

{5.1절}

5.6 S; 직사각판 + 위  $\frac{1}{4}$ 원판 - 아래  $\frac{1}{4}$ 원판

M;

A; ① 직사각판

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

$$\bar{x} = -30 \text{ mm}$$

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

② 위  $\frac{1}{4}$ 원판

$$A = \frac{1}{4}\pi(60 \text{ mm})^2 = 2,827 \text{ mm}^2$$

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

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

③ 아래  $\frac{1}{4}$ 원판

$$A = -\frac{1}{4}\pi(60 \text{ mm})^2 = -2,827 \text{ mm}^2$$

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

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

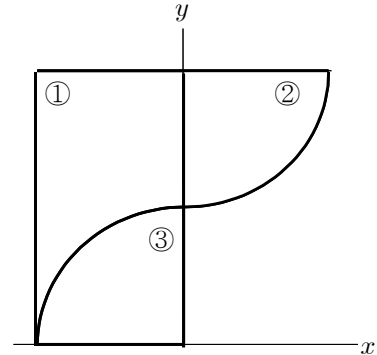
$$\Sigma A = (7,200 \text{ mm}^2) + (2,827 \text{ mm}^2) + (-2,827 \text{ mm}^2) = 7,200 \text{ mm}^2$$

$$\Sigma(\bar{x}A) = (-30 \text{ mm})(7,200 \text{ mm}^2) + (25.46 \text{ mm})(2,827 \text{ mm}^2) + (-25.46 \text{ mm})(-2,827 \text{ mm}^2) = -72,049 \text{ mm}^3$$

$$\Sigma(\bar{y}A) = (60 \text{ mm})(7,200 \text{ mm}^2) + (94.54 \text{ mm})(2,827 \text{ mm}^2) + (25.46 \text{ mm})(-2,827 \text{ mm}^2) = 627,289 \text{ mm}^3$$

$$\bar{X} = \frac{\Sigma(\bar{x}A)}{\Sigma A} = \frac{-72,049 \text{ mm}^3}{7,200 \text{ mm}^2} = -10.007 \text{ mm}$$

$$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{627,289 \text{ mm}^3}{7,200 \text{ mm}^2} = 87.12 \text{ mm} \Rightarrow \text{centroid} = (-10.01 \text{ mm}, 87.1 \text{ mm})$$



R; (과정의 타당성 검토) (가령, 다르게 분할 하는 방안)

T; (결과의 의미 검토) (가령, 도심 좌표의 위치)

{5.4절}

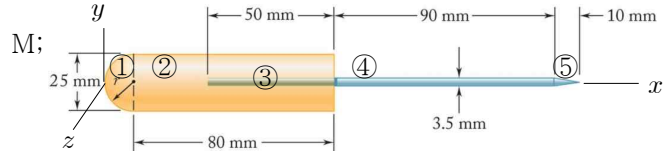
5.118  $\rho_p = 1,030 \text{ kg/m}^3 = 1.030 \times 10^{-6} \text{ kg/mm}^3$

$\rho_s = 7,860 \text{ kg/m}^3 = 7.860 \times 10^{-6} \text{ kg/mm}^3$

S; 대칭구조  $\bar{Y} = \bar{Z} = 0$

$W = mg = \rho Vg \Rightarrow m = \rho V$

$\bar{X} = \frac{\Sigma(\bar{x}W)}{\Sigma W} = \frac{\Sigma(\bar{x}m)}{\Sigma m}$



A; ① 반구 + ② 원기둥 - ③ 원기둥 구멍 + ④ 원기둥 + ⑤ 원뿔

① 반구 (플라스틱)  $a_1 = 12.5 \text{ mm}$

$V = \frac{1}{2} \left( \frac{4}{3} \pi a_1^3 \right) = \frac{1}{2} \left[ \frac{4}{3} \pi (12.5 \text{ mm})^3 \right] = 4,091 \text{ mm}^3$

$m = \rho_p V = (1.030 \times 10^{-6} \text{ kg/mm}^3)(4,091 \text{ mm}^3) = 4.213 \times 10^{-3} \text{ kg}$

$\bar{x} = a_1 - \frac{3}{8} a_1 = \frac{5}{8} a_1 = \frac{5}{8} (12.5 \text{ mm}) = 7.813 \text{ mm}$

② 원기둥 (플라스틱)  $L_1 = 80 \text{ mm}$

$V = \pi a_1^2 L_1 = \pi (12.5 \text{ mm})^2 (80 \text{ mm}) = 39,270 \text{ mm}^3$

$m = \rho_p V = (1.030 \times 10^{-6} \text{ kg/mm}^3)(39,270 \text{ mm}^3) = 40.448 \times 10^{-3} \text{ kg}$

$\bar{x} = a_1 + \frac{1}{2} L_1 = (12.5 \text{ mm}) + \frac{1}{2} (80 \text{ mm}) = 52.5 \text{ mm}$

③ 원기둥 구멍 (플라스틱)  $a_2 = 1.75 \text{ mm}, L_2 = 50 \text{ mm}$

$V = -\pi a_2^2 L_2 = -\pi (1.75 \text{ mm})^2 (50 \text{ mm}) = -481.1 \text{ mm}^3$

$m = \rho_p V = (1.030 \times 10^{-6} \text{ kg/mm}^3)(-481.1 \text{ mm}^3) = -0.4955 \times 10^{-3} \text{ kg}$

$\bar{x} = a_1 + L_1 - \frac{1}{2} L_2 = (12.5 \text{ mm}) + (80 \text{ mm}) - \frac{1}{2} (50 \text{ mm}) = 67.5 \text{ mm}$

④ 원기둥 (스틸)  $L_3 = 50 + 90 \text{ mm} = 140 \text{ mm}$

$V = \pi a_2^2 L_3 = \pi (1.75 \text{ mm})^2 (140 \text{ mm}) = 1,347.0 \text{ mm}^3$

$m = \rho_s V = (7.860 \times 10^{-6} \text{ kg/mm}^3)(1,347.0 \text{ mm}^3) = 10.587 \times 10^{-3} \text{ kg}$

$\bar{x} = a_1 + L_1 - L_2 + \frac{1}{2} L_3 = (12.5 \text{ mm}) + (80 \text{ mm}) - (50 \text{ mm}) + \frac{1}{2} (140 \text{ mm})$   
 $= 112.5 \text{ mm}$

⑤ 원뿔 (스틸)  $h = 10 \text{ mm}$

$V = \frac{1}{3} \pi a_2^2 h = \frac{1}{3} \pi (1.75 \text{ mm})^2 (10 \text{ mm}) = 32.07 \text{ mm}^3$

$m = \rho_s V = (7.860 \times 10^{-6} \text{ kg/mm}^3)(32.07 \text{ mm}^3) = 0.252 \times 10^{-3} \text{ kg}$

$\bar{x} = a_1 + L_1 + (L_3 - L_2) + \frac{1}{4} h = (12.5 \text{ mm}) + (80 \text{ mm}) + (90 \text{ mm}) + \frac{1}{4} (10 \text{ mm})$   
 $= 185 \text{ mm}$

$\Sigma m = [4.213 + 40.448 + (-0.4955) + 10.587 + 0.252] \times 10^{-3} \text{ kg} = 55.00 \times 10^{-3} \text{ kg}$

$\Sigma(\bar{x}m) = [(7.813)(4.213) + (52.5)(40.448) + (67.5)(-0.4955) + (112.5)(10.587) + (185)(0.252)] \times 10^{-3} \text{ kg}\cdot\text{mm} = 3,361 \times 10^{-3} \text{ kg}\cdot\text{mm}$

$\bar{X} = \frac{\Sigma(\bar{x}m)}{\Sigma m} = \frac{3,361 \times 10^{-3} \text{ kg}\cdot\text{mm}}{55.00 \times 10^{-3} \text{ kg}} = 61.10 \text{ mm} \Rightarrow \text{중심} = (61.1 \text{ mm}, 0, 0)$

R; (과정의 타당성 검토) (가령, 손잡이 속 스틸 처리 방법)

T; (결과의 의미 검토) (가령, 중심의 위치)