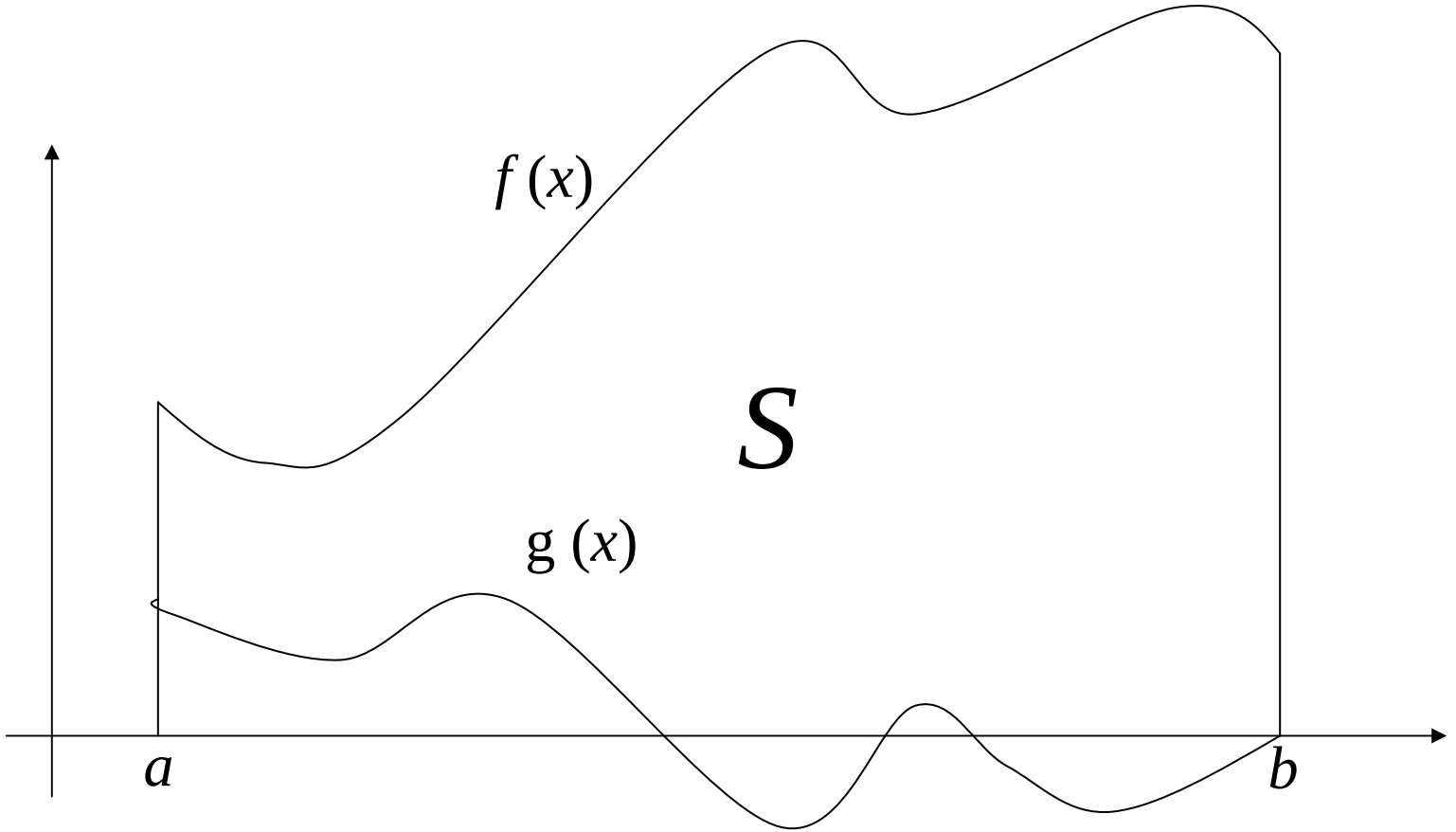
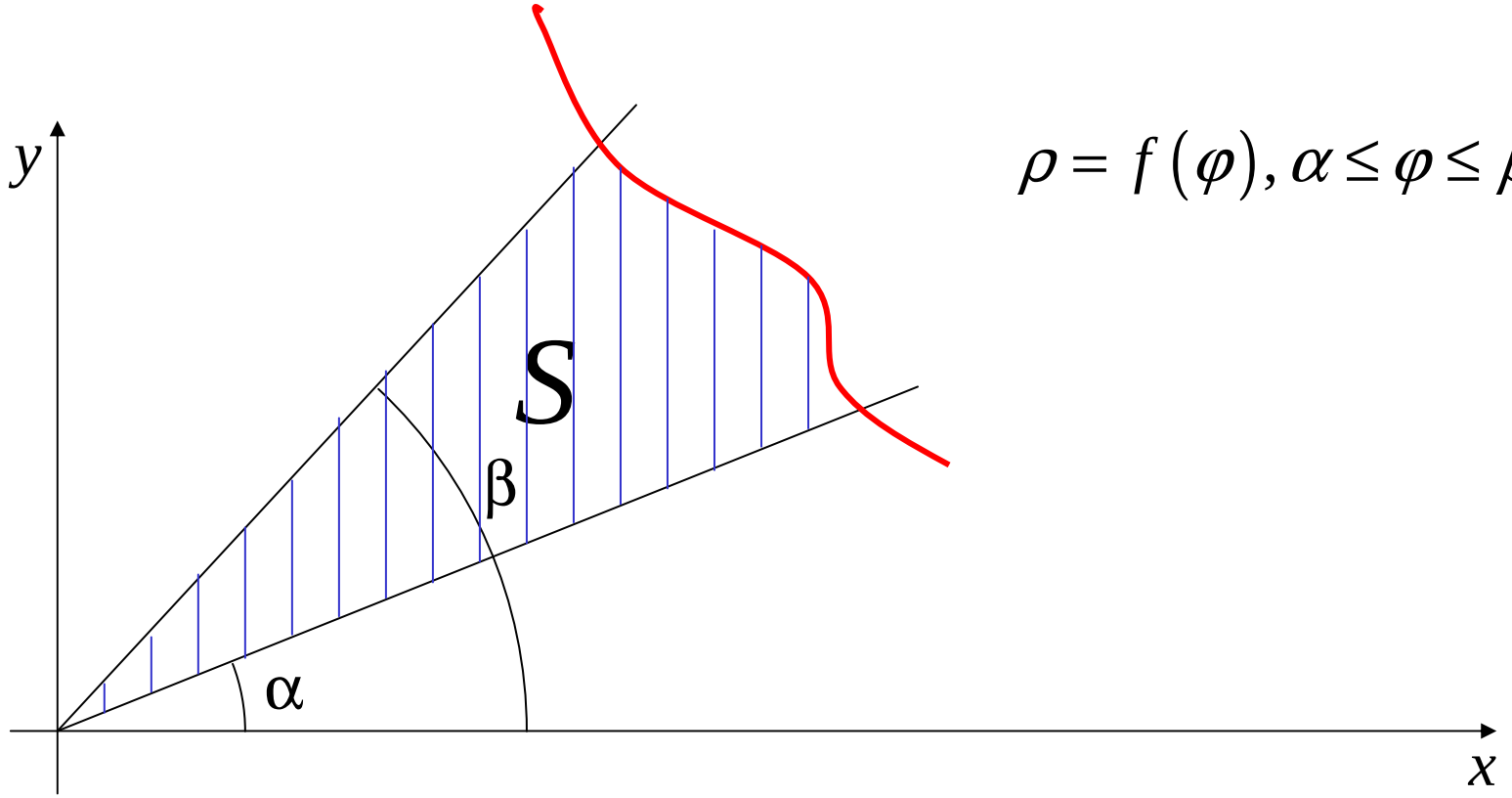
Area of plane figures in Cartesian coordinates



$$S = \int_a^b \left[f(x) - g(x) \right] dx$$

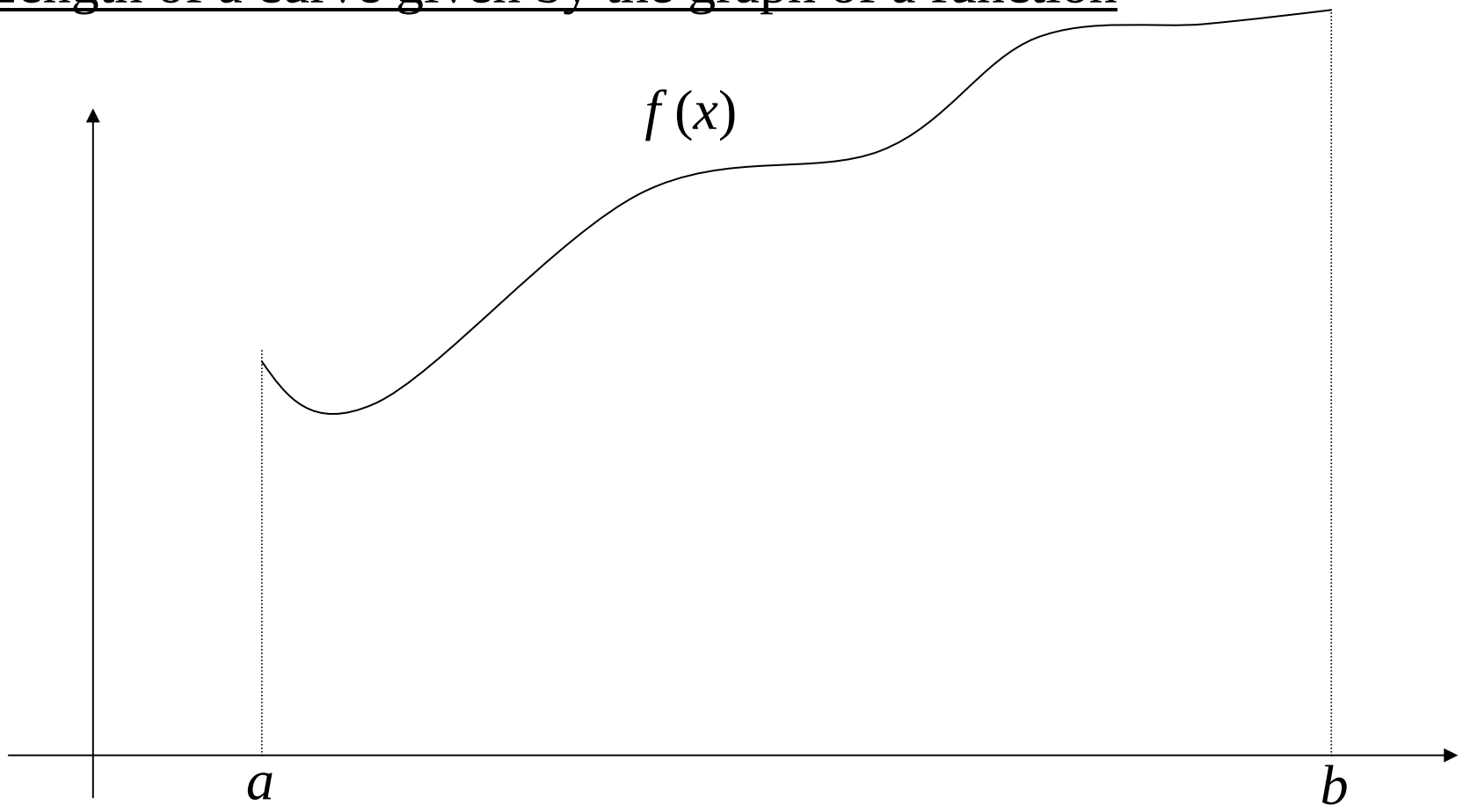
Area of plane figures in polar coordinates



$$\rho = f(\varphi), \alpha \le \varphi \le \beta$$

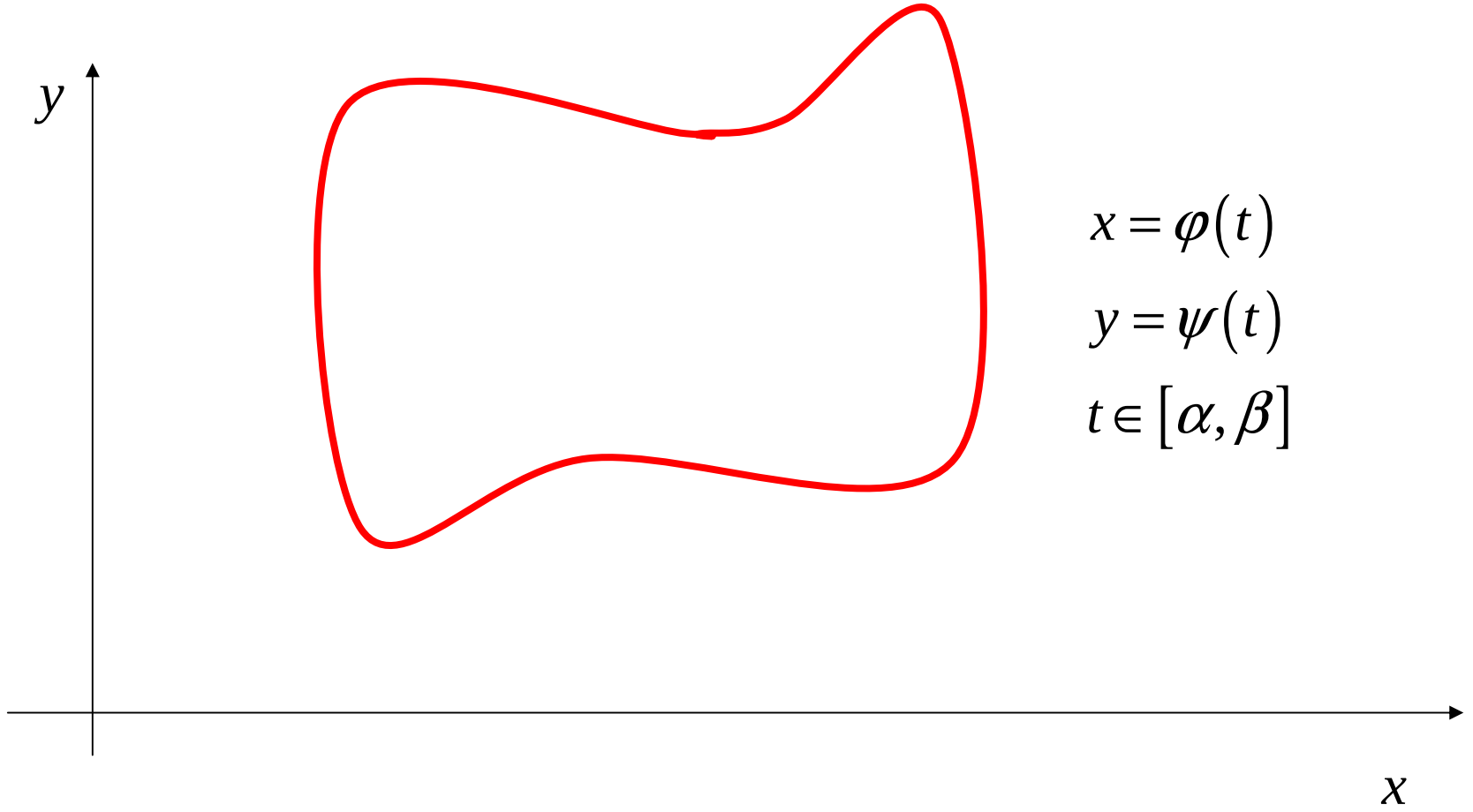
$$S = \frac{1}{2}\int_{\alpha}^{\beta} \left[f(\varphi) \right]^2 dx$$

Length of a curve given by the graph of a function



$$s = \int_a^b \sqrt{1 + \left[f(x)' \right]^2}\, dx$$

Length of a curve given by parametric equations



$$x = \varphi(t)$$

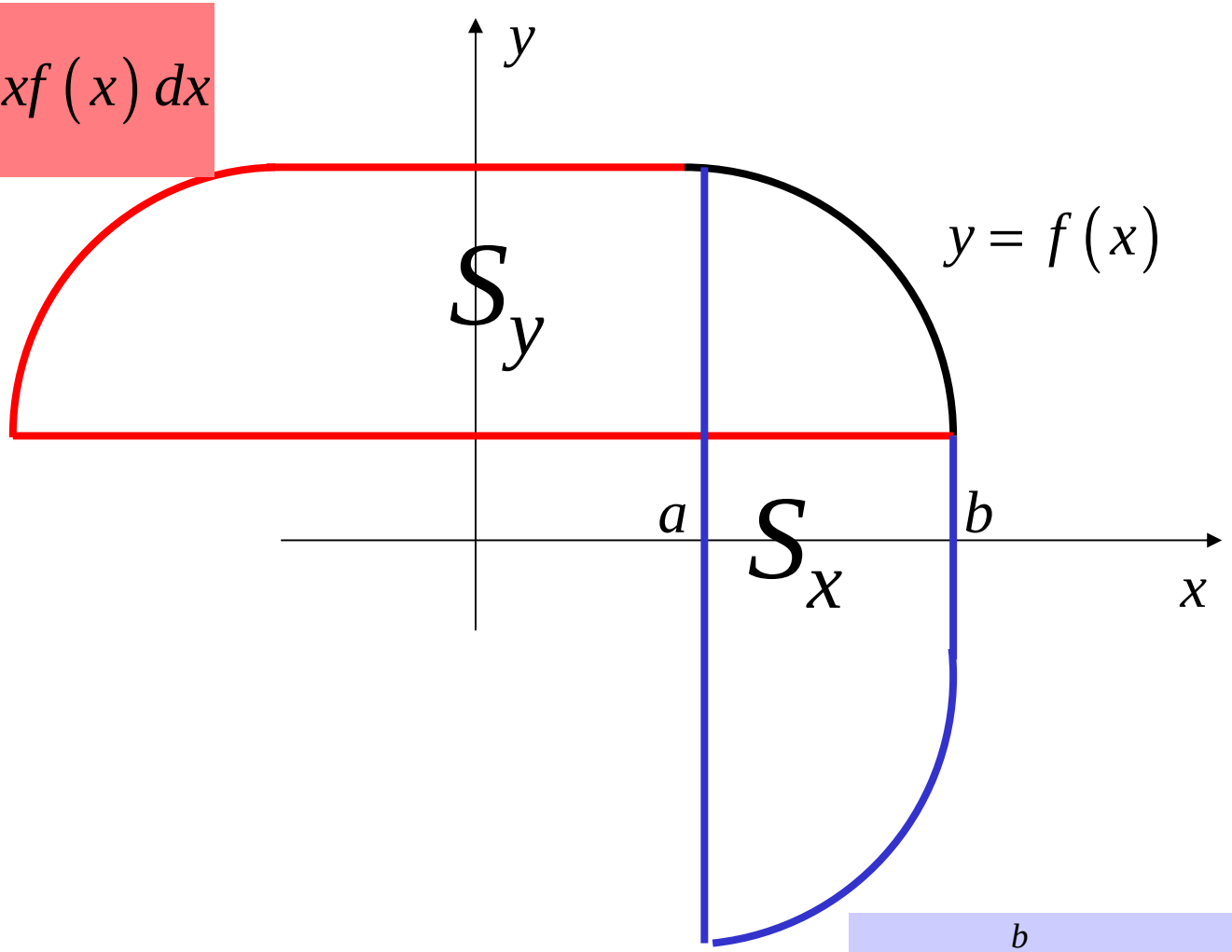
$$y = \psi(t)$$

$$t \in [\alpha, \beta]$$

$$s = \int_{\alpha}^{\beta} \sqrt{\left[\varphi(t)'\right]^2 + \left[\psi(t)'\right]^2}\, dt$$

Volume of bodies created by rotation

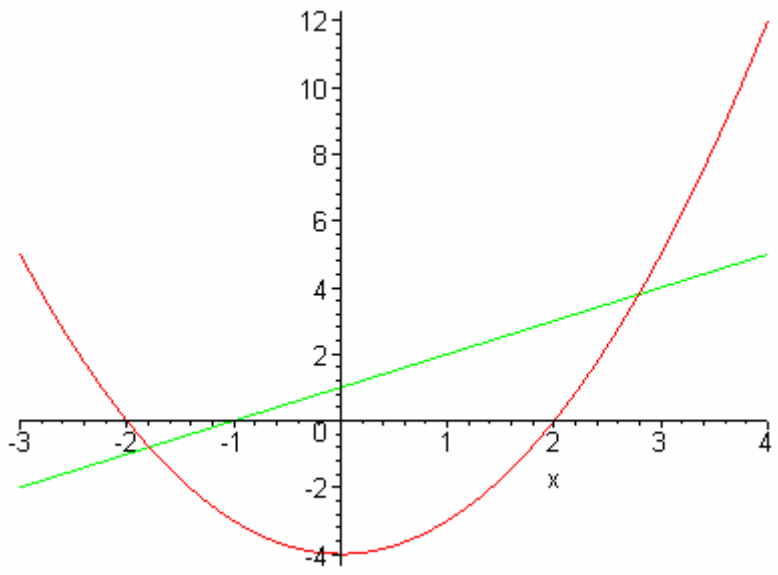
$$S_y = 2\pi \int_a^b x f(x)\, dx$$



$$S_x = \pi \int_a^b f^2(x)\, dx$$

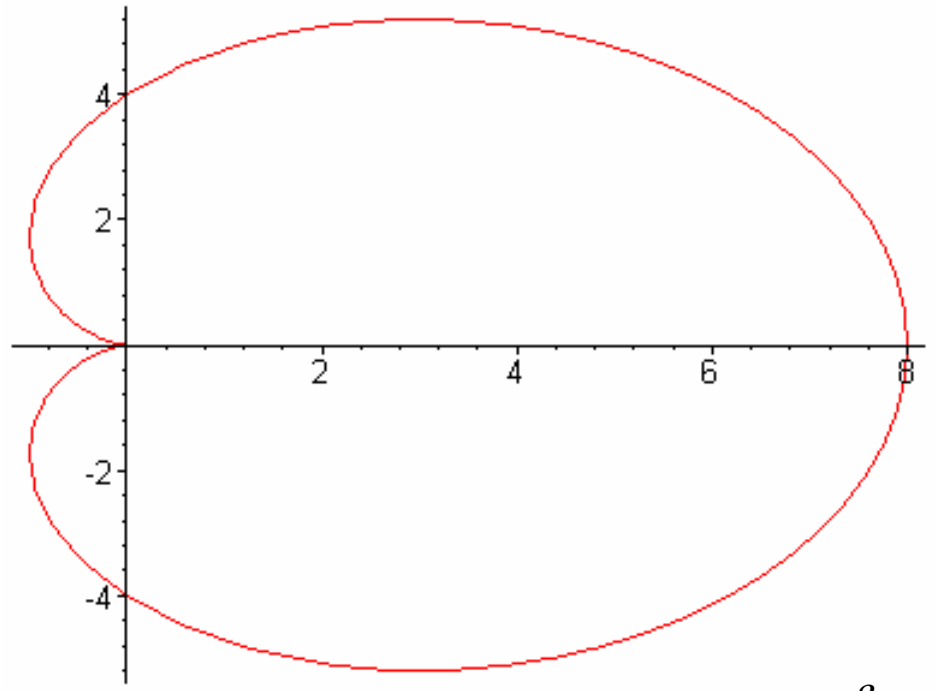
Find the area of the plane figure bounded by the curves

$$y = x^2 - 4, \quad y = x + 1$$



Find the area of the cardoid

$$\left(x^2+y^2-4x\right)^2=16\left(x^2+y^2\right)$$

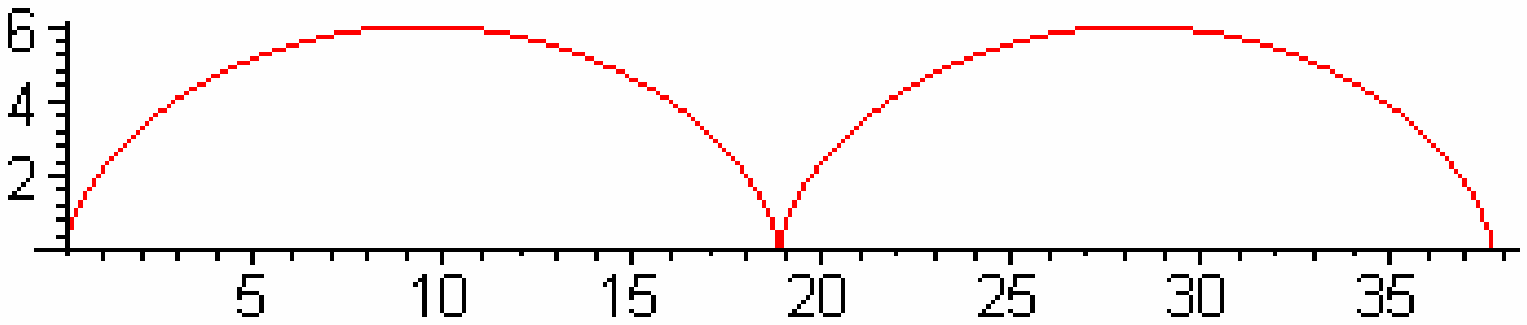


$$\rho=4\left(1+\cos\varphi\right)$$

$$S=\frac{1}{2}\int_{\alpha}^{\beta}\left[f\left(\varphi\right)\right]^2\,dx$$

Find the length of one arc of the cycloid

$$x = 3(\varphi - \sin\varphi); y = 3(1 - \cos\varphi)$$



Find the volume of a ball with a diameter of *r* using the equation of a circle in two different ways

$$S_y = 2\pi \int_a^b x f(x)\, dx$$

$$S_x = \pi \int_a^b f^2(x)\, dx$$