Assume $y = f(x)$ is a continuous function from $x = a$ to $x = b$. We seek a formula for the length of its graph from $x = a$ to $x = b$.

Assume that $(ds)^2 = (dx)^2 + (dy)^2$ so that $ds = \sqrt{(dx)^2 + (dy)^2}$.

Arc length from $x = a$ to $x = b$ is

\[
ARC = \int_a^b ds = \int_a^b \sqrt{(dx)^2 + (dy)^2} \\
= \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} \, dx, \quad \text{i.e.,} \\
ARC = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} \, dx \text{ OR}
\]
arc length from \( y = c \) to \( y = d \) is

\[
\text{ARC} = \int_{c}^{d} ds = \int_{c}^{d} \sqrt{(dx)^2 + (dy)^2}
\]

\[
= \int_{c}^{d} \sqrt{\left(\frac{dx}{dy}\right)^2 + 1} \, dy , \text{ i.e.,}
\]

\[
\text{ARC} = \int_{c}^{d} \sqrt{1 + \left(\frac{dx}{dy}\right)^2} \, dy
\]