1. Compute the derivative of $f(x)$ using the formulas for derivatives we have learned. Do not simplify your answer.

$$f(x) = \cos \sqrt{x^2 + 1}$$

In this case we must use the chain rule twice.

$$f'(x) = \frac{d}{dx} \left[ \cos \sqrt{x^2 + 1} \right]$$

$$= -\sin \sqrt{x^2 + 1} \left[ \frac{d}{dx} \sqrt{x^2 + 1} \right]$$

(1st chain rule)

$$= -\sin \sqrt{x^2 + 1} \left[ \frac{d}{dx} (x^2 + 1)^{1/2} \right]$$

$$= -\sin \sqrt{x^2 + 1} \left[ \frac{1}{2} (x^2 + 1)^{-1/2} \frac{d}{dx} (x^2 + 1) \right]$$

(2nd chain rule)

$$= -\sin \sqrt{x^2 + 1} \left[ \frac{1}{2} (x^2 + 1)^{-1/2} (2x) \right]$$

You were not required to simplify the answer, but if you did you might proceed as in the following steps.

$$f'(x) = -\sin \sqrt{x^2 + 1} \left[ \frac{x}{(x^2 + 1)^{1/2}} \right]$$

$$= -\sin \sqrt{x^2 + 1} \left[ \frac{x}{(x^2 + 1)^{1/2}} \right]$$

$$= -\frac{x}{\sqrt{x^2 + 1}} \sin \sqrt{x^2 + 1}$$
2. Compute the derivative of \( f(x) \) using the formulas for derivatives we have learned. Do not simplify your answer.

\[
f(x) = \left[ \ln(x^2 + 1) \right]^8
\]

Once again we will use the chain rule twice.

\[
f'(x) = 8 \left[ \ln(x^2 + 1) \right]^7 \frac{d}{dx} \ln(x^2 + 1) \quad (1^{st} \text{ chain rule})
\]
\[
= 8 \left[ \ln(x^2 + 1) \right]^7 \frac{1}{x^2 + 1} \frac{d}{dx} (x^2 + 1) \quad (2^{nd} \text{ chain rule})
\]
\[
= 8 \left[ \ln(x^2 + 1) \right]^7 \frac{1}{x^2 + 1} (2x)
\]

You were not required to simplify your answer but if you did you would probably write the answer in the form:

\[
f'(x) = \frac{16x}{x^2 + 1} \left[ \ln(x^2 + 1) \right]^7
\]