{2} (120 \text{ mm})^2 = 22.62 \times 10^3 \text{ mm}^2$$

$$\bar{y} = \frac{4}{3\pi} (120 \text{ mm}) = 50.93 \text{ mm}$$

$$\textcircled{2} A = -\frac{1}{2} (240 \text{ mm})(90 \text{ mm}) = -10.80 \times 10^3 \text{ mm}^2$$

$$\bar{y} = \frac{1}{3} (90 \text{ mm}) = 30 \text{ mm}$$

$$\Sigma A = (22.62 - 10.80) \times 10^3 \text{ mm}^2 = 11.82 \times 10^3 \text{ mm}^2$$

$$\Sigma(\bar{y}A) = [(50.93)(22.62) + (30)(-10.80)] \times 10^3 \text{ mm}^3 = 828.0 \times 10^3 \text{ mm}^3$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{828.0 \times 10^3 \text{ mm}^3}{11.82 \times 10^3 \text{ mm}^2} = 70.05 \text{ mm}, \quad \text{symmetry} \Rightarrow \bar{X} = 0$$

$$\bar{J}_C = J_O - A \bar{Y}^2 = (122.36 \times 10^6 \text{ mm}^4) - (11.82 \times 10^3 \text{ mm}^2)(70.05 \text{ mm})^2 = 64.36 \times 10^6 \text{ mm}^4$$

$$\Rightarrow \bar{J}_C = 64.4 \times 10^6 \text{ mm}^4$$