

[5.1~5.5절]

5.7 y 축 대칭이므로 $\bar{X} = 0$

① 직사각형

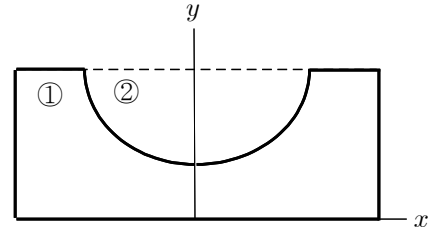
$$A = (6 \text{ cm})(3 \text{ cm}) = 18 \text{ cm}^2$$

$$\bar{y} = \frac{1}{2}(3 \text{ cm}) = 1.5 \text{ cm}$$

② 반원

$$A = -\frac{1}{2}\pi(2 \text{ cm})^2 = -6.283 \text{ cm}^2$$

$$\bar{y} = (3 \text{ cm}) - \frac{4}{3\pi}(2 \text{ cm}) = 2.151 \text{ cm}$$



$$\Sigma A = (18 \text{ cm}^2) + (-6.283 \text{ cm}^2) = 11.717 \text{ cm}^2$$

$$\Sigma(\bar{y}A) = (1.5 \text{ cm})(18 \text{ cm}^2) + (2.151 \text{ cm})(-6.283 \text{ cm}^2) = 13.485 \text{ cm}^3$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{13.485 \text{ cm}^3}{11.717 \text{ cm}^2} = 1.1509 \text{ cm} \Rightarrow \text{centroid} = (0, 1.151 \text{ cm})$$

5.24 ① $L = \sqrt{30^2 + 72^2} \text{ mm} = 78.0 \text{ mm}$

$$\bar{x} = \frac{1}{2}(30 \text{ mm}) = 15.0 \text{ mm}$$

$$\bar{y} = \frac{1}{2}(72 \text{ mm}) = 36.0 \text{ mm}$$

② $L = \sqrt{48^2 + 72^2} \text{ mm} = 86.53 \text{ mm}$

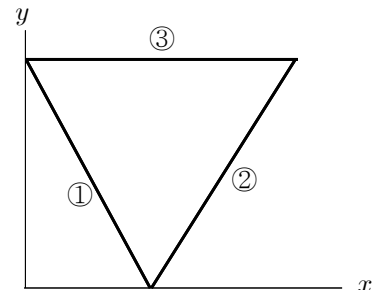
$$\bar{x} = (30 \text{ mm}) + \frac{1}{2}(48 \text{ mm}) = 54.0 \text{ mm}$$

$$\bar{y} = \bar{y}① = 36.0 \text{ mm}$$

③ $L = 30 + 48 \text{ mm} = 78.0 \text{ mm}$

$$\bar{x} = \frac{1}{2}(78 \text{ mm}) = 39.0 \text{ mm}$$

$$\bar{y} = 72.0 \text{ mm}$$



$$\Sigma L = 78.0 + 86.53 + 78.0 \text{ mm} = 242.53 \text{ mm}$$

$$\Sigma(\bar{x}L) = (15.0)(78.0) + (54.0)(86.53) + (39.0)(78.0) \text{ mm}^2 = 8,884.62 \text{ mm}^2$$

$$\Sigma(\bar{y}L) = (36.0)(78.0) + (36.0)(86.53) + (72.0)(78.0) \text{ mm}^2 = 11,539.08 \text{ mm}^2$$

$$\bar{X} = \frac{\Sigma(\bar{x}L)}{\Sigma L} = \frac{8,884.62 \text{ mm}^2}{242.53 \text{ mm}} = 36.63 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma(\bar{y}L)}{\Sigma L} = \frac{11,539.08 \text{ mm}^2}{242.53 \text{ mm}} = 47.58 \text{ mm}$$

$$\Rightarrow \text{center of gravity} = (36.6 \text{ mm}, 47.6 \text{ mm})$$

5.31 $W = 40 \text{ N}, \quad r = 10 \text{ cm}$

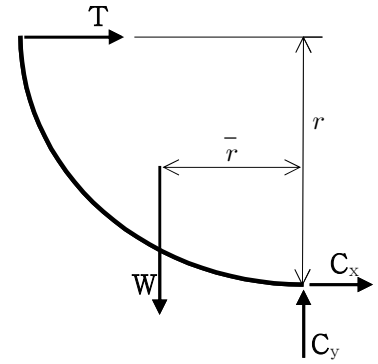
$$\bar{r} = \frac{2r}{\pi}$$

(a) $\Sigma M_C = 0$

$$W \left(\frac{2r}{\pi} \right) - T r = 0$$

$$\Rightarrow T = W \frac{2}{\pi} = (40 \text{ N}) \frac{2}{\pi} = 25.46 \text{ N}$$

$$\Rightarrow T = 25.5 \text{ N}$$



(b) $\Sigma F_x = 0$

$$C_x + T = 0$$

$$\Rightarrow C_x = -T = -25.5 \text{ N}$$

$$\Sigma F_y = 0$$

$$C_y - W = 0$$

$$\Rightarrow C_y = W = 40 \text{ N}$$

$$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(25.5 \text{ N})^2 + (40 \text{ N})^2} = 47.42 \text{ N}$$

$$\tan \theta = \frac{C_y}{C_x} = \frac{40 \text{ N}}{-25.5 \text{ N}} = -1.5686$$

$$\Rightarrow \theta = \tan^{-1}(-1.5686) = -57.48^\circ, 122.5^\circ$$

$$C = 47.4 \text{ N} \searrow 57.5^\circ$$