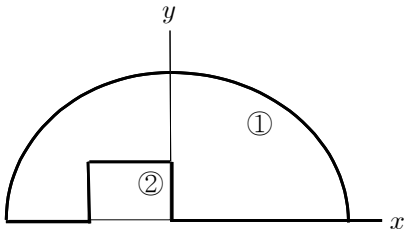
{5.1~5.5절}

5.6　반원 면(r=38mm)과 직사각형(a=20mm, b=16mm) 구멍으로 구분



① 반 원　$A = \frac{1}{2}\pi(38\ \text{mm})^2 = 2{,}268\ \text{mm}^2$

$\bar{x} = 0$

$\bar{y} = \frac{4}{3\pi}(38\ \text{mm}) = 16.128\ \text{mm}$

② 직사각형

$A = -(20\ \text{mm})(16\ \text{mm}) = -320\ \text{mm}^2$

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

$\bar{y} = \frac{1}{2}(16\ \text{mm}) = 8\ \text{mm}$

$\Sigma A = (2{,}268\ \text{mm}^2) + (-320\ \text{mm}^2) = 1{,}948\ \text{mm}^2$

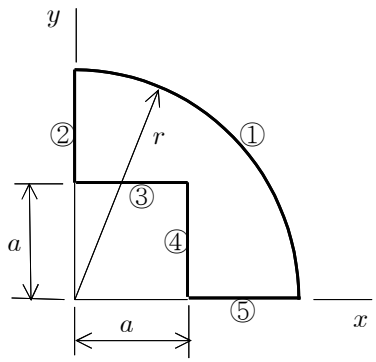
$\Sigma(\bar{x}A) = (0)(2{,}268\text{m}^2) + (-10\ \text{mm})(-320\ \text{mm}^2) = 3{,}200\ \text{mm}^3$

$\Sigma(\bar{y}A) = (16.128\ \text{mm})(2{,}268\text{m}^2) + (8\ \text{mm})(-320\ \text{mm}^2) = 34{,}018\ \text{mm}^3$

$\bar{X} = \frac{\Sigma(\bar{x}A)}{\Sigma A} = \frac{3{,}200\ \text{mm}^3}{1{,}948\ \text{mm}^2} = 1.643\ \text{mm}$

$\bar{Y} = \frac{\Sigma(\bar{y}A)}{\Sigma A} = \frac{34{,}018\ \text{mm}^3}{1{,}948\ \text{mm}^2} = 17.463\ \text{mm}$　⇒　centroid = (1.64 mm, 17.46 mm)

5.27　r = 10 cm,　a = 5 cm,　대칭 $\bar{X} = \bar{Y}$



① 1/4 원호

$L = \frac{1}{4}(2\pi r) = \frac{1}{2}\pi\ (10\ \text{cm}) = 15.708\ \text{cm}$

$\bar{x} = \frac{2}{\pi}r = \frac{2}{\pi}\ (10\ \text{cm}) = 6.366\ \text{cm}$

$\bar{x}\,L = (\frac{2}{\pi}r)(\frac{\pi}{2}r) = r^2$

② $L = r - a = (10\ \text{cm}) - (5\ \text{cm}) = 5\ \text{cm}$

$\bar{x} = 0$

③ $L = a = 5\ \text{cm}$

$\bar{x} = \frac{1}{2}a = \frac{1}{2}\ (5\ \text{cm}) = 2.5\ \text{cm}$

④ $L = 5\ \text{cm}$

$\bar{x} = a = 5\ \text{cm}$

⑤ $L = 5\ \text{cm}$

$\bar{x} = \frac{1}{2}(r - a) + a = \frac{1}{2}\ (r + a) = \frac{1}{2}[(10\ \text{cm})+(5\ \text{cm})] = 7.5\ \text{cm}$

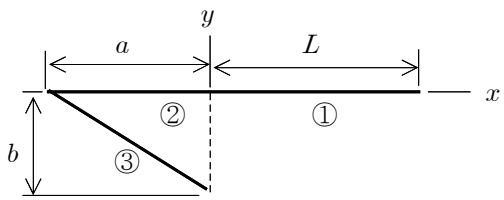
$\Sigma L = 15.708 + 5 + 5 + 5 + 5\ \text{cm} = 35.708\ \text{cm}$

$\Sigma(\bar{x}L) = (10)^2 + (5)(0) + (5)(2.5) + (5)(5) + (5)(7.5)\ \text{cm}^2 = 175\ \text{cm}^2$

$\bar{X} = \frac{\Sigma(\bar{x}L)}{\Sigma L} = \frac{175\ \text{cm}^2}{35.708\ \text{cm}} = 4.901\ \text{cm}$　⇒　$\bar{X} = \bar{Y} = 4.90\ \text{cm}$

5.28 $a = 80$ mm, $b = 60$ mm

BCD is horizontal $\Rightarrow$ $\overline{X} = 0$ $\Rightarrow$ $\Sigma(\overline{x}\, l) = 0$



① $l = L$

$\overline{x} = \dfrac{L}{2}$

② $l = a = 80$ mm

$\overline{x} = -\dfrac{1}{2}a = -40$ mm

③ $l = \sqrt{a^2 + b^2} = 100$ mm

$\overline{x} = -\dfrac{1}{2}\, a = -40$ mm

$\Sigma(\overline{x}\, l) = \dfrac{L}{2}\, L + (-40 \text{ mm})(80 \text{ mm}) + (-40 \text{ mm})(100 \text{ mm}) = 0$

$\Rightarrow \quad \dfrac{L^2}{2} = 7{,}200 \text{ mm}^2 \quad \Rightarrow \quad L = 120.0 \text{ mm}$