

&lt;5.1~5.5절&gt;

5.2 ①  $A = (20 \text{ mm})(24 + 36 \text{ mm}) = 1,200 \text{ mm}^2$

$$\bar{x} = \frac{1}{2}(20 \text{ mm}) = 10 \text{ mm}$$

$$\bar{y} = \frac{1}{2}(60 \text{ mm}) = 30 \text{ mm}$$

②  $A = \frac{1}{2}(30 \text{ mm})(36 \text{ mm}) = 540 \text{ mm}^2$

$$\bar{x} = (20 \text{ mm}) + \frac{1}{3}(30 \text{ mm}) = 30 \text{ mm}$$

$$\bar{y} = (24 \text{ mm}) + \frac{1}{3}(36 \text{ mm}) = 36 \text{ mm}$$

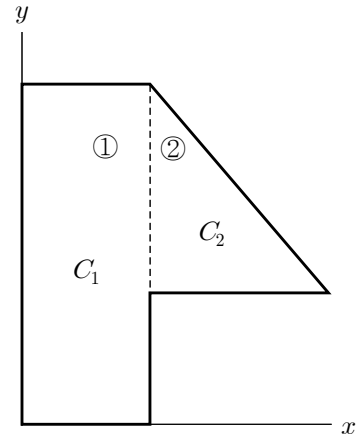
$$\Sigma A = (1,200 \text{ mm}^2) + (540 \text{ mm}^2) = 1,740 \text{ mm}^2$$

$$\Sigma(\bar{x}A) = (10 \text{ mm})(1,200 \text{ mm}^2) + (30 \text{ mm})(540 \text{ mm}^2) = 28,200 \text{ mm}^3$$

$$\Sigma(\bar{y}A) = (30 \text{ mm})(1,200 \text{ mm}^2) + (36 \text{ mm})(540 \text{ mm}^2) = 55,440 \text{ mm}^3$$

$$\bar{X} = \frac{\Sigma(\bar{x}A)}{\Sigma A} = \frac{28,200 \text{ mm}^3}{1,740 \text{ mm}^2} = 16.207 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{55,440 \text{ mm}^3}{1,740 \text{ mm}^2} = 31.86 \text{ mm} \quad \Rightarrow \quad \text{centroid} = (16.21 \text{ mm}, 31.9 \text{ mm})$$



5.9 ① 직사각형

$$A = (60 \text{ mm})(120 \text{ mm}) = 7,200 \text{ mm}^2$$

$$\bar{x} = -\frac{1}{2}(60 \text{ mm}) = -30 \text{ mm}$$

$$\bar{y} = 60 \text{ mm}$$

②  $\frac{1}{4}$  원

$$A = \frac{1}{4}\pi(60 \text{ mm})^2 = 2827.4 \text{ mm}^2$$

$$\bar{x} = \frac{4}{3\pi}(60 \text{ mm}) = 25.46 \text{ mm}$$

$$\bar{y} = (120 \text{ mm}) - \frac{4}{3\pi}(60 \text{ mm}) = 94.54 \text{ mm}$$

③  $\frac{1}{4}$  원 구멍

$$A = -(\text{②}A) = -2827.4 \text{ mm}^2$$

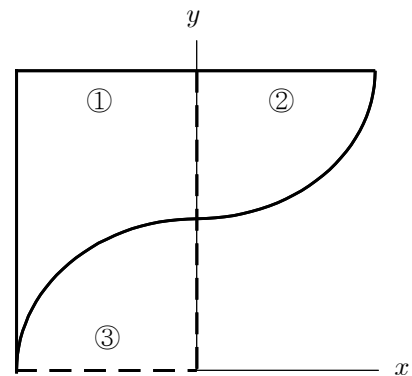
$$\bar{x} = -(\text{②}\bar{x}) = -25.46 \text{ mm}$$

$$\bar{y} = (\text{②}\bar{y}) = 25.46 \text{ mm}$$

$$\Sigma A = (7,200 \text{ mm}^2) + (2827.4 \text{ mm}^2) + (-2827.4 \text{ mm}^2) = 7,200 \text{ mm}^2$$

$$\Sigma(\bar{x}A) = (-30 \text{ mm})(7,200 \text{ mm}^2) + (25.46 \text{ mm})(2827.4 \text{ mm}^2) + (-25.46 \text{ mm})(-2827.4 \text{ mm}^2) = -72,029 \text{ mm}^3$$

$$\Sigma(\bar{y}A) = (60 \text{ mm})(7,200 \text{ mm}^2) + (94.54 \text{ mm})(2827.4 \text{ mm}^2) + (25.46 \text{ mm})(-2827.4 \text{ mm}^2) = 627,317 \text{ mm}^3$$



$$\bar{X} = \frac{\Sigma(\bar{x}A)}{\Sigma A} = \frac{-72,029 \text{ mm}^3}{7,200 \text{ mm}^2} = -10.00 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{627,317 \text{ mm}^3}{7,200 \text{ mm}^2} = 87.13 \text{ mm} \Rightarrow \text{centroid} = (-10.00 \text{ mm}, 87.1 \text{ mm})$$

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

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

(a)  $\uparrow \Sigma M_C = 0 ; \quad -T r + W \bar{r} = 0$

$$\begin{aligned} \Rightarrow T &= \frac{\bar{r}}{r} W = \frac{\frac{2}{\pi} r}{r} W = \frac{2}{\pi} W \\ &= \frac{2}{\pi} (40 \text{ N}) = 25.46 \text{ N} \end{aligned}$$

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

(b)  $\rightarrow \Sigma F_x = 0 ; \quad T + R_x = 0$

$$\Rightarrow R_x = -T = -25.46 \text{ N} \quad (\mathbf{R}_x = 25.5 \text{ N} \leftarrow)$$

$\uparrow \Sigma F_y = 0 ; \quad -W + R_y = 0$

$$\Rightarrow R_y = W = 40 \text{ N} \quad (\mathbf{R}_y = 40.0 \text{ N} \uparrow)$$

$$R = \sqrt{R_x^2 + R_y^2} = \sqrt{(-25.46 \text{ N})^2 + (40 \text{ N})^2} = 47.42 \text{ N}$$

$$\tan \theta = \frac{R_y}{R_x} = \frac{40 \text{ N}}{-25.46 \text{ N}} = -1.571 \Rightarrow \theta = \tan^{-1}(-1.571) = -57.52^\circ$$

$$\Rightarrow \mathbf{R} = 47.2 \text{ N} \searrow 57.5^\circ$$

