1 | **Formula**

$$\int_a^b \sqrt{1 + f'^2(x)}dx$$

2 | **Derivation**

Let S equal the total length of the curve.

Start with the pythagorean theorem: for any differentiable function,

$$S = \sum_a^b dS$$

where dS can be calculated using the pythagorean theorem:

$$dS = \sqrt{\Delta y^2 + \Delta x^2}$$

We can simplify this by dividing dS by Δx

$$\begin{aligned}
\frac{dS}{\Delta x} &= \lim_{\Delta x \to 0} \sqrt{\frac{\Delta y^2}{\Delta x^2} + \frac{\Delta x^2}{\Delta x^2}} \\
&= \lim_{\Delta x \to 0} \sqrt{\frac{\Delta y^2}{\Delta x^2} + 1} \\
&= \sqrt{f'^2(x) + 1}
\end{aligned}$$

Now, to find dS again, we just have to multiply by dx

$$dS = \frac{dS}{\Delta x}dx = \sqrt{1 + f'^2(x)}dx$$