

$$(1) \quad y = \log(x + \sqrt{x^2 + 1}) \quad x > 0$$

$$\begin{aligned} y' &= \frac{1}{x + \sqrt{x^2 + 1}} \times \left(1 + \frac{2x}{2\sqrt{x^2 + 1}}\right) \\ &= \frac{1}{\cancel{x} + \sqrt{x^2 + 1}} \times \frac{\sqrt{x^2 + 1} + \cancel{x}}{\sqrt{x^2 + 1}} = \frac{1}{\sqrt{x^2 + 1}} \end{aligned}$$

$$\begin{aligned} (2) \quad \int_1^{\sqrt{3}} \frac{1}{\sqrt{x^2 + 1}} dx &= \left[\log(x + \sqrt{x^2 + 1}) \right]_1^{\sqrt{3}} \\ &= \log(\sqrt{3} + \sqrt{4}) - \log(1 + \sqrt{2}) \\ &= \log \frac{2 + \sqrt{3}}{1 + \sqrt{2}} \\ &= \log \frac{(2 + \sqrt{3})(1 - \sqrt{2})}{1 - 2} \\ &= \log \frac{2 + \sqrt{3} - 2\sqrt{2} - \sqrt{6}}{-1} \\ &= \log(-2 - \sqrt{3} + 2\sqrt{2} + \sqrt{6}) \end{aligned}$$