Formulas for Arc (Curve) Length in the Plane:

$$\textit{Arc Length for a curve } y = \mathrm{f}(x): \quad \int_a^b \sqrt{1 + \mathrm{f}\,'(x)^2}\,dx$$

$$\textit{Arc Length for a curve } x = \mathrm{g}(y): \quad \int_c^d \sqrt{1 + \mathrm{g}\,'(y)^2}\,dy$$

$$\textit{Arc Length for a parametric curve } [x, y] = [\mathrm{x}(t), \mathrm{y}(t)]: \quad \int_{t_1}^{t_2} \sqrt{\mathrm{x}\,'(t)^2 + \mathrm{y}'(t)^2}\,dt$$

Arc Length Exercises:

Arc Length Exercise 5.1 [Use Integration by Parts]: $y = \ln(1 - x^2),\ x = 0..\frac{1}{2}$

Arc Length Exercise 5.2 [Use Hyperbolic Functions]: $y = cosh(x) = \dfrac{e^x + e^{(-x)}}{2},\ x = 0..1$

Arc Length Exercise 5.3 : $y = e^x,\ x = 0..1$

Arc Length Exercise 5.4 : $x = \dfrac{t}{1+t}, \quad y = \ln(1+t),\ t = 0..2$

Formulas for Surface Area:

$$\textit{Surface Area rotate about } x - axis = \int_a^b 2\,\pi\,\mathrm{f}(x)\,\sqrt{1 + \mathrm{f}\,'(x)^2}\,dx$$

$$\textit{Surface Area rotate about } y - axis = \int_c^d 2\,\pi\,\mathrm{g}(y)\,\sqrt{1 + \mathrm{g}\,'(y)^2}\,dy$$

$$\textit{Parametric Surface Area rotate about } x - axis = \int_{t_1}^{t_2} 2\,\pi\,\mathrm{y}(t)\,\sqrt{\mathrm{x}\,'(t)^2 + \mathrm{y}'(t)^2}\,dt$$

$$\textit{Parametric Surface Area rotate about } y - axis = \int_{t_1}^{t_2} 2\,\pi\,\mathrm{x}(t)\,\sqrt{\mathrm{x}\,'(t)^2 + \mathrm{y}'(t)^2}\,dt$$

Surface Area Exercises:

Surface Area Exercise 5.1 : $y = \sqrt{4 - x^2},\ x = -1..1,$ *rotate about* $x - axis.$

Surface Area Exercise 5.2 : $x = \sqrt{y},$ *from* $[1, 1]$ *to* $[2, 4]$, *choose axis.*

Surface Area Exercise 5.3 : $y = e^x$, $x = 0..1$, *rotate about* $x - axis$.

Surface Area Exercise 5.4 : $y = \sin(x)$, $x = 0..\pi$, *rotate about* $x - axis$.

Surface Area Exercise 5.5 : $y = cosh(x) = \dfrac{e^x + e^{(-x)}}{2}$, $x = 0..1$, *rotate about* $x - axis$.

Surface Area Exercise 5.6 : r *is constant,* $x = r\cos(t)$, $y = r\sin(t)$, $t = 0..\pi$, *rotate about* $x -$ *axis.*

Surface Area Exercise 5.7 : r *is constant,* $x = r\,(t - \sin(t))$, $y = r\,(1 - \cos(t))$, $t = 0..2\,\pi$, *rotate about* $x -$ *axis.*

Surface Area Exercise 5.8 : $x = t^3$, $y = t^4$, $t = 0..1$, *rotate about* $y -$ *axis.*