Show your work and simplify your answers.

(1) (5 pts) Find the derivative of the following function

\[ f(x) = \ln \sqrt{x^2 + 6x + 11} \]

\[ y = f(x) = \ln \sqrt{x^2 + 6x + 11} = \frac{1}{2} \ln (x^2 + 6x + 11) \quad (1 \text{ pt}) \]

We use the chain rule with \( y = \frac{1}{2} \ln u \) and \( u = x^2 + 6x + 11 \).

We have

\[ \frac{dy}{du} = \frac{1}{2u} = \frac{1}{2(x^2 + 6x + 11)} \]

So

\[ \frac{du}{dx} = 2x + 6 \]

\[ \frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx} = \frac{2x + 6}{2(x^2 + 6x + 11)} \]

\[ = \frac{x + 3}{x^2 + 6x + 11} \quad (1 \text{ pt}) \]

(2) (5 pts) Find the derivative of the following function

\[ g(x) = x \sin^{-1} x + 3 \tan^{-1} (2x) \]

\[ \frac{d}{dx}(x \sin^{-1} x) = \frac{1}{\sqrt{1-x^2}} x + \sin^{-1} x \cdot \frac{1}{\sqrt{1-x^2}} \]

\[ = \sin^{-1} x + \frac{x}{\sqrt{1-x^2}} \]

\[ \frac{d}{dx}(3 \tan^{-1} 2x) = 3 \cdot \frac{1}{1+(2x)^2} \cdot 2 = \frac{6}{1+4x^2} \]

\[ g'(x) = \sin^{-1} x + \frac{x}{\sqrt{1-x^2}} + \frac{6}{1+4x^2} \]

(1 pt)